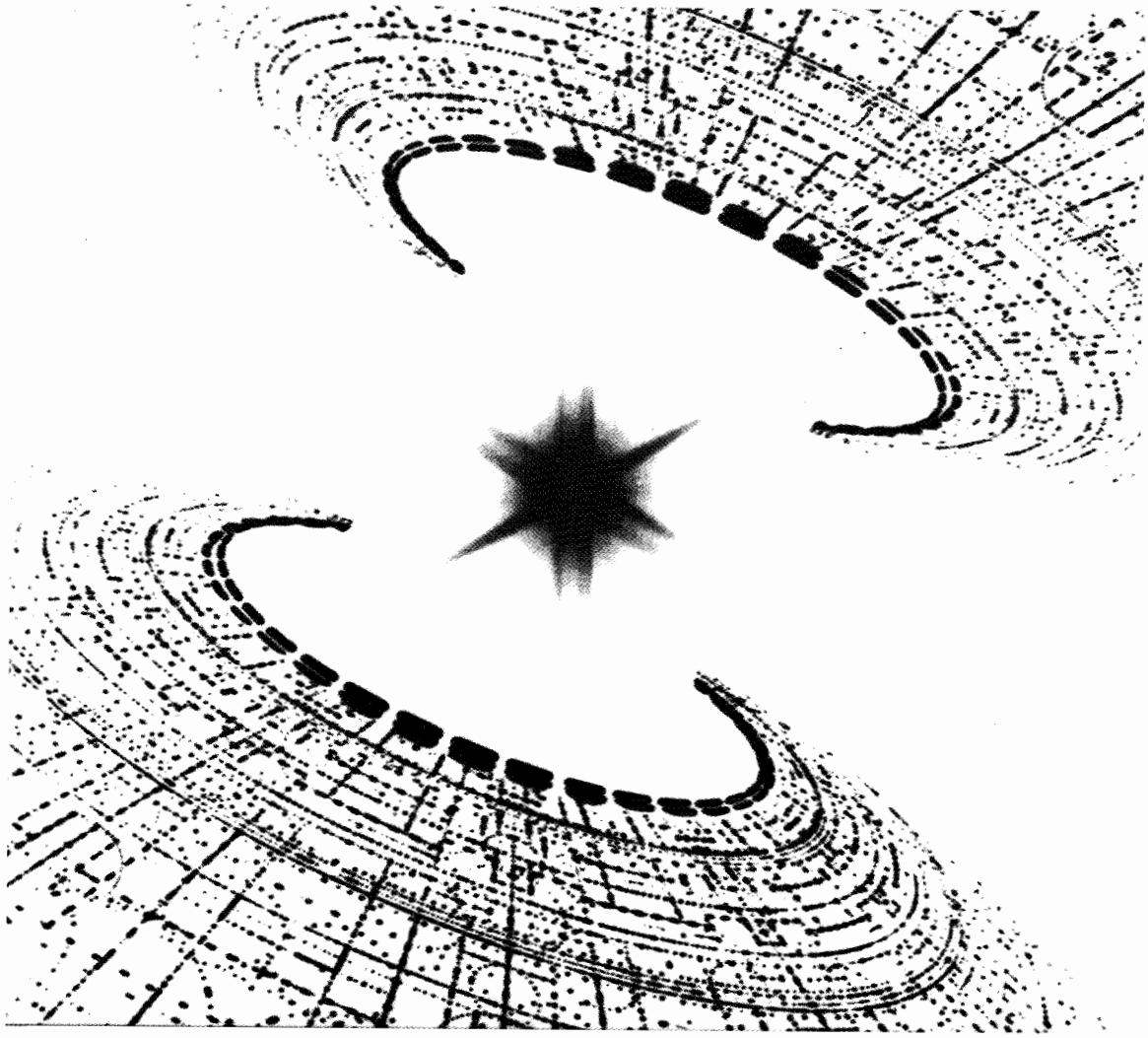
KOHLER
GENERATORS

FAST RESPONSE II



Service Manual
Dec-3 Microcomputer & Overspeed Relay Controllers

TP-5262

Table of Contents

Introduction

This manual covers the concept, operation, troubleshooting, and repair of Kohler Fast-Response II generators equipped with Dec-3 Microcomputer or Overspeed Relay controllers.

Service Assistance

Contact your Kohler Generator distributor to obtain additional information for particular models. See yellow page listing under **Generators-Electric.** Order ES-797 and supply Model, Spec, and Serial numbers from generator nameplate for complete engine service manual and generator set parts list.

Safety Precautions

Read these instructions carefully before operating the generator. Failure to follow these instructions and safety precautions could result in serious bodily injury and/or damage to the generator or test equipment.

⚠WARNING

LETHAL EXHAUST GAS! The engine powering your generator discharges deadly carbon monoxide as part of the exhaust gas when operating. Carbon monoxide is particularly dangerous in that it is odorless and colorless. Keep in mind that it can cause death if inhaled for even a short period of time. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate in any area where exhaust gas could accumulate and seep back inside an occupied building. Avoid breathing exhaust fumes when working on or near the generator set.

⚠WARNING

BACKFIRE! A sudden backfire can cause serious burns. Keep hands and face away from the carburetor when the air cleaner is removed.

⚠WARNING

DANGEROUS FUELS! Use extreme caution when handling, storing, and using fuels — all fuels are highly explosive in a vapor state. Store fuel in a well ventilated area away from spark producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running to prevent spilled fuel from igniting on contact with hot parts or from ignition spark. Keep fuel lines and connections tight and in good condition — don't replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. Additional precautions should be taken when using the following fuels:

Gasoline — Store gasoline only in approved red containers clearly marked GASOLINE. Don't store gasoline in any occupied building.

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

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

⚠WARNING

FLASH FIRE! To avoid the possibility of a flash fire, do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors.

⚠WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and wherever electrical energy is present there is the potential danger of electrocution. Keep everyone, especially children, away from the set while it is running and take precautions to prevent unqualified personnel from tampering with or attempting to operate your generator set. Have the set and electrical circuits serviced only by qualified technicians. Wiring should be inspected frequently — replace leads that are frayed or in poor condition. Be sure that generator is properly grounded. Do not operate electrical equipment when standing in water, on wet ground, or when your hands are wet.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic Transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Main Switch on controller to OFF position and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to the generator.

⚠WARNING

EXPLOSIVE GASES! The gases generated by a battery being charged are highly explosive. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is charging. Any room containing charging batteries should be well-ventilated to prevent accumulation of explosive gases. To avoid sparks do not disturb battery charger connections while battery is charging and always turn charger off before connecting or disconnecting. When operating any test equipment from an auxiliary battery in an enclosed area, auxiliary battery should be located at least 18 inches above the floor to minimize the possibility of igniting fuel vapors.

⚠WARNING

EXCESSIVE NOISE! Never operate without adequate muffler or with faulty exhaust system — exposure to excessive noise is not only tiring but can lead to impairment of hearing.

⚠WARNING

SHOCK HAZARD! Disconnect set from load by opening line circuit breaker, or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. The GENERATOR SAFEGUARD BREAKER MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER! If high voltage is transferred to load during test, personal injury and equipment damage may result.

⚠WARNING

DANGEROUS ACID! Avoid contact with battery electrolyte. It contains acid which can eat holes in clothing, burn skin, and cause permanent damage to eyes. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in dangerous spattering of electrolyte.

⚠WARNING

HOT COOLANT! Engine coolant is pressurized and hot enough to cause severe burns. If generator set is equipped with a coolant recovery tank, check coolant level at tank. If necessary to check coolant level at radiator or surge tank (on city-water or remote radiator-cooled sets), place a rag over the cap and turn slowly to release pressure before removing cap.

⚠WARNING

HIGH VOLTAGE! When testing photo transistor board, keep all other light sources away. Otherwise, dangerous ceiling voltage may result.

⚠WARNING

HIGH VOLTAGE! Do not reverse FR activator leads E and C. Ceiling voltage will result causing equipment damage and possible personal injury.

⚠WARNING

HOT PARTS! Exciter armature will get hot if armature is shorted. Avoid touching armature.

⚠WARNING

HIGH VOLTAGE! Be sure that foil side of photo transistor board, end of shaft, and threaded holes are clean and free of metal particles and chips. Dangerous HIGH VOLTAGE may result. AC voltmeter must show proper output before generator may be reconnected to load.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Move Generator Master Switch to OFF and disconnect remote start leads from terminals 3 and 4 in controller to prevent remote start-up while working on generator set. Potential injury or electrocution can result. Disconnect battery negative (-) lead from ground on generator set before working near rotor or attached parts.

⚠ WARNING

DANGER OF ELECTROCUTION! When the generator is used for standby power, use of an automatic transfer switch is required to prevent inadvertent interconnection of standby and other sources of power. In some states and/or localities it is illegal to operate a standby generator without an automatic transfer switch. Failure to install an automatic transfer switch will cause "backfeed" into utility transmission lines and can cause serious injury or death.

⚠WARNING

HOT PARTS! Generator field will get hot if field is shorted. Avoid touching generator field; severe burns may result.

⚠WARNING

HIGH VOLTAGE! Use high voltage test only as directed. High voltage may cause personal injury, damage equipment, or lead to future failures. Follow manufacturer's instructions when operating tester.

⚠WARNING

MOVING PARTS! Keep hands, hair, necktie, loose clothing, and test leads well away from moving parts as serious injury could result from entanglement. Never run generator set with guards, covers or screens removed.

⚠WARNING

ELECTRICAL SHOCK! Battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings and any other jewelry.

⚠WARNING

HIGH VOLTAGE! Make sure leads "C" and "E" to FR activator are connected to the correct terminals. Reversal of these leads or grounding of "C" (red) lead will turn the FR activator full on resulting in ceiling output voltage.

⚠WARNING

HIGH VOLTAGE! The heat sink of the SCR assembly contains high voltage. Do not touch when testing SCR assembly or electrical shock will occur.

Section 1.
Fast-Response II Concepts

General

A Kohler Fast-Response II set is a rotating-field generator and a smaller rotating armature generator turned by a common shaft. The main, rotating field generator supplies current to load circuits while the rotating armature (exciter) generator supplies DC to excite the main generator's field. See Figure 1-1.

System

The Fast-Response II excitation system uses a permanent magnet exciter with an FR activator (SCR Bridge) which controls the amount of the DC current fed to the generator field. This type of system uses a voltage regulator which signals the FR activator through an optical coupling. The voltage regulator monitors engine speed and generator output voltage to turn a stationary LED (light emitting diode) on or off, according to engine speed and output voltage. The LED is mounted on the end bracket opposite a photo transistor which rotates on the shaft. The photo transistor picks up the signal from the LED and tells the SCR rotating bridge to turn on or off, depending upon the need, as dictated by the voltage regulator. This type generator has a voltage recovery time several times faster than the conventional wound field brushless generator because it does not have the inductance of the exciter field to contend with. It also has better recovery characteristics than the static excited machine because it is not dependent upon the generator output voltage for excitation power. Possibly the greatest advantage of this type machine is its inherent ability to support short circuit current and allow system coordination for tripping downstream branch circuit breakers.

Fast response II systems deliver proper exciter current to the main field within 0.05 seconds of a change in load demand.

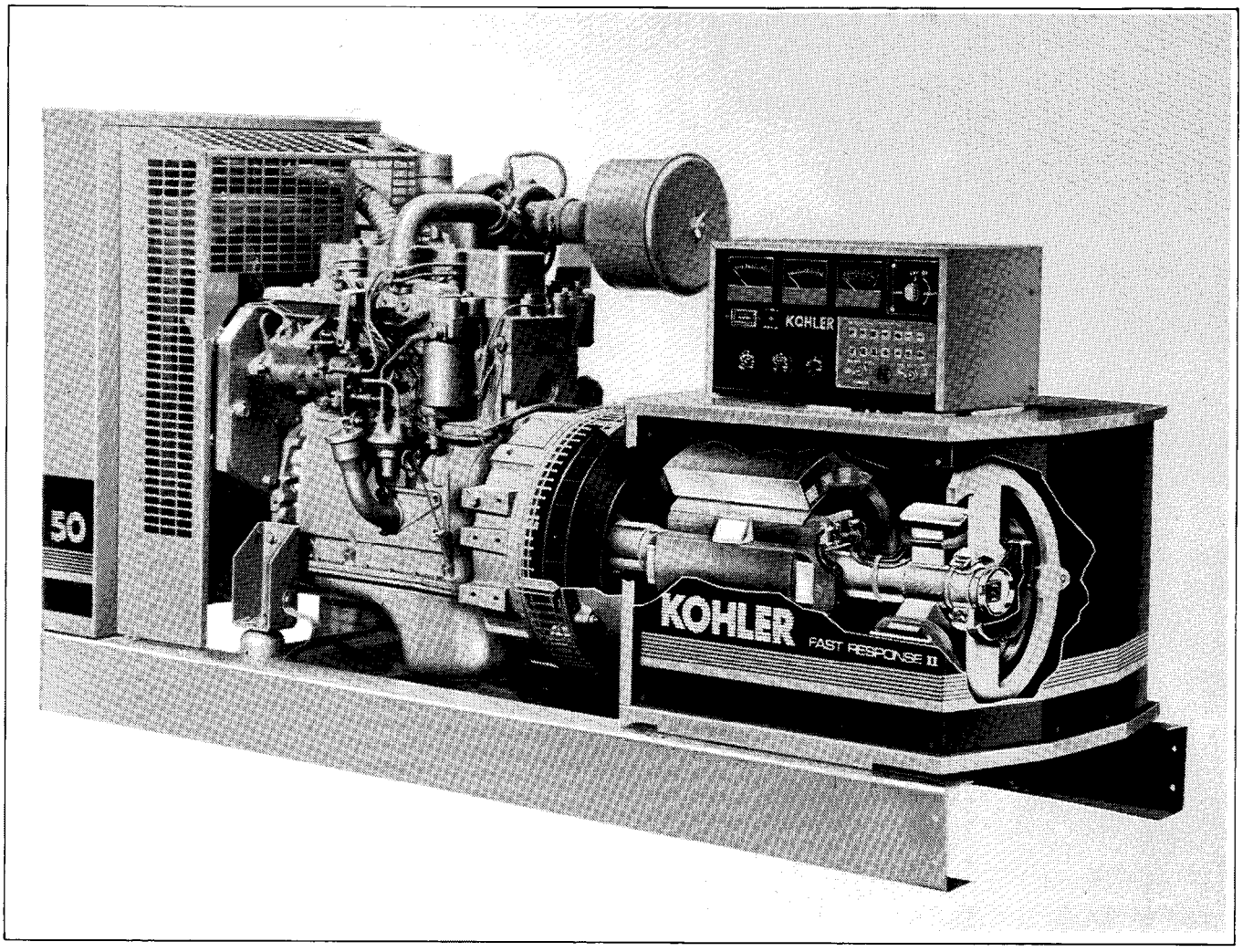


Figure 1-1. Generator Cutaway

Fast-Response II Concepts — cont'd.

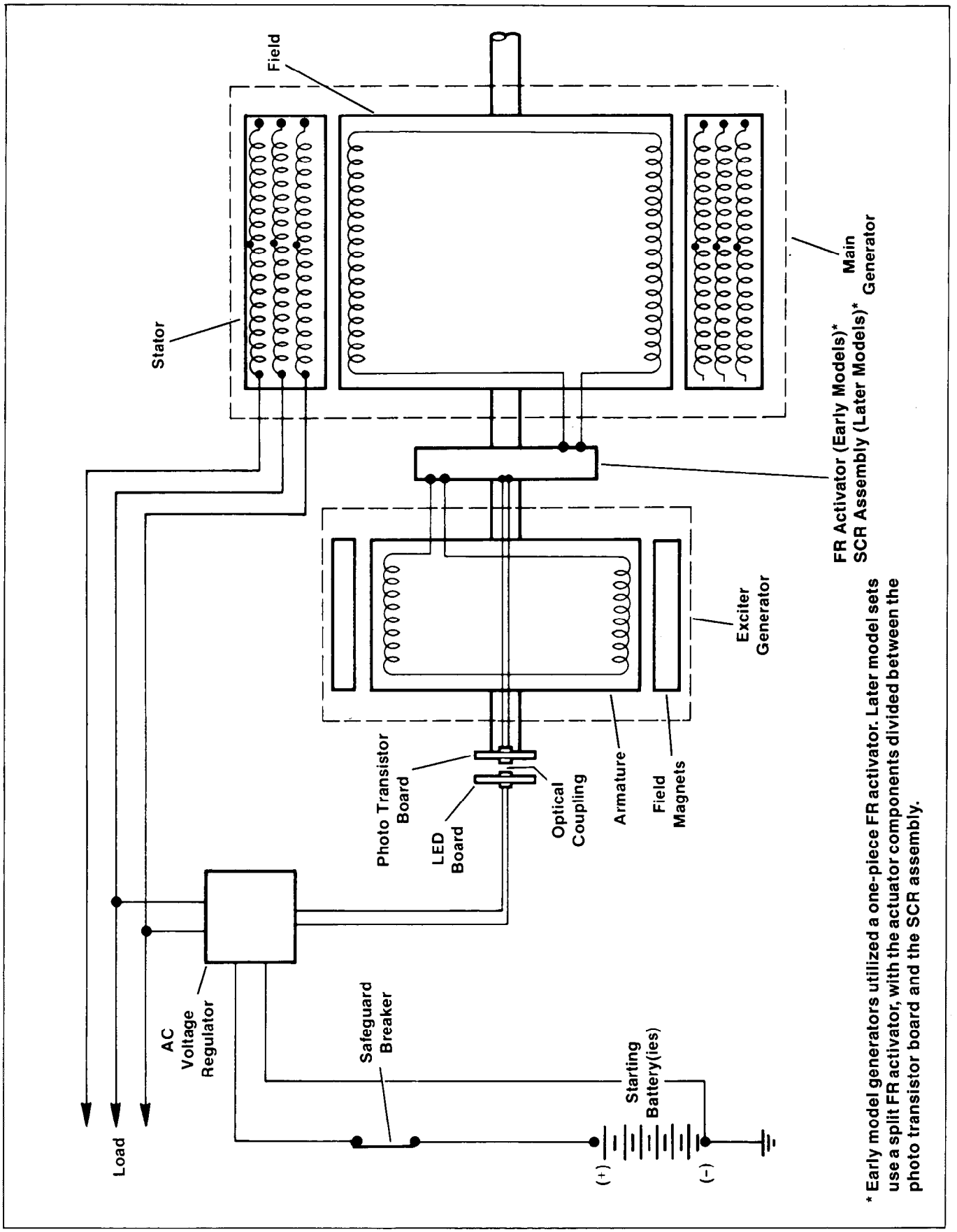


Figure 1-2. Fast Response II Schematic

Short Circuit Performance

When a short circuit occurs in the load circuit(s) being served, output voltage drops to a low level until the short is removed, and amperage momentarily rises to 600-1000% of the generator's rated current. The FR activator sends full exciter power to the main field. The generator then sustains up to 300% of its rated amperage. Sustained high current will cause properly rated load circuit fuses/breakers to open or generator safeguard breaker to trip. The safeguard breaker serves to collapse the generator's main field in the event of a sustained heavy overload or short circuit.

Section 2.
Operation

Prestart Checklist

The following items should be checked before each start-up of manually controlled generator sets and at regular intervals on sets equipped with automatic transfer switches. See your engine operation/maintenance manual for specific service procedures.

OIL LEVEL: Should be at or near FULL mark on dipstick — not over.

FUEL LEVEL: Make sure there is an adequate supply; keep tanks full to allow operation for extended periods.

BATTERY: Check connections and level of battery electrolyte.

COOLANT LEVEL: Maintain coolant level at one-half to one inch below top of radiator filler neck or to proper level in recovery tank. If unit is equipped with a coolant recovery tank, level in tank should be between 1/3 full (cold) and 2/3 full (hot) See "Safety Precautions".

NOTE

A coolant solution of 50% ethylene glycol and 50% clean, soft water is recommended to inhibit rust/corrosion and prevent freezing to −34° F (−37° C).

CAUTION

Do not turn on block heater before filling cooling system. Run engine until warm and refill radiator to purge air from the system. Block heater failure could result if not immersed in water.

AIR CLEANER: Must be clean and properly installed to prevent unfiltered air from entering engine.

DRIVE BELTS: Make visual check of radiator fan, water pump and battery charging alternator belt to make sure it is tight and in good condition.

OPERATING AREA: Make sure there are no obstructions that could block the flow of cooling air. Make sure area is clean. Rags, tools or debris must not be left on or near the generator set.

EXHAUST SYSTEM: Exhaust outlet must be clear; silencer and piping must be tight and in good condition.

LAMP TEST: (If equipped) Press the lamp test button to verify all controller lamps are operational.

Overspeed Relay Controller Operation

For identification of overspeed relay controller components and an explanation of their function, refer to Figure 2-1 and the following paragraphs.

1. **Frequency Meter** — measures frequency (Hz) of generator output voltage.
2. **AC Voltmeter** — measures voltage across output leads indicated by selector switch.
3. **AC Ammeter** — measures amperage from output leads indicated by selector switch.
4. **Selector Switch (Voltmeter-Ammeter)** — selects generator output circuits to be measured. If switched to a point with three circuit lead labels, voltage is measured between the lower two leads and amperage on the upper lead. With switch in OFF position, AC voltmeter and ammeter will not register.
5. **Scale Lamps (upper and lower)** — indicate voltage and/or ammeter scales to be read.
6. **Hourmeter** — records generator set total operating hours for reference in scheduling maintenance.
7. **Reset Lamp** — lights to indicate that the engine protection circuit has stopped the engine due to:

- **Overcrank** — if the engine fails to start in 30 to 60 seconds.
- **No AC Voltage** — if no AC voltage is detected for 30 to 60 seconds.
- **Low Coolant Level** — (if equipped) if the engine has stopped due to low coolant level in the radiator.
- **High Water Temperature** — if the engine has stopped due to high coolant temperature.
- **Low Oil Pressure** — if the engine loses oil pressure.
- **Overspeed** — if the generator governed frequency exceeds specified limits.

Overspeed Relay Controller Operation — cont'd.

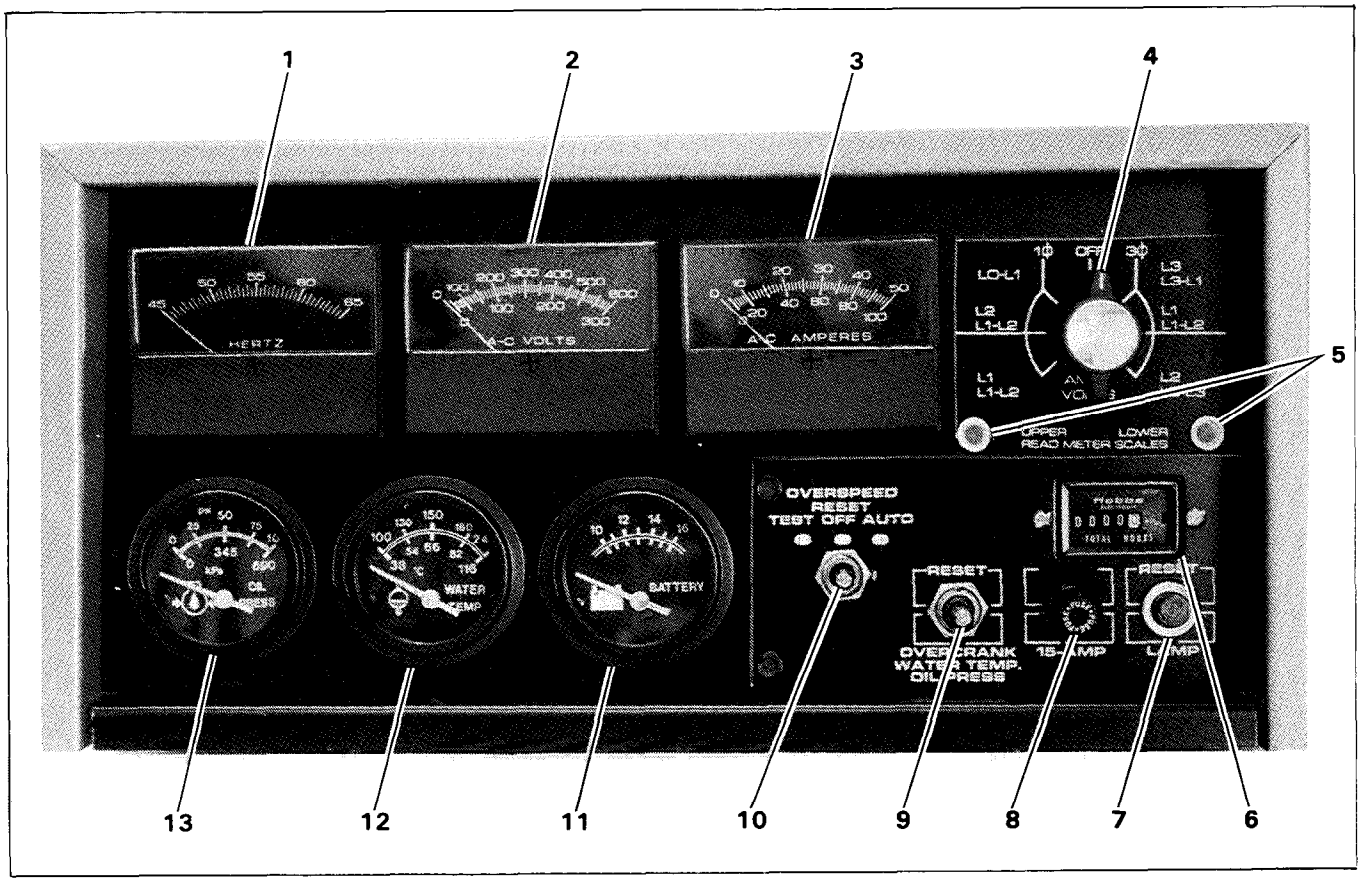


Figure 2-1. Relay Controller with Overspeed Shutdown

See "Fault Shut-downs" and "Resetting — Fault Shutdowns" following.

8. **Fuse** — protects DC controller and engine circuits.

9. **Reset Switch** — allows genset to resume operation following overcrank, high water temperature, low coolant level, high oil pressure and no AC voltage shutdowns. Refer to "Resetting — Fault Shutdowns."

10. **Generator Master Switch** — dual function of overspeed reset and selector switch for generator operation. Refer to "Testing, Starting, Stopping and Resetting" following.

11. **DC Voltmeter** — measures voltage of starting battery(ies)/charging system.

12. **Water Temperature** — measures engine coolant temperature.

13. **Oil Pressure** — measures oil pressure.

Testing

To test run the generator set at the controller, move the Generator Master Switch to the TEST position.

Starting

Move the Generator Master Switch to the AUTO position to allow start-up by automatic transfer switch or remote start/stop switch. If the genset is not connected to an automatic transfer or remote start/stop switch, move the Generator Master Switch to the TEST position for local start-up.

Stopping

1. Run the generator set at no load for 5 minutes to allow engine to cool down.

NOTE

Run the generator at no load for 5 minutes prior to stopping to insure adequate cooling of the set.

2. Move Generator Master Switch or remote start/stop switch to the OFF position.

Fault Shutdowns

The generator set will shut down automatically and the RESET lamp will light if any of the malfunctions below occurs.

OVERCRANK:	Shutdown occurs if engine does not start after 30-60 seconds of cranking.
NO AC VOLTAGE:	If no AC voltage is detected after 30 to 60 seconds of cranking.
OVERSPEED:	Shutdown occurs when generator governed frequency reaches 68-70 Hz on 50 and 60 Hz models.
HIGH ENGINE TEMPERATURE:	Shutdown occurs 5 seconds after fault; shutdown occurs at engine temperature of approximately 225° F (107° C).

CAUTION

High temperature shutdown will not function if proper coolant level is not maintained.

LOW OIL PRESSURE:	Shutdown occurs 5 seconds after fault; 5.5 to 10.5 psi (38 to 72 kPa) on diesel models, 11.5 to 18.5 psi (79 to 126 kPa) on gasoline models.

CAUTION

Low oil pressure shutdown will not function at low oil level. Check for proper oil level at engine.

LOW COOLANT LEVEL: (If equipped):	Shutdown occurs 5 seconds after fault.

Resetting — Fault Shutdowns

1. Move the Generator Master Switch to the OFF position. Placing Master Switch in the OFF position also resets Overspeed shutdown circuit. If reset lamp goes out, fault shutdown was due to an overspeed condition. If reset lamp stays lit, fault shutdown was due to an overcrank, high water temperature, low coolant level or low oil pressure condition. Push reset switch up to reset fault circuitry caused by these conditions.

NOTE

The reset switch is a free-floating toggle which may appear loose or broken. This is the switch's normal condition and does not require replacement.

2. Disconnect generator set from load with line circuit breaker or automatic transfer switch.
3. Refer to "Troubleshooting" section following to determine cause of shutdown.
4. Make the necessary repairs to correct the problem. Follow "Safety Precautions".
5. Move Generator Master Switch to necessary position (AUTO or TEST) for start-up.
6. Close line circuit breaker.

Voltage Adjustment

Use the rheostat mounted on the back of the controller to adjust generator output voltage. Refer to Figure 2-2.

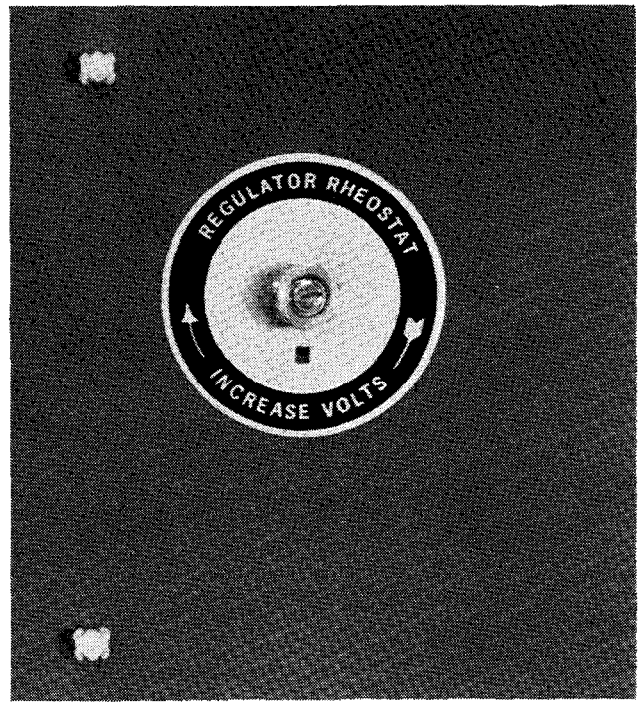


Figure 2-2. Voltage Adjustment

Dec-3 Microcomputer Controller Operation

For identification of Dec-3 Controller components and an explanation of their function, refer to Figure 2-3 and the paragraphs below.

Lamps

1. **System Ready** — lamp lights when Generator Master Switch is in AUTO position and the system senses no faults.

2. **High Engine Temperature** — lamp lights if engine has shut down due to high engine coolant temperature.

3. **Low Oil Pressure** — lamp lights if set shuts down due to insufficient oil pressure.

4. **Overspeed** — lamp lights if set shuts down due to overspeed condition.

5. **Overcrank** — cranking stops and overcrank lamp will light if engine does not start after 45 seconds of continuous cranking or 75 seconds of cyclic cranking. See "Starting".

   — cranking stops and overcrank lamp will light after 15 seconds if starter or engine will not turn (locked rotor).

   — overcrank lamp will flash if speed sensor signal is absent longer than one second.

NOTE

The Dec-3 controller is equipped with an Automatic Restart function. The genset will attempt to restart if the engine speed drops below 249 rpm (13 Hz). Failure to correct the cause of the decreased engine speed will result in an overcrank condition.

6. **Auxiliary** — auxiliary lamp will flash immediately if controller senses no AC output (except during first 10 seconds after start-up).

   — auxiliary lamp lights and engine stops 5 seconds after high oil temperature or low coolant level fault (if equipped); inhibited during first 30 seconds after crank disconnect.

   — auxiliary lamp will flash if the DC power supply is connected with Generator Master Switch in RUN or AUTO position.

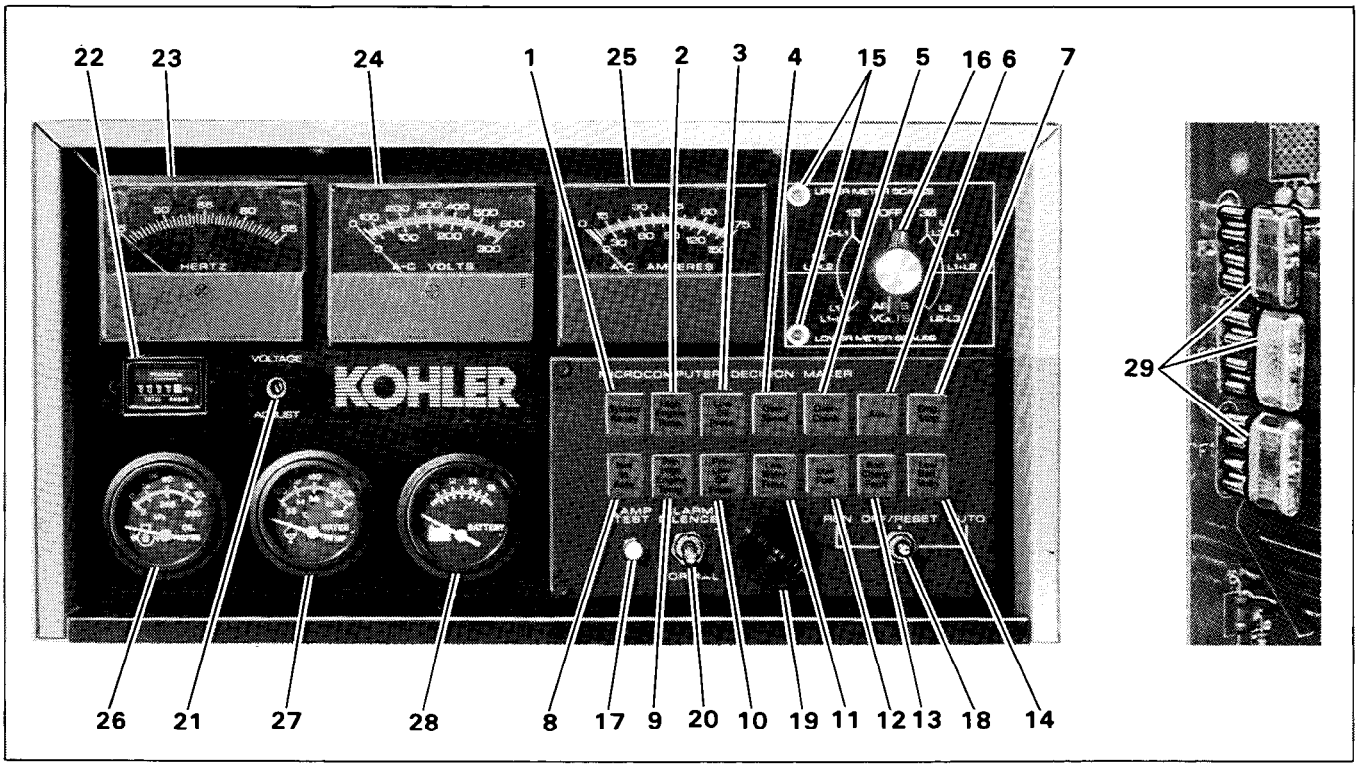


Figure 2-3. Dec-3 Microcomputer Controller

— auxiliary lamp will flash due to low voltage reset or hardware reset of controller board watchdog timer.

— auxiliary lamp lights and engine shuts down immediately if overvoltage condition arises (if overvoltage equipped).

— auxiliary lamp lights and engine shuts down if activated by sensing devices connected to auxiliary immediate shutdown ports (P1-17 and P1-18).

— auxiliary lamp lights if optional Emergency Stop Switch is reset with Generator Master Switch in the AUTO or RUN position.

7. **Emergency Stop (if equipped)** — lamp lights and engine stops if emergency stop is made.

8. **Not In Auto** — lamp lights when Generator Master Switch is in RUN or OFF/RESET position.

9. **Pre-High Engine Temperature (if equipped)** — lamp lights if engine coolant temperature approaches shutdown range.

10. **Pre-Low Oil Pressure (if equipped)** — lamp lights if engine oil pressure approaches shutdown range.

11. **Low Water Temperature (if equipped)** — lamp lights if optional engine block heater malfunctions and/or temperature is too low (below 70° F, 21° C) for 10-second start-up.

12. **Low Fuel (if equipped)** — lamp lights if fuel level in tank approaches empty.

13. **Battery Charger Fault (if Battery Charger equipped)** — lamp lights if battery charger malfunctions.

14. **Low Battery Volts (if Battery Charger equipped)** — lamp lights if battery or charging voltage drops below preset level. Lamp will also light if undervoltage condition occurs due to battery or charger malfunction when the set is not running.

15. **Scale Lamps (upper/lower)** — indicate AC voltmeter and/or ammeter scales to be read.

Switches and Alarms

16. **Selector Switch** — selects generator output circuits to be measured. When switched to a position with three circuit lead labels, amperage is measured on the upper lead and voltage is measured between the lower two leads. AC ammeter and voltmeter will not register with switch in the OFF position.

17. **Lamp Test** — press to test the controller indicator lamps.

18. **Generator Master Switch** — dual function of controller reset and generator operation switch. Refer to "Testing, Starting, Stopping and Resetting" following.

19. **Alarm Horn** — horn sounds if any fault or prealarm condition exists (except Emergency Stop, Battery Charger Fault or Low Battery Volts). The Alarm Horn can only be silenced with the Generator Master Switch in the AUTO position. See "Resetting" following.

20. **Alarm Silence** — disconnects alarm during servicing (Generator Master Switch must be in the AUTO position). Alarm Horn switches at all locations (controller, remote annunciator or A/V alarm) must be restored to normal position after fault shutdown is corrected to avoid reactivating alarm horn. See "Resetting" following.

21. **Voltage Adjustment** — used to fine-adjust generator output voltage.

Meters and Fuses

22. **Hourmeter** — records generator set total operating hours for reference in scheduling maintenance.

23. **Frequency Meter** — measures frequency (Hz) of generator output voltage.

24. **AC Voltmeter** — measures voltage across output leads indicated.

25. **AC Ammeter** — measures amperage from output leads indicated by selector switch.

26. **Oil Pressure** — measures engine oil pressure.

27. **Water Temperature** — measures engine coolant temperature.

28. **DC Voltmeter** — measures voltage of starting battery(ies).

29. **Fuses:** Located on controller circuit board adjacent to K3 relay.

    3-Amp. Remote Annunciator (F1) — protects remote annunciator circuit, A/V Alarm and Isolated Alarm Kit (if equipped).

    3-Amp. Controller (F2) — protects controller circuit board, speed sensor and lamp circuit board.

    15-Amp. Engine and Accessories (F3) — protects engine /starting circuitry and accessories.

"Local" Starting

To start the generator set at the controller, move the Generator Master Switch to the RUN position.

NOTE

The Alarm Horn will sound and the "Not In Auto" lamp will light whenever the Generator Master Switch is not in the AUTO position.

NOTE

The Dec-3 controller is equipped with a Transient Start/Stop function to avoid accidental cranking of the rotating engine. If the Generator Master Switch is momentarily placed in the OFF/RESET position then quickly returned to RUN, the genset will slow to 249 rpm and recrank before returning to rated speed.

"AUTO" Starting

To allow start-up by automatic transfer switch or remote start/stop switch (connected to controller terminals 3 and 4) move the Generator Master Switch to the AUTO position.

NOTE

The Dec-3 Microcomputer Controller provides up to 45 seconds of continuous cranking or 75 seconds of cyclic cranking (crank 15 seconds, rest 15 seconds, crank 15 seconds, etc.) before overcrank shutdown.

Cranking mode (cyclic or continuous) selection is made on the controller circuit board TB terminal strip (identified in Section 3). For cyclic cranking, leave circuit board TB 9 open. Continuous cranking is achieved by running a jumper between circuit board terminals TB 2 (ground) and TB 9.

Stopping

1. Disconnect load from generator set and allow it to run without load for 5 minutes.

   NOTE

   Run the generator at no load for 5 minutes prior to stopping to insure adequate cooling of the set.

2. Move Generator Master Switch to the OFF/RESET position. Engine will stop.

   NOTE

   If engine stop is signaled by a remote switch or Automatic Transfer Switch, the generator set will continue running during a 5 minute cool-down cycle.

Emergency Stopping

Turn Generator Master Switch to the OFF/RESET position or operate remote Emergency Stop switch (if equipped) for immediate shutdown. If the Emergency Stop switch is activated, the controller Emergency Stop lamp will light and the unit will shut down. When the Emergency Stop Switch is reset (by replacing glass face), the Auxiliary lamp will light. Move the Generator Master Switch to the OFF/RESET position to reset generator and resume operation.

NOTE

If the generator is not equipped with Emergency Stop Kit (K4 relay), a jumper must extend between controller circuit board ESR terminals. Remove this jumper if Emergency Stop Kit is installed.

Fault Shutdowns

The generator set will shut down automatically under the following fault conditions:

OVERSPEED: Unit shuts down immediately if governed frequency exceeds 70 Hz.

OVERCRANK: Shutdown occurs after 45 seconds of continuous cranking.

Shutdown occurs after 75 seconds of cyclic cranking (crank 15 seconds, rest 15 seconds, crank 15 seconds, etc. for a total of 75 seconds).

Shutdown occurs after 15 seconds if engine or starter will not turn (locked rotor).

LOW OIL PRESSURE: Shutdown occurs 5 seconds after fault; 5.5 to 10.5 psi (38-72 kPa) on diesel models; 11.5 to 18.5 psi (79-126 kPa) on gasoline models. *

CAUTION

Low oil pressure shutdown will not function at low oil level. Check for proper oil level at engine.

HIGH ENGINE TEMPERATURE: Shutdown occurs 5 seconds after fault (shutdown occurs at engine temperature of approximately 225° F, 107° C). *

CAUTION

High temperature shutdown will not function if proper coolant level is not maintained.

HIGH OIL TEMPERATURE: (if equipped) Shut down occurs 5 seconds after fault.*

LOW COOLANT LEVEL: Shutdown occurs 5 seconds after fault.*

*** NOTE**

Low Oil Pressure, High Engine Temperature, High Oil Temperature and Low Coolant Level Shutdowns will not function during the first 30 seconds after start-up.

OVERVOLTAGE: (If equipped) Unit will shut down after approximately one second of voltage 15% or more over nominal voltage. AUXILIARY lamp will light.

CAUTION

Sensitive equipment may suffer damage in less than one second of an overvoltage condition. On-line equipment requiring faster shutdowns should have its own overvoltage protection.

Resetting

Use the following procedure to restart the genset after a fault shutdown.

1. Move Controller alarm horn switch to the SILENCE position. If equipped, AV/annunciator alarm horn and lamp are activated. Move AV/annunciator alarm switch to SILENCE to stop alarm horn. AV/annunciator lamp stays lit.
2. Disconnect generator set from load with line circuit breaker or automatic transfer switch.
3. Correct cause of fault shutdown. See "Safety Precautions" section.
4. Move Generator Master Switch to OFF/RESET and then to the RUN position for start-up. If equipped, AV/annunciator alarm horn sounds and lamp goes out.
5. Verify that cause of shutdown has been corrected.
6. Reconnect generator to load via line circuit breaker or automatic transfer switch.
7. Move Generator Master Switch to AUTO position for start-up by remote transfer switch or remote start/stop switch. If equipped, move AV/annunciator alarm switch to NORMAL.
8. Move Controller alarm horn switch to the NORMAL position.

NOTE

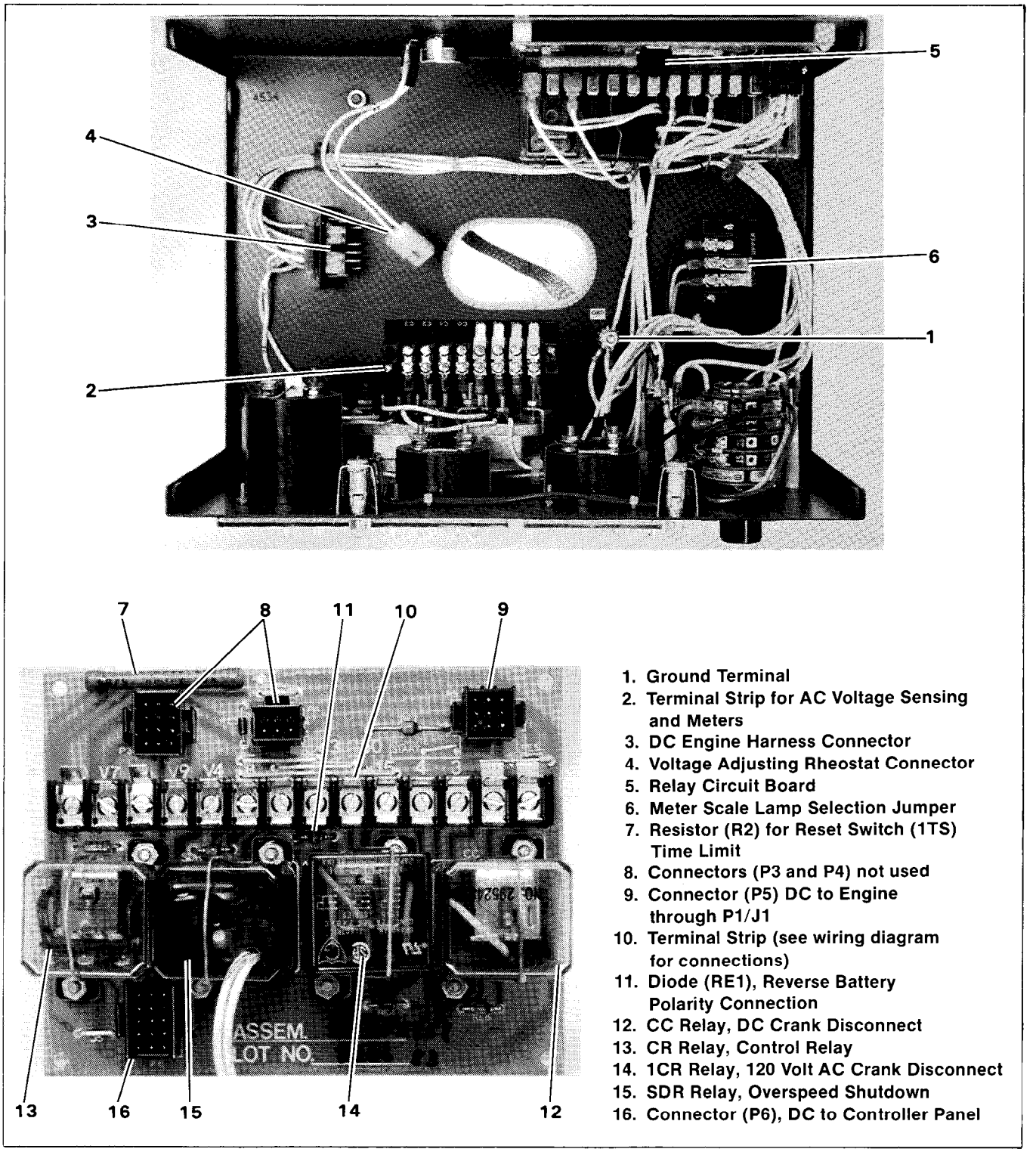
Controller alarm horn can only be silenced with Controller Master Switch in AUTO position.

Section 3.
Controller Troubleshooting

Overspeed Relay Controller

Description

Internal components of the Overspeed Relay Controller are shown in Figure 3-1. For a description of controller external features, see Section 2. Operation, "Overspeed Relay Controller."



1. Ground Terminal
2. Terminal Strip for AC Voltage Sensing and Meters
3. DC Engine Harness Connector
4. Voltage Adjusting Rheostat Connector
5. Relay Circuit Board
6. Meter Scale Lamp Selection Jumper
7. Resistor (R2) for Reset Switch (1TS) Time Limit
8. Connectors (P3 and P4) not used
9. Connector (P5) DC to Engine through P1/J1
10. Terminal Strip (see wiring diagram for connections)
11. Diode (RE1), Reverse Battery Polarity Connection
12. CC Relay, DC Crank Disconnect
13. CR Relay, Control Relay
14. 1CR Relay, 120 Volt AC Crank Disconnect
15. SDR Relay, Overspeed Shutdown
16. Connector (P6), DC to Controller Panel

Figure 3-1. Overspeed Relay Controller Components

Overspeed Relay Controller

Sequence of Operation (With or Without Meters)

The controller is the controlling point for generator set operation. The following sequence of operation should serve as a good starting point in fault detection. Refer to Figures 3-1 (Relay Controller Parts) and 3-2 (Relay Sequence of Operation) when troubleshooting.

Cranking

- Move Master Switch to TEST position (or AUTO position if connected to transfer switch for automatic start-up).
- CR relay energizes. CR contacts close, energizing the K1 (starter solenoid) relay and the fuel solenoid or ignition coil (FS).
- Current will flow through the ITS switch and normally closed 1CR contacts. The optional engine gauges, voltage regulator, hour meter, and battery charging alternator are energized.
- K1 relay contacts close, energizing the starter motor. Starter motor cranks the engine.

Cranking Disconnect

- As engine starts and generator voltage builds up, the 1CR relay will energize.
- The 1CR relay contacts open, deenergizing the K1 relay.
- CC contacts open, disconnecting the K1 relay.
- K1 relay contacts will open, disconnecting the starter motor (SM).
- The 1CR contacts will open, deenergizing the 1TS and preventing overcrank shutdown.
- CC relay is energized by battery charging alternator.
- Cranking stops.

Running

The 1CR, CR, and CC relays are energized.

Stopping

- Move Master Switch to OFF position.
- CR relay deenergized. CR relay contacts open, shutting off the fuel solenoid (FS).
- CC and 1CR relays deenergize.

Fault Shutdowns

Safeguard Breaker (See "Operation")

- If safeguard breaker opens, battery voltage is shut off to the voltage regulator resulting in a loss of generator AC output.
- 1CR relay deenergized. 1CR relay contacts close. 1TS switch will time out in approximately 30-60 seconds, the 1TS will trip causing the CR relay to deenergize. Reset lamp will light.
- CR relay contacts open, shutting off fuel solenoid or ignition coil (FS). Engine stops.

Low Oil Pressure

- Low oil pressure causes LOP contacts to close.
- 1TS switch will time out causing the CR relay to deenergize.
- CR relay contacts open shutting off fuel solenoid or ignition coil (FS).
- Reset lamp lights.

High Engine Temperature (Coolant)

- High engine temperature causes HET contacts to close.
- 1TS switch will time out causing the CR relay to deenergize. Reset lamp will light.
- CR relay contacts open shutting off fuel solenoid or ignition coil (FS).

Low Coolant Level (If Equipped)

- Low coolant level causes coolant level switch to close.
- 1TS switch will time out causing the CR relay to deenergize. Reset lamp will light.
- CR relay contacts open shutting off fuel solenoid or ignition coil (FS).

Overspeed Relay Controller — cont'd.

Overcrank

- After 30-60 seconds of cranking, the 1CR relay will not energize. Current will still be flowing through 1TS switch. 1TS will time out causing the CR relay to deenergize. Reset lamp will light.
- CR relay contacts open shutting off the SS relay, fuel solenoid, or ignition coil (FS).

Overspeed

The SDR relay monitors generator output. If governed frequency exceeds 70 Hz, SDR relay is energized and normally closed SDR contacts open. CR relay is deenergized. CR relay contacts open shutting off fuel solenoid or ignition coil.

Fuse

One 15-Amp. fuse located in the controller protects against damage in the event of a wiring short circuit or circuit overload. If the fuse "blows" the generator set will stop. Unit will not crank with a blown fuse. If set has stopped due to causes other than lack of fuel or fault shutdown, check the fuse. If blown, replace the fuse and attempt to restart generator set. If the set will not start, or if the fuse blows again, locate and correct the cause.

Fault Shutdowns

If the generator set stops running due to a fault shutdown, refer to the chart below to identify the cause. Consult the engine service manual for detailed information on correcting engine related faults. To restart the set after a fault shutdown, see Section 2 (Relay Controller Operation — Resetting).

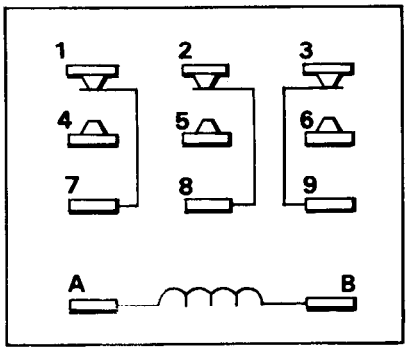
Fault	Cause
Overcrank	Shutdown occurs if engine does not start after 30-60 seconds of cranking.
Overspeed	Shutdown occurs when generator governed frequency reaches 68-70 Hz on 50 and 60 Hz models.
No AC Voltage	If no AC voltage is detected after 30-60 seconds of cranking.
High Engine Temperature	Shutdown occurs 5 seconds after fault. Shutdown occurs at engine temperature of approximately 225° F (107° C). **CAUTION** High temperature shutdown will not function if proper coolant level is not maintained.
Low Oil Pressure	Shutdown occurs 5 seconds after fault — 5.5 to 10.5 psi (38 to 72 kPa) on diesel models, 11.5 to 18.5 psi (79 to 126 kPa) on gasoline models. **CAUTION** Low oil pressure shutdown will not function at low oil level. Check for proper oil level at engine.
Low Coolant Level (if equipped) Auxiliary Lamp Lit	Shutdown occurs 5 seconds after fault.
High Oil Temperature (if equipped) Auxiliary Lamp Lit	Shutdown occurs 5 seconds after fault.

Overspeed Relay Controller — cont'd.

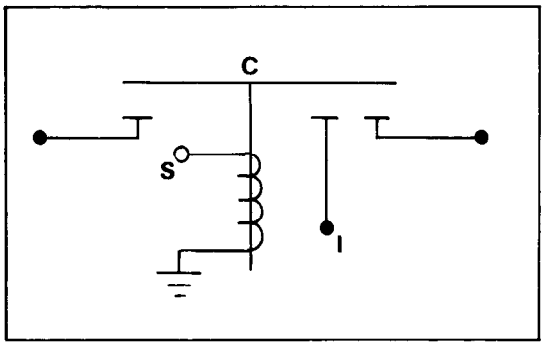
Relay Descriptions

A description and schematic of each relay is given below. Consult the wiring diagram and the "Troubleshooting" section for additional information.

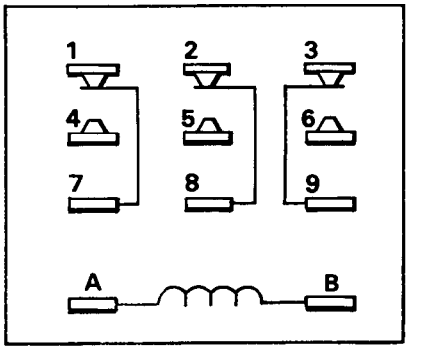
1. CR (Control Relay)
   - — Energizes voltage regulator (Generator)
   - — Initiates cranking
   - — Energizes ignition circuit (gas-gasoline)
   - — Energizes fuel solenoid (diesel)
   - — Energizes 1TS circuit
   - — Energizes hourmeter
   - — Energizes panel lamps
   - — Energizes anti-diesel solenoid (Gasoline Only)
   - — Energizes water valve (city-water cooled only)
   - — Energizes choke (Gasoline Only)
   - — Energizes gas valve (gas) or fuel pump (gasoline)



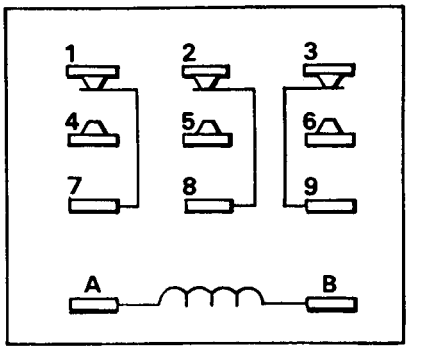
2. K1 (Starter Solenoid)
   - — Energizes starter



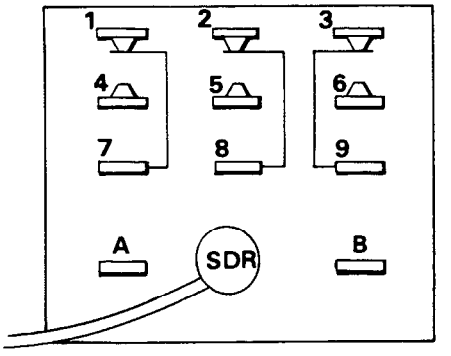
3. CC (Cranking Cutout)
   - — Deenergizes K1 relay



4. 1CR (Control Relay)
   - — Deenergizes K1 relay
   - — Initiates overcrank shutdown
   - — Provides path for fault shutdowns



5. SDR (Overspeed relay)
   - — Deenergizes CR relay
   - — Energizes reset lamp



Overspeed Relay Controller — cont'd.

Troubleshooting

Problem	Possible Cause	Corrective Action (Refer to Figure 3-2)	Figure Ref. Letter
Unit will not crank (Controller switch in TEST position)	Reversed or poor battery connections	Units require a negative ground connection. Battery cable connections must be clean and tight.	(A)
	Weak or dead battery	Minimum voltage at battery must be 10 Volts with controller switch in TEST position.	(A)
	Controller fuse blown (15 Amp.)	See "Fuse", Section 2.	(B)
	Shutdown due to fault protection (open 1TS contacts)	Press appropriate rest switch. Low engine oil pressure, high water temperature, low coolant level, engine overcranking engine overspeed or no AC generator output will cause 1TS to trip.	(C)
Will not crank (No voltage to CR coil)	Open SDR or 1TS contacts in series with Off/Auto/Test switch	Check for battery voltage to lead 44 on master switch. SDR relay must make good contact in socket.	(D)
	Open foil pattern on relay circuit board. Open RE1 diode on relay circuit board	Visually inspect; make continuity check; check diode with ohmmeter.	(G)
	Poor pin connection in P6 connector.	Visually inspect pin 8, 1, 2 and 13. Make continuity check.	(E)
	Faulty CR relay	12-volt coil resistance is approximately 125 ohms. Measure between terminals A and B. Normally closed contacts (continuity) are 1-7, 2-8, 3-9.	(H)
Will not crank (CR relay energizes)	Low battery. Battery cables or connections in poor condition.	Voltage at battery terminals must be at least 10 volts, recharge if necessary. Clean and tighten battery cable connections.	(A)
	No voltage at K1 — solenoid coil	Open CR, 1CR, or CC contacts in series with SS solenoid. Open in P5 connector (pin 4) Open in P1 connector (pin 16).	(I) (J) (K)
	Faulty starter motor.	Repair or replace.	(M)
	Faulty K1 relay/open coil.	Check continuity of coil out of circuit.	(I)
Will not crank (CR relay and SS solenoid energizes)	No voltage at starter motor.	High resistance or faulty K1 contacts.	(L)
	Loose or corroded starter lead connections.	Clean and tighten.	(A) (M)
	Faulty starter motor.	Repair or replace.	(M)

Overspeed Relay Controller — cont'd.

Troubleshooting (Continued)

Problem	Possible Cause	Corrective Action (Refer to Figure 3-2)	Figure Ref. Letter
Unit cranks but will not start	No fuel.	Check for fuel at pump or carburetor. Check for clogged fuel filter. Check engine fuel system.	
	Ignition system.	Check for battery voltage at ignition coil. Check ignition points. Check engine ignition system.	(N)
	Open in wiring harness.	While cranking, check for battery voltage (terminal 70) at ignition coil (gas/gasoline) or fuel solenoid (diesel). P1 connector, pin 9, must conduct battery (+) voltage to connector P5, pin 5. P1 connector, pin 9, must conduct battery voltage to fuel solenoid or ignition coil.	(N)
Unit runs for 30-60 seconds then shuts down	No AC output available to 1CR relay coil. Safeguard breaker (if equipped) must be closed.	Check for 120 volts AC to controller terminal strip V0 and V8. See generator troubleshooting (No Output). If 1CR relay does not energize, normally closed contact of relay will energize 1TS thermal switch and shut down unit.	(O)
	No or low engine oil pressure.	Engine oil pressure must be available to open L.O.P. switch (closed switch contacts will energize 1TS and shut down unit). Correct engine oil pressure problem.	(P)
	High engine coolant temperature.	Excessive coolant temperature will activate H.W.T. switch. Check coolant level. Check ignition timing. Check for cooling restrictions and radiator cooling air.	(Q)
Unit starts and shuts down immediately	Overspeed.	Governed frequency exceeding 70 Hz will energize SDR relay and shutdown unit. Overspeed shutdown may be caused by governor malfunction/misadjustment or rapid loss of load.	(F)

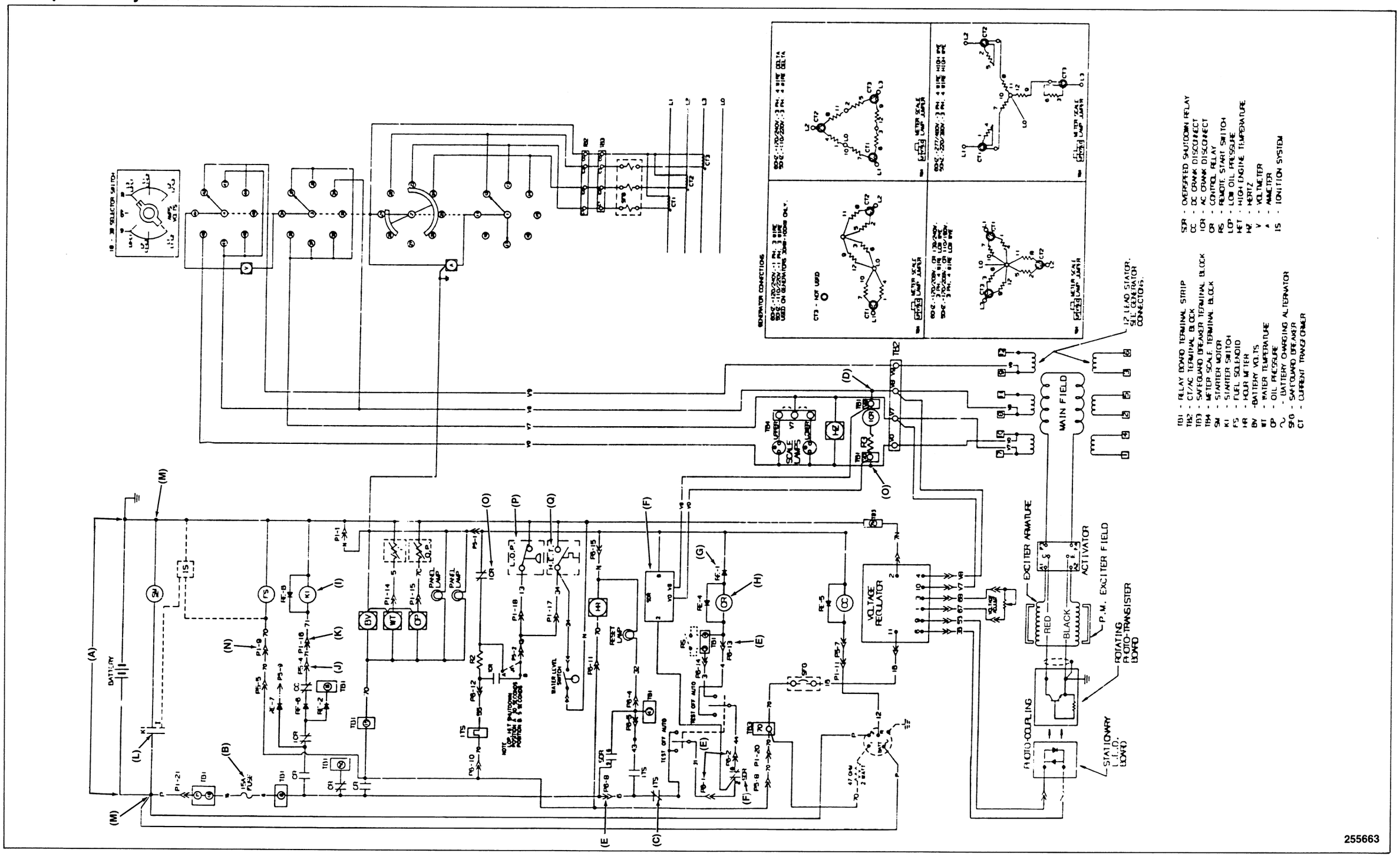


Figure 3-2a. Relay Controller Sequence of Operation (Generators w/Standard One-Piece FR Activator)

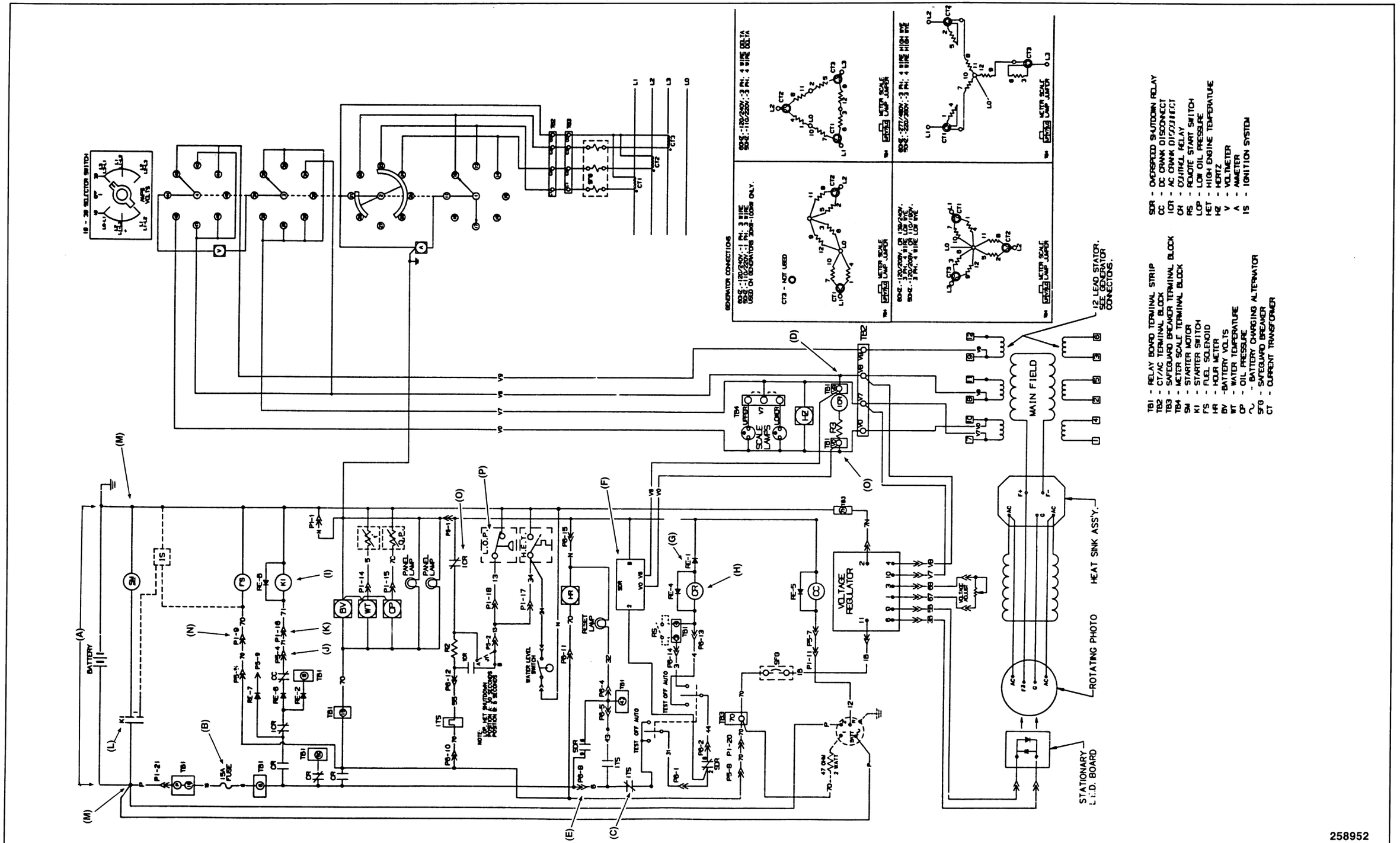
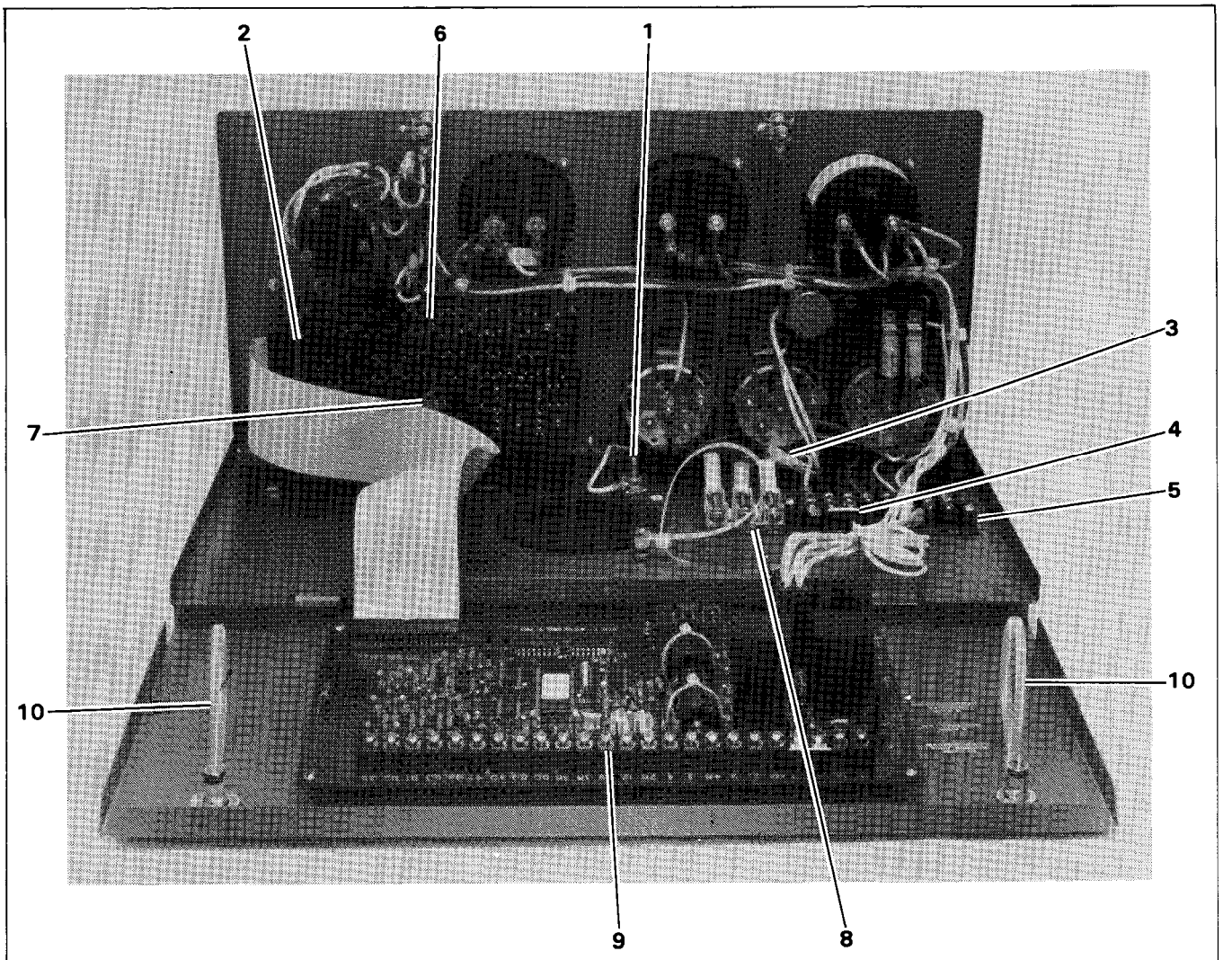


Figure 3-2b. Relay Controller Sequence of Operation (Generators w/Split FR Activator)

Dec-3 Microcomputer Controller

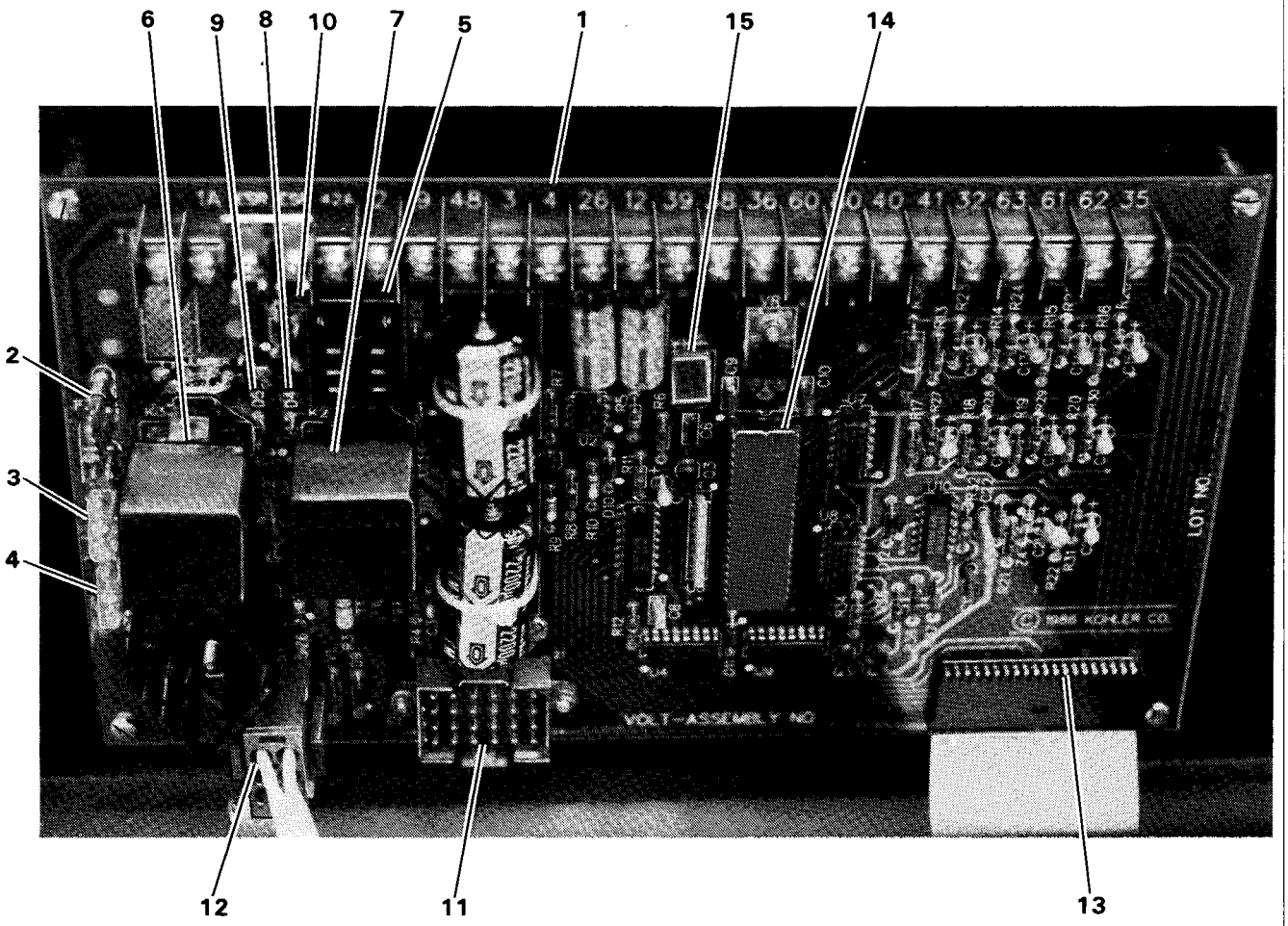
Description

For external features, see Section 2—"Operation Dec-3 Microcomputer Controller," Figures 3-3 to 3-5 show locations of controller components and connections. Figures 3-6a, 3-6b, 3-6c, and 3-6d are logic schematics showing input/output circuits for reference in troubleshooting.



1. Controller DC Ground Terminal (N)
2. Control Panel Harness Connector (P4)
3. Voltage Adjustment Rheostat Connector
4. Lamp Selection Jumper
5. CT/Meter Scale Terminal Block (TB2)
6. Lamp Circuit Board
7. Alarm Horn
8. AC Fuse Terminal Block (TB3)
9. Controller Main Circuit Board
10. Accessory Wire Guide Loops

Figure 3-3. Dec-3 Microcomputer Controller



1. TB Terminal Strip
2. Fuse — 15 Amp. (F3) Engine and Accessories
3. Fuse — 3 Amp. (F2) Controller
4. Fuse — 3 Amp. (F1) Remote Annunciator
5. K4 Relay (Optional Emergency Stop Relay — Not Shown)
6. K3 Relay (Control Relay)
7. K2 Relay (Control Relay)
8. D4 Diode — See "Troubleshooting" Section
9. D5 Diode — See "Troubleshooting" Section
10. D7 Diode — See "Troubleshooting" Section
11. P1 Connector (DC Harness Connector)
12. P2 Connector (AC Harness Connector)
13. P3 Connector (Control Panel Harness Connector)
14. Microcomputer Chip (U6)
15. Timing Crystal (Y1)

Figure 3-4. Dec-3 Microcomputer Controller Circuit Board Components

Dec-3 Microcomputer Controller — cont'd.

CIRCUIT BOARD TERMINAL IDENTIFICATION (TB)

1. 1 — Ground — Emergency Stop Relay (K4)
2. 1A — Emergency Stop Relay (K4) Coil, Negative
3. ESR — Emergency Stop Relay (K4), Common Contact
4. ESR — Emergency Stop Relay (K4), N/O
5. 42A — Battery Voltage (Fuse #1 Protected)
6. 2 — Ground
7. 9 — Crank Mode (open — cyclic crank; ground — continuous crank)
8. 48 — Emergency Stop Indicator
9. 3 — Remote Start Ground
10. 4 — Remote Start (Active Low *)
11. 26 — Auxiliary Indicator
12. 12 — Overcrank Indicator
13. 39 — Overspeed Indicator
14. 38 — Low Oil Pressure Indicator
15. 36 — High Engine Temperature Indicator
16. 60 — System Ready Indicator
17. 80 — Not In Auto Indicator
18. 40 — Prealarm High Engine Temperature Indicator
19. 41 — Prealarm Low Oil Pressure Indicator
20. 32 — Common Fault Line
21. 63 — Low Fuel (Active Low *)
22. 61 — Battery Charger Fault (Active Low *)
23. 62 — Low Battery Volts (Active Low *)
24. 35 — Low Water Temperature

P1 CONNECTOR PINS

1. Output to K1 Relay (Crank Relay), Wire 71
2. Ground for Speed Sensor, Wire 2
3. Output to Safeguard Breaker Terminal, Wire 70
4. Alternator Flash
5. Ground (-), Wire N
6. Speed Sensor Shield Ground, Wire S2
7. Output to Fuel Solenoid (FS), Wire 70
8. Battery Positive to Speed Sensor, Wire 24
9. Input from Speed Sensor, Wire 16
10. Output from Battery-Charging Alternator (if equipped), Wire 12
11. Not Used
12. Input from Battery Positive (P)
13. Input from High Oil Temperature Switch, Wire 31
14. Input from Water Level Switch, Wire 31
15. Input from Auxiliary Delay Shutdown, Wire 31
16. Input from Pre-High Engine Temperature Switch, Wire 40A
17. Input from Auxiliary Immediate Shutdown, Wire 30
18. Input from Auxiliary Immediate Shutdown, Wire 30
19. Not Used
20. Not Used
21. Input from High Engine Temperature Switch, Wire 34
22. Input from Low Oil Pressure Switch, Wire 13
23. Input from Pre Low Oil Pressure Switch, Wire 41A
24. Input from Low Water Temperature Switch, Wire 35A

P2 CONNECTOR PINS

1. Output to Oil Pressure Sender, Wire 70
2. Input from Overvoltage Board, Wire 30
3. Input for AC Crank Disconnect and Instrumentation, Wire V7F
4. Not Used
5. Input for AC Crank Disconnect and Instrumentation, Wire V0
6. Engine Ground, Wire 2

P3 CONNECTOR PINS

1. Output to Emergency Stop Lamp, Wire 48
2. Output to Auxiliary Indicator, Wire 26
3. Output to Overcrank Indicator, Wire 12
4. Output to Overspeed Indicator, Wire 39
5. Output to Low Oil Pressure Indicator, Wire 38
6. Output to High Engine Temperature Indicator, Wire 36
7. Output to System Ready Indicator, Wire 60
8. Voltage (+) to Front Panel, Wire 24
9. Output to Not In Auto Indicator, Wire 80
10. Output to Pre High Engine Temperature Indicator, Wire 40
11. Output to Pre Low Oil Pressure Indicator, Wire 41
12. Output to Low Water Temperature Indicator, Wire 35
13. Output to Low Battery Volts Indicator, Wire 62
14. Output to Battery Charger Fault Indicator, Wire 61
15. Output to Low Fuel Indicator, Wire 63
16. Output to Common Alarm, Wire 32
17. Input from Generator Master Switch, RUN position, Wire 47
18. Input from Generator Master Switch, OFF/RESET position, Wire 43
19. Input from Generator Master Switch, AUTO position, Wire 46
20. Ground (-), Front Panel, Wire 2

P4 CONNECTOR PINS

1. Input to Emergency Stop Lamp, Wire 48
2. Input to Auxiliary Indicator, Wire 26
3. Input to Overcrank Indicator, Wire 12**
4. Input to Overspeed Indicator, Wire 39**
5. Input to Low Oil Pressure Indicator, Wire 38**
6. Input to High Engine Temperature Indicator, Wire 36**
7. Input to System Ready Indicator, Wire 60
8. Voltage (+) to Front Panel, Wire 24
9. Input to Not In Auto Indicator, Wire 80
10. Input to Pre-High Engine Temperature Indicator, Wire 40**
11. Input to Pre-Low Oil Pressure Indicator, Wire 41**
12. Input to Low Water Temperature Indicator, Wire 35**
13. Input to Low Battery Voltage Indicator, Wire 62
14. Input to Battery Charger Fault Indicator, Wire 61
15. Input to Low Fuel Indicator, Wire 63**
16. Input to Common Alarm, Wire 32**
17. Output from Generator Master Switch, RUN Position, Wire 47
18. Output from Generator Master Switch, OFF/RESET Position, Wire 43
19. Output from Generator Master Switch, AUTO Position, Wire 46
20. Ground (-), Front Panel

* Active Low Circuits—Test by grounding designated terminal.

** Common alarm triggered by High Engine Temperature, High Engine Temperature Prealarm, Low Oil Pressure, Low Oil Pressure Prealarm, Low Water Temperature, Overcrank, Overspeed, Low Fuel, and Auxiliary Faults.

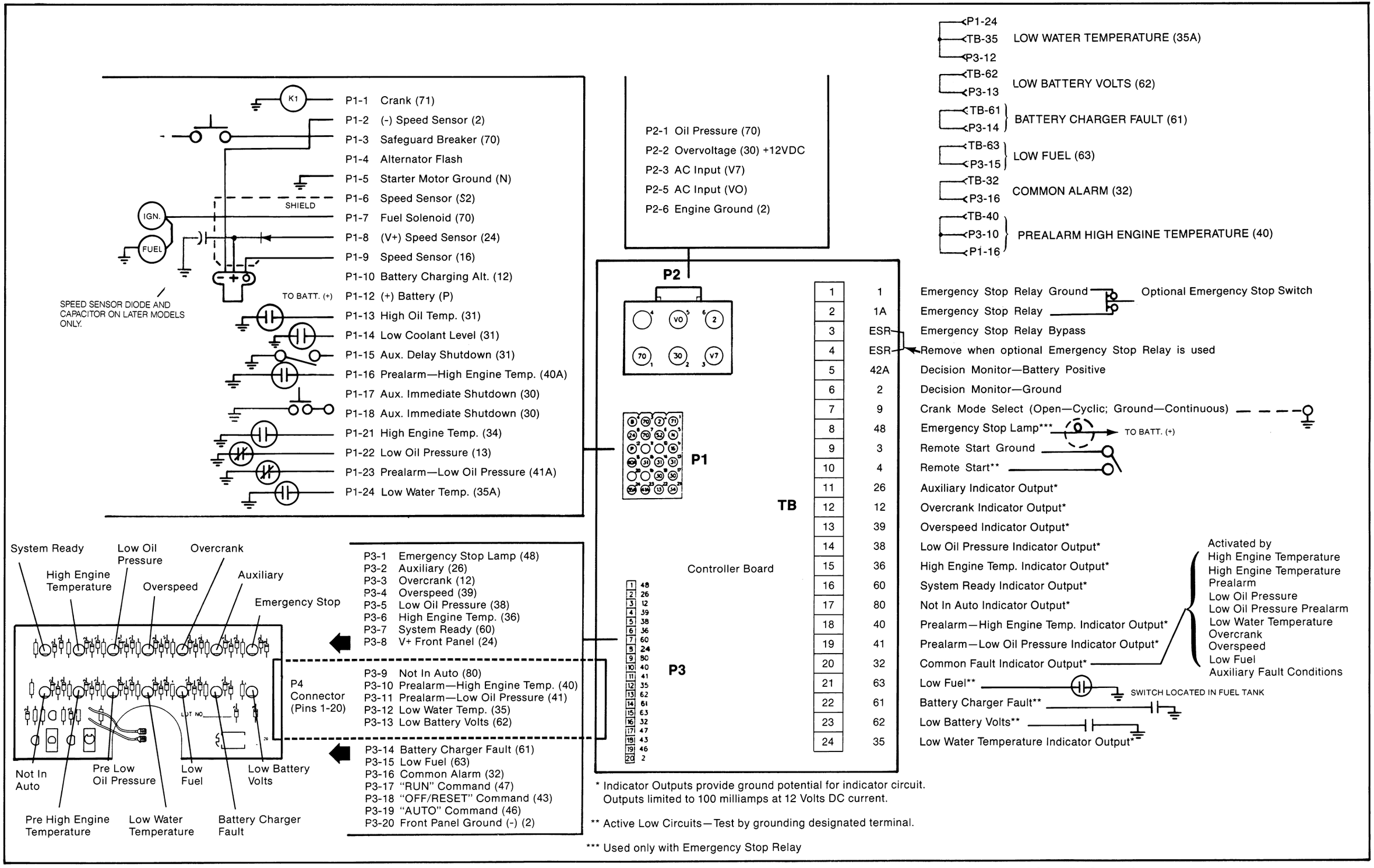
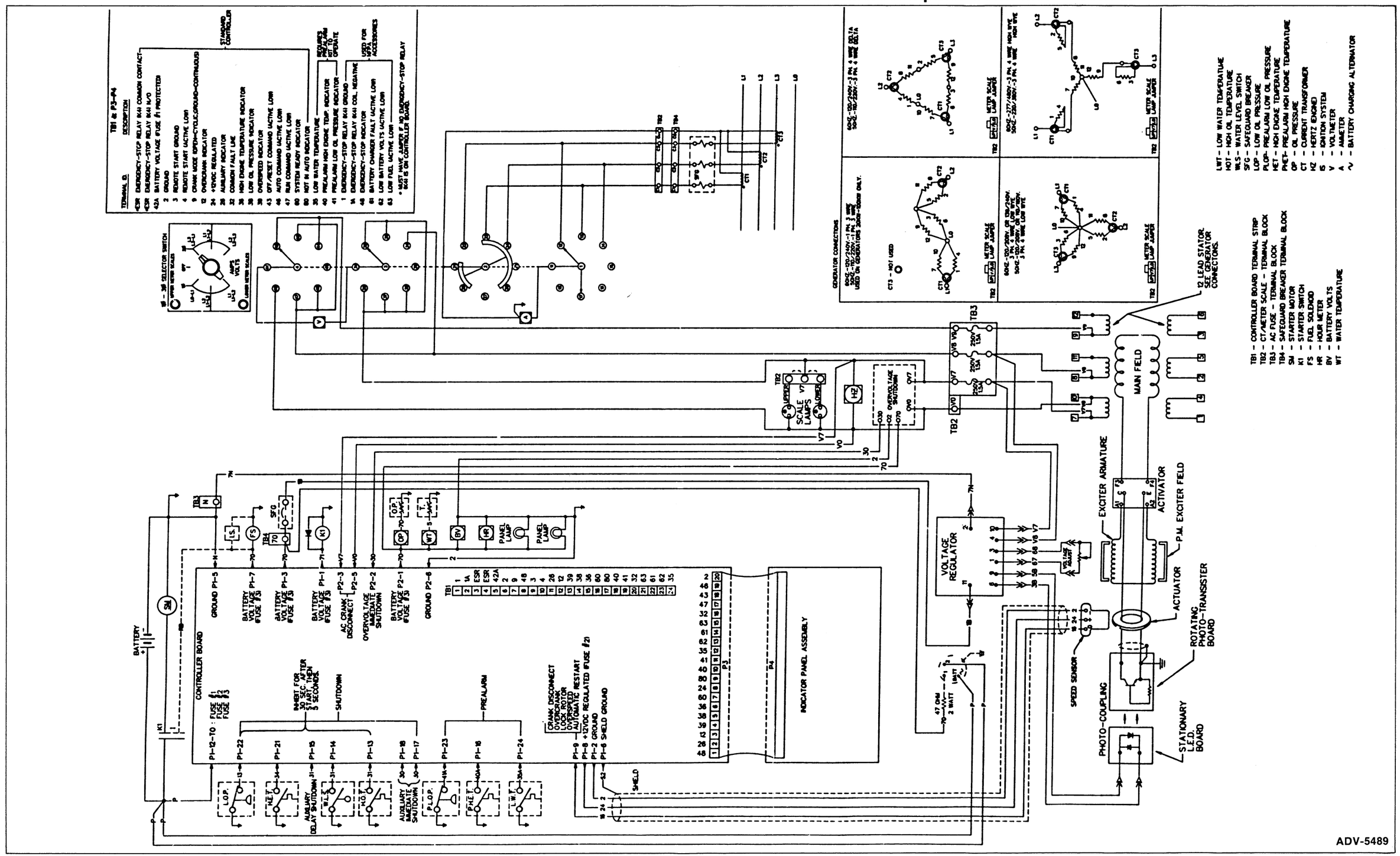


Figure 3-5. Dec-3 Microcomputer Controller Connections



ADV-5489

Figure 3-6a. Logic Schematic, Dec-3 Microcomputer Controller (1-Phase/3-Phase) (Generators w/Standard, One-Piece FR Activator)

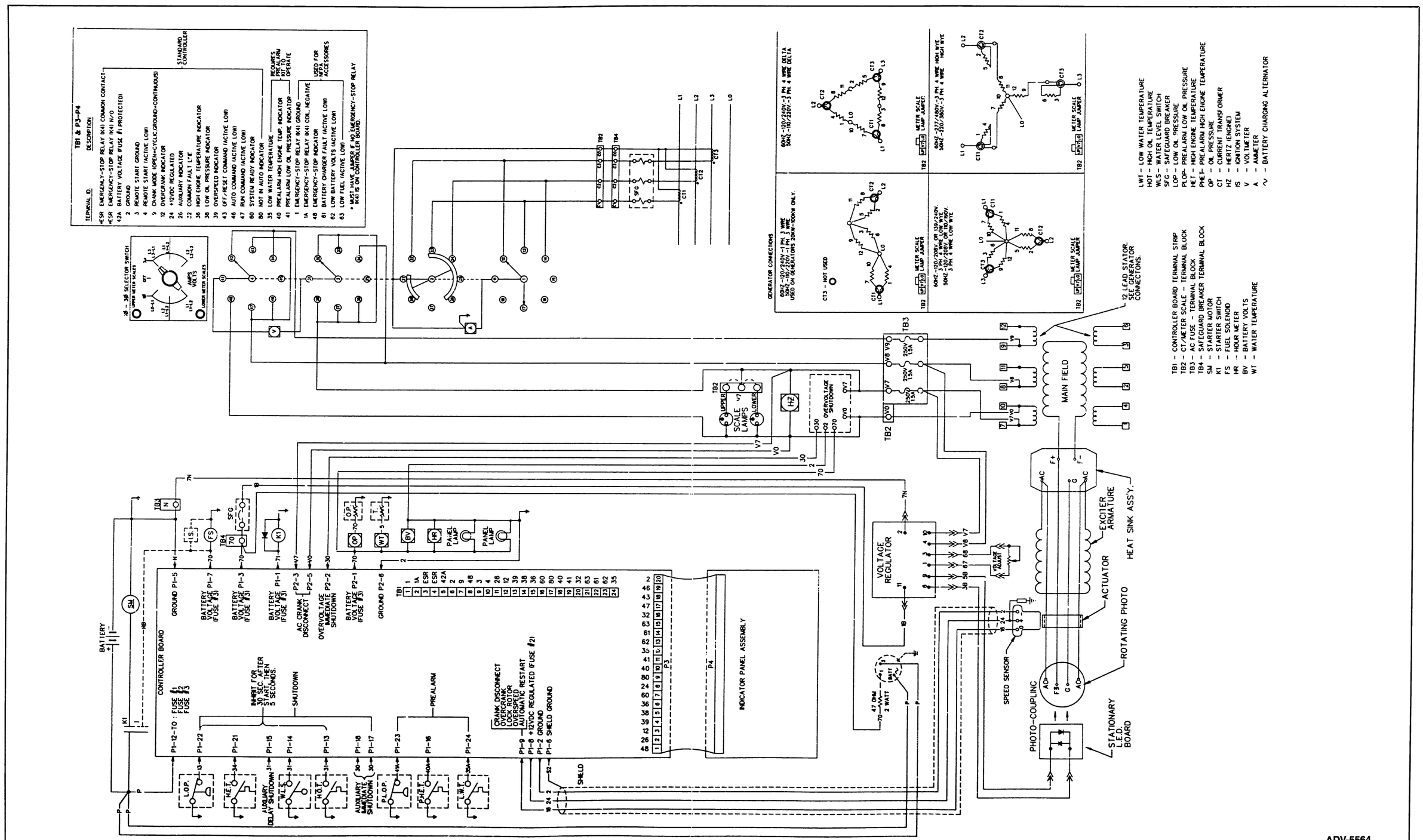


Figure 3-6b. Logic Schematic, Dec-3 Microcomputer Controller (1-Phase/3-Phase) (Generators w/Split FR Activator)

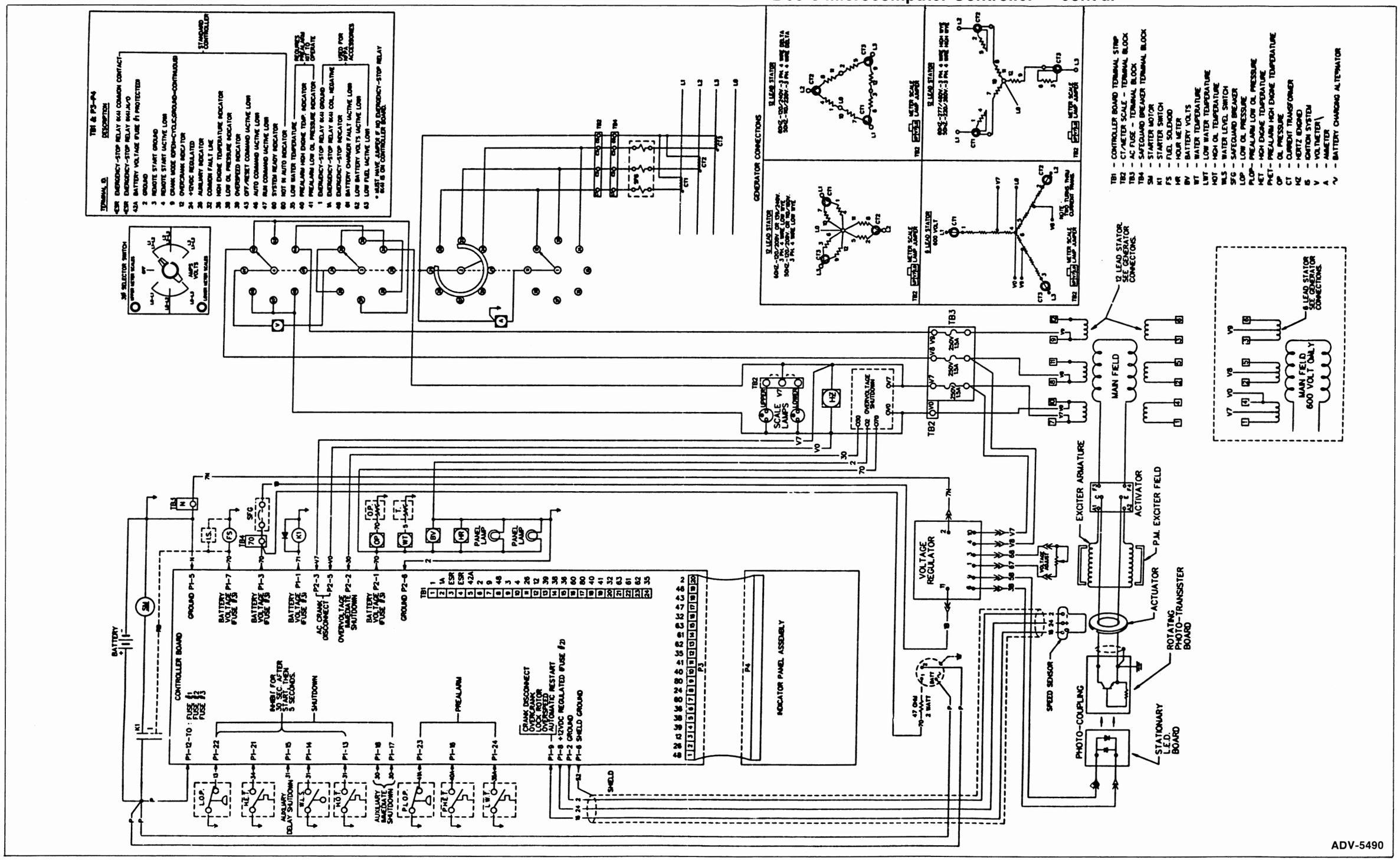


Figure 3-6c. Logic Schematic, Dec-3 Microcomputer Controller (3-Phase and 600 Volt) (Generators w/Standard One-Piece FR Activator)

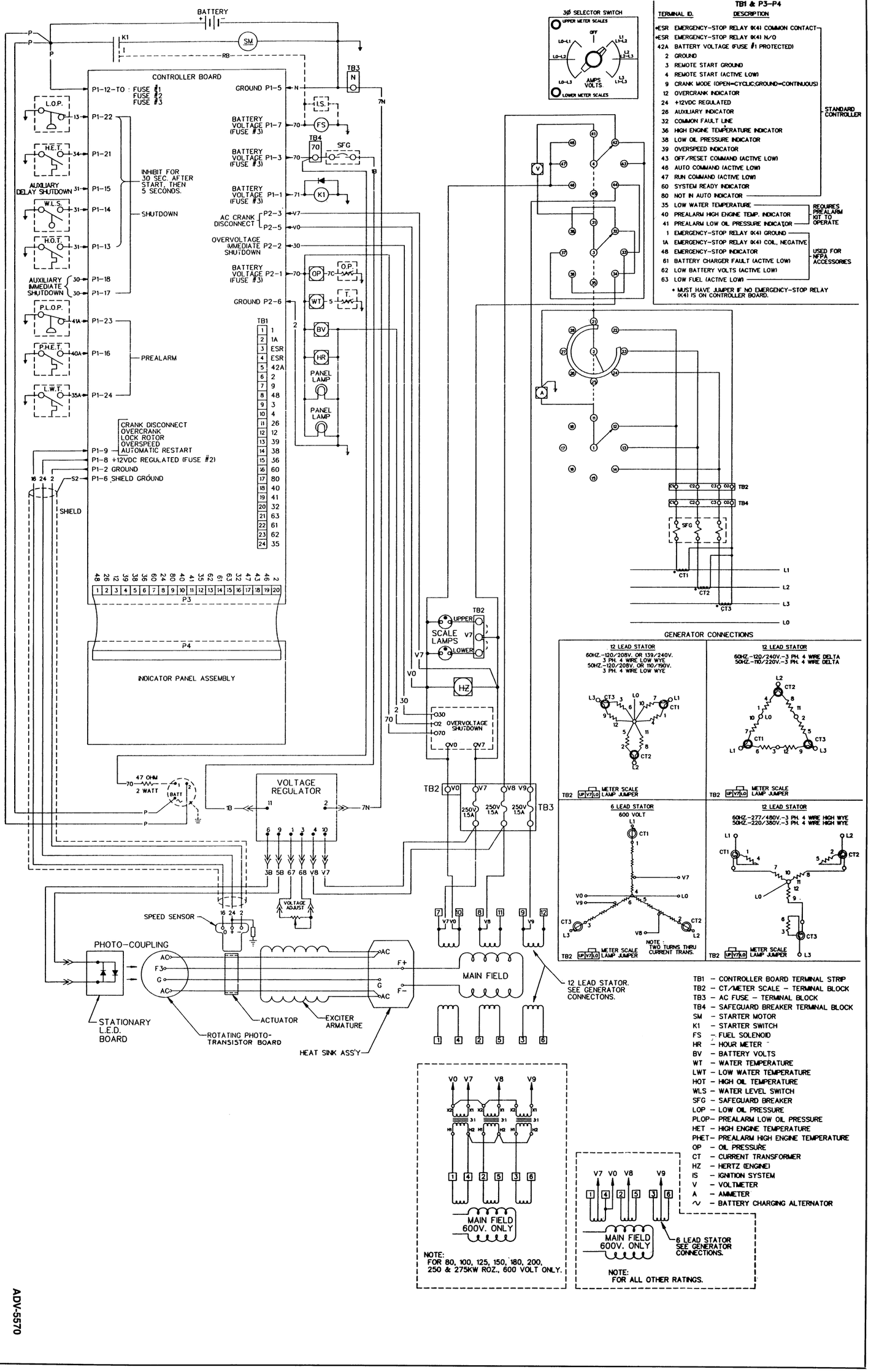


Figure 3-6d. Logic Schematic, Dec-3 Microcomputer Controller (3-Phase and 600 Volt) (Generators w/Split FR Activator)

Fault shutdowns — Dec-3 Microcomputer Controller

If the generator set will not start or stops running due to a fault shutdown (fault lamp lit), refer to the following chart to identify fault conditions. Consult the Engine Service Manual for detailed information on correcting engine related faults. To reset the set after a fault shutdown, see Section 2. Dec-3 Controller — "Resetting."

Indicator	Fault Condition
High Engine Temperature Lamp Lights	Engine Coolant Temperature above 225° F (107° C).
	Cooling System Malfunction
Low Oil Pressure Lamp Lights	Engine oil pressure between 5.5-10.5 psi 38-72 kPa) on diesel-powered models; 11.5-18.5 psi (79-126 kPa) on gasoline-powered models.
Overspeed Lamp Lights	Governed frequency in excess of 70 Hz (all models).
Overcrank Lamp Lights	More than 45 seconds of continuous cranking.
	More than 75 seconds of cyclic cranking.
	Locked rotor.
Overcrank Lamp Flashes	Speed sensor signal absent longer than one second.
Auxiliary Lamp Lights	Low coolant level.
	High engine oil temperature (if sensor equipped).
	Overvoltage (if equipped) — voltage 15% greater than nominal voltage (for period longer than one second).
Emergency Stop (if equipped)	Emergency stop switch activated.
	Emergency stop switch disconnected from controller terminals TB1 or 1A.

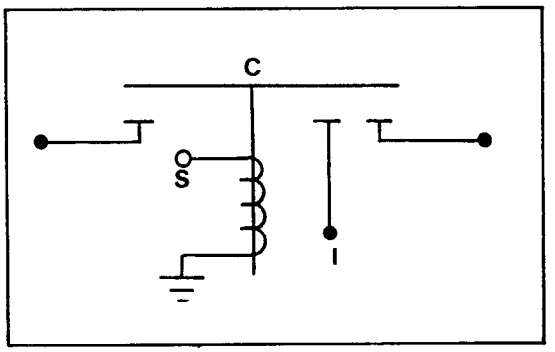
Dec-3 Microcomputer Controller — cont'd.

Relay Descriptions

A description and schematic of each relay is given below. Consult the wiring diagrams and the "Troubleshooting" section following for additional information.

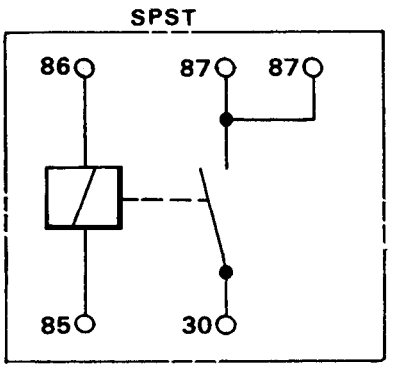
K1 Relay (Starter Solenoid)

Energizes starter



K2 Relay

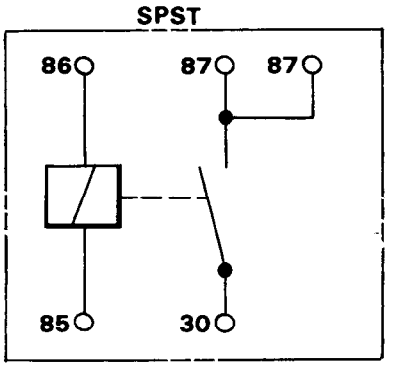
Energizes K1 Relay



K3 Relay

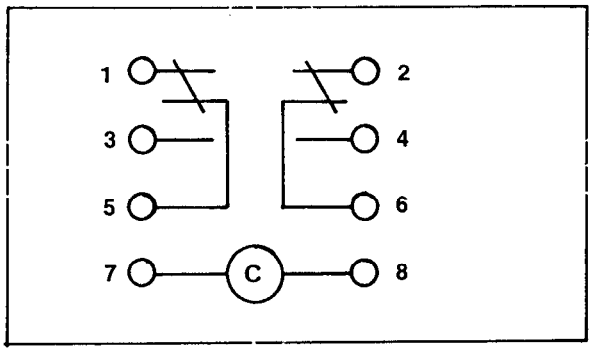
Energizes ignition, fuel solenoid, fuel pump, choke and instrumentation.

Energizes generator voltage regulator.



K4 Relay

Emergency Stop Relay (optional — included with Emergency Stop Kit). If K4 is used, remove jumper from controller circuit board ESR terminals and connect Emergency Stop Switch to circuit board terminals TB1 and 1A. If K4 relay is not used, a jumper (standard) must connect the two circuit board ESR terminals. The K4 relay is energized continuously, except during emergency stop conditions.



Troubleshooting

Use the following tables as a quick reference in troubleshooting individual problems. Consult the first table to aid in locating the cause of blown fuses. In the second table, generator faults are listed by specific groups and correlated with possible causes and corrective action. Before beginning any troubleshooting procedure, read all safety precautions at the beginning of this manual and those included in the text. Do not neglect these precautions.

⚠WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and whenever electrical energy is present there is the potential danger of electrocution. Keep everyone, especially children, away from the set while it is running and take precautions to prevent unqualified personnel from tampering with or attempting to operate your generator set. Have the set and electrical circuits serviced only by qualified specialists. Wiring should be inspected frequently — replace leads that are frayed or in poor condition. Be sure that generator is properly grounded. Do not operate electrical equipment when standing in water, on wet ground or when your hands are wet.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic Transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Master Switch on controller to OFF/RESET and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to the generator.

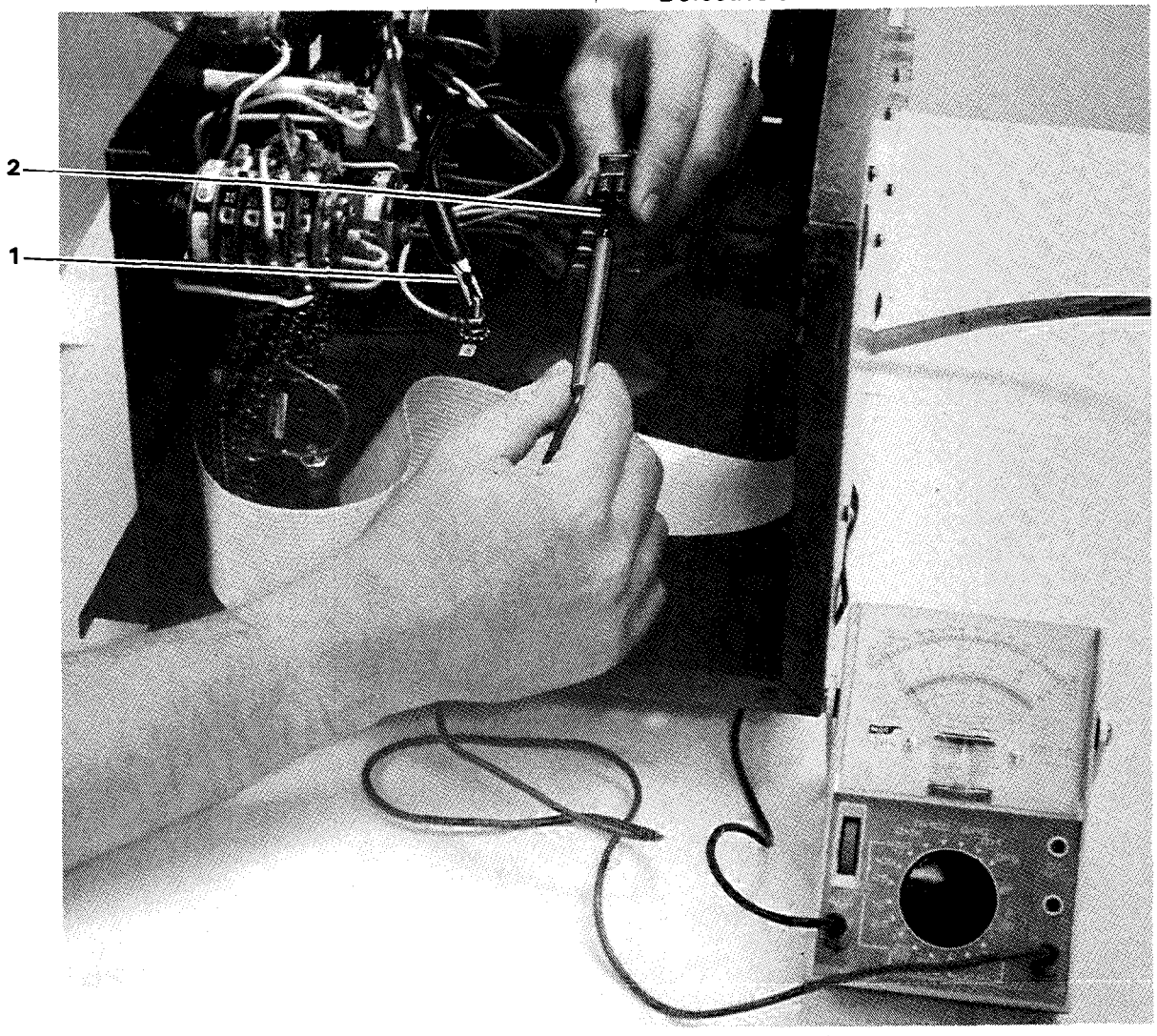
Fuses

Before beginning any controller troubleshooting procedure, check the condition of fuses F1, F2, and F3. If any of these fuses is blown, replace it before resuming operation. If the fuse blows again, use the chart below as a general aid in identifying faulty components. Additional test procedures are included in the text.

Blown Fuse	Possible Cause
F1 Fuse — Remote Annunciator (3 Amp.)	• Defective Decision Monitor * • Defective Remote Annunciator * • Defective Audio-Visual Alarm * * Accessories connected to controller TB42A
F2 — Controller (3 Amp.)	• Shorted speed sensor • Shorted DC supply to indicator panel • Shorted controller circuit board
F3 — Engine and Accessories (15 Amp.)	If equipped with K4 (emergency stop) relay: • Defective engine electrics • Defective overvoltage board • Defective circuit board To quickly check the condition of the components listed under F3 (except circuit board) use an ohmmeter to read resistance between the designated terminal and ground (see chart below and Figure 3-7). With ohmmeter on the R x 1 scale, a reading of less than one ohm (continuity) indicates that component may be defective. Isolate the defective component and repair or replace. If the ohmmeter check of these components indicates no short circuits (no continuity) the circuit board may be defective.

Dec-3 Microcomputer Controller — cont'd.

Blown Fuse	Possible Cause
	Gauges — Connector P2, socket 1 to ground Overvoltage — Connector P2, socket 2 to ground Crank — Connector P1, socket 1 to ground Safeguard Breaker — Connector P1, socket 3 to ground Generator Field Flash — Connector P1, socket 4 to ground Engine Run — Connector P1, socket 7 to ground If the genset is not equipped with a K4 relay (emergency stop), the F3 fuse may blow because of: • Defective gauges • Defective safeguard breaker/voltage regulator • Defective engine run circuit • Defective crank circuit



1. Ground Connection 2. P2 Connection

Figure 3-7. P1/P2 Component Ohmmeter Checks

Dec-3 Microcomputer Controller — cont'd.

⚠WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and whenever electrical energy is present there is the potential danger of electrocution. Keep everyone, especially children, away from the set while it is running and take precautions to prevent unqualified personnel from tampering with or attempting to operate your generator set. Have the set and electrical circuits serviced only by qualified specialists. Wiring should be inspected frequently — replace leads that are frayed or in poor condition. Be sure that generator is properly grounded. Do not operate electrical equipment when standing in water, on wet ground or when your hands are wet.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic Transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Master Switch on controller to OFF/RESET and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to the generator.

NOTE

It may be necessary to scrape conformal coating from test points on controller circuit board during troubleshooting procedure. Revarnish all test points after testing is complete.

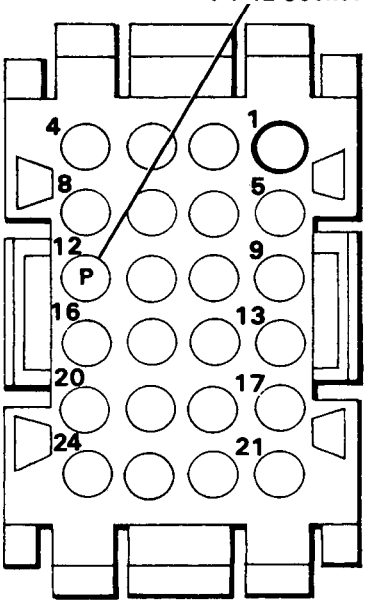
NOTE

If starting unit by remote switch, verify proper operation of remote switch before troubleshooting controller. Test remote switch operation by placing Master Switch in the AUTO position and running a jumper between terminals 3 and 4 on controller circuit board. If the generator does not start, proceed with the controller troubleshooting procedure outlined below.

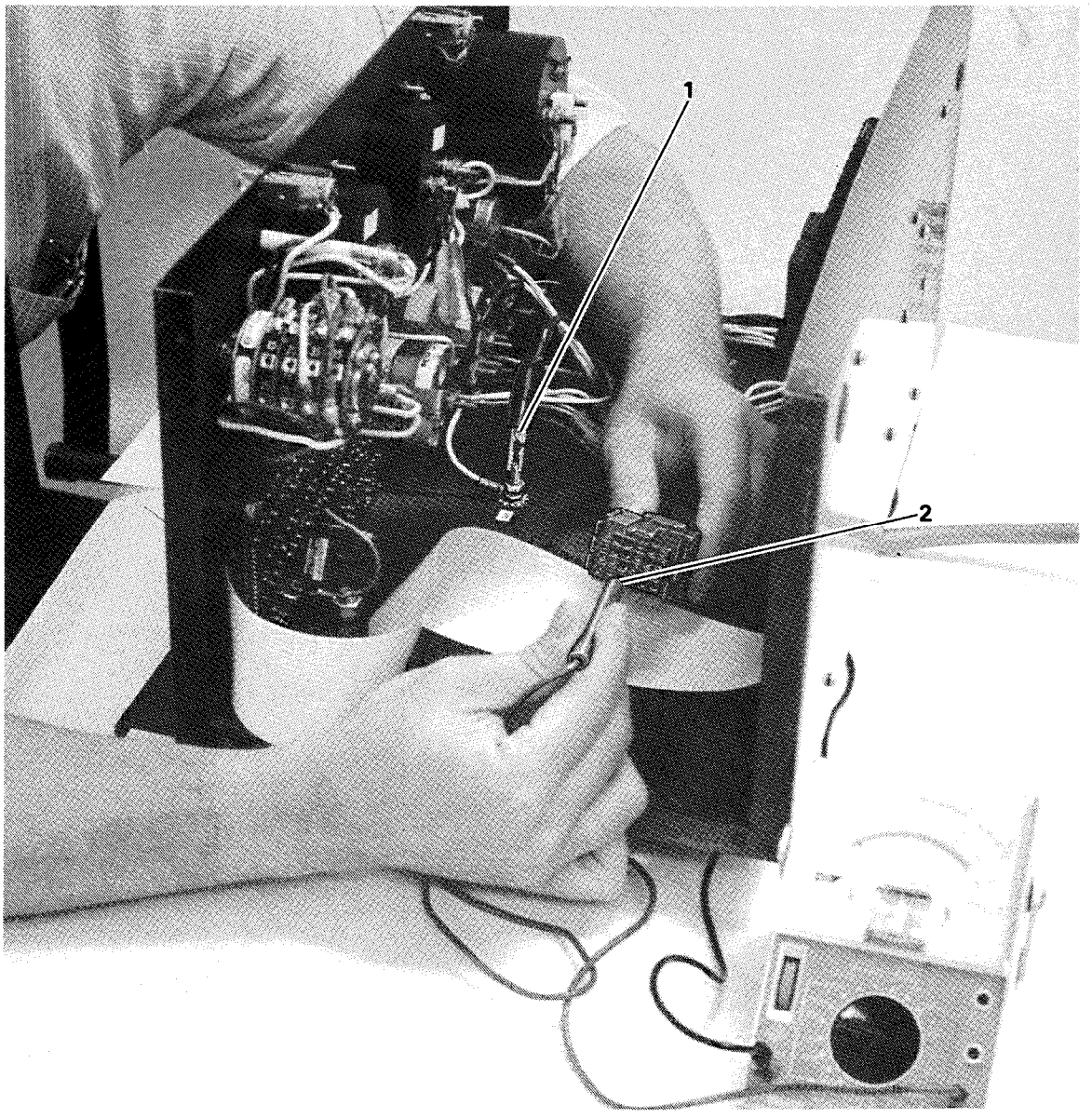
CAUTION

NEGATIVE GROUND CONTROL SYSTEM! The generator set will not function if the battery leads are reversed. Reversed battery connections will cause the 3 Amp. fuse (F2) to blow and make the genset inoperable.

Dec-3 Microcomputer Controller — cont'd.

Problem	Possible Cause	Corrective Action
Engine will not crank with Master Switch in RUN position (no power to controller circuit board — See below) **NOTE** Check for battery voltage to controller between P1-12 (battery positive) socket in P1 connector (female end) and ground terminal. See illustration below and Figure 3-8. P1-12 Socket  P1 Connector (Female End)	Battery weak or dead	Recharge or replace battery. Verify proper operation of battery charger.
	Reversed or loose battery connections	Check for proper battery connection (negative - ground). Clean and tighten battery connections. **NOTE** The generator will not run with reversed battery connections although battery voltage may be indicated at the harness connector. Controller 3 Amp. fuse (F2) will blow if battery connections are reversed.
	Faulty P1 connector or DC wire harness **CAUTION** Use care when contacting connector pins and sockets with meter probe. Contact only one pin at a time. Short circuiting pins may result in circuit board failure!	Check condition of P1 connector pins and sockets. Verify continuity of battery (P) and and ground (N) leads in wiring harness.

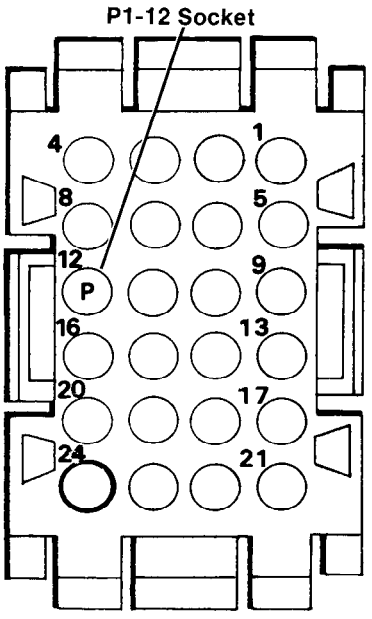
Problem	Possible Cause	Corrective Action
	NOTE Battery voltage must show at connector P1-12 socket in order for controller to function. Check voltage from P1-12 socket to ground (Figure 3-8).	

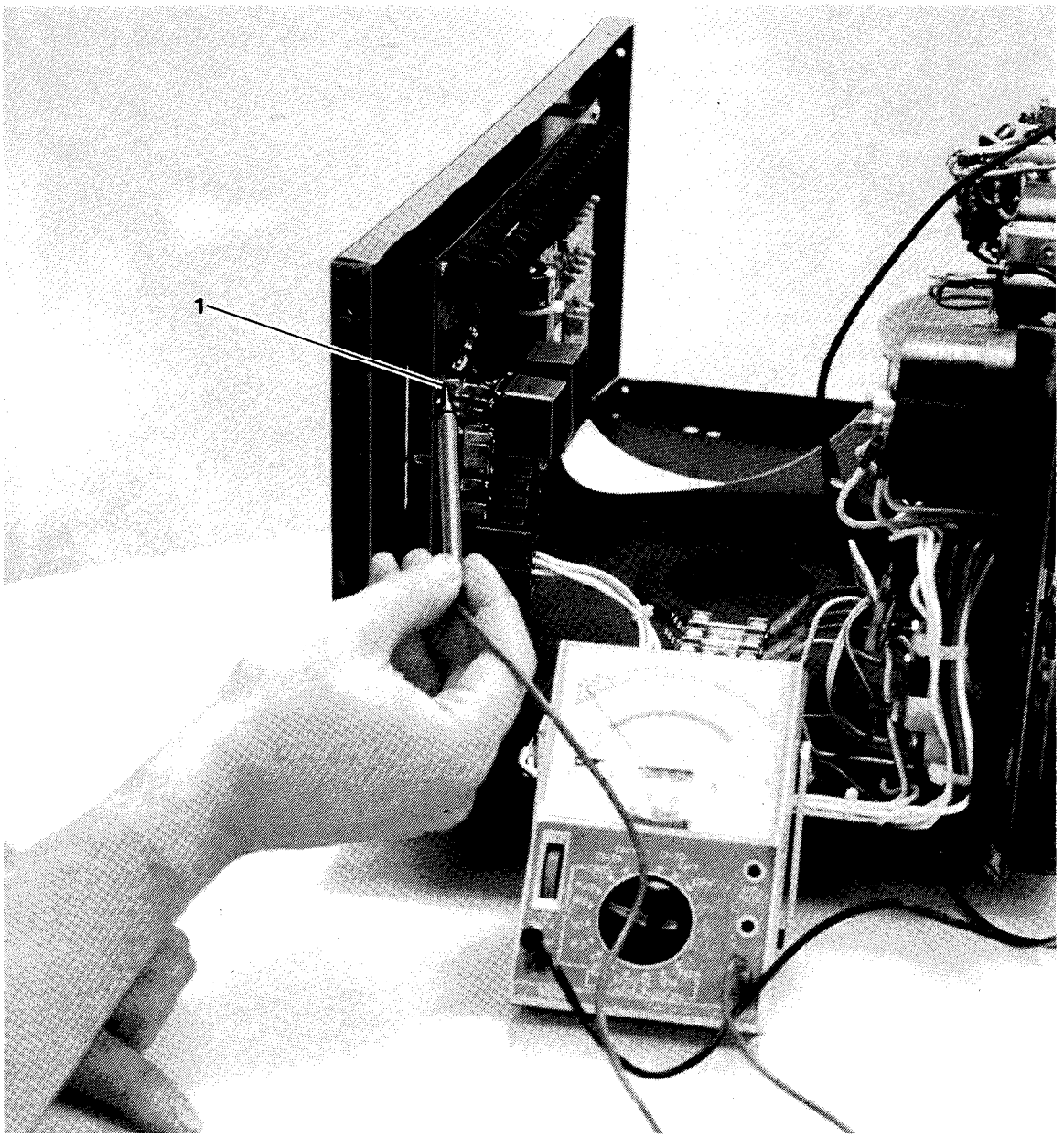


1. Meter Ground Connection
2. Meter Probe Contact at Connector Socket

Figure 3-8. Checking Input Voltage to Circuit Board

Dec-3 Microcomputer Controller — cont'd.

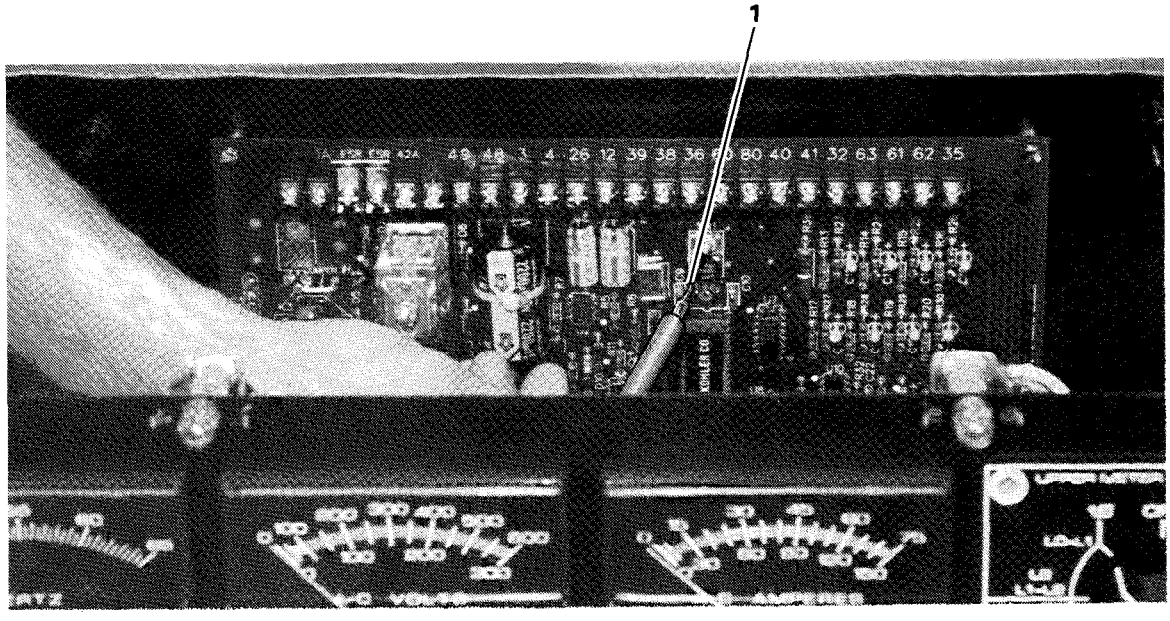
Problem	Possible Cause	Corrective Action
	NOTE If starting unit by remote switch, verify proper operation of remote switch before troubleshooting controller. Test remote switch by placing Master Switch in AUTO position and running a jumper between terminals 3 and 4 on controller terminal strip. If the generator does not start, proceed with controller troubleshooting procedure outlined below.	
Engine will not crank with Generator Master Switch in RUN position (circuit board receiving power — relays energized)	Fault shutdown: High Engine Temperature, Low Oil Pressure, Overspeed, Overcrank, Low Coolant Level, High Engine Oil Temperature or Overvoltage	Correct fault — See "Resetting" procedure in Section 2.
NOTE Check for battery voltage to controller between P1-12 (battery positive) socket in P1 connector and ground terminal. See illustration below and Figure 3-8. Battery voltage should also be present across terminals 42A (battery voltage) and 2 (ground) on controller terminal strip.  P1 Connector (Female End)	Defective Master Switch or ribbon connector between lamp panel connector (P4) and controller circuit board (P3)	Examine Master Switch terminals for loose connections. Check ribbon connector for visible damage and snug connections at P3 and P4. **NOTE** The generator will shut down after one second if the ribbon connector is disconnected between P3 and P4.
	Faulty or loose DC connector (P1) at controller circuit board	Check P1 connection. Generator will not crank or run if P1 connector is loose or disconnected.
	Blown F1 (3 Amp.), F2 (3 Amp.), or F3 (15 Amp.) fuse	If no battery voltage is detected at lower connection of fuse, replace fuse.
	NOTE To determine condition of fuse, check for battery voltage at top and bottom terminals of F1, F2 and F3 on circuit board (see Figure 3-9 for meter connections). Place meter negative lead on terminal strip ground (TB2).	**NOTE** If F2 (3 Amp.) fuse is proven good, check for 12 volts DC at input to VR1 (see Figure 3-10). If no voltage exists at input to VR1, controller circuit board may be defective. Output of VR1 should be approximately (+) 5 Volts.



1. Fuse Terminal

Figure 3-9. Checking Fuse

Problem	Possible Cause	Corrective Action
Engine will not crank with Generator Master Switch in RUN position (circuit board receiving power — relays energized) — cont'd.	Defective or loose K2, K3 or K4 relay (if equipped). **NOTE** If controller is not equipped with K4 relay (emergency stop relay), a jumper must be placed between ESR terminals on controller circuit board. If controller is equipped with K4, connect emergency stop switch to circuit board terminals TB1 and 1A.	Check circuit board relay connections. Relay will not function if relay coil is open. Check relay coil resistance; replace relay if coil resistance is significantly different from readings given below. K2 relay coil resistance: 85 ohms ±6% (across terminals 85 and 86) K3 relay coil resistance: 85 ohms ±6% (across terminals 85 and 86) K4 relay coil resistance: 160 ohms ±10% (across terminals 7 and 8)



1. VR1 Input

Figure 3-10. Input at VR1

Problem	Possible Cause	Corrective Action
Engine will not crank with Generator Master Switch in RUN position (circuit board receiving power — relays energized) — cont'd.		**NOTE** If relay is believed good, verify that battery voltage exists at D4 (K2 relay), D5 (K3 relay) and D7 (K4 relay) when energized before replacing corresponding relay. Reference information below and Figure 3-11. K2 relay coil voltage can only be measured across D4 during crank mode. K3 relay coil voltage can be measured across D5 during crank and run modes. Optional K4 relay coil voltage can be measured across D7 whenever generator is running. **NOTE** Battery voltage at VR1 input indicates controller fuse F2 is good and K2, K3 and K4 relays are functioning properly (Figure 3-10). The output of VR1 should be approximately 5 Volts DC.

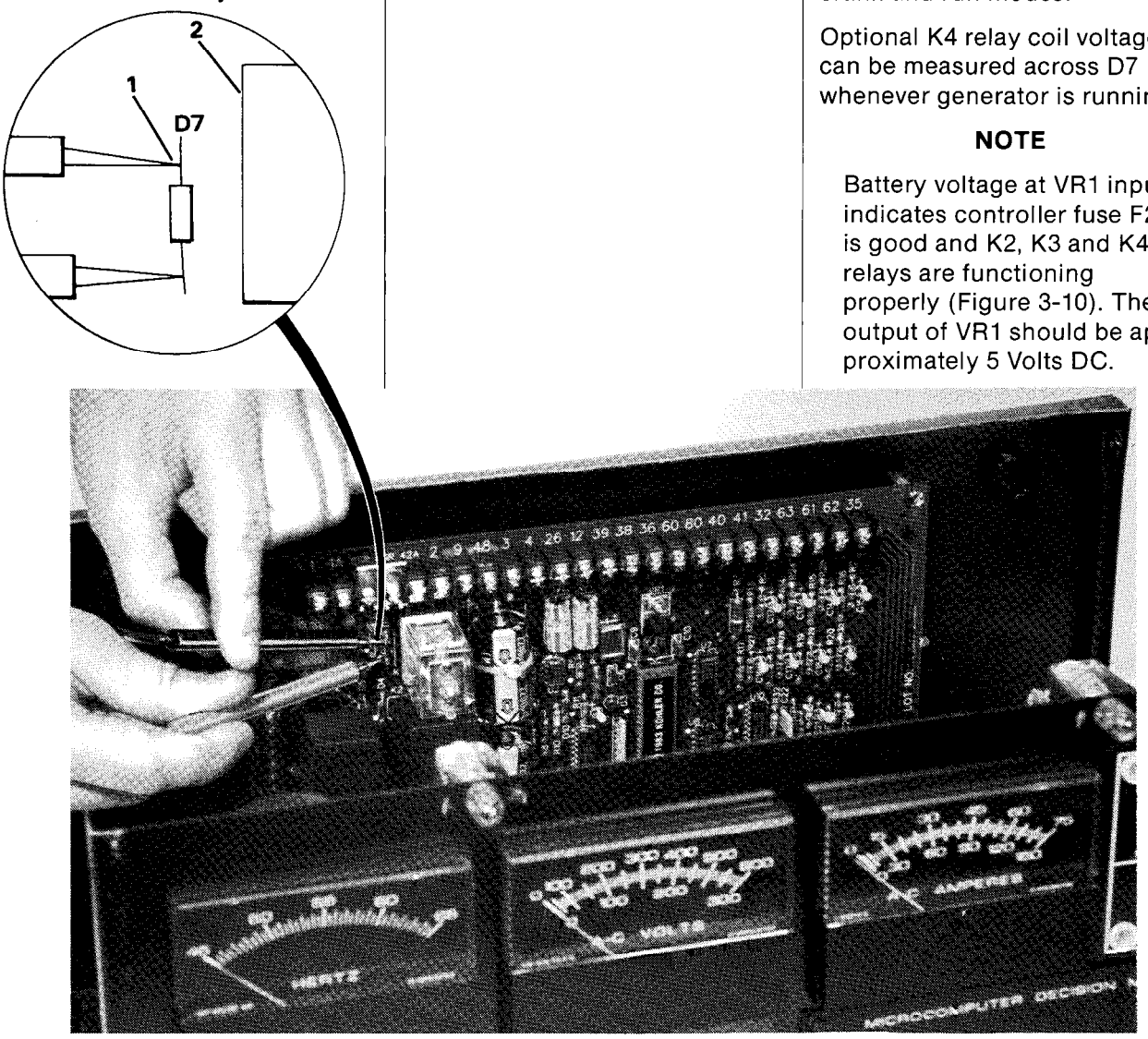
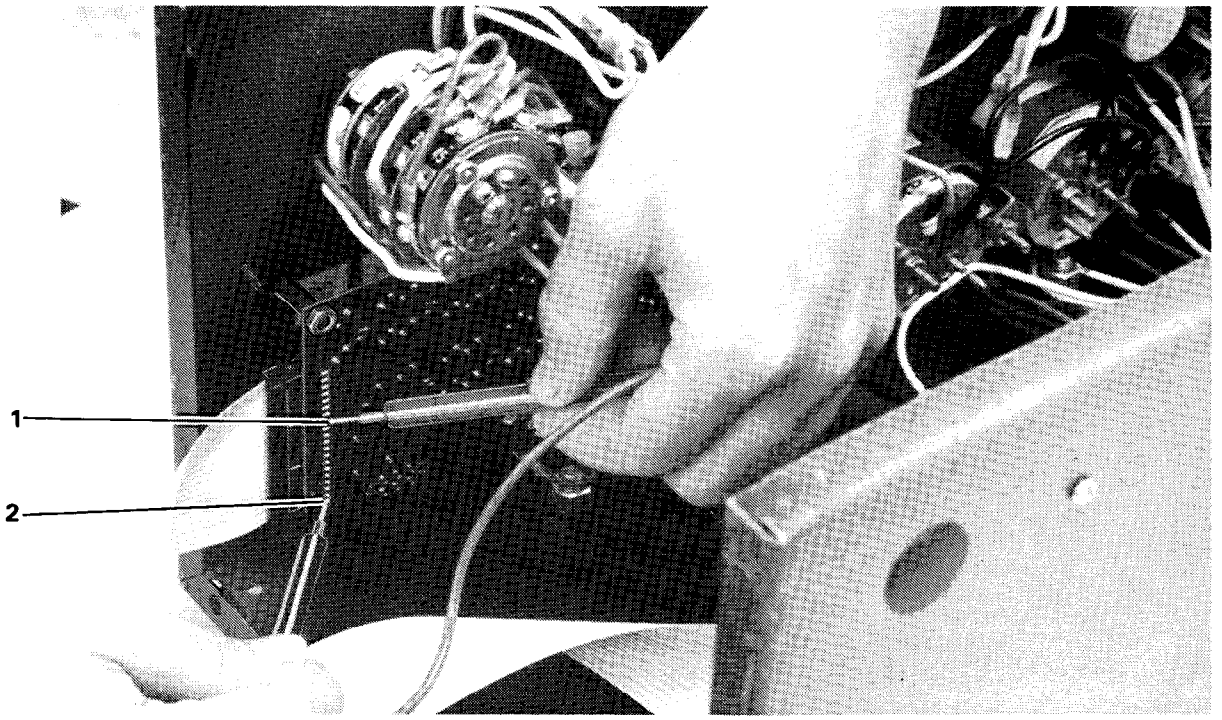


Figure 3-11. Checking Input to Relay (K4)

Problem	Possible Cause	Corrective Action
Engine will not crank with Generator Master Switch in RUN position (circuit board receiving power — relays energized) — cont'd.	**NOTE** Be sure you have thoroughly checked all wiring and connections before replacing controller microcomputer circuit board.	
Instrumentation not functioning properly	Loose input or instrument lead connection at AC Fuse Terminal Block (TB3)	Check connections at AC Fuse Terminal Block (TB3).
	Blown 1.5 Amp. fuse at AC Fuse Terminal Block (TB3)	Replace blown fuse
Lamp circuit board not functioning (fault lamps and alarm horn)	No input voltage to lamp circuit board. If no fault lamps illuminate when lamp tests switch is pressed, check for input voltage on lamp circuit board. **NOTE** Check for input voltage at P4-8 (+) and P4-20 (-) soldered connections on lamp circuit board. See Figure 3-12.	If lamp circuit board is receiving input voltage, lamp circuit board may be defective. If lamp circuit board is not receiving input voltage, refer to microcomputer circuit board troubleshooting procedure covered previously in table.

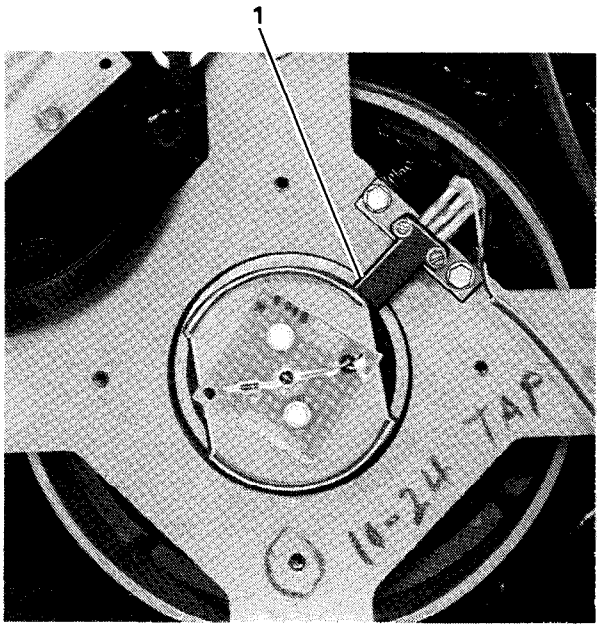


1. P4-8 (+) Connection 2. P4-20 (-) Connection

Figure 3-12. Checking Input to Lamp Circuit Board

Dec-3 Microcomputer Controller — cont'd.

Problem	Possible Cause	Corrective Action
Engine cranks but will not start	Low Fuel	Check fuel supply; replenish as necessary
	No battery voltage to ignition coil (gas/gasoline) or injector pump (diesel)	Check for open circuit in P1 connector, pin 7 (wire 70)
	K3 relay not energizing	Verify voltage to relay. If voltage at relay, check resistance of relay coil (see relay coil and voltage check preceding).
Engine starts and runs, but overcrank lamp flashes	Excessive speed sensor air gap	Adjust to 0.020 in. (0.508 mm). See Figure 3-13.
	Open speed sensor circuit	Check continuity of wire 2 (black), wire 16 (white) and wire 24 (red) through P1 connector.
		Check for battery voltage across speed sensor (+) positive (wire 24) and (-) negative (wire 2) terminals. See "Speed Sensor Test" following.
	Defective speed sensor	See "Speed Sensor Test" following.
	NOTE The controller overcrank lamp will flash if speed sensor signal is absent longer than one second.	



1. **Speed Sensor**
2. **Wire 16 — White/Clear**
3. **Wire 24 — Red**
4. **Wire 2 — Black**
5. **Air Gap — 0.020 in. (0.508 mm)**
6. **Actuator Cup**

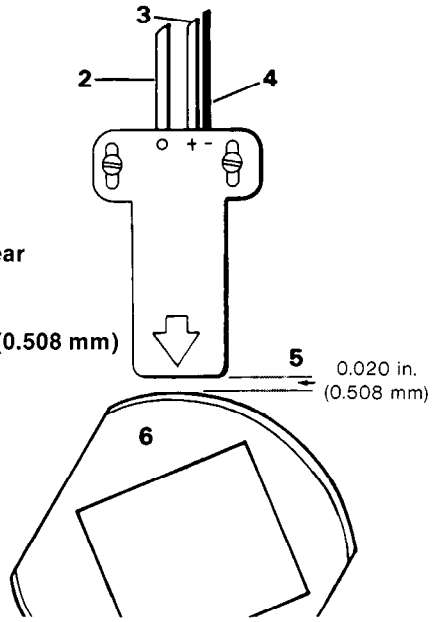


Figure 3-13. Speed Sensor Air Gap

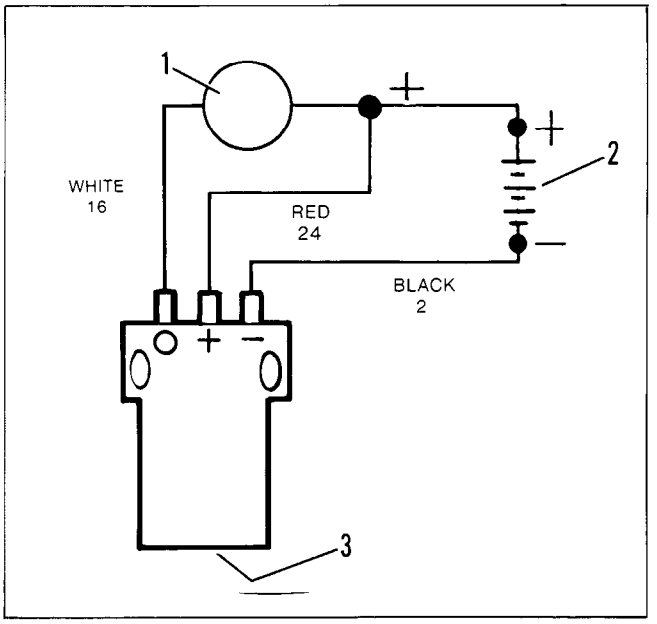
Speed Sensor Test

To determine if the speed sensor is emitting a signal, follow the procedure outlined below.

1. With Generator Master Switch in OFF/RESET position, connect a DC voltmeter between positive (+) lead (wire 24) at speed sensor and ground (wire 2). Voltmeter should read approximately 12 Volts DC.
2. With generator set running, connect DC voltmeter negative probe to "0" terminal (wire 16 — white) on speed sensor. Place voltmeter positive probe on positive (+) terminal (wire 24 — red). Voltmeter should indicate approximately 12 Volts DC.

If speed sensor is emitting a signal, check continuity of speed sensor leads (wires 2, 16 and 24). If the speed sensor is not emitting a signal, test the speed sensor through the following procedure:

1. Connect speed sensor, voltmeter and DC voltage source as shown in Figure 3-14.
2. Touch sensing surface with a flat piece of iron or steel — at least 1/4 cubic inch (4.1 cm).
3. Voltmeter test reading should equal source voltage.
4. Remove iron or steel from sensing surface and observe NO test voltmeter reading.



1. **DC Voltmeter**
2. **12-Volt DC Power Supply**
3. **Sensing Surface**

Figure 3-14. Speed Sensor Test

Fast Check Features and Operation

The Fast Check is an engine simulator for testing and troubleshooting the Dec-3 Microcomputer Controller.

Operation

The Fast Check can be used to test the Dec-3 Microcomputer Controller on the generator set when troubleshooting start-up problems, or to test and troubleshoot the controller when removed from the generator set.

To operate the Fast Check the following equipment is required:

- Fast Check simulator (A-291930) and harness (255915)
- Variable low-voltage DC power supply; 0 to 30 Volt, 3 Amp. minimum current, 0.5% maximum output voltage ripple at 30 Volts DC. A 12 or 24 Volt battery (depending on system voltage) can also be used to operate the Fast Check.

Features (Figure 3-15)

Engine conditions are simulated by the following engine switch positions:

- **OFF** — locked engine (starter energized but not turning).
- **CRANK** — engine cranking, but not started
- **RUN** — engine running

Indicator lamps:

IGN. — (ignition) lamp shows:

— battery voltage supplied to ignition, fuel valves, water valve (city water cooled sets)

— lights during cranking and running

CRK. — (crank) lamp shows:

— battery voltage switched to starter (engine not necessarily turning)

— lights only during "on-crank" cycles

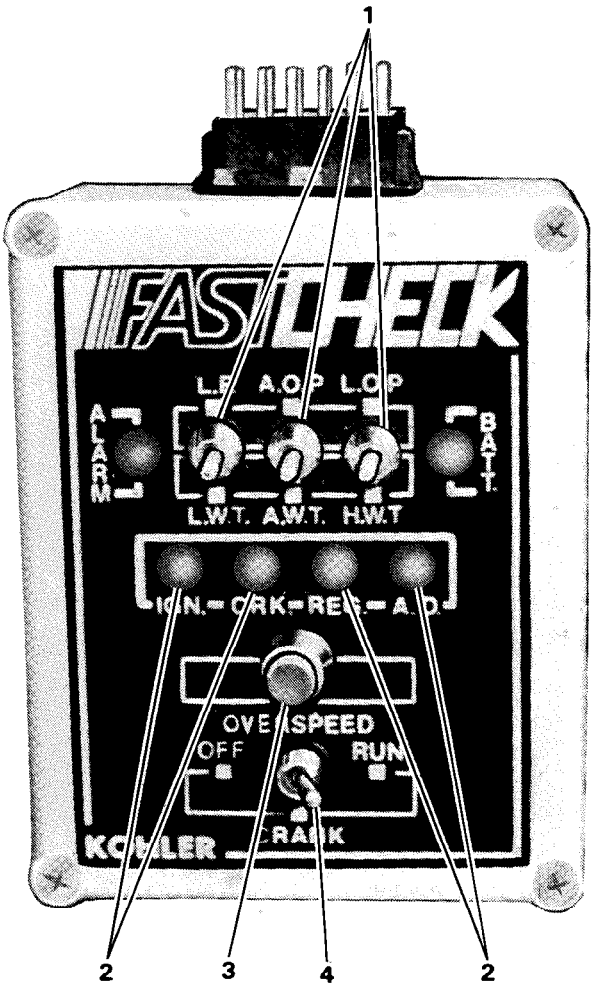
REG. — (regulator) lamp shows:

— battery voltage supplied to generator's AC voltage regulator

— lights during cranking and running

BATT. — (battery) lamp:

— lights when test battery(ies) or DC power supply is live and properly connected



1. **Toggle Switches**
2. **Indicator Lamps**
3. **Overspeed Button**
4. **Engine Switch**

Figure 3-15. Fast Check Simulator

NOTE

L.O.P., H.W.T. and OVERSPEED simulate malfunctions causing engine shut-down. L.O.P. and H.W.T. circuits will start timing after "engine" has been running for 30 seconds. "Engine" shut-down should occur 5 seconds after pushing fault switch.

Switches:

L.O.P. — low oil pressure

H.W.T. — high water (engine) temperature

OVERSPEED — simulates a 70 Hz overspeed condition

L.F. — low fuel (not used for testing)

L.W.T. — low engine water temperature

A.O.P. — anticipatory (low) oil pressure

A.W.T. — anticipatory (high) water temperature

To connect the Fast Check simulator:

1. Unplug DC engine harness from DC harness connector (P1). See Figure 3-16.
2. Connect Fast Check harness to DC harness connector (P1) and top of Fast Check.
3. Move Dec-3 Controller Master Switch to OFF/RESET position.
4. Move Fast Check engine switch to OFF.
5. Clip red (+) and black (-) harness leads to battery(ies) or DC power supply of proper voltage for generator set (12 or 24 Volt). See BATT rating on nameplate. Generator set's battery(ies) may be used if accessible and fully charged.

⚠WARNING

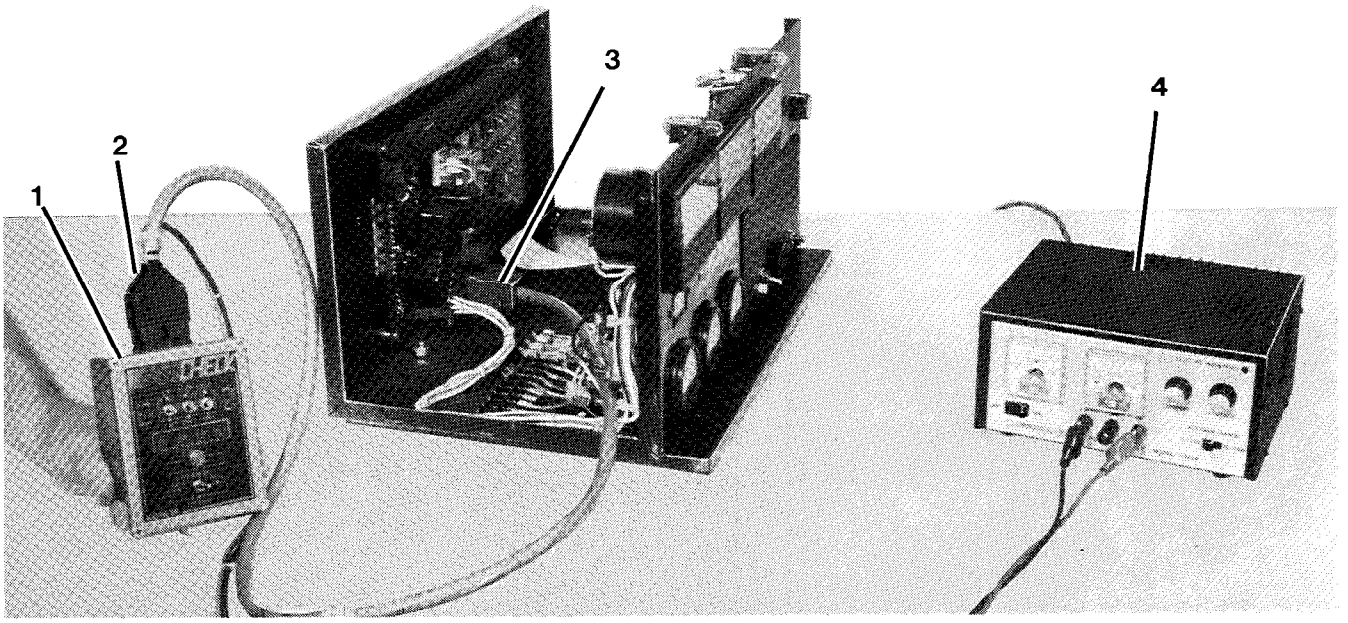
ELECTRICAL SHOCK! Battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings and any other jewelry.

NOTE

Due to the absence of AC output, the AUX. lamp will flash during controller testing. The NOT IN AUTO lamp is illuminated whenever the Generator Master Switch is not in the AUTO position.

NOTE

Leave Fast Check engine switch in RUN position for at least 30 seconds before pushing toggle switches. Toggle Generator Master Switch to OFF/RESET and back to RUN after simulated fault shutdowns.



1. **Fast Check**
2. **Fast Check Wiring Harness**
3. **DC Harness Connector (P1)**
4. **DC Power Supply**

Figure 3-16. Fast Check Connections

Overcrank

To test the controller's ability to:

- Detect a locked engine.
- Stop a start-up attempt if the starter locks or will not engage.

1. Move Fast Check engine switch to OFF.
2. Move Generator Master Switch to OFF.
3. IGN., CRK., and REG. lamps on Fast Check should light for approximately 5 seconds and then go out. 5 seconds later the IGN., CRK. and REG. lamps should relight for 5 seconds before going out again (15 seconds total elapsed time). Controller OVERCRANK lamp lights. Check for operating voltage between TB 42A (+) and TB 12 (-).
4. This test verifies the proper operation of the entire overcrank circuit. If the OVERCRANK shutdown fails to function, check the speed sensor and related circuitry. See "Controller Speed Sensor Circuitry" below and "Speed Sensor Test" earlier in this section.

Controller Speed Sensor Circuitry

To check the controller's ability to respond to signals from the speed sensor, perform the following test:

1. Move controller Master Switch to OFF/RESET position.
2. Move Fast Check engine switch to OFF position.
3. Move Generator Master Switch to RUN position. Observe IGN., CRK. and REG. lamps light.
4. Within 5 seconds, move Fast Check engine switch to RUN.
5. If CRK. lamp goes out on Fast Check, the controller speed sensor circuitry is functioning properly.

Generator Condition Indicators

Before testing the circuitry of generator condition indicators, press the LAMP TEST button to be sure all lamps are functioning. To test the operation of each indicator, place the Generator Master Switch and Fast Check engine switch in the position indicated (see chart on following page). Check for voltage at the prescribed test points with the Fast Check toggle in the position prescribed. Test point voltage should be slightly less than the voltage being supplied to the controller (12 or 24 Volts). If proper voltage is not detected at the test point, remote accessories (A-V alarm, Decision Monitor, Isolated Alarm Contacts, etc.) will not function. Test point connections are shown in Figure 3-17.

NOTE

When checking controller test point voltage, place negative (-) lead of voltmeter on terminal designated in table and voltmeter positive (+) lead on TB 42A.

NOTE

Due to the absence of AC output, the AUX. lamp will flash during controller testing. The NOT IN AUTO lamp is illuminated whenever the Generator Master Switch is not in the AUTO position.

NOTE

Leave Fast Check engine switch in the RUN position for at least 30 seconds before pushing toggle switches. Toggle Generator Master Switch to OFF/RESET and back to RUN after simulated fault shutdowns.

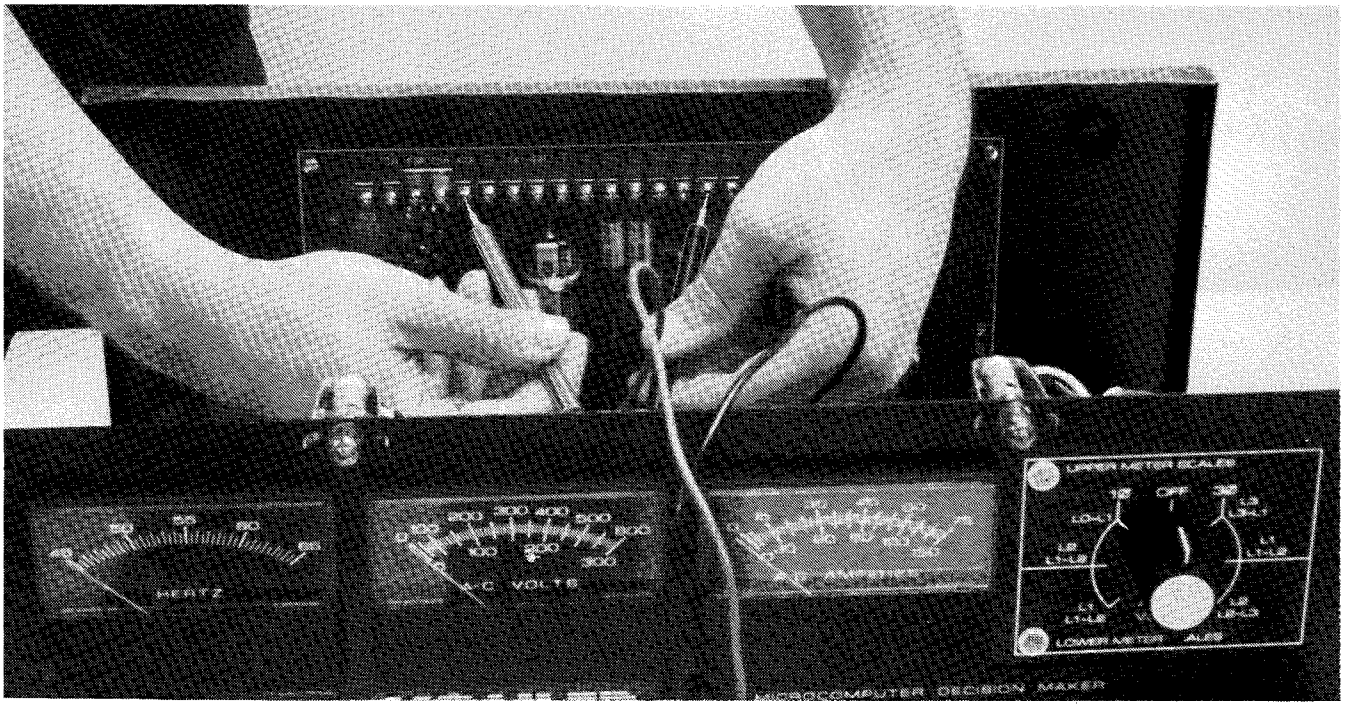


Figure 3-17. Indicator Lamp Test Connections

Dec-3 Microcomputer Controller — cont'd.

Indicator	Switch Position/Remarks	Check Voltage Between:
System Ready	Master Switch in AUTO position; engine switch in any position	TB 42A (+) and TB 60 (-)
High Engine Temperature (H.W.T.)	Master Switch in RUN position; engine switch in RUN position; hold toggle switch to H.W.T. for at least 5 seconds	TB 42A (+) and TB 36 (-)
Low Oil Pressure (L.O.P.)	Master Switch in RUN position; engine switch in RUN position; hold toggle switch to L.O.P. for at least 5 seconds	TB 42A (+) and TB 38 (-)
Auxiliary (AUX.)	Master Switch in RUN position; engine switch in RUN position; wait 10 seconds. Flashing AUX. lamp indicates proper operation of all Auxiliary functions	TB 42A (+) and TB 26 (-)
Emergency Stop (if equipped)	Master Switch in RUN position; engine switch in RUN position; remove switch lead connected to controller terminals TB1 or 1A.	Not Applicable
Not in Auto	Master Switch in RUN or OFF/RESET; engine switch in any position	TB 42A (+) and TB 80 (-)
Pre High Engine Temperature (A.W.T.)	Master Switch in RUN position; engine switch in RUN; hold toggle to A.W.T.	TB 42A (+) and TB 40 (-)
Pre Low Oil Pressure (A.O.P.)	Master Switch in RUN position; engine switch in RUN; hold toggle to A.O.P.	TB 42A (+) and TB 41 (-)
Low Water Temperature (L.W.T.)	Master Switch in RUN position; engine switch in RUN position; hold toggle switch to L.W.T.	TB 42A (+) and TB 35 (-)
Low Fuel	Generator Master Switch in OFF/RESET; engine switch in RUN position Ground controller terminal TB 63 to test. If Low Fuel Lamp lights, circuit is functioning properly	Not Applicable

Dec-3 Microcomputer Controller — cont'd.

Indicator	Switch Position/Remarks	Check Voltage Between:
Battery Charger Fault (if battery charger equipped)	Generator Master Switch in OFF/RESET; engine switch in RUN position Ground controller terminal TB 61 to test. If Battery Charger lamp lights, circuit is functioning properly	Not Applicable
Low Battery Volts (if battery charger equipped)	Generator Master Switch in OFF/RESET; engine switch in RUN Ground controller terminal TB 62 to test. If Low Battery Volts lamp lights, circuit is functioning properly	Not Applicable

Section 4.
Generator Troubleshooting

Generator Conditions

This section will serve as a guide when troubleshooting your generator set. The generator conditions listed below are covered in this section.

- No Output On Any Phase
- Overvoltage
- Fluctuating Voltage

Later model generators are being manufactured with split FR activators. Although the function of the activator remains unchanged, the components of the activator are now distributed between the rotating photo transistor board and the SCR assembly. The SCR assembly occupies the same position as the old FR activator and still controls current flow to the generator field. However, the command and sensing circuitry to control the SCR assembly is now located on the shaft mounted photo transistor board. Refer to Figure 4-1 for a comparison between the one-piece and split FR activators. Generator troubleshooting procedures will vary with the type of FR activator used; procedural differences are noted throughout Section 4.

Follow all safety precautions in front of this manual and the additional warnings within the text. Refer to Figure 4-2, AC Voltage Control, for assistance in troubleshooting. In addition, Table 4-1 lists the various generator output conditions and component tests to be used.

⚠WARNING

HIGH VOLTAGE! Disconnect set from load by opening line circuit breaker, or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. THE GENERATOR SAFEGUARD BREAKER MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER! If high voltage is transferred to load during test, personal injury and equipment damage may result.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Move generator master switch to OFF and disconnect remote start leads from terminals 3 and 4 in controller to prevent remote start-up while working on generator set. Potential injury or electrocution can result. Disconnect battery negative (-) lead from ground on generator set before working near rotor or attached parts.

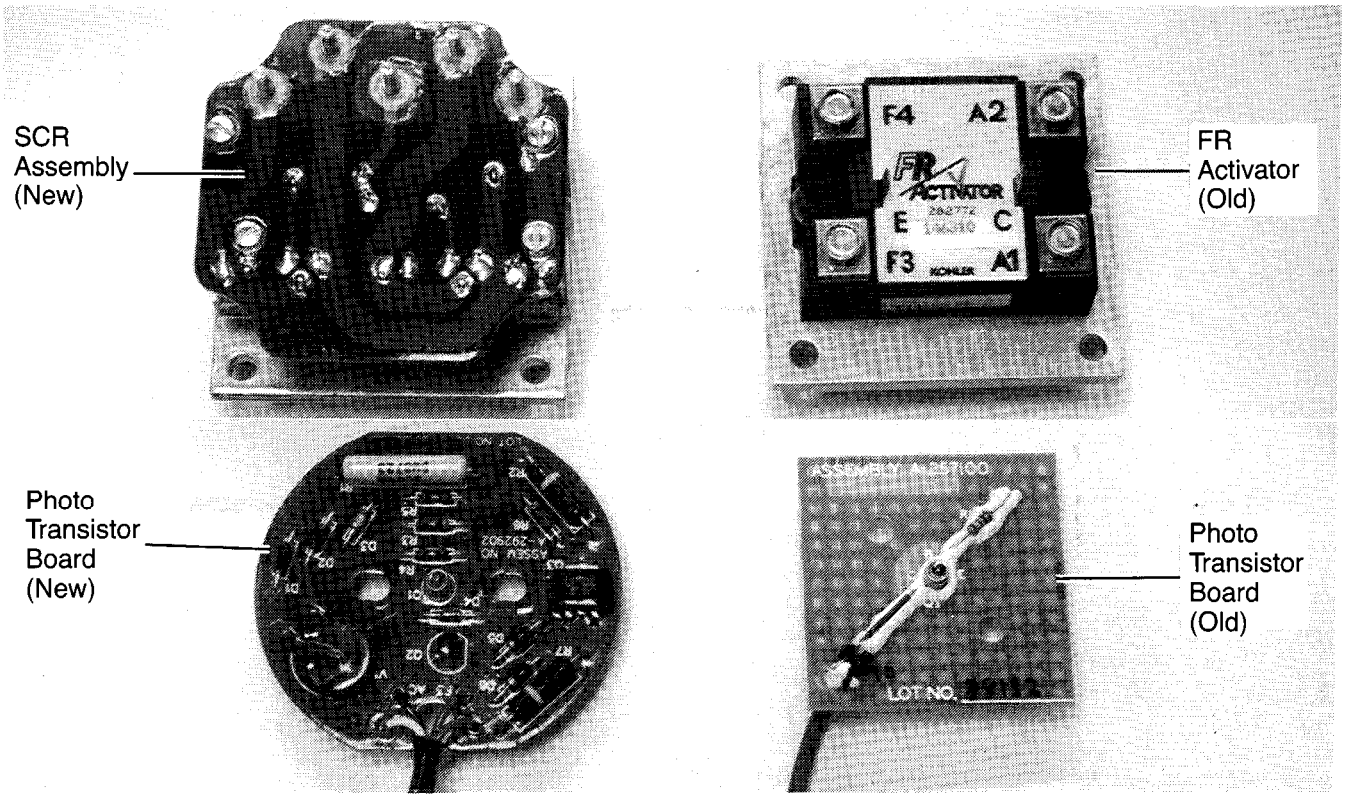


Figure 4-1. FR Activators (Old and New)

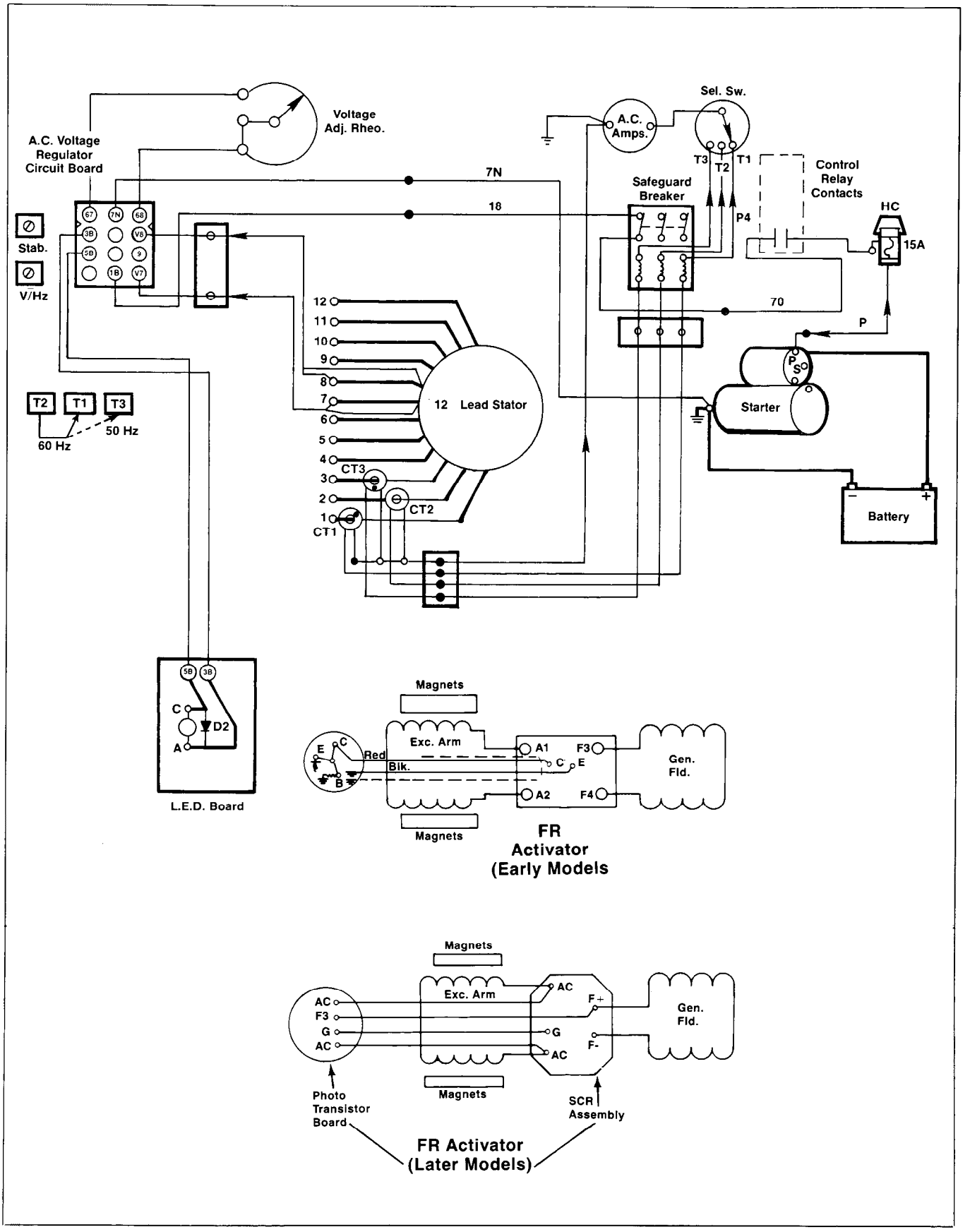


Figure 4-2. AC Voltage Control

No Output On Any Phase

1. Check the safeguard breaker (if equipped). If safeguard breaker is open, close breaker and, with set running, check AC voltmeter for proper output voltage.

2. If proper output does not show:
   a. Check the 15 Amp. fuse on controller.
   b. Check wire 1B from safeguard breaker and wire 7N (ground) to voltage regulator.
   c. Check for voltage to safeguard breaker (if equipped).

3. If all items in step 2 are okay, proceed to the LED circuit board flashlight test and AVR (voltage regulator) test as described in "Component Testing".

4. If tests indicate LED and AVR are functioning properly, proceed to the Photo Transistor Board tests as described in "Component Testing".

5. If the Photo Transistor Board test indicates it is functioning properly, proceed to the Exciter Armature test as described in "Component Testing".

6. If the Exciter Armature test indicates the armature is functioning properly, proceed to the Generator Field test as described in "Component Testing".

7. If the Generator Field test indicates the field is functioning properly, replace the FR activator as described in "Component Testing". On later models equipped with split FR activators, determine which actuator component is defective (photo transistor board or SCR assembly) to avoid replacing entire FR activator. See "Split FR Activator" later in this section.

Overvoltage

NOTE

If overvoltage occurs, disconnect harness plug at AVR (voltage regulator). If overvoltage continues, the problem lies in the photo transistor circuit and/or FR activator; proceed through the following checks. If output voltage disappears, the problem is in the AVR (voltage regulator), including connections and/or wiring. See "Component Testing."

Overvoltage - Generators with Standard FR Activator

1. If overvoltage is read with the safeguard breaker open or closed, check the photo transistor board for a grounded "C" lead. Check the photo transistor board as described in "Component Testing".
2. If the Photo Transistor Board is functioning properly, check for reversed E and C leads on the FR Activator.
3. If the Photo Transistor Board functions properly and is properly connected, but ceiling voltage is read, replace FR Activator. See "Component Testing — FR Activator."

	COMPONENTS AND CIRCUITS							
Generator Output Condition	LED Board	Photo Transistor Board	AVR – Automatic Voltage Regulator	FR Activator	Safeguard Breaker	Exciter Armature	Generator Field	Generator Stator
No Output	•	•	•	•	•	•	•	•
Over Voltage		•	•	•				
Fluctuating Voltage	•	•	•	•		•	•	•

Table 4-1. Troubleshooting Guide

4. If overvoltage is read with the Safeguard Breaker closed only, check for an open circuit in leads V7 and V8 to the AVR (voltage regulator). If these circuits are open or shorted, repair or replace. Check the voltage rheostat circuit (leads 67 and 68). Repair and/or replace as necessary.
5. If all the circuits in step 4 are okay, check the voltage regulator (AVR) as described in "Component Testing."

Overvoltage - Generators with Split FR Activator

1. Examine photo transistor board for visible signs of damage (open foil pattern, heat discoloration). Replace photo transistor board if visibly damaged. If overvoltage continues after replacement of photo transistor board, proceed to step 2.
2. Remove green lead from G terminal of SCR assembly. (Tape terminal end of green lead to prevent contact with adjacent metal components.)
3. With safeguard breaker open, start generator set. If the FR activator is functioning properly, there will be no AC output. If overvoltage continues, replace the activator SCR assembly.

CAUTION

When replacing SCR assembly, do not exceed a torque value of 8 in. lbs. (.9 Nm) when tightening SCR mounting bolts.

4. If overvoltage is read with the Safeguard Breaker closed, check for an open circuit in leads V7 and V8 to the AVR (voltage regulator). If these circuits are open or shorted, repair or replace. Check the voltage rheostat circuit (leads 67 and 68). Repair or replace as necessary.
5. If all the circuits described in step 4 are okay, check the voltage regulator (AVR) as described in "Component Testing".

Fluctuating Voltage

1. Check the generator output leads for proper connections (refer to Section 7, Wiring Diagrams).
2. Check for loose connections to the AVR (voltage regulator), LED board photo transistor or FR activator.
3. Check the stator for shorted or open windings, refer to Component Testing.

Component Testing

LED Circuit Board Test

⚠WARNING

HIGH VOLTAGE! When testing photo transistor board, keep all other light sources away. Otherwise, dangerous ceiling voltage may result.

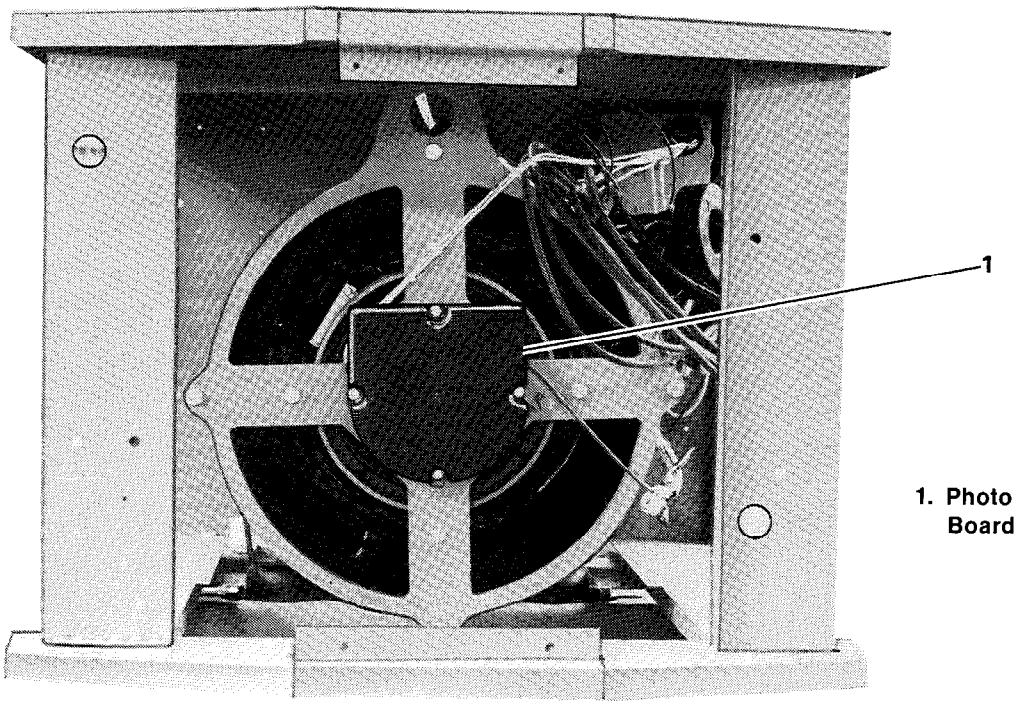
⚠WARNING

HIGH VOLTAGE! Disconnect set from load by opening line circuit breaker, or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. THE GENERATOR MASTER SWITCH MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER! If high voltage is transferred to load during test, personal injury and equipment damage may result.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Move generator master switch to OFF and disconnect remote start leads from terminals 3 and 4 in controller to prevent remote start-up while working on generator set. Potential injury or electrocution can result if generator is connected. Disconnect battery negative (-) lead from ground on generator set before working near rotor or attached parts.

1. Remove junction box panels from generator end of unit (Figure 4-3), and remove photo transistor board cover.
2. With the generator set running at no load, shine a flashlight on the exposed photo transistor board. See Figures 4-4a or 4-4b.
3. Observe the AC output voltmeter. High AC output voltage indicates the photo transistor board and FR activator (early models) or split FR activator (later models) are functioning properly, and the fault is in the wiring, AVR, or LED circuit board (output voltage should drop to low level when flashlight is removed). If no output is observed, check the photo transistor board and the FR activator (early models) or split FR activator (later models).
4. With the generator set running, approximately 1-2 volts DC should be observed at 3B (+) and 5B (-) at the LED board (see Figure 4-5). Shine flashlight on photo transistor. DC voltage reading should drop, showing the AVR is functioning properly. If voltages are not observed, refer to the AVR test.



1. Photo Transistor Board Cover

Figure 4-3. Panels Removed

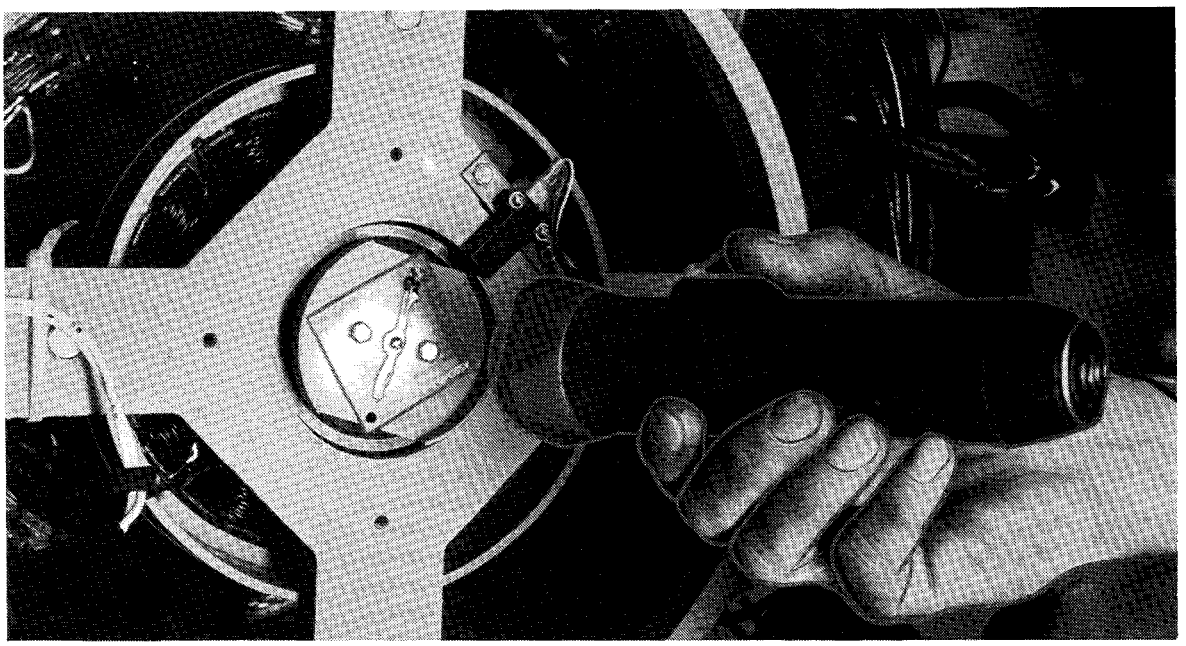


Figure 4-4a. LED Flashlight Test (Generator Equipped with Standard FR Activator)

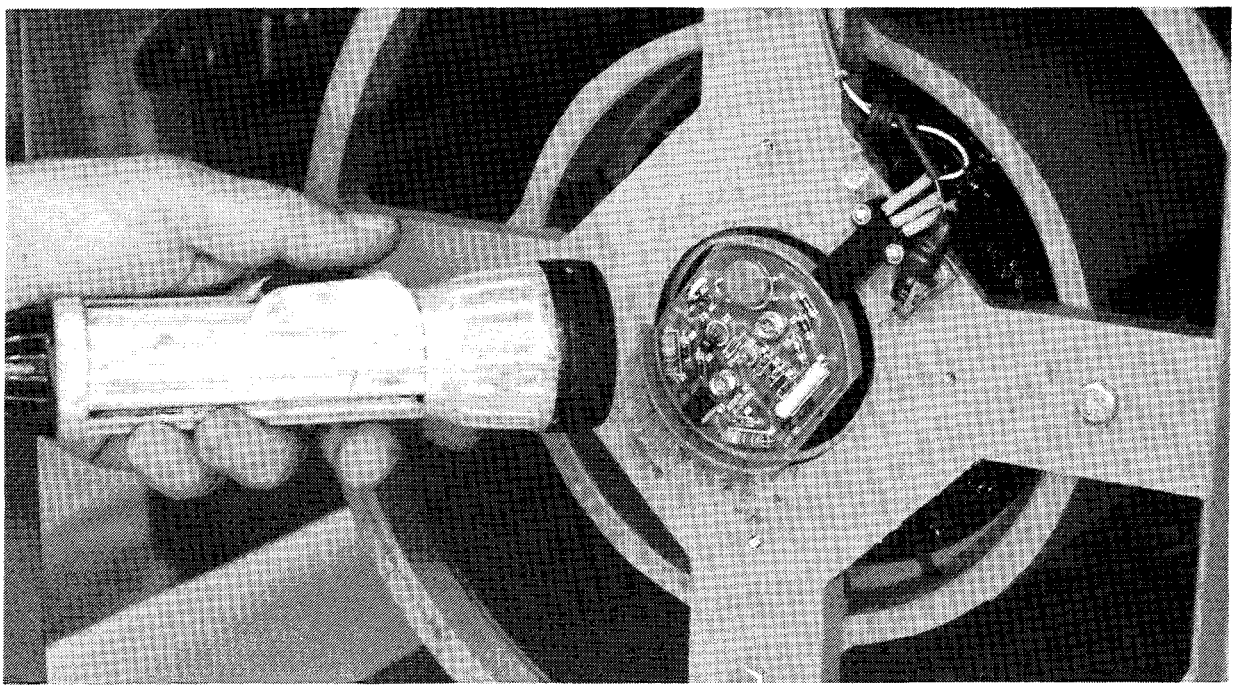


Figure 4-4b. LED Flashlight Test (Generator Equipped with Split Fr Activator)

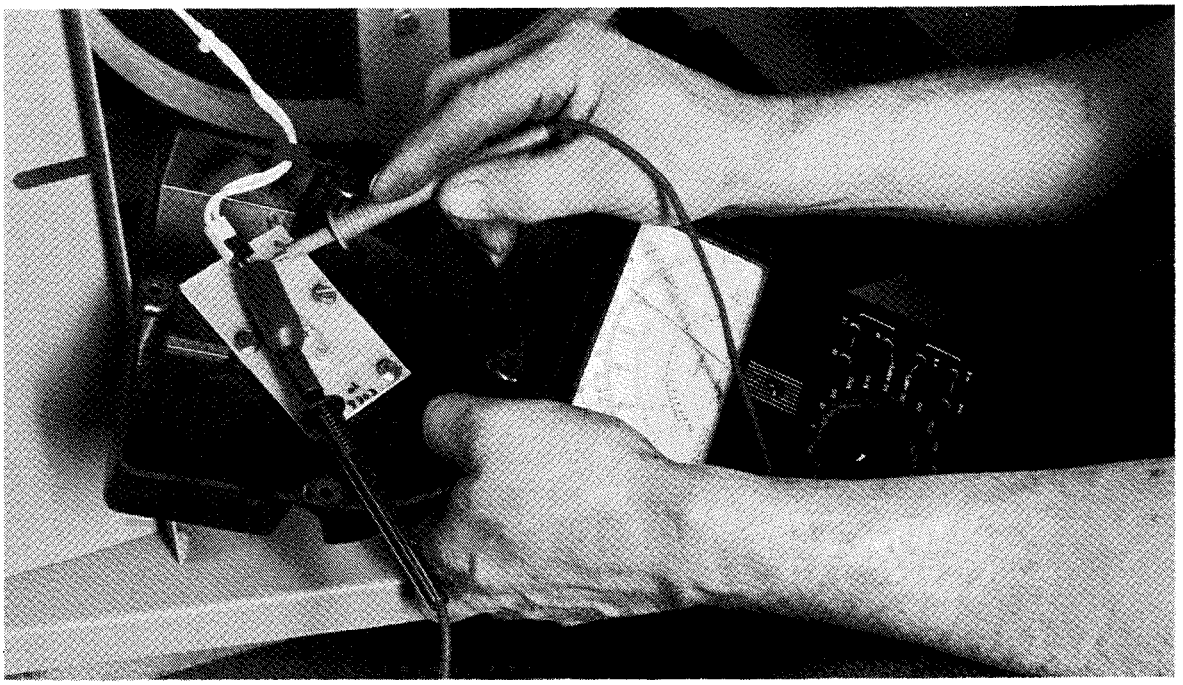


Figure 4-5. Checking LED Board

FR Activator

Standard FR Activator (One-Piece, Early Models)

Whenever replacing an FR activator, use an ohmmeter to check continuity between terminals E and F3 of the FR activator with leads disconnected. No continuity indicates that FR activator is defective and generator rotor is shorted to ground. Replace or repair generator rotor assembly and replace FR activator.

To replace the FR activator, begin by seeing "End Bracket Removal and Replacement." Observe the label markings on the FR activator. Leads F3 and F4 are the generator field leads; leads A1 and A2 are the exciter armature leads; lead E (black) is the emitter of the photo transistor board and lead C (red) is the collector for the photo transistor board (see Figure 4-6).

⚠WARNING

HIGH VOLTAGE! Do not reverse FR activator leads E and C. Ceiling voltage will result causing equipment damage and possible personal injury.

CAUTION

Make sure FR activator and heat sink mounting surfaces are flat, clean, and free of dirt or metal chips. Be sure ceramic surface on back of FR activator is not cracked or damaged.

1. Apply a thin coating of thermal compound to back of activator before mounting.
2. Using new washers install washers so the convex side is against socket cap screwhead.
3. Tighten FR activator mounting screws to 20-25 in. lbs. (2.3-2.8 Nm) or only as necessary to compress washers.

CAUTION

FR ACTIVATOR DAMAGE! Overtightening FR activator screws can cause activator failure. Do not exceed maximum torque settings.

4. Connect leads to FR activator and tighten A and F terminal screws to 20-25 in. lbs. (2.3-2.8 Nm).

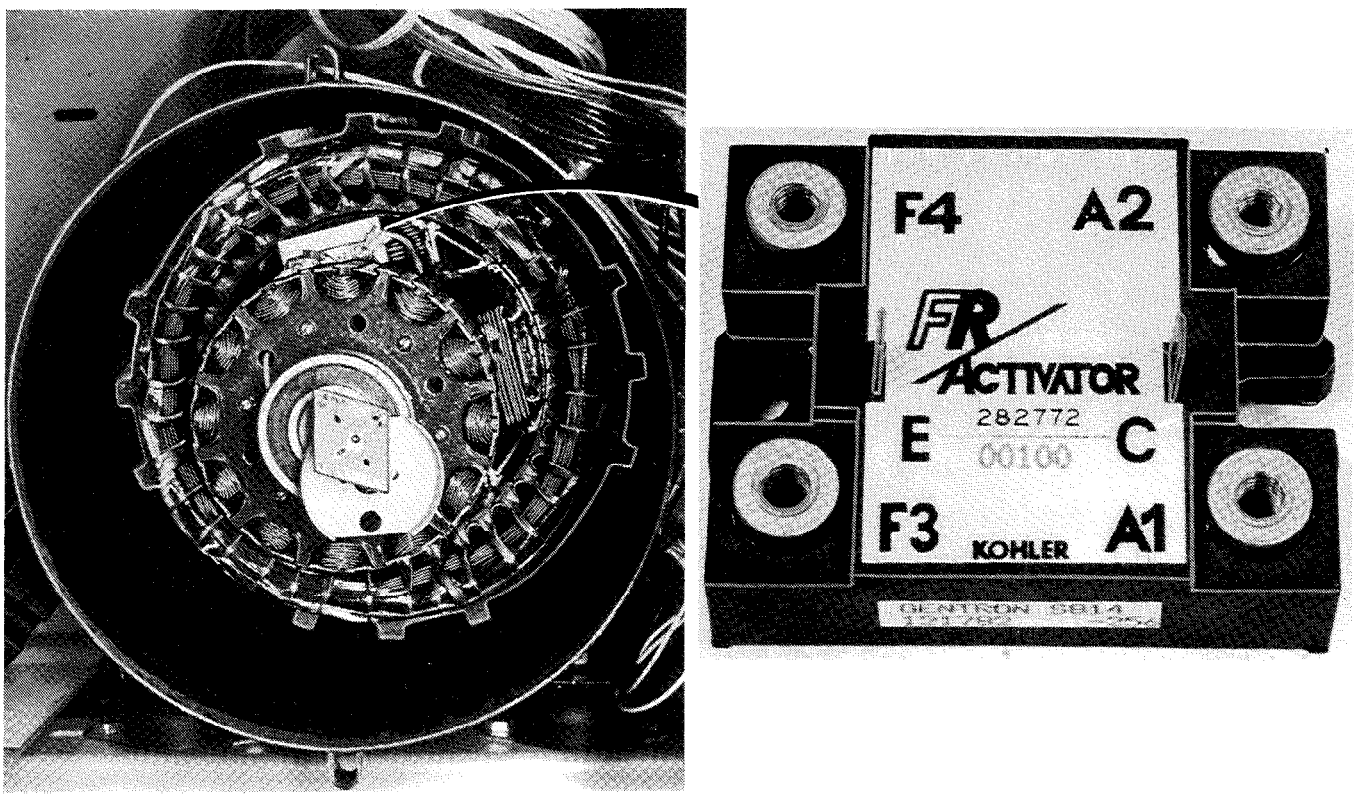


Figure 4-6. Standard FR Activator and Location

CAUTION

FR ACTIVATOR DAMAGE! Do not bend C and E terminals on FR activator. Internal damage and failure may result.

5. Secure leads with tie cable. These leads rotate with the rotor shaft during operation and must be secured to prevent damage.

Split FR Activator

Later model sets are equipped with split FR Activators with components of the activator divided between the photo transistor board and the SCR assembly. See Figure 4-7. Both components must be "good" for the generator to function. The following test will determine which component(s) of the split activator may be faulty. Since it is necessary to remove the end bracket from the set to properly test these components, do not begin this procedure unless absolutely certain the FR activator is defective. See "Generator Troubleshooting" earlier in this section. Examine the photo transistor board for visible signs of damage (open foil pattern, heat discoloration) before removing entire activator assembly for testing.

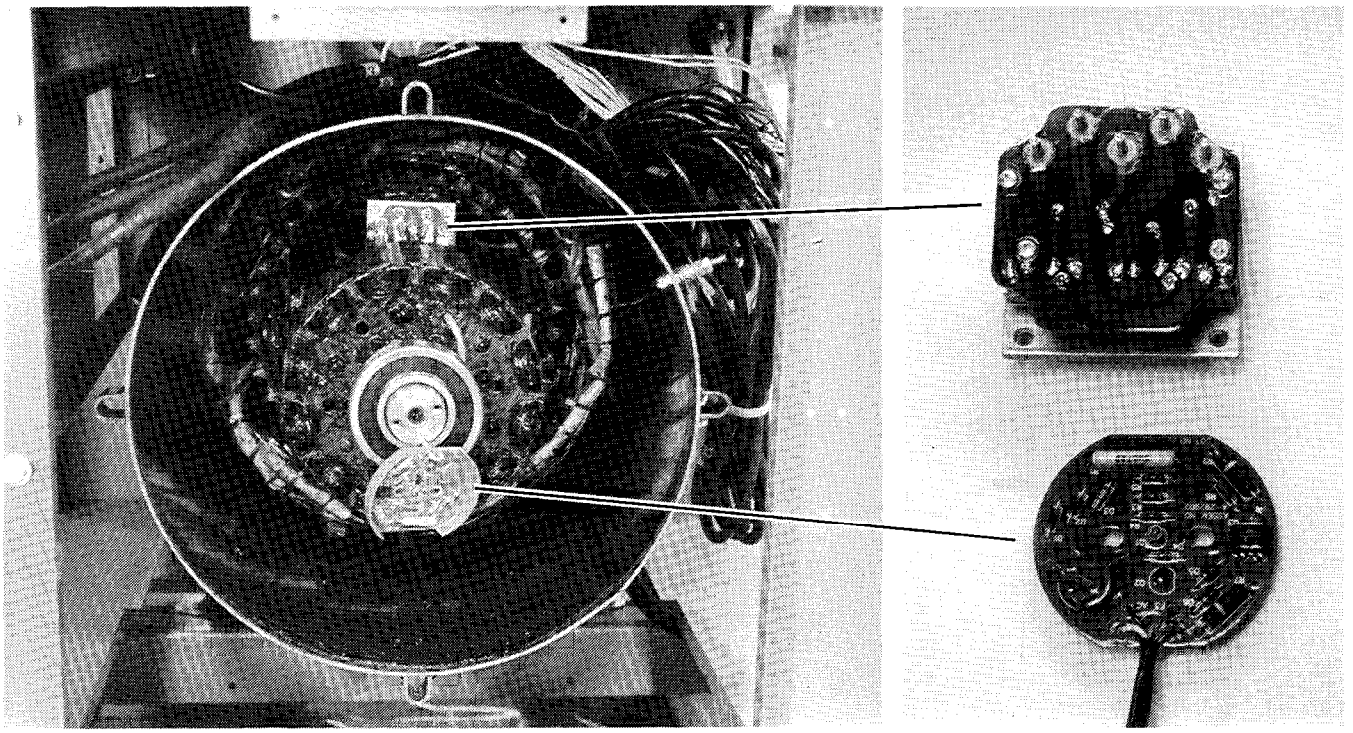


Figure 4-7. Split FR Activator Location

To test the split FR activator, the following components are needed:

- One 120 Volt/100 watt light bulb with socket
- Switch - DPST, 120 Volt (10 Amp. minimum)
- Fuse, 1 Amp. (in holder)
- 120 Volt AC plug with cord
- One "good" split FR activator (SCR and photo transistor board)

⚠WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and wherever electrical energy is present there is the potential danger of electrocution. Keep everyone, especially children, away from the set while it is running and take precautions to prevent unqualified personnel from tampering with or attempting to operate the generator set. Have the set and electrical circuits serviced only by qualified specialists. Wiring should be inspected frequently—replace leads that are frayed or in poor condition. Be sure that generator is properly grounded. Do not operate electrical equipment when standing in water, on wet ground, or when your hands are wet.

WARNING

HIGH VOLTAGE! The heat sink of the SCR assembly contains high voltage. Do not touch when testing or electrical shock will occur.

The split FR activator test simulates the normal operation of activator components when the generator is running. In the test, a "known-good" component of the activator (example: photo transistor board) is matched with an activator component of unknown quality (example: SCR). If the FR activator does not function normally during the test, it can be reasoned that the component of unknown quality is defective. Either component of the split activator can be tested in this manner.

1. Connect components as illustrated in Figure 4-8. If testing the photo transistor board the SCR assembly must be "known-good". If testing the SCR assembly, the photo transistor board must be "known-good".

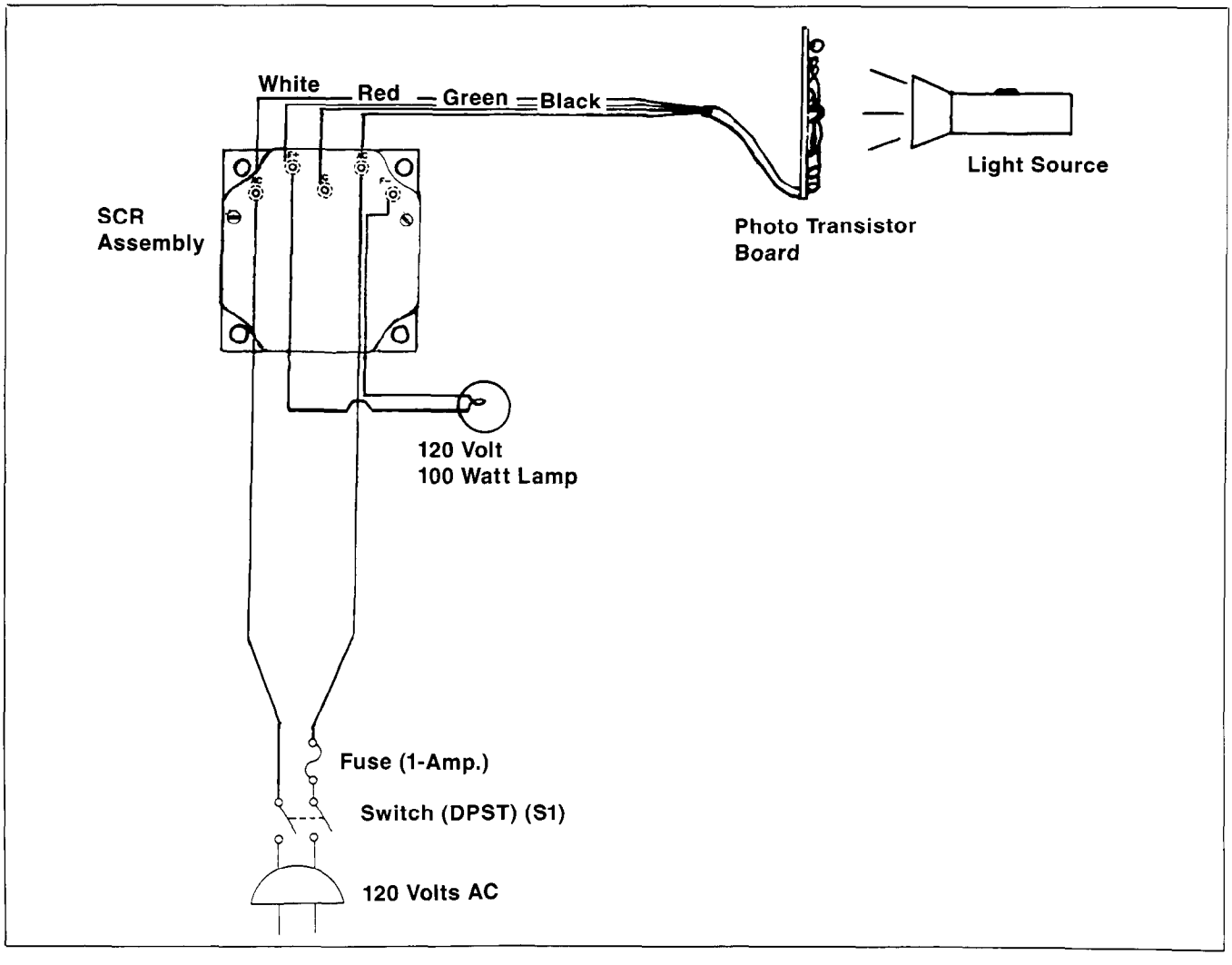


Figure 4-8. Split FR Activator Test

NOTE

Electrical connections on the SCR assembly must contact the SCR foil pattern. Secure all SCR connections with terminal nuts to insure good contact with foil pattern during testing. The SCR threaded terminals are insulated from the SCR foil pattern and will not come in contact except when "bridged" by terminal nut, electrical lead, etc.

2. With cord switch in the OFF position, plug in electrical cord.
3. Turn cord switch to ON position.
4. Apply light source directly to photo transistor board. (The photo transistor board must be shielded from all other light sources during test procedure.) If both components of the split activator are "good", the test fixture light bulb will light when the external light source is applied to the photo transistor board. Remove the external light source; the fixture light bulb should go out. If the test fixture light bulb does not light or is lit prior to receiving external light source, the activator component being tested must be defective (in this example the SCR). Replace the SCR assembly.

NOTE

When replacing SCR assembly, do not exceed a torque value of 8 in. lbs. (.9 Nm) when tightening SCR mounting bolts.

AVR (Voltage Regulator) Operation and Adjustment (AVR Circuit Board A-255670 or B-255670 Only)

NOTE

The following information applies only to AVR's (voltage regulators) using Circuit Boards A-255670 or B-255670. If the AVR on your genset does not utilize this circuit board, proceed to "To Test AVR" section following.

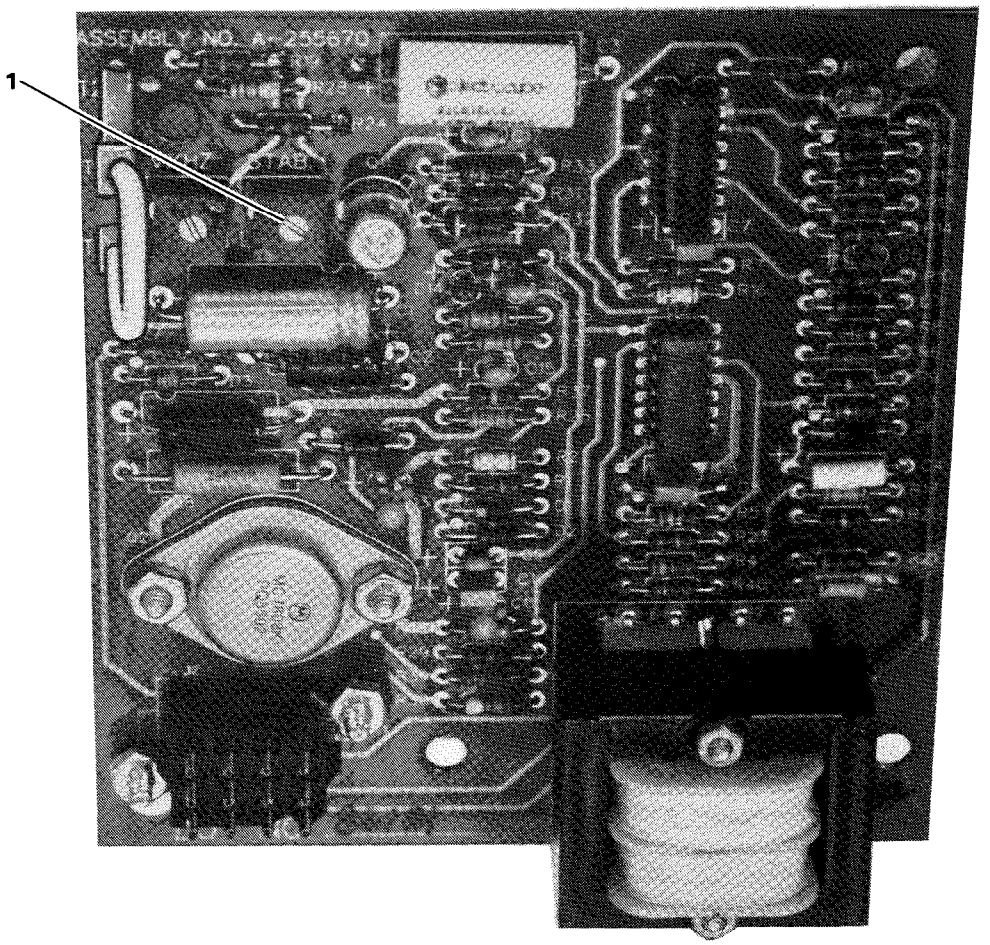
The AVR monitors output voltage magnitude and frequency to supply current to the stationary LED board. AVR's using Circuit Board A/B-255670 include volts/Hz and stability adjustment pots. The volts/Hz adjustment is factory set and requires no further adjustment. If replacement of the controller circuit board or operation of the generator under extreme load results in voltage instability, adjust the stability pot according to the following procedure.

adjustment. If replacement of the controller circuit board or operation of the generator under extreme loads results in voltage instability, adjust the stability pot according to the following procedure:

1. Set stability pot to far counterclockwise position. See Figure 4-9.

2. Connect a 100-watt light bulb across terminals V0 and V7 on controller terminal strip or across terminals on controller Hertz meter.

3. With generator running at no load, observe light bulb flicker. Excessive light bulb flicker indicates poor stability conditions.



1. Stability Adjustment

Figure 4-9. AVR Stability Adjustment (AVR Circuit Board A-255670 or B-255670 Only)

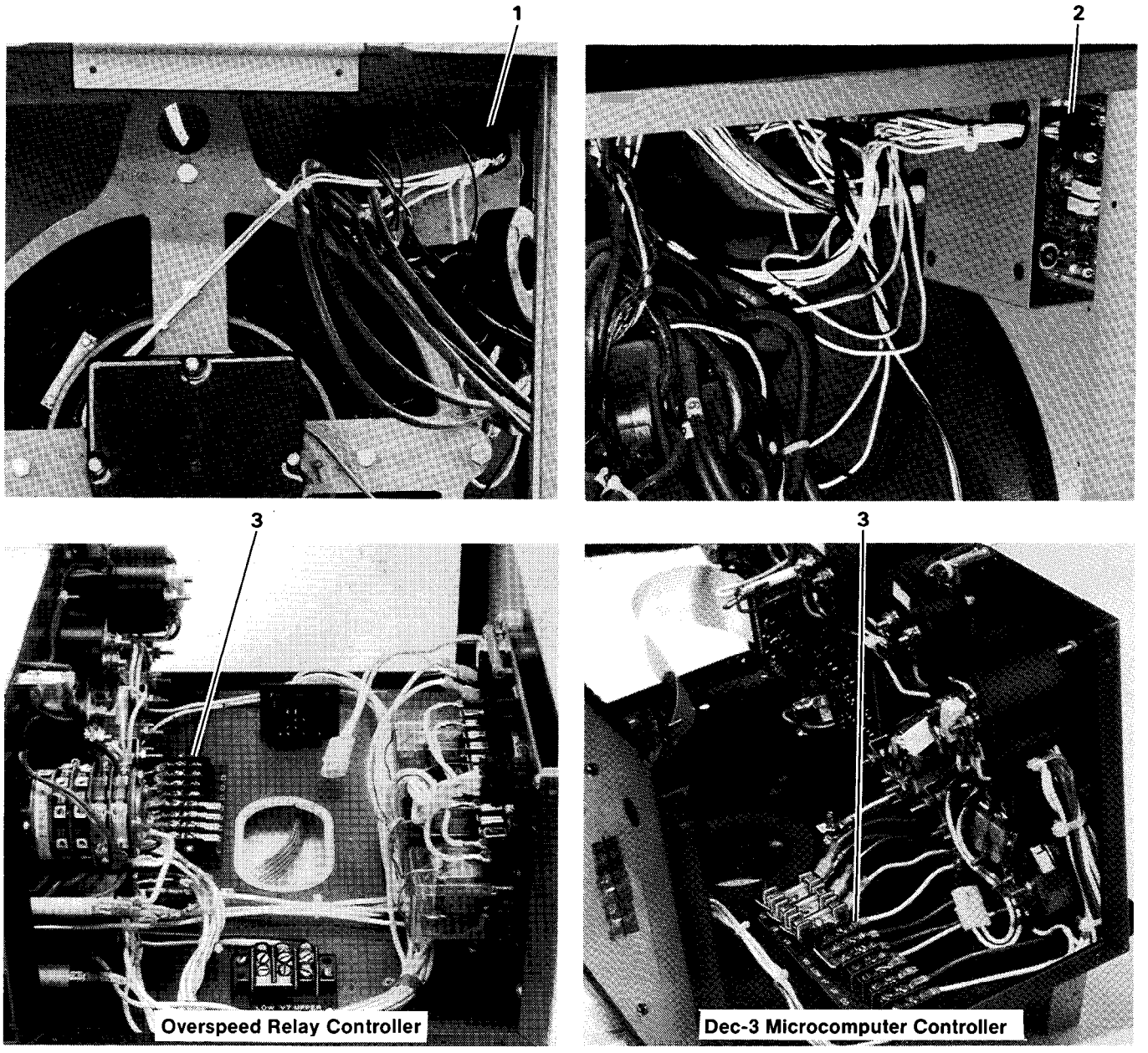
4. Rotate stability pot clockwise until minimum flicker is obtained. Use voltage rheostat to make final adjustments to genset while running under normal load.

To determine whether the AVR is functioning properly, reduce engine speed (Hz) and watch for a corresponding drop in AC voltage. At 60 Hz operation, the voltage will remain constant until engine speed drops below 58 Hz (approximately). If AC frequency drops below 58 Hz, AC voltage will decline. At 50 Hz operation, AC voltage remains constant until engine speed is reduced to 48 Hz (approximately). If the AVR is not functioning properly, refer to the following tests to determine cause of malfunction.

To Test AVR (all sets)

With the safeguard breaker closed (if equipped).

1. Check for an open circuit between leads V7 and V8 (voltage sensing leads) from voltage regulator (AVR) to controller terminal strip (see Figure 4-10). If these circuits are open or shorted, repair or replace. Check 15 Amp. fuse (if equipped).



1. AVR
2. Voltage Regulator Board
3. Controller Terminal Strip NFPA 110 Controller/Overspeed Relay Controller

Figure 4-10. AVR and Connection

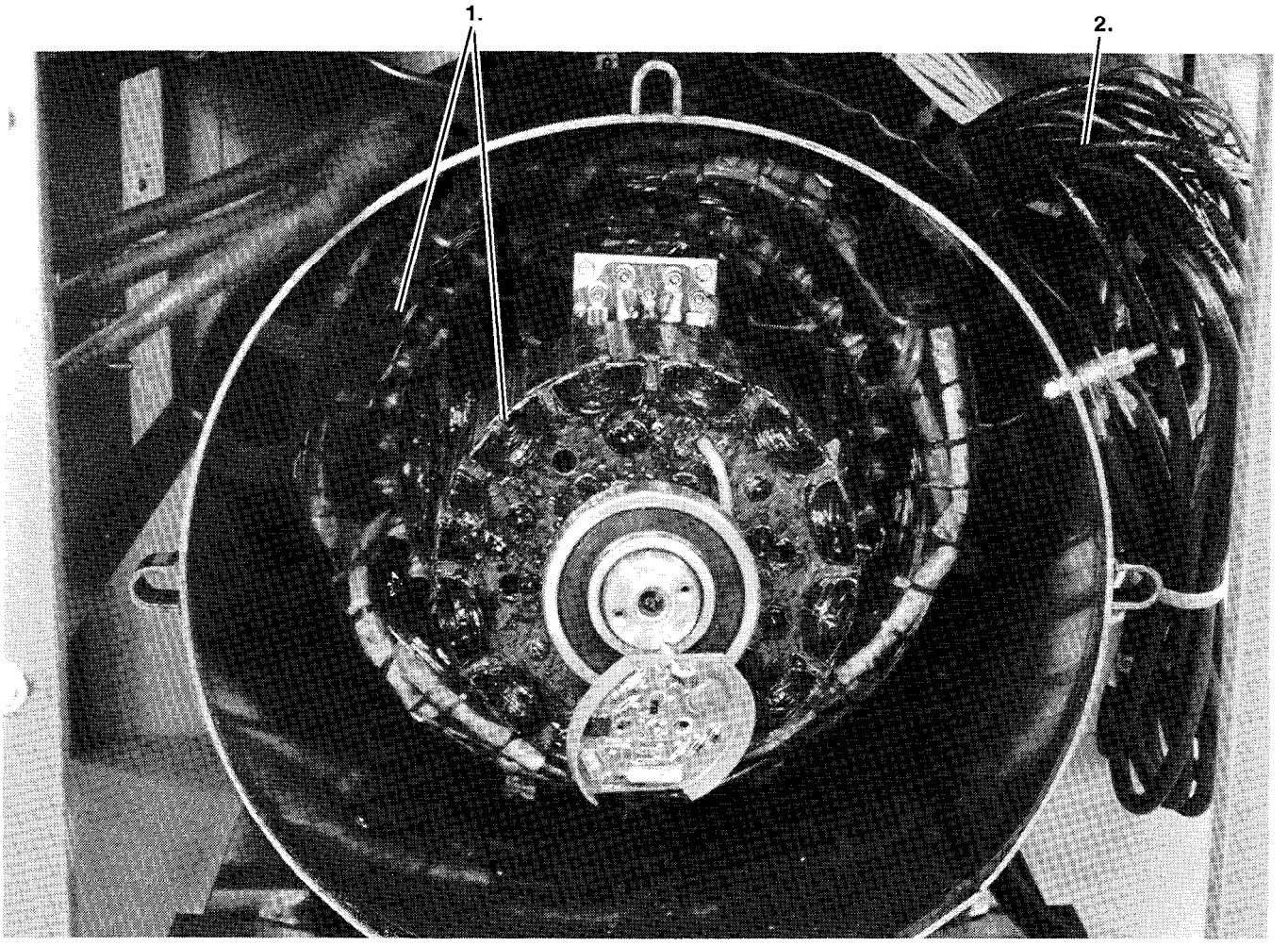
2. If continuity is read between V7 and V8 check the voltage rheostat circuit (leads 67 and 68). Repair or replace as necessary.
3. To check for input battery voltage to the regulator, check battery voltage at voltage regulator harness plug pins 2 and 11 (with the generator running). If you do not get a voltage reading, check the safeguard breaker.
4. Check for approximately 1-2 volts DC output at terminals 3B (+) and 5B (-) on the LED board. Separate 3B/5B connector and check for battery voltage at connector. If voltage is not read at connection points, repair wiring or replace voltage regulator. If voltage is read, replace LED board.

Stator

NOTE

Later FRII models use a rotor with slanted laminations (skewed) and a stator with straight laminations. When replacing either rotor or stator, be sure replacement is the same as the original. Rotor and stator must be of dissimilar styles (skewed rotor with straight stator or straight rotor with skewed stator) for generator to function properly.

1. Check the generator output leads for proper connections (see wiring diagrams, Section 7.)
2. Check the stator windings for:
   - Shorted windings: inspect for burnt or hot windings. Replace stator if windings are burnt or hot. See Figure 4-11.



1. Windings
2. Leads

Figure 4-11. Stator

— Open windings: with an ohmmeter, repeat check for **each pair** of leads for high resistance readings. High resistance across "A" or continuity across "B" and ground indicates a faulty stator; replace stator (see Figure 4-12).

NOTE

Disconnect V7, V8, V9, V0 at AC terminal strip in controller before doing this test.

Generator Field

1. Disconnect battery (negative lead first). See "End Bracket Removal and Replacement." Remove end bracket. Disconnect F3 and F4 from standard FR activator. Remove F+ and F- from SCR assembly on sets with split FR activator.
2. With an ohmmeter check for continuity across F3 and F4 or F+ and F- (see Figure 4-13).

Rotor Resistance 2-3.75 ohms, ±5%.

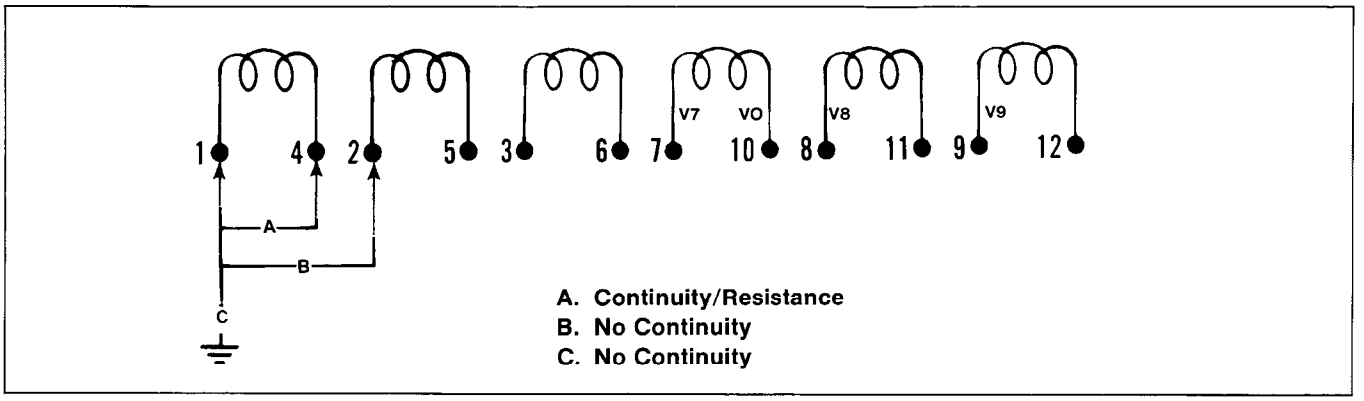


Figure 4-12. Stator Winding Test

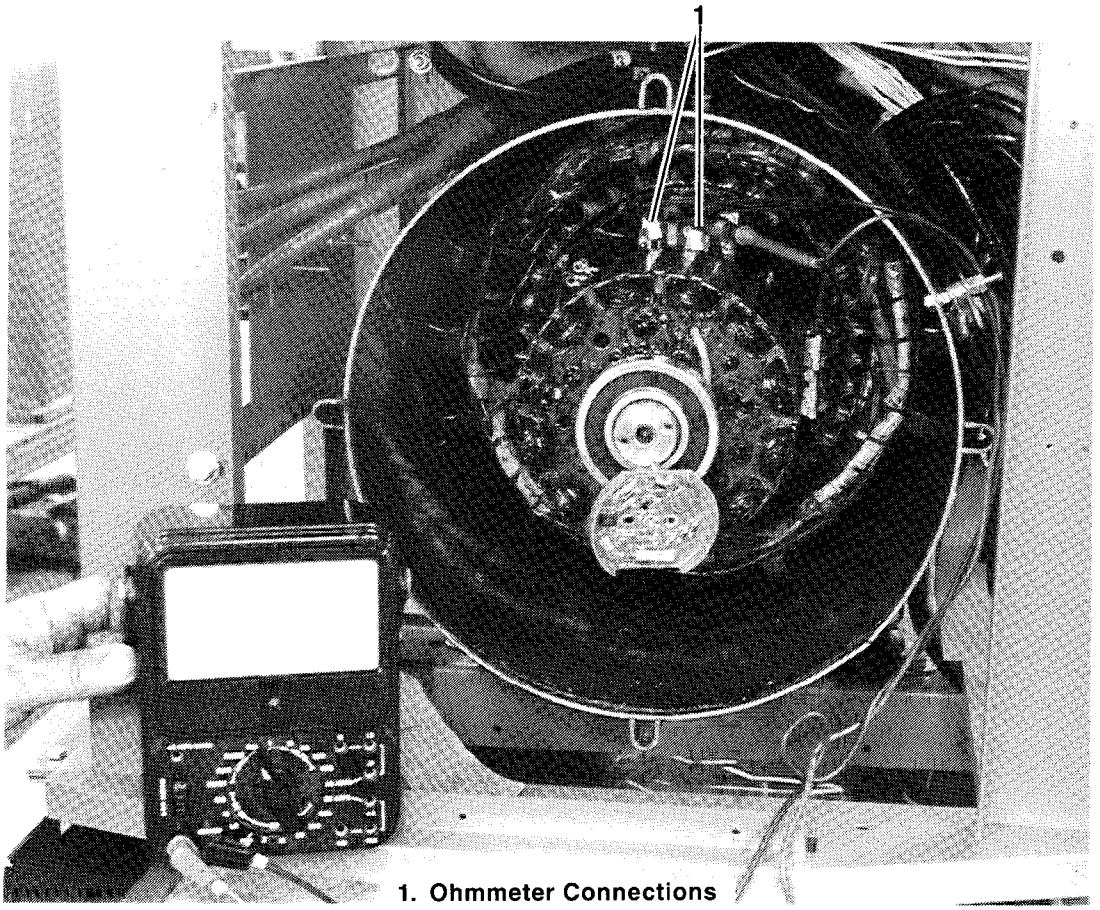


Figure 4-13. Field Continuity Check

3. Check for a grounded generator field. There should be no continuity between field leads and rotor assembly.

⚠WARNING

HOT PARTS! Generator field will get hot if field is shorted. Avoid touching generator field, severe burns may result.

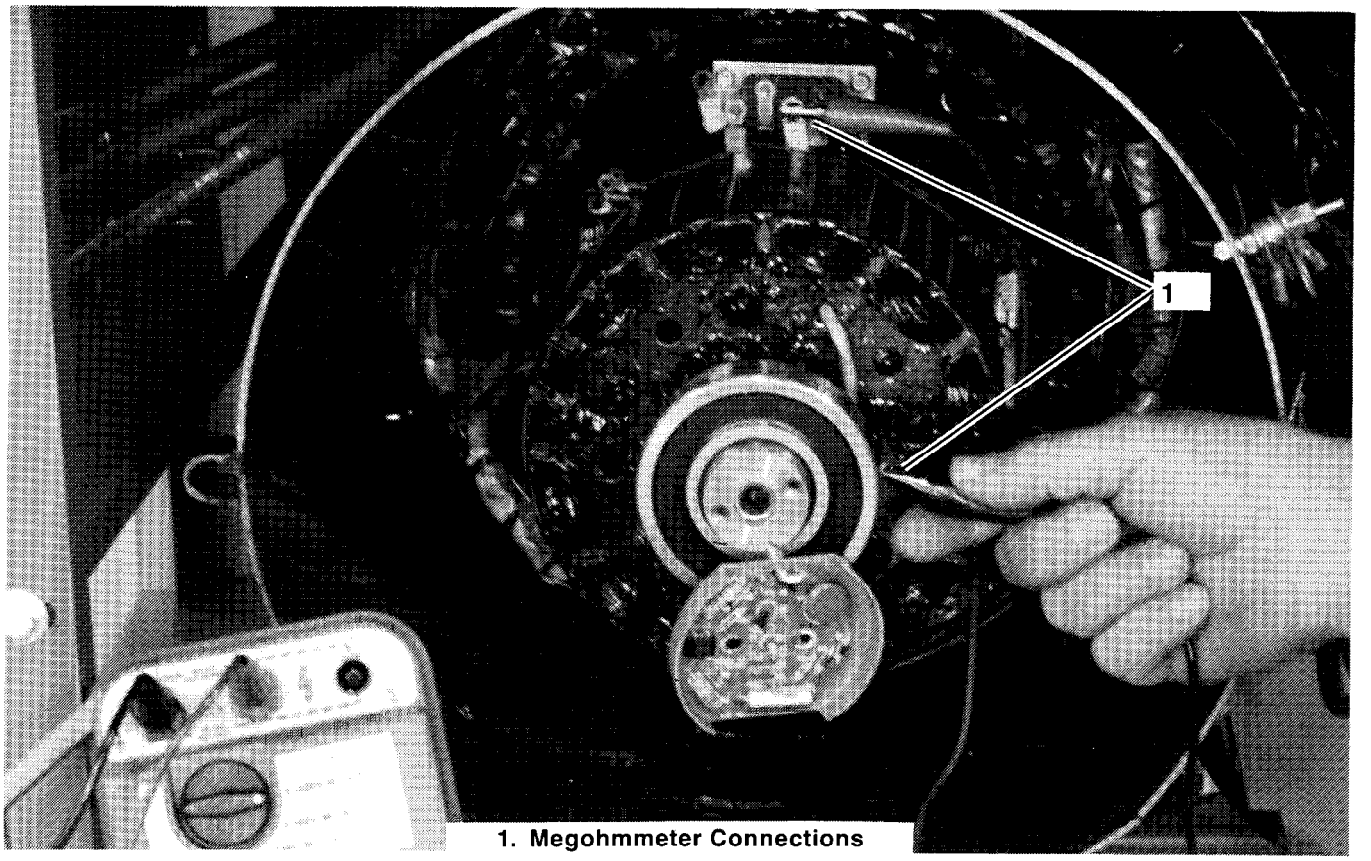
⚠WARNING

HIGH VOLTAGE! Use high voltage test only as directed. High voltage may result in electrocution or severe injury. Follow manufacturer's instructions to operate tester.

CAUTION

When performing the megohmmeter test, disconnect windings from all electronic components (photo transistor board, SCR assembly). Electronic components may be damaged if subjected to megohmmeter high voltage.

4. Using a megohmmeter, apply 500 Volts DC to F3 or F4 lead (one-piece FR activator) or F+ and F- (split FR activator). See Figure 4-14. (Follow the instructions of the megohmmeter manufacturer when performing this test.) A reading of approximately 500K ohms (½ megohm) and higher indicates the field winding is good. A reading of less than 500K ohms (approx.) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the rotor assembly is necessary.
5. Repair F3 and F4 (one-piece activator) or F+ and F- (split activator), if test should show leads shorted to ground. Solder and insulate splices. Use new sleeving when tying leads to shaft or heat sink.
6. Replace generator rotor assembly if tests show a short or ground.



1. Megohmmeter Connections

Figure 4-14. High Voltage Test

Exciter Armature

1. Disconnect battery (negative lead first). See "End Bracket Removal and Replacement." Remove end bracket. Disconnect leads A1 and A2 from one-piece FR activator and AC leads from split FR activator.
2. With an ohmmeter, check for continuity across A1 and A2 or AC leads (see Figure 4-15).
3. Repair A1 and A2 leads (one-piece activator) or AC leads (split activator) if damaged or open. Solder and insulate splices. Use new sleeving when tying leads to shaft or heat sink.
4. Visually check exciter armature for shorted winding(s); with an ohmmeter check for low resistance readings (under 0.1-0.2 ohms) Figure 4-15. Low resistance readings indicate a faulty exciter armature requiring replacement of rotor assembly.

⚠WARNING

HOT PARTS! Exciter armature will get hot if armature is shorted. Avoid touching armature or severe burns can result.

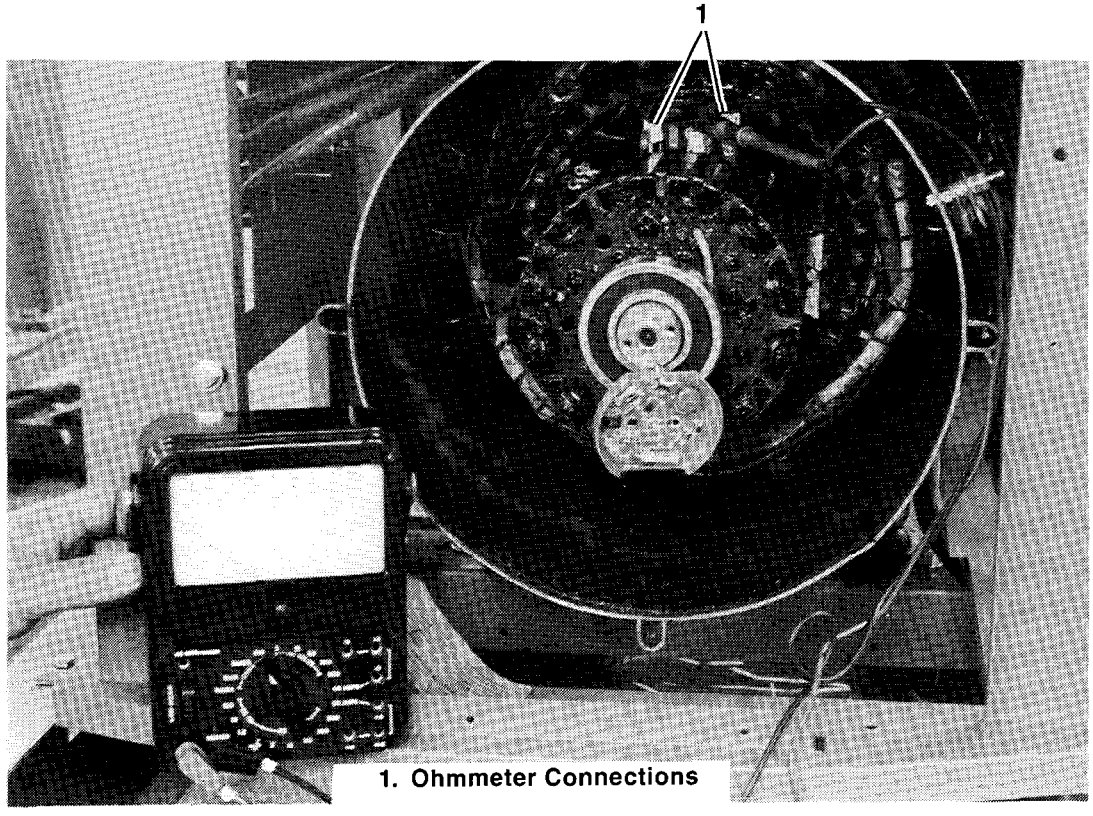
⚠WARNING

HIGH VOLTAGE! Use high voltage test only as directed! High voltage may result in electrocution or severe injury. Follow manufacturer's instructions when operating tester.

CAUTION

When performing the megohmmeter test, disconnect windings from all electronic components (photo transistor board, SCR assembly). Electronic components may be damaged if subjected to megohmmeter high voltage.

5. Using a megohmmeter, apply 500 Volts DC to rotor shaft and A1 or A2 lead (one-piece FR activator) or either AC lead (split FR activator). See Figure 4-16. (Follow the instructions of the megohmmeter manufacturer when performing this test.) A reading of approximately 500K ohms (1/2 megohm) and higher indicates the field winding is good. A reading of less than 500K ohms (approx.) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the rotor is necessary.



1. Ohmmeter Connections

Figure 4-15. Exciter Armature Continuity Check

6. Repair A1 and A2 or AC leads if test indicates leads shorted to ground. Solder and insulate splices. Use new sleeving when tying leads to shaft or heat sink.
7. Replace rotor assembly if test should show armature shorted or grounded.

Photo Transistor Board

Used with Standard, One-Piece FR Activator

This section covers diagnostic procedures for units utilizing a photo transistor board similar to that shown in Figure 4-17. This type of photo transistor board is used with the standard one-piece FR activator only. To test the photo transistor board used with split FR activators, refer to "Split FR Activator" earlier in this section.

1. Disconnect battery, negative lead first.

⚠WARNING

HIGH VOLTAGE! When testing photo transistor board, keep all other light sources away. Otherwise, dangerous ceiling voltage may result.

2. Disconnect leads E and C from FR activator.

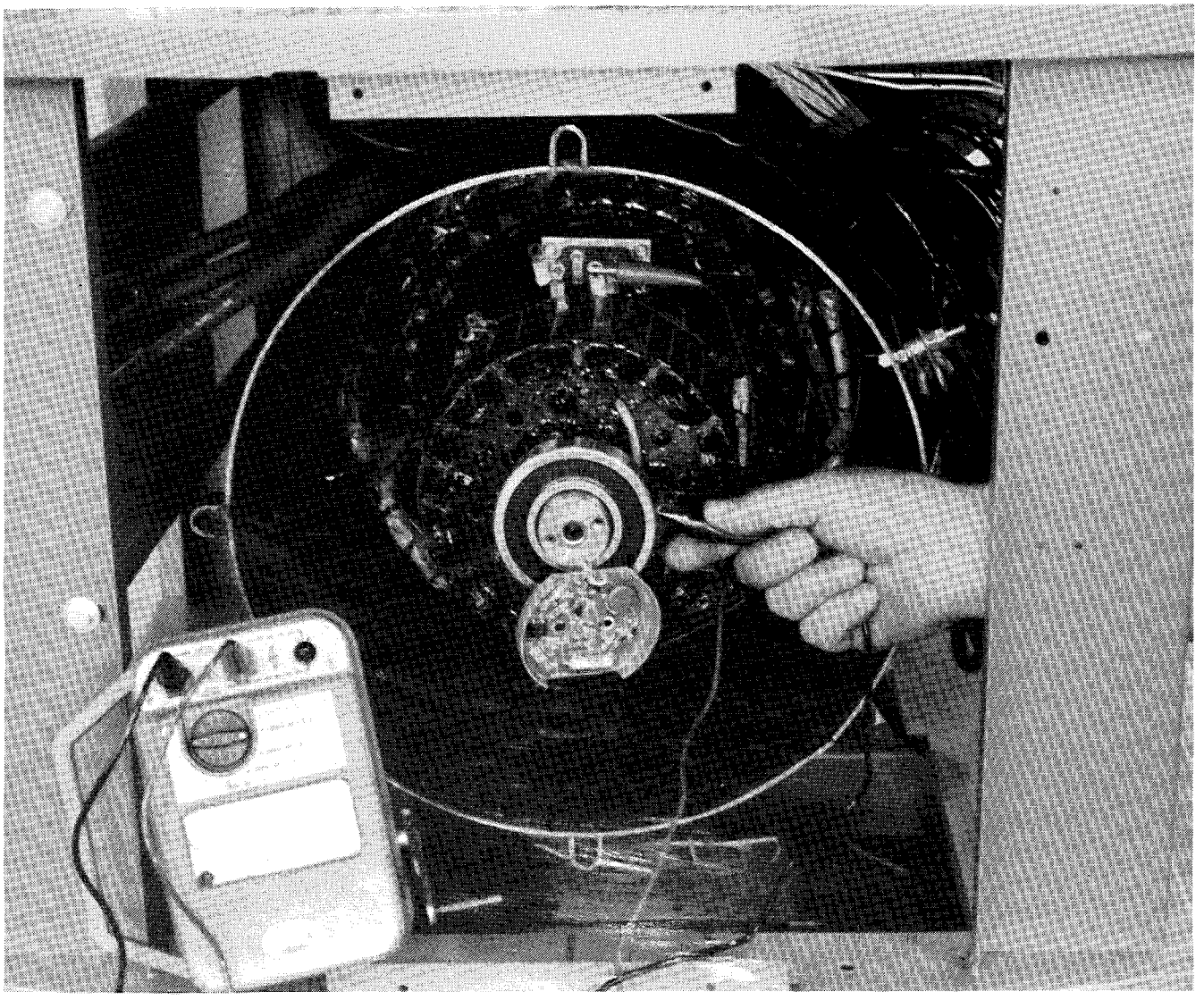


Figure 4-16. High Voltage Test

3. Connect red and black photo transistor leads to ohmmeter (+) and (-). Cover the photo transistor. Meter should read 300 K ohms or higher.
4. Shine a bright flashlight on photo transistor board; meter should read 5K ohms or lower.
5. If ohmmeter does not respond, reverse ohmmeter leads and repeat check (meter polarity may be reversed).
6. If ohmmeter does not respond, replace photo transistor board and harness assembly.
7. Reconnect C (red) and E (black) photo transistor board leads to C and E terminals of FR activator.

⚠WARNING

HIGH VOLTAGE! Make sure leads "C" and "E" to FR activator are connected to the correct terminals. Reversal of these leads or grounding of "C" (red) lead will turn the FR activator full on resulting in ceiling output voltage. Damage to equipment or personal injury can result.

CAUTION

FR ACTIVATOR DAMAGE! Do not bend C and E terminals on FR activator. Internal damage and failure may result.

8. Start set and shine bright flashlight on photo transistor board (see Figure 4-17). AC voltmeter

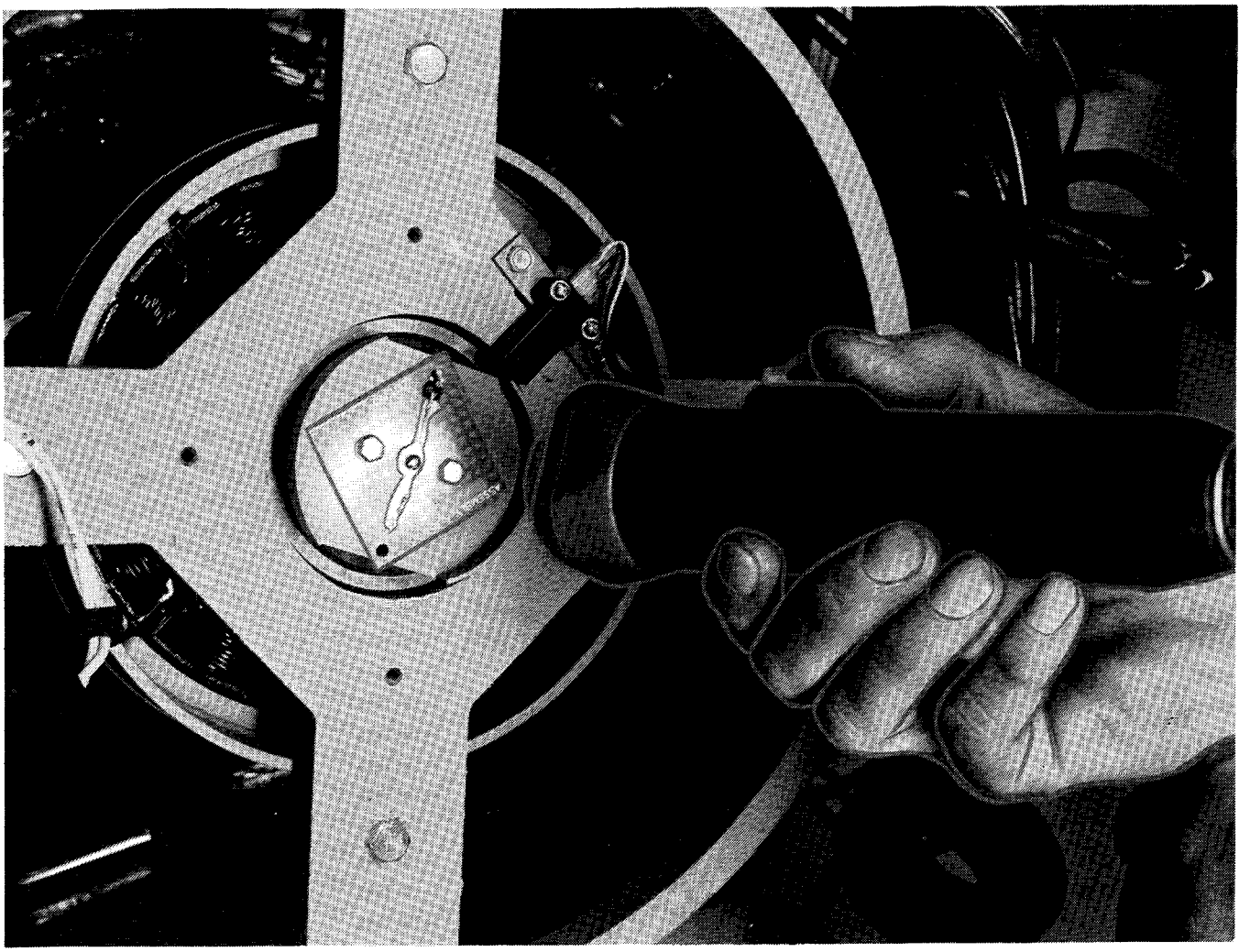


Figure 4-17. Flashlight Test

1. Photo Transistor Board

should show ceiling voltage and return to very low voltage when flashlight is removed. Repeat test seven times. If output does not drop to low voltage when flashlight is removed, replace FR Activator. See "FR Activator." If ceiling voltage is not read, go to exciter armature test.

End Bracket Removal and Replacement

NOTE

On 30kW models, remove the end bracket mounting bolts. On 40kW models, the junction box must be loosened to allow end bracket removal. Remove the six (6) junction box mounting screws and pull the junction box away from the engine to remove end bracket.

1. Remove LED board and cover. Disconnect leads from speed sensor.
2. Remove screws holding actuator cup and photo-transistor board.

CAUTION

FR ACTIVATOR DAMAGE! Do not bend C and E terminals on FR Activator. Internal damage and failure may result.

3. On models with standard, one-piece FR activator, reach in and remove leads C and E from FR Activator. For units with split FR activators, remove the four leads from the photo transistor board. This will allow slack when removing the end bracket.
4. Remove 4 bolts holding end bracket to stator.
5. Use a pulling tool to remove end bracket. See Figure 4-18.

CAUTION

To avoid loosening exciter field magnets, do not attempt to remove end bracket by pounding with a hammer.

6. Pull the end bracket and exciter field assembly over the exciter armature. Be extremely careful to avoid damaging exciter field magnets or photo transistor board.
7. Reverse order of disassembly to reinstall end bracket/exciter field assembly.

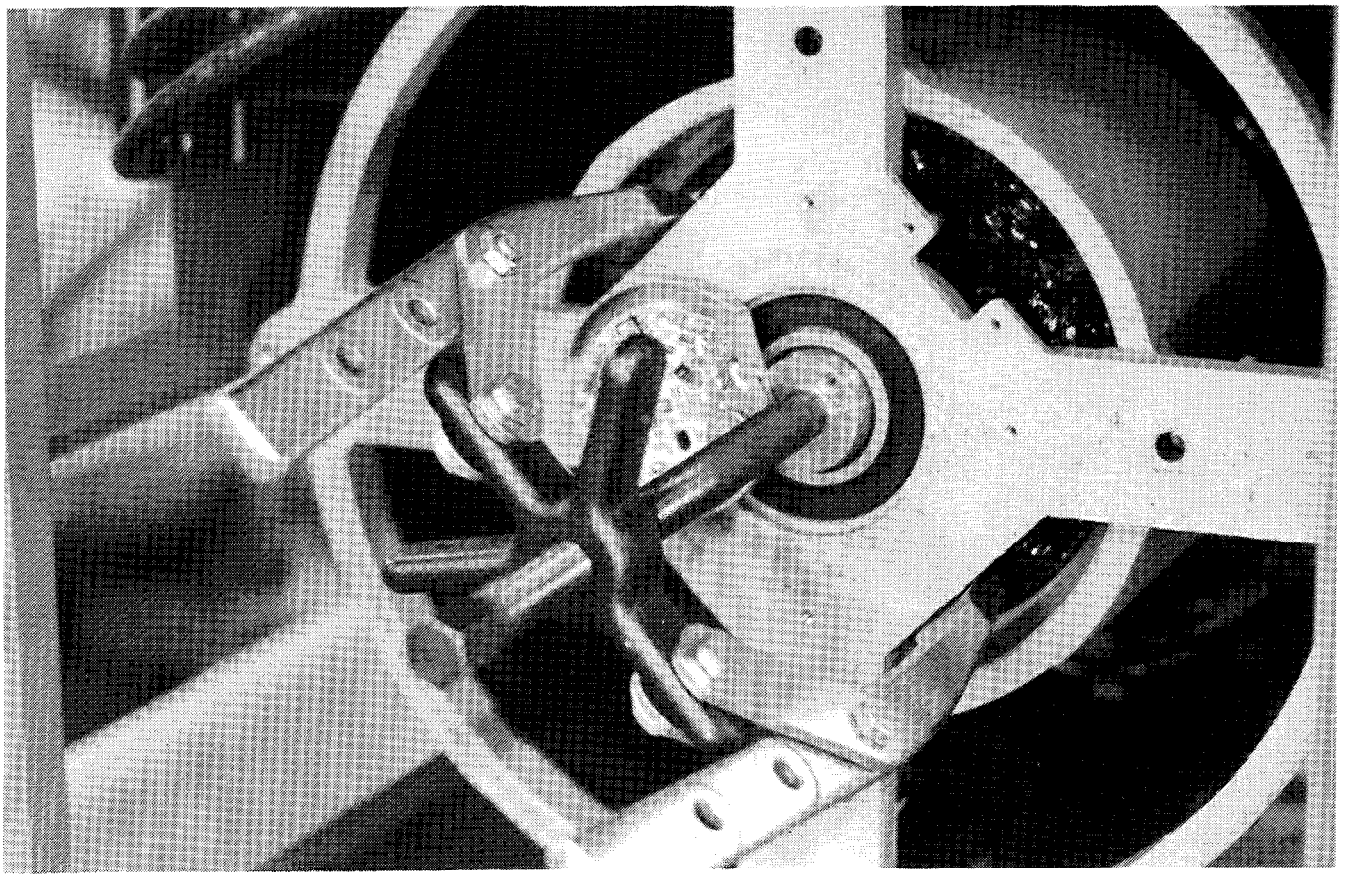


Figure 4-18. Removing End Bracket

Section 5.
Generator Reconnection & Frequency Adjustment

Generator Reconnection

The stator leads of the generator may be reconnected if a different output phase or voltage is desired. Refer to the following procedure and the connection schematics below. Follow all safety precautions at the front of this manual and in the text during this procedure.

1. Move controller Master Switch to OFF/RESET (Dec-3 Controller) or OFF (Relay Controller) position.

⚠WARNING

ELECTRICAL SHOCK! The Battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings and other jewelry.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Master Switch to OFF position and remove battery cables (remove negative lead first and reconnect it last) to disable the generator set before working on any equipment connected to the generator.

2. Disconnect engine starting battery, negative (-) lead first.

3. Select desired voltage connection from Figure 5-1. Route leads through current transformers and connect according to the diagram for desired phase and voltage.

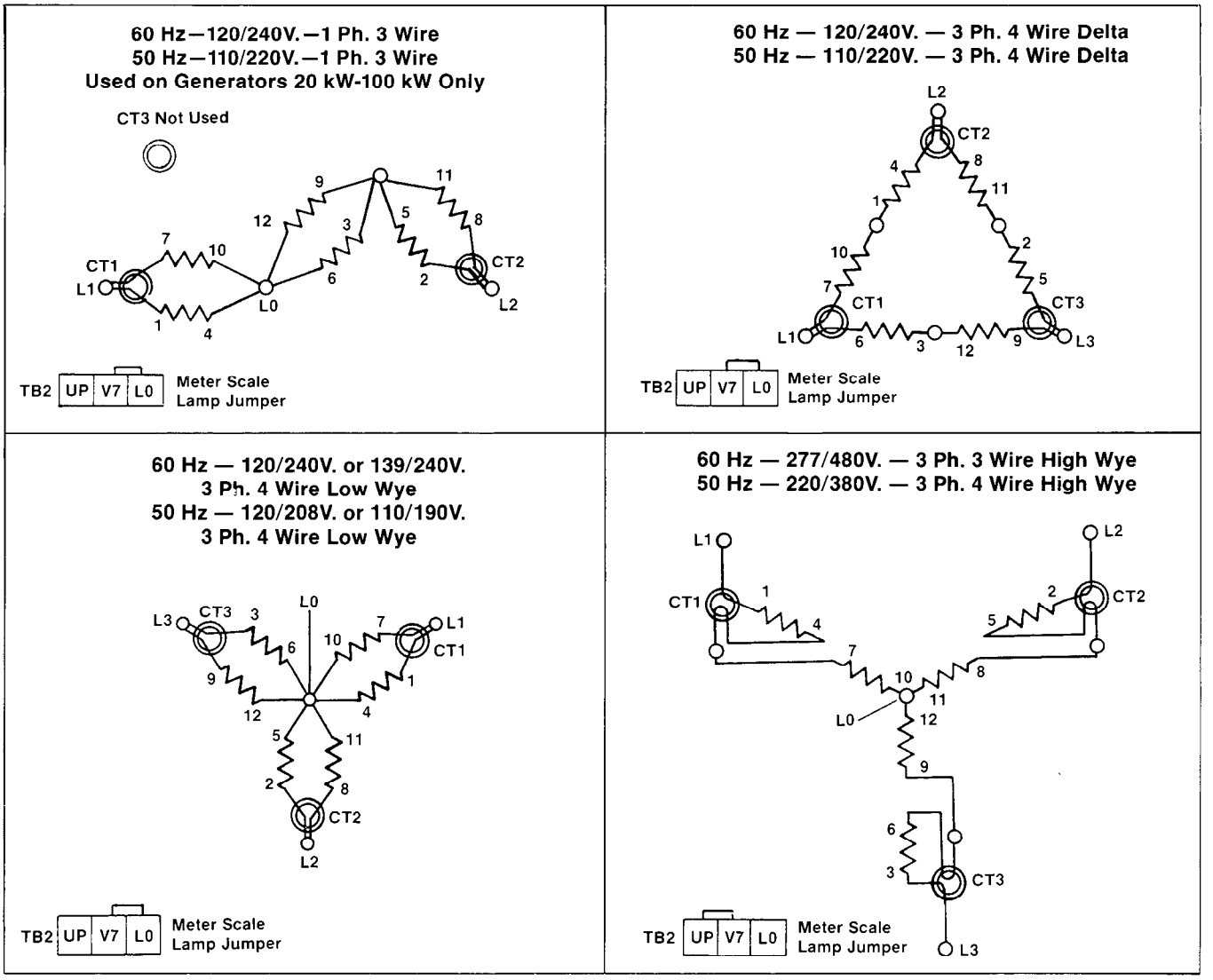


Figure 5-1. Generator Reconnections

Generator Reconnection & Frequency Adjustment — cont'd.

NOTE

With CT1 and CT3, place dot on "H1" mark side away from generator set. With CT2, place dot on "H1" mark toward generator set.

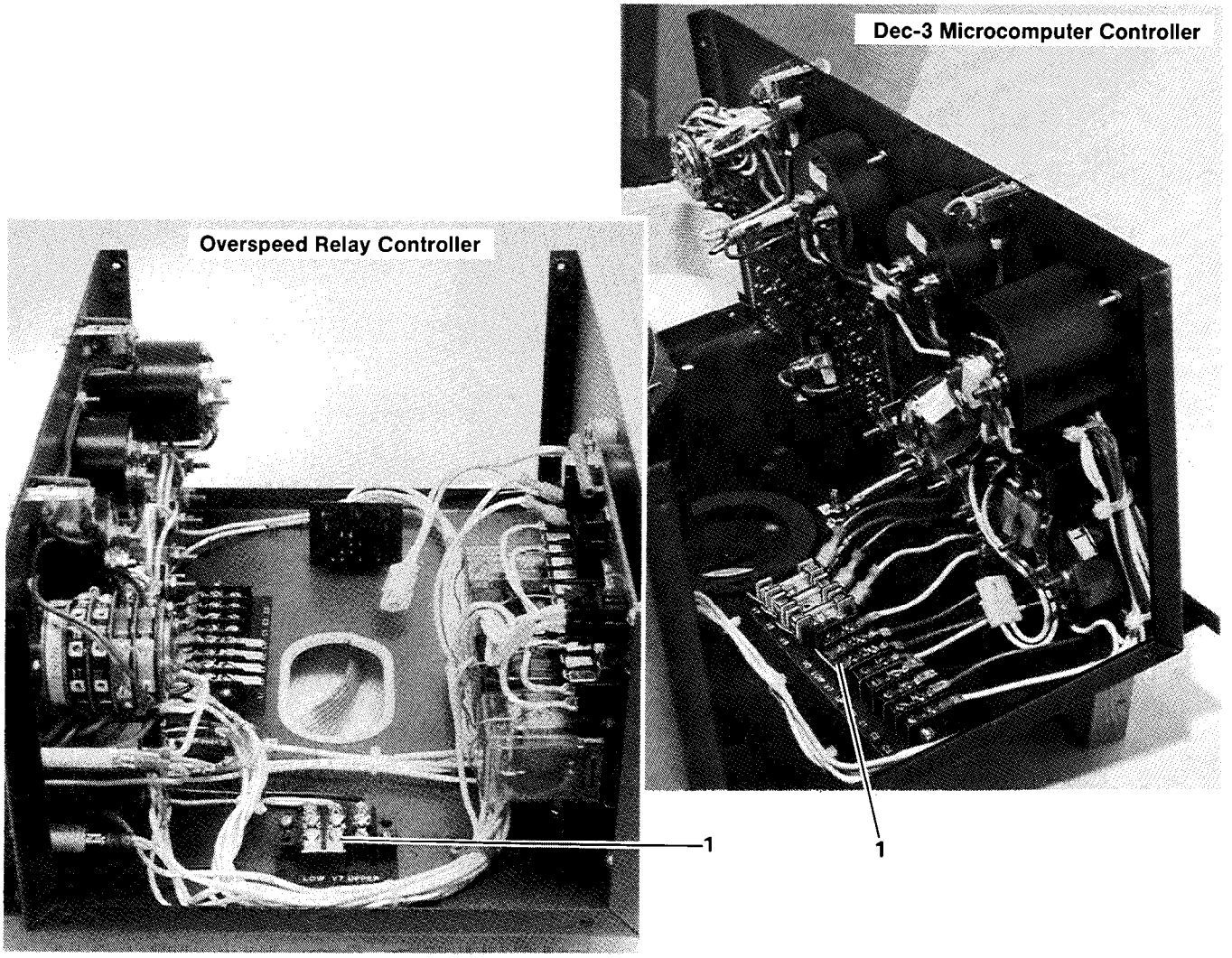
NOTE

Current transformers (CT's) will only be used on generator sets equipped with metered controllers and/or Safeguard Breakers.

⚠WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and wherever electrical energy is present there is the potential danger of electrocution. Keep everyone, especially children, away from the set while it is running and take precautions to prevent unqualified personnel from tampering with or attempting to operate your generator set. Have the set and electrical circuits serviced only by qualified technicians. Wiring should be inspected frequently — replace leads that are frayed or in poor condition. Do not operate electrical equipment when standing in water, on wet ground or when your hands are wet.

4. If controller is equipped with meters, remove controller cover and reposition meter scale lamp jumper (see Figure 5-2), if necessary, to match proper position for desired voltage (shown in Figure 5-1). Replace cover.



1. Lamp Jumper

Figure 5-2. Meter Scale Lamp Jumper

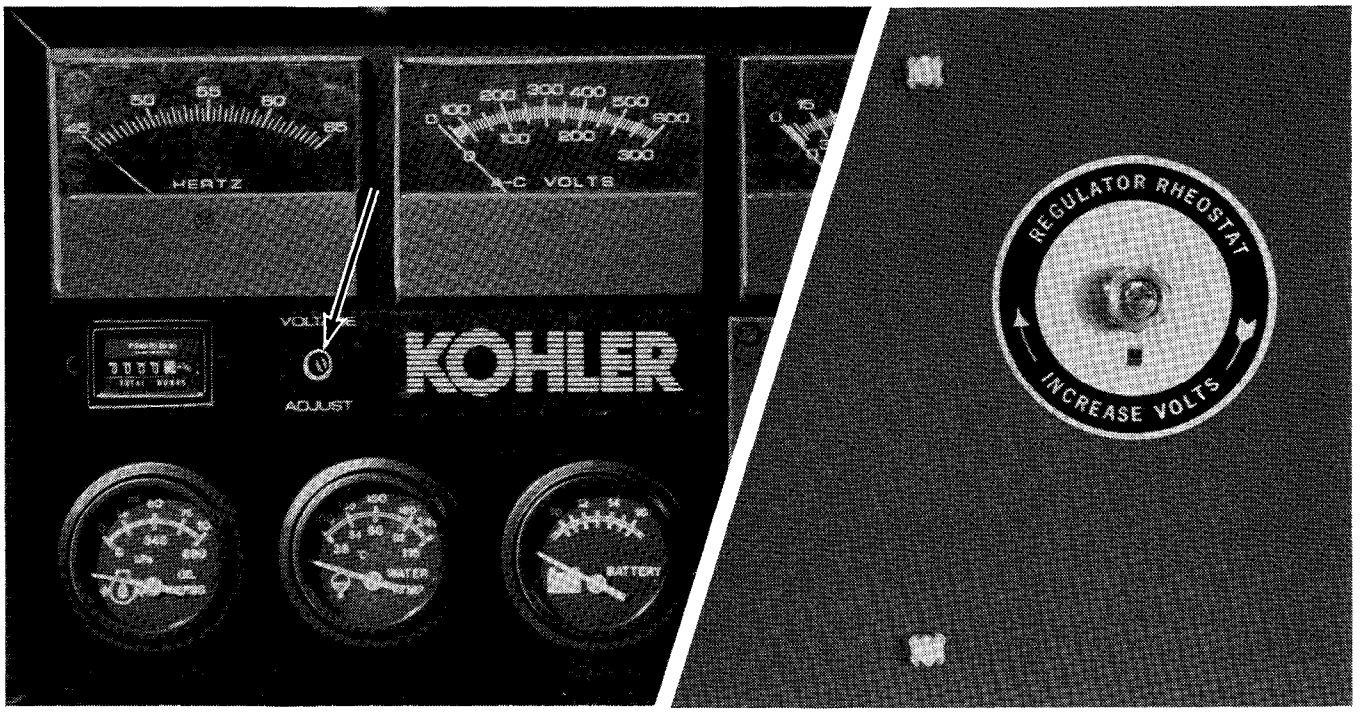
Generator Reconnection & Frequency Adjustment — cont'd.

5. If the controller is equipped with meters, turn the phase selector switch to the L1-L2 position (1-Phase or 3-Phase depending on generator connection). If the controller is not equipped with meters, connect a voltmeter across leads L1 and L2.

CAUTION

EQUIPMENT DAMAGE! Be sure that line circuit breakers, transfer switch and any other accessories using line voltage are properly sized for the voltage selected.

6. Reconnect starting battery, negative lead last. Move controller Master Switch to the TEST or RUN position to start the generator set. Check voltmeter for proper voltage. Adjust voltage, if necessary, with the Voltage Adjustment on Dec-3 microcomputer controllers or the Regulator Rheostat on relay controllers. See Figure 5-3.



Dec-3 Microcomputer Controller **Overspeed Relay Controller**

Figure 5-3. Voltage Adjustment

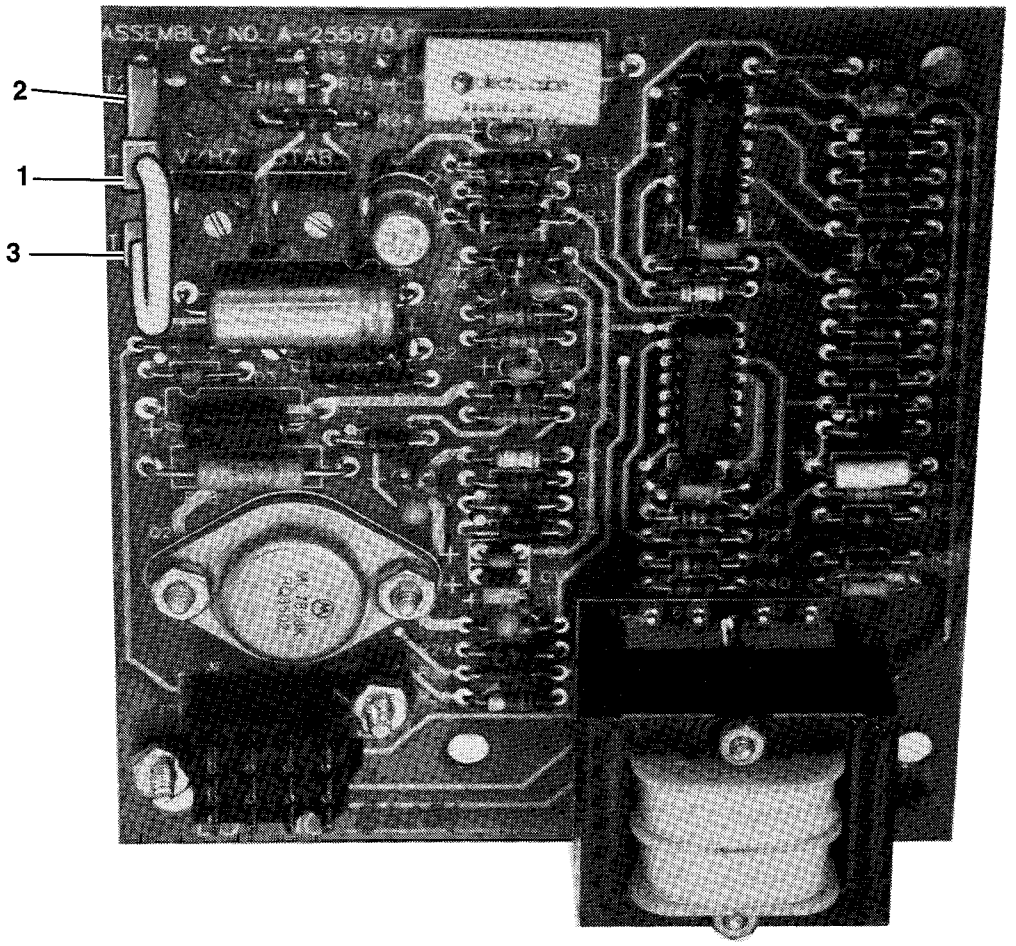
Generator Frequency Change and Adjustment

Frequency Change

NOTE

Frequency change is possible only on gensets utilizing AVR (voltage regulator) circuit board A-255670 or B-255670.

Generator frequency is determined by jumper position on the AVR (voltage regulator) circuit board. See Figure 5-4. Jumper terminals T1 and T2 for 60 Hz operation. To convert generator to 50 Hz output, jumper terminals T1 and T3.



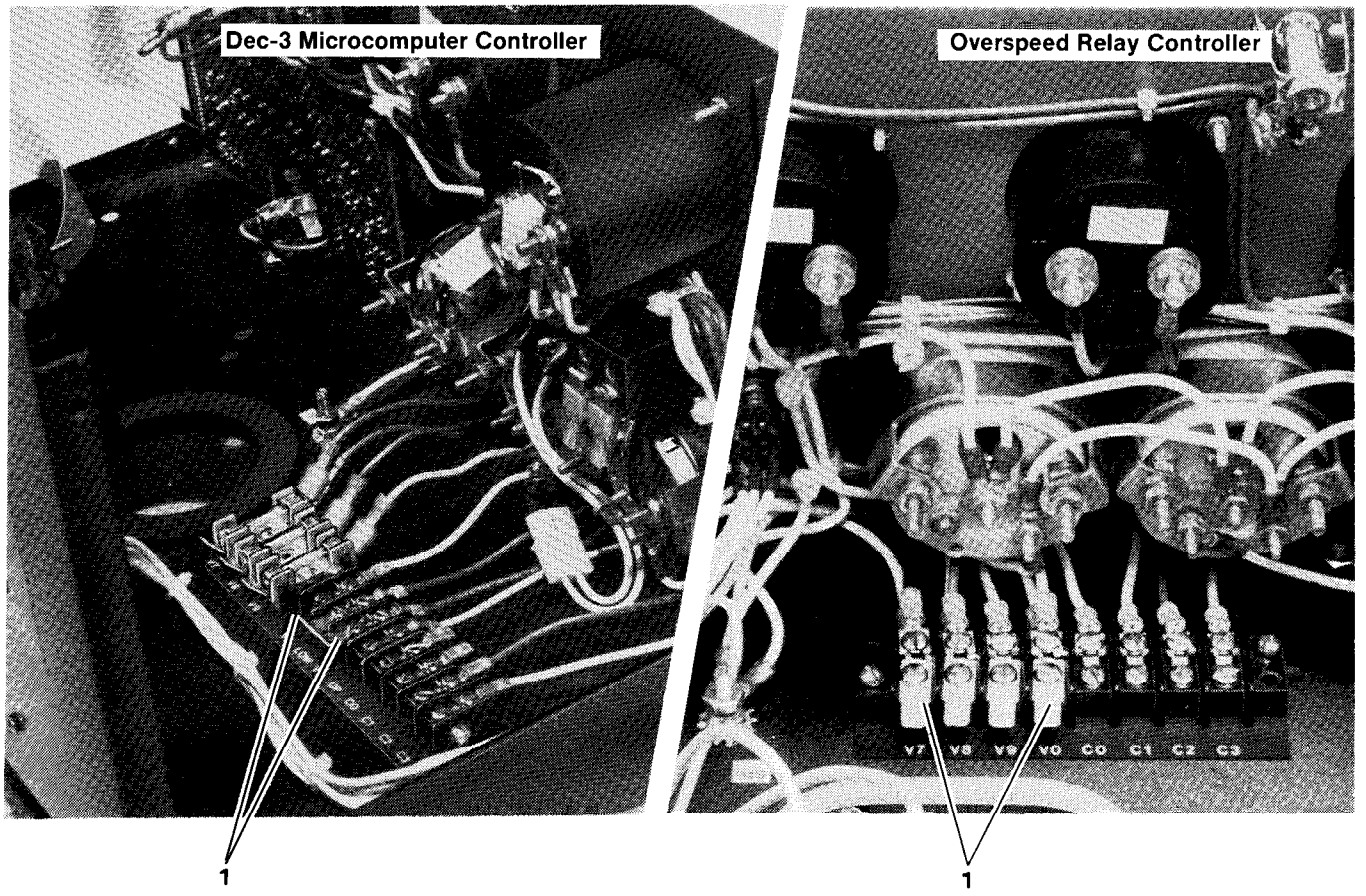
1. T1 Terminal
2. T2 Terminal
3. T3 Terminal

Figure 5-4. Jumper Location — 50/60 Hz Operation

Frequency Adjustment

To check your generator set for proper frequency operation, check the frequency meter for a no load reading of 63 Hz for 60 Hz operation and 53 Hz for 50 Hz operation. If your generator is equipped with an isochronous governor, check for 50 and 60 Hz operation at no load. If your controller is not equipped with a frequency meter, connect a meter across V0 and V7 on the control board terminal strip (set must not be running while making connection). Refer to Figure 5-5.

To adjust governor speed, refer to the governor adjustment section for your specific unit.



1. Frequency Meter Connection

Figure 5-5. Frequency Meter Connections

Section 6.
Generator Disassembly/Reassembly

Before beginning generator disassembly procedure, carefully read all safety precautions at the beginning of this manual. Please observe these precautions and those included in text during the disassembly/reassembly procedure.

⚠WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic Transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Master Switch on controller to OFF position and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to the generator.

⚠WARNING

ELECTRICAL SHOCK! The battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings and any other jewelry.

⚠WARNING

HOT PIPING! An engine gets hot while running and exhaust system components get extremely hot. Do not work on generator set until unit is allowed to cool.

1. Disconnect (negative lead first) and remove starting batteries from work area to prevent fire hazard. Disconnect any AC accessories such as battery charger, block heater and fuel transfer pump.
2. Shut off fuel supply. Drain fuel system as necessary by emptying fuel into proper containers. Remove any fuel containers from work area to prevent fire hazard. Ventilate work area to clear fumes.

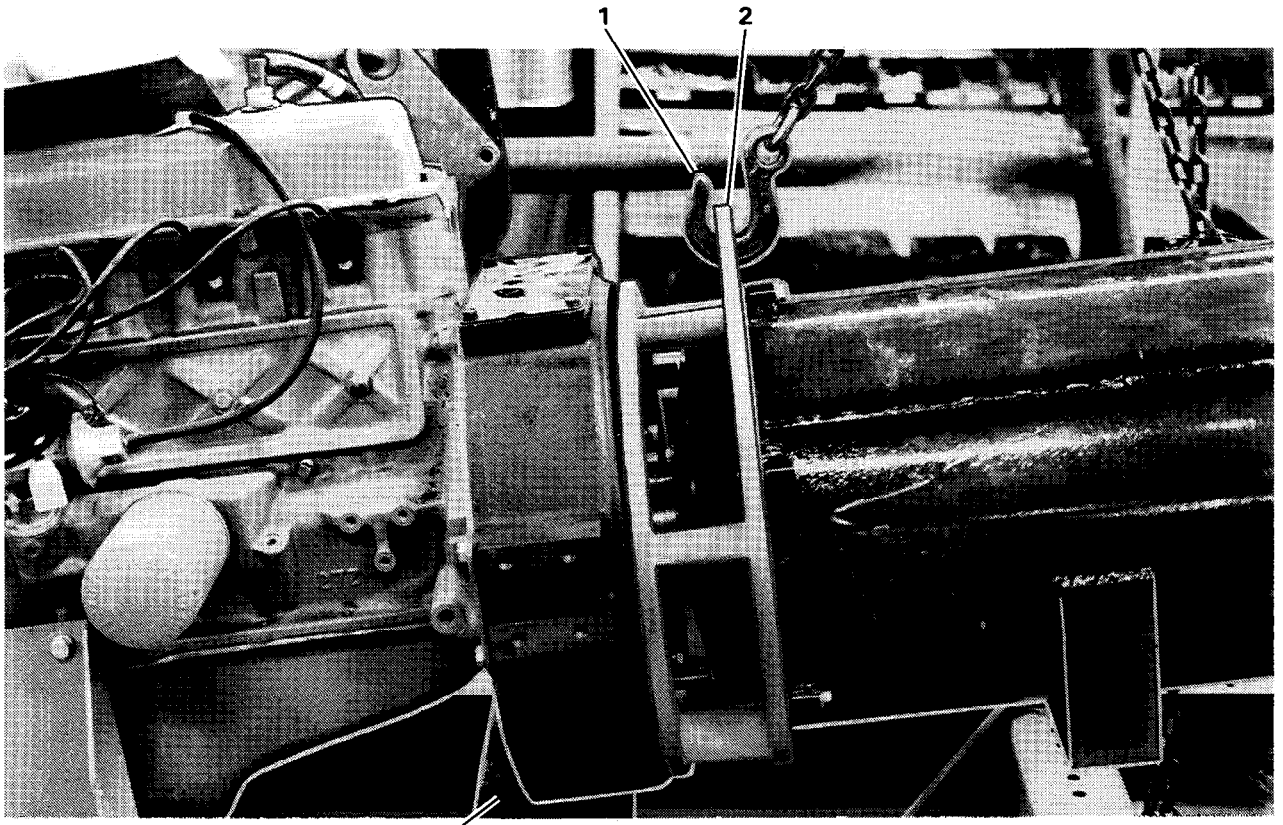
⚠WARNING

FLASH FIRE! To avoid the possibility of a flash fire, do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors.

3. Disconnect fuel, cooling and exhaust systems as necessary to tilt generator set. Disconnect output leads or load circuit cables at generator.
4. Any cranes, hoists or other devices used in disassembly or reassembly must be rated for weight of generator set. Check generator nameplate for weight.

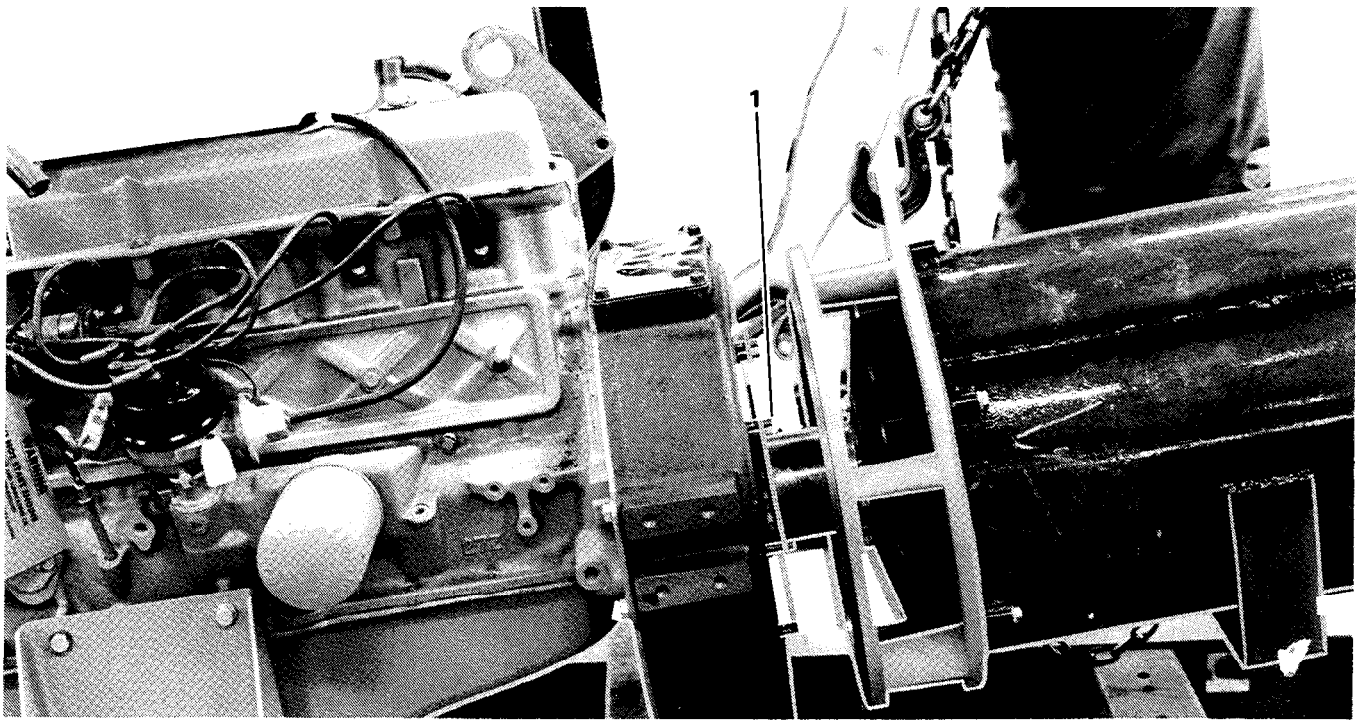
Disassembly

1. Disconnect all controller-to-engine and engine-to-generator harnesses and wiring. Disconnect alarm horn circuit board connector (if equipped), LED board and housing, and speed sensor. Junction box and controller can be removed as a unit.
2. Remove bolts from generator vibro-mounts.
3. Suspend the generator at both ends with hooks in lifting eyes. Use a hoist to raise generator end off vibro-mounts. Figure 6-1.
4. Support the engine by placing wood blocks under flywheel housing. Lower generator end until generator flywheel housing rests on blocks. Figure 6-1.
5. Remove fan guard. Remove bolts holding adapter to flywheel housing.
6. Remove nuts and spacers holding drive discs to flywheel.
7. Work drive discs over studs to separate generator from engine. Figure 6-2.
8. Set the generator assembly on the floor in a horizontal position. Remove support slings or chains.



1. Hook
2. Adapter
3. Wood Block(s)

Figure 6-1. Hoisting Generator

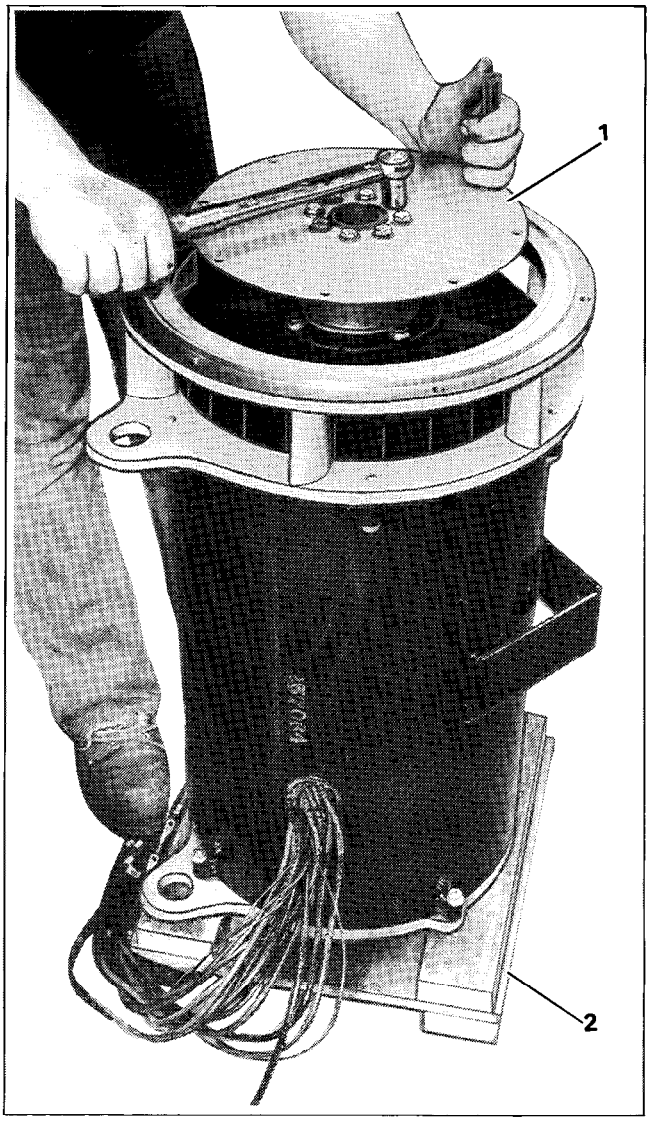


1. Drive Discs

Figure 6-2. Separating Generator and Engine

Generator Disassembly/Reassembly — cont'd.

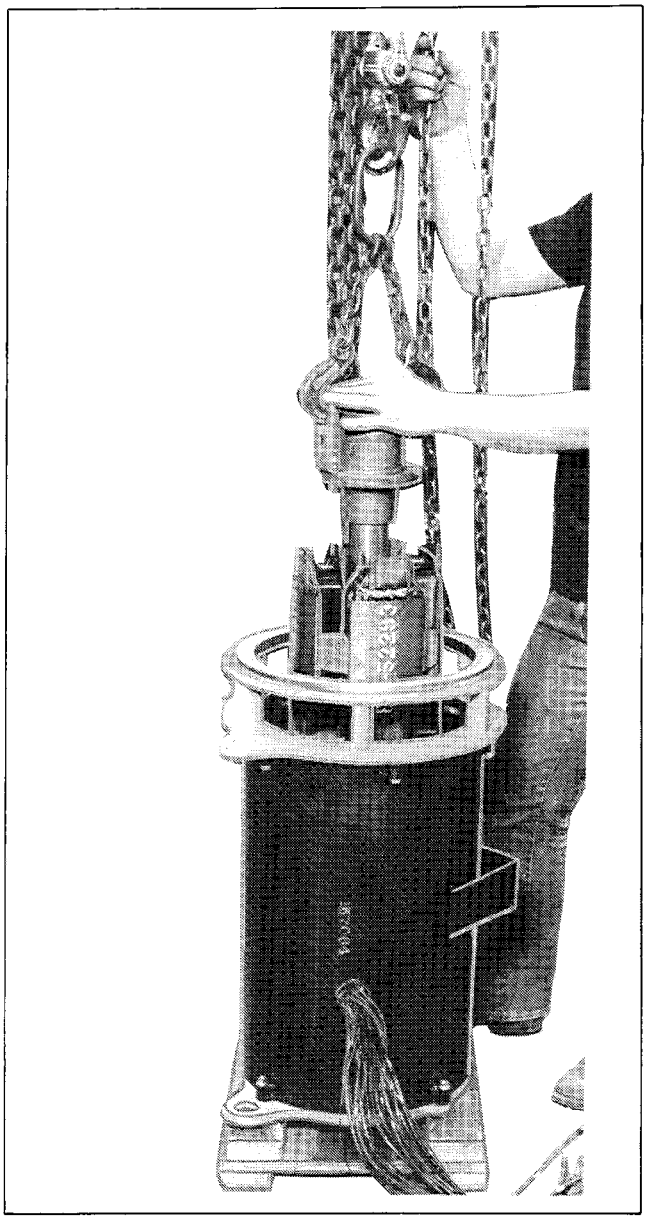
9. To remove the rotor assembly, hook hoist to adapter and place generator assembly on floor in a vertical position. Figure 6-3. Before lowering assembly, place boards along the edge of end bracket to prevent damage to photo transistor board.
10. Remove drive discs and fan from generator assembly. See Figure 6-3.



1. Drive Disc Removal
2. End Bracket Support

Figure 6-3. Generator Support/Drive Disc and Fan Removal

11. Fasten lifting eye and hoist hook to rotor flange. Hoist rotor while being careful to avoid damaging exciter armature or exciter field magnets. See Figure 6-4.
12. While rotor is suspended, remove photo transistor board and actuator cup. On sets with standard, one-piece FR activators, remove leads C (red) and E (black) from FR Activator. On units with split FR activators, disconnect leads AC, F3, and G from SCR assembly. Cut terminals on photo transistor board to remove board. If photo transistor board will be removed, leave leads as long as possible.

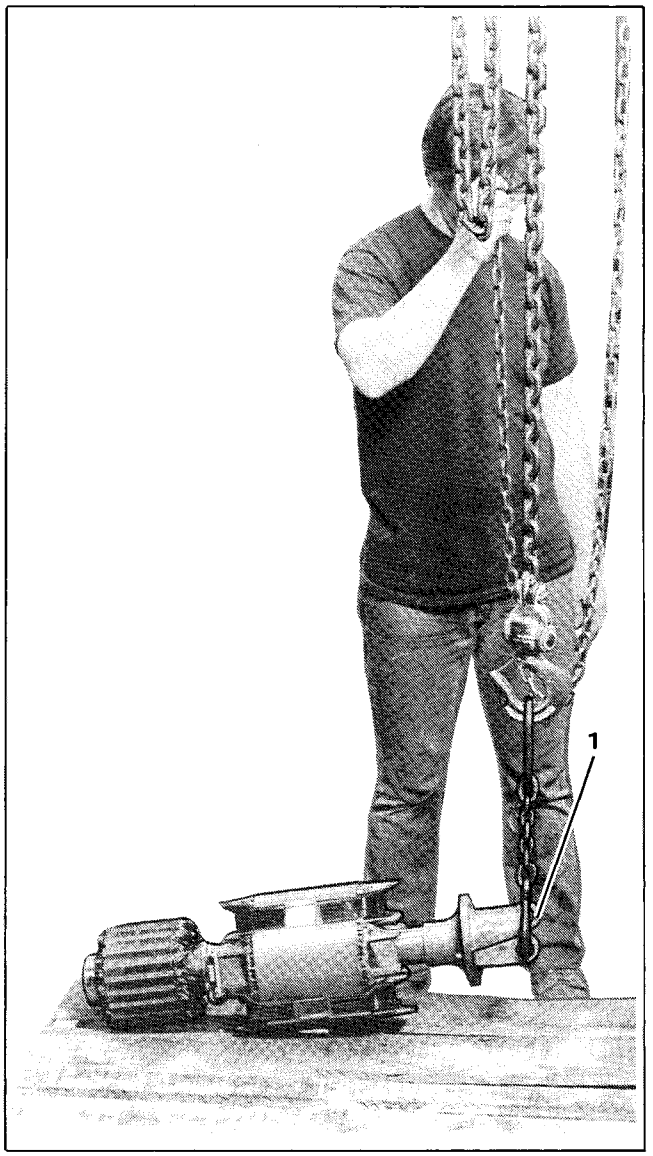


1. Hoist Hook Locations

Figure 6-4. Rotor Removal

Generator Disassembly/Reassembly — cont'd.

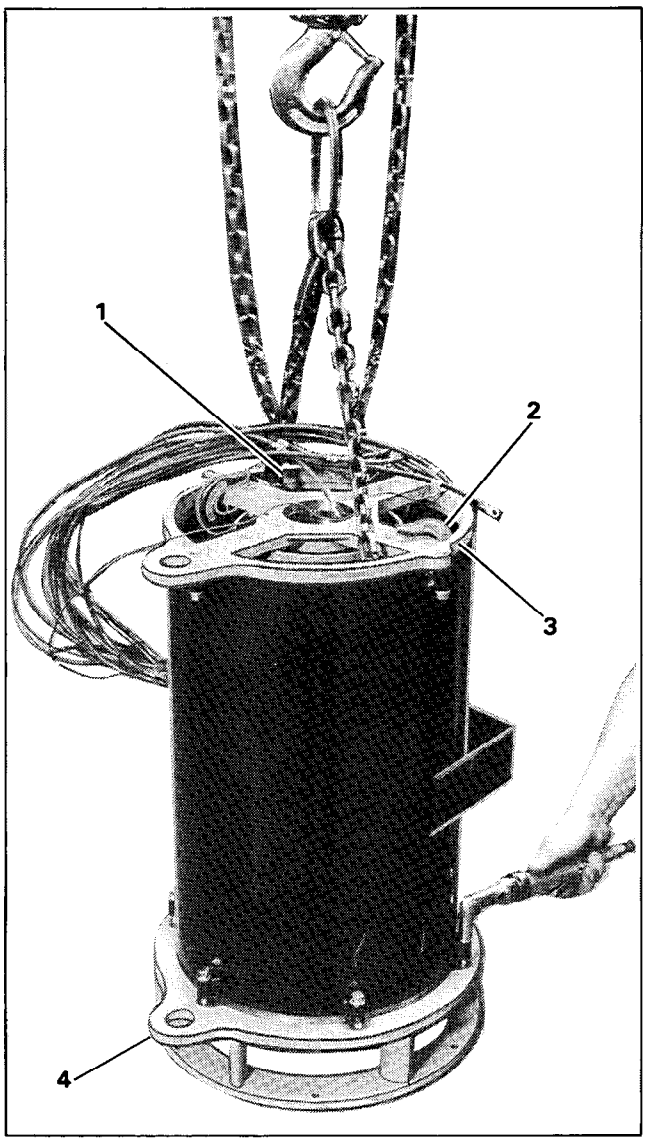
13. Slowly lower rotor to horizontal position. Set the rotor on a wooden surface. Take care not to damage windings, laminations or bearing. See Figure 6-5.



1. Rotor Assembly

Figure 6-5. Lowering Rotor

14. In order to remove the adapter and end bracket from the stator, the generator assembly must be set on the adapter end. Fasten chains to adapter and lower to a horizontal position. Fasten hook to end bracket eye and hoist to a vertical position. See Figure 6-6.



1. Hoist Hook
2. Hoist Hook
3. End Bracket
4. Adapter

Figure 6-6. Removing Adapter

15. Remove adapter mounting bolts. Fasten hoist hooks to end bracket and raise assembly slightly. Bump adapter loose by using a rubber mallet.

16. Lower stator assembly. Remove end bracket mounting bolts. Separate end bracket from stator by bumping loose with a rubber mallet.

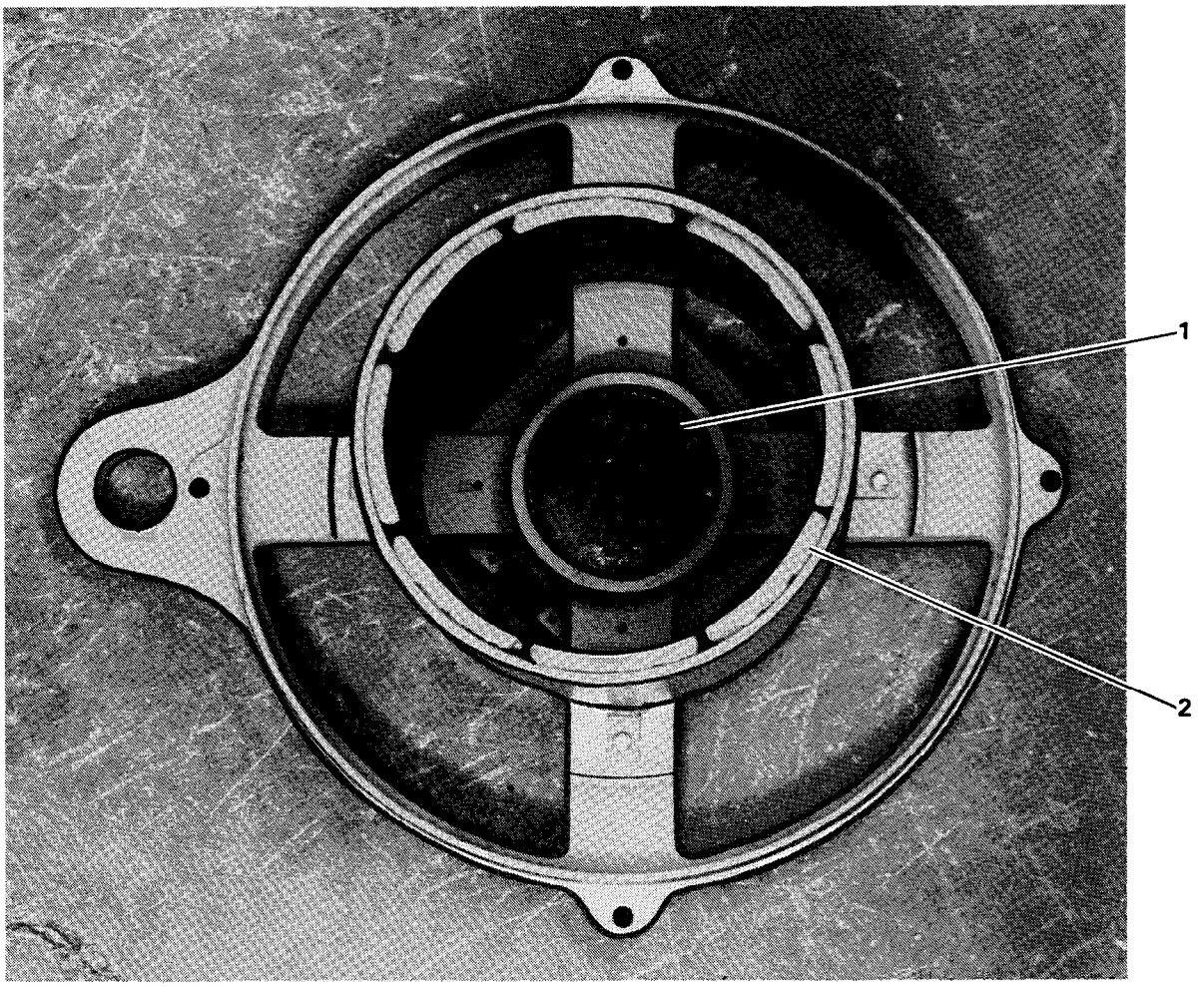
17. Remove exciter magnets from end bracket. A flat edge screwdriver can be used to remove tolerance ring. Figure 6-7.

Reassembly

1. Install new tolerance ring in end bracket. Attach exciter field to end bracket with four mounting screws. See Figure 6-7.
2. Place the stator in a vertical position, end bracket side up.

NOTE

End bracket side of stator has four mounting bosses.



1. **Tolerance Ring**
2. **Exciter Magnets**

Figure 6-7. End Bracket View

3. Place end bracket on stator; use bolts to align holes. Use a rubber mallet to mount end bracket flush with stator. See Figure 6-8.

NOTE

End Bracket housing eye must be opposite of the stator mounting bracket.

NOTE

Later FRII models use a skewed (slanted) rotor with straight stator. When replacing either rotor or stator, be sure replacement is the same as the original. Rotor and stator must be of dissimilar styles (skewed rotor with straight stator or straight rotor with skewed stator) for generator to function properly.

4. Install bolts to attach end bracket to stator.
5. Attach hoist hooks to end bracket and suspend stator. Place the adapter on the floor and lower stator to within 1/2-1/4 in. (12.7-6.4 mm) of the adapter lip. See Figure 6-9.
6. Align adapter with stator and start bolts with washers. Lower stator onto adapter and finish tightening bolts.

NOTE

Adapter hoisting eye must be opposite of the stator mounting bracket and directly below end bracket hoisting eye.

7. To install rotor, the generator assembly must be set on the end bracket end. Fasten hoisting hook to end bracket eye and lower generator assembly to a horizontal position.

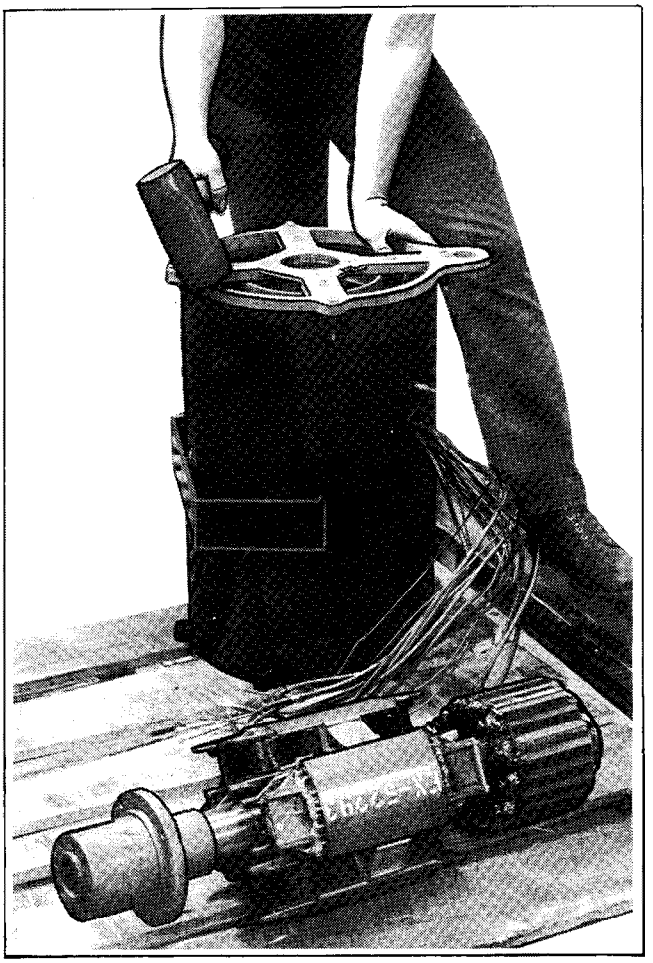


Figure 6-8. Mounting End Bracket on Stator

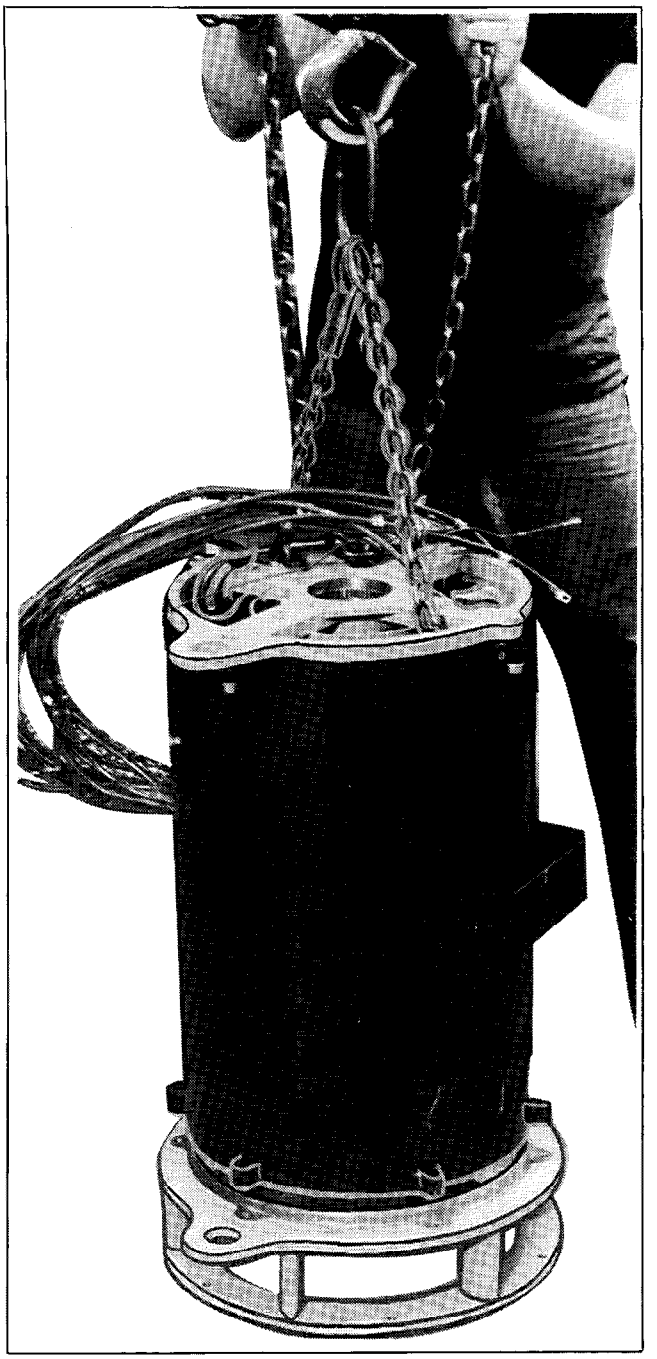


Figure 6-9. Aligning Adapter and Stator

8. Attach hoisting hooks to adapter as shown in Figure 6-10. Suspend generator assembly. Before lowering generator, place boards along the edge of the end bracket. A one in. (2.54 cm) clearance must be available underneath the center of the end bracket to prevent damage to the photo transistor board and actuator cup when the rotor is installed.

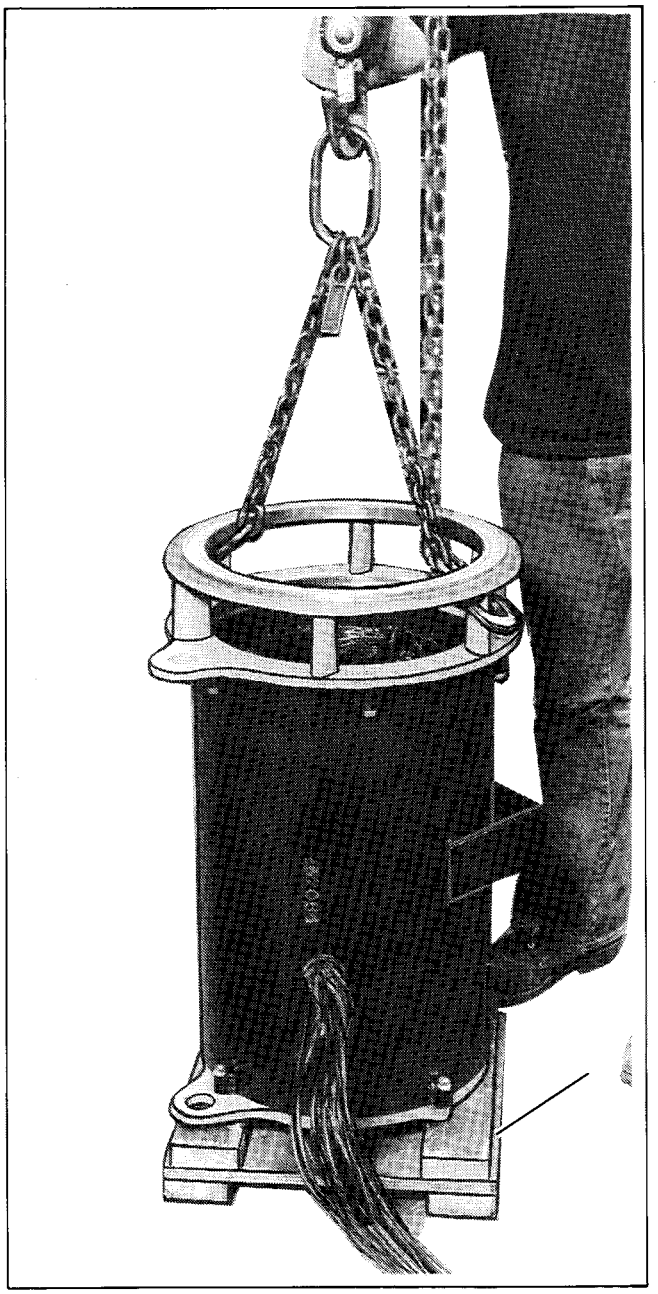


Figure 6-10. Supporting Generator Assembly

9. Fasten lifting eye and hoist hook to rotor flange. Figure 6-11. Hoist rotor to a vertical position, taking care not to damage windings, laminations or bearing.

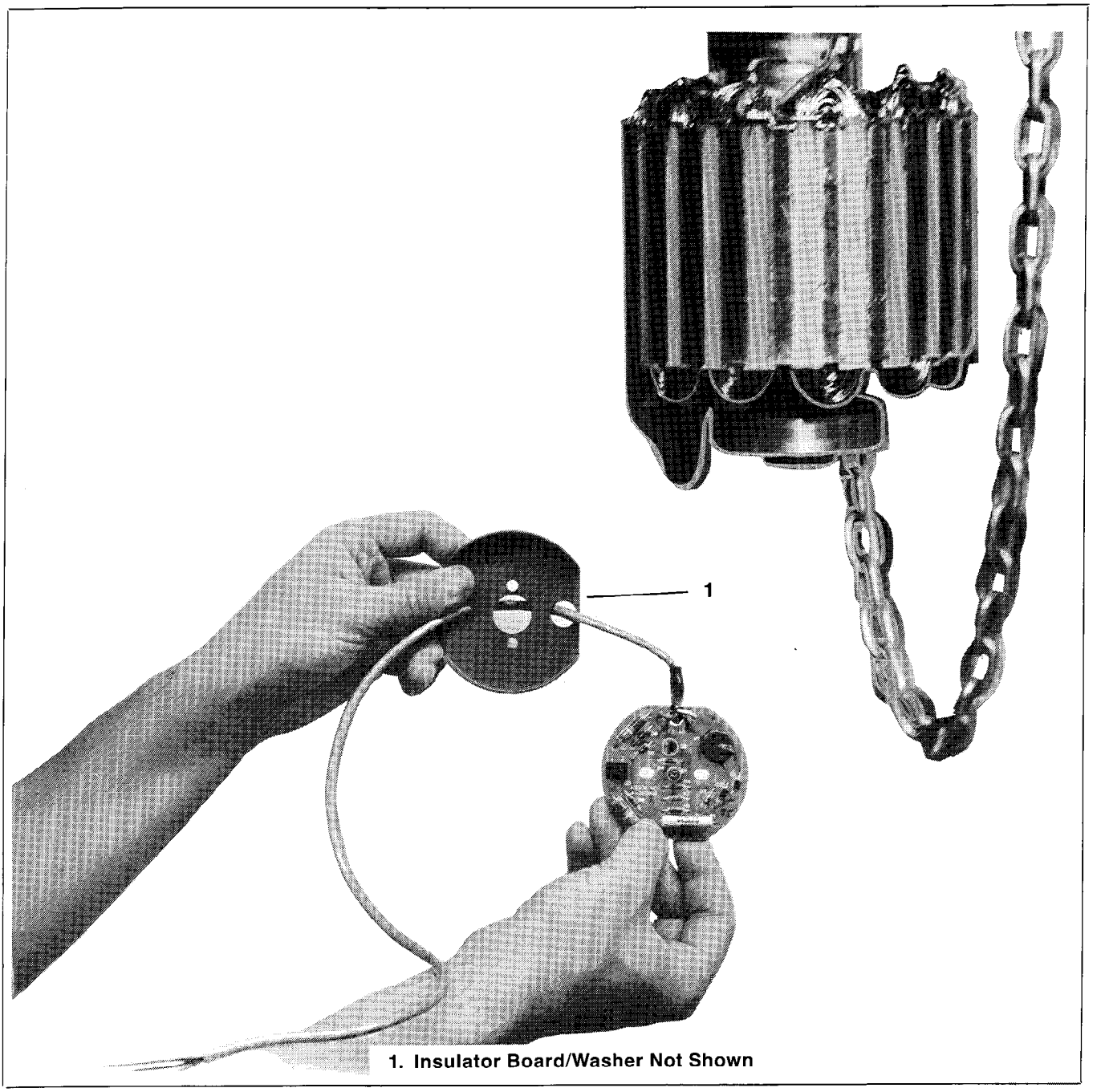
1. Hoist Hook

Figure 6-11. Hoisting Rotor

10. While the rotor is suspended, install the photo transistor board, insulator board, and actuator cup. Early split activator generators used washers to insulate the photo transistor board from the actuator cup. If the unit is disassembled, replace washers with insulated board (available from service parts.) Place photo transistor board lead through actuator cup as shown in Figure 6-12. Push lead through hole in rotor shaft and then through exciter laminations ending near the FR Activator (older models) or SCR assembly (newer models).

NOTE

The photo transistor board used on older model generators will differ from that shown.



1. Insulator Board/Washer Not Shown

Figure 6-12. Installing Photo Transistor Board

⚠WARNING

HIGH VOLTAGE! Be sure that foil side of photo transistor board, end of shaft and threaded holes are clean and free of metal particles and chips. Dangerous HIGH VOLTAGE may result. AC voltmeter must show proper output before generator may be reconnected to load.

11. Attach photo transistor board, insulator board, and actuator cup to end of rotor shaft with two mounting screws. Figure 6-13. Cut off excess lead wire, leaving enough wire to reach FR Activator or SCR assembly. Strip 2-3 in. (50-75 mm) of gray insulator jacket from lead. Cut off all exposed uninsulated wire. Strip about 1/4 in. (6 mm) of insulation on red and black leads and crimp on 3/16 in. (4.7 mm) female push-on terminals (part no. X-431-19). Before connecting to FR Activator or SCR assembly terminals, secure leads with tie wraps. On models equipped with standard, one-piece FR activators, reconnect red lead to "C" terminal and black lead to "E" terminal on FR Activator. On sets with a split FR activator, connect white lead to AC terminal, red lead to F+ terminal, green lead to G terminal, and black lead to remaining AC terminal.
12. Suspend rotor over generator assembly. Lower rotor field into stator. Be extremely careful while lowering rotor to avoid damaging exciter armature, field magnets, stator windings or rotor laminations. See Figure 6-14. Carefully align rotor bearing into end bracket tolerance ring. Check for an outer race measurement of 1/4 in. from bracket to bearing. Make sure the photo transistor board and actuator cup have clearance below the end bracket.

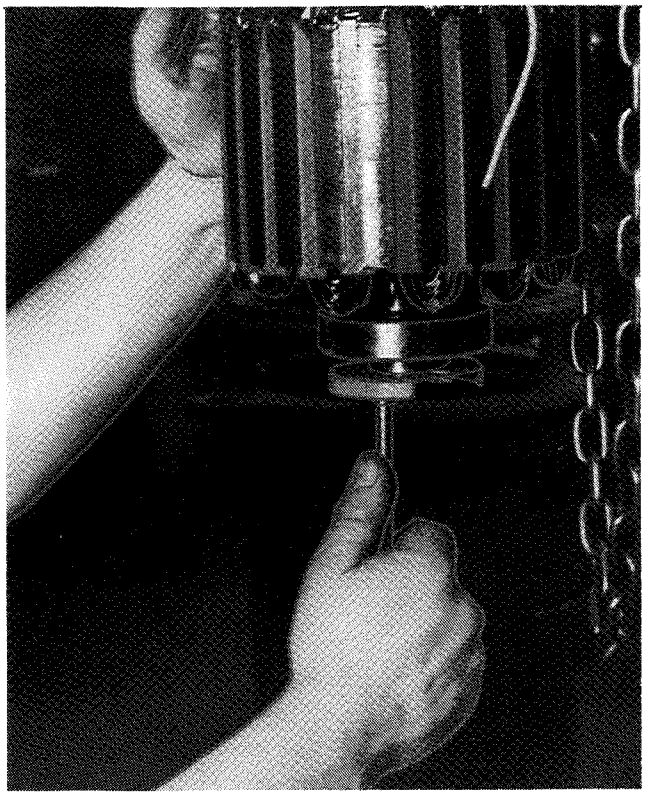


Figure 6-13. Mounting Photo Transistor Board and Actuator Cup

13. Place fan over rotor flange and torque bolts to 260 in. lbs. (29.4 Nm).
14. Fasten drive discs to end of rotor shaft. Torque drive disc mounting bolts to 50 ft. lbs. (108.48 Nm).

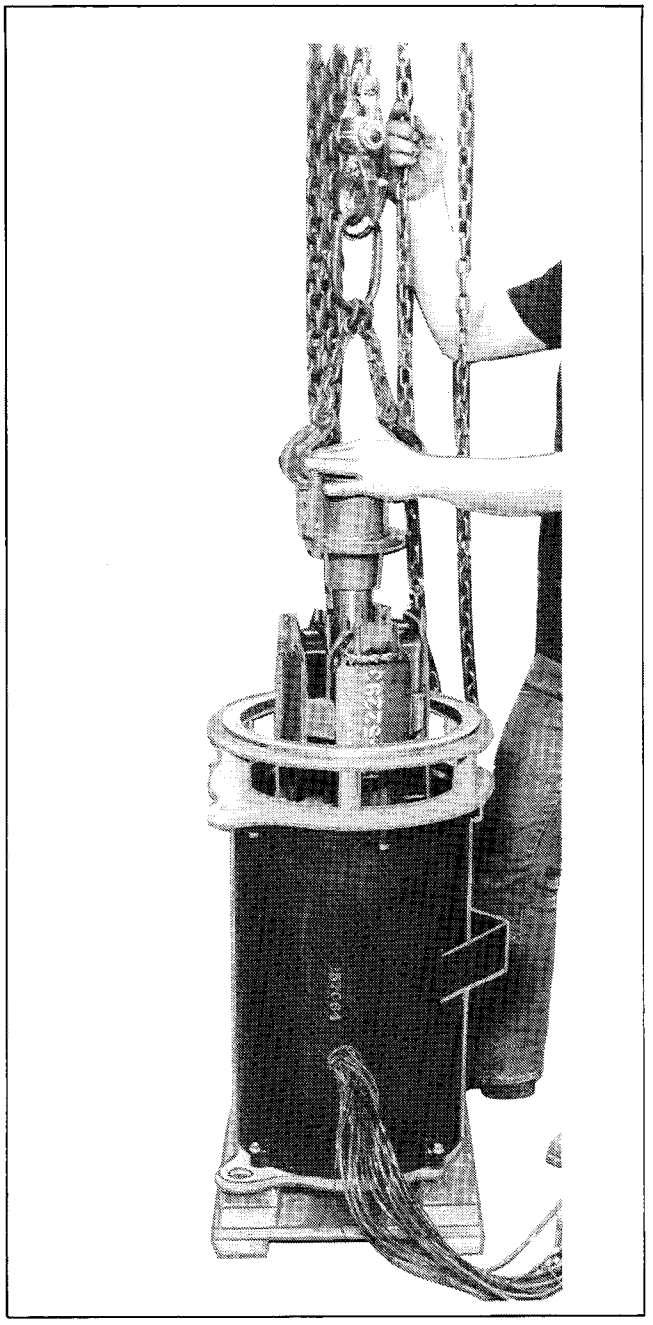
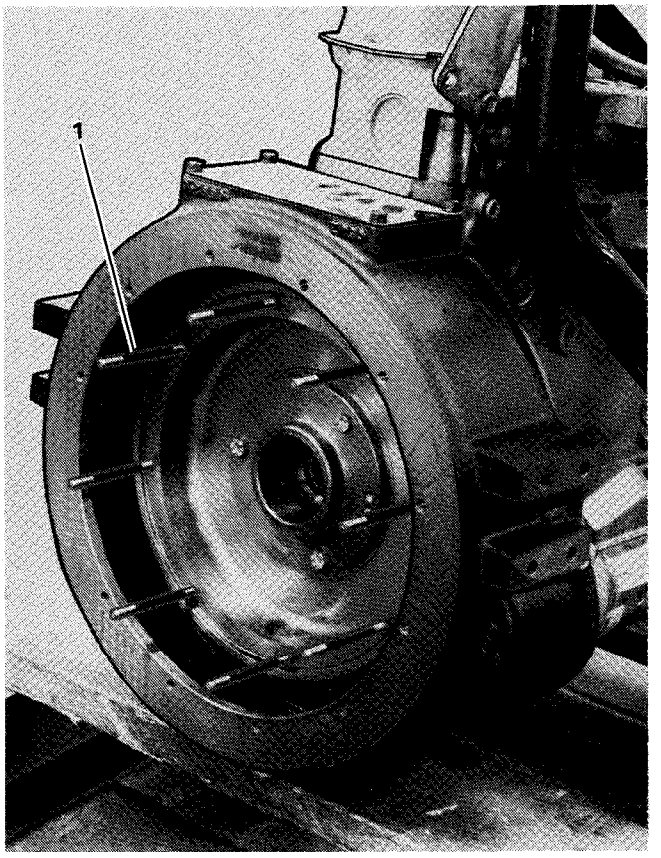


Figure 6-14. Installing Rotor



1. Flywheel Studs

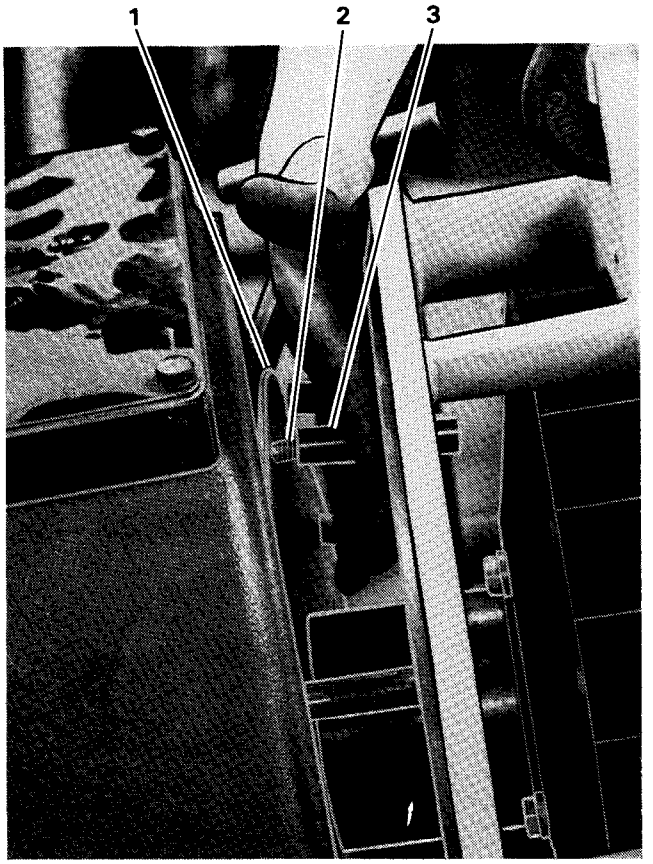
Figure 6-15. Flywheel Studs

15. Attach hoist to adapter eye and place generator assembly in a horizontal position. Take care not to damage rotor or stator. Hoisting eyes of generator should be to the top.

16. Thread studs into flywheel as shown in Figure 6-15.

Generator Disassembly/Reassembly — cont'd.

17. Place hoist hooks into end bracket and adapter eye. Raise generator assembly and align studs with drive discs by turning the flywheel. Move generator as necessary to work drive discs over studs. When drive discs are about 1 in. (25 mm) over studs, install spacers. Figure 6-16.
18. Move generator as necessary to align adapter and flywheel housing. Fasten and final tighten adapter to flywheel housing bolts and lock washers. Figure 6-17.
19. Install nuts on studs.
20. Hoist generator and engine slightly to remove wood block(s) from under flywheel housing. Align generator assembly and vibro mounts. Lower generator and tighten vibro mount mounting bolts.
21. Remove chains or slings used to suspend generator. Final tighten drive discs to flywheel.
22. Install fan guard.
23. Reinstall junction box and controller. Reconnect all controller-to-engine and engine-to-generator harnesses and wiring. Refer to Section 7, Wiring Diagrams.
24. Reconnect fuel, cooling and exhaust systems that were disconnected during disassembly. Reconnect output leads or load circuit cables at generator. Open fuel supply valve.



1. **Drive Discs**
2. **Studs**
3. **Spacers**

Figure 6-16. Installing Spacers

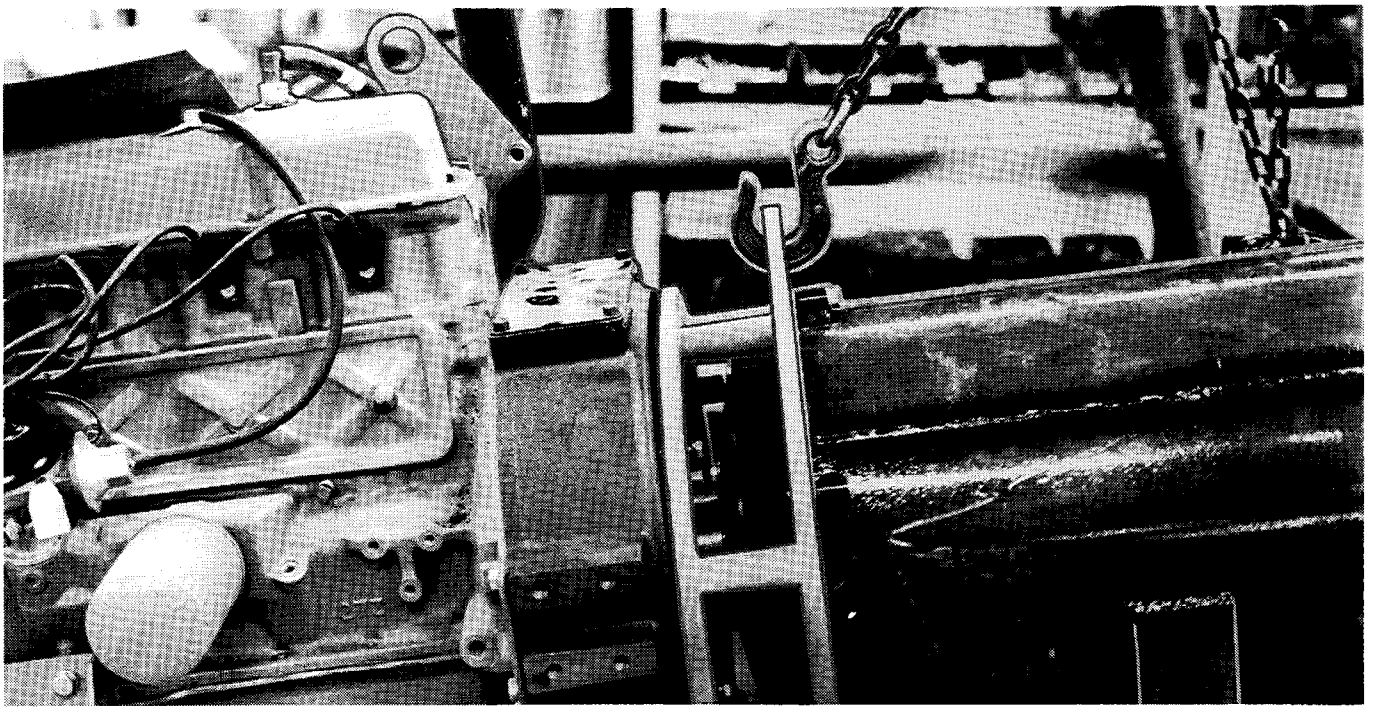


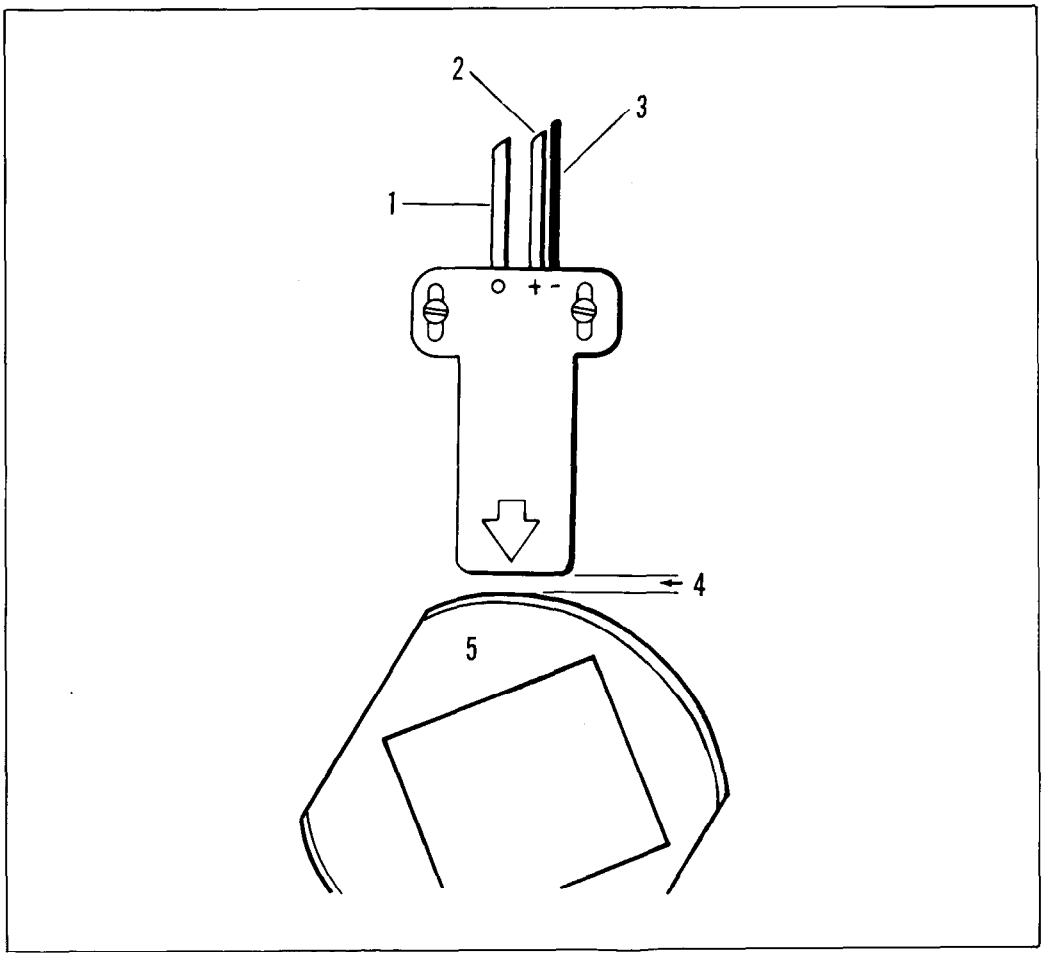
Figure 6-17. Aligning Adapter and Flywheel Housing

Generator Disassembly/Reassembly — cont'd.

25. Reconnect starting batteries and connect any AC accessories, such as battery charger, block heater and fuel transfer pump.

NOTE

Set speed sensor gap at 0.020 in. (0.508 mm) when remounting. See Figure 6-18.



1. White/Clear (16)
2. Red (24)
3. Black (2)
4. .020 in. (0.508 mm) Gap
5. Actuator Cup

Figure 6-18. Speed Sensor Air Gap

Section 7.
Governor Adjustment

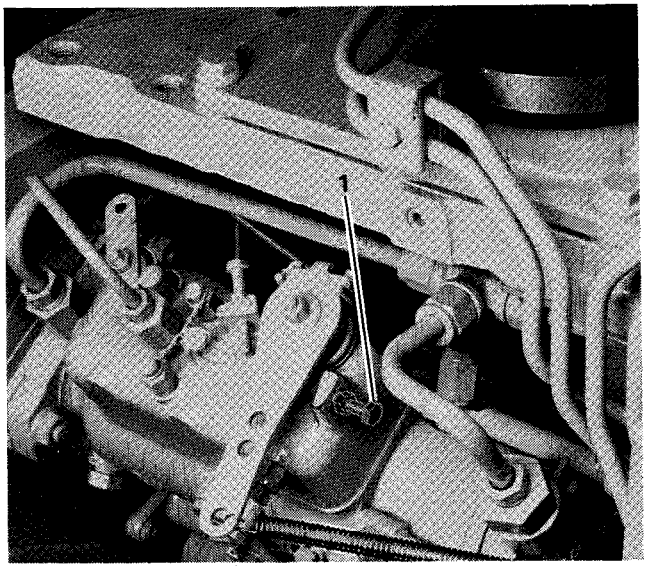
Mechanical Governor Adjustments — Diesel Engines

Frequency Adjustment

1. Start the generator set, observe the frequency meter.
2. Loosen the fuel pump high speed screw locknut to make the adjustments. See Figure 7-1 or 7-2.
3. To increase or decrease the frequency (at no load), rotate the screw clockwise or counterclockwise respectively. Tighten the locknut.

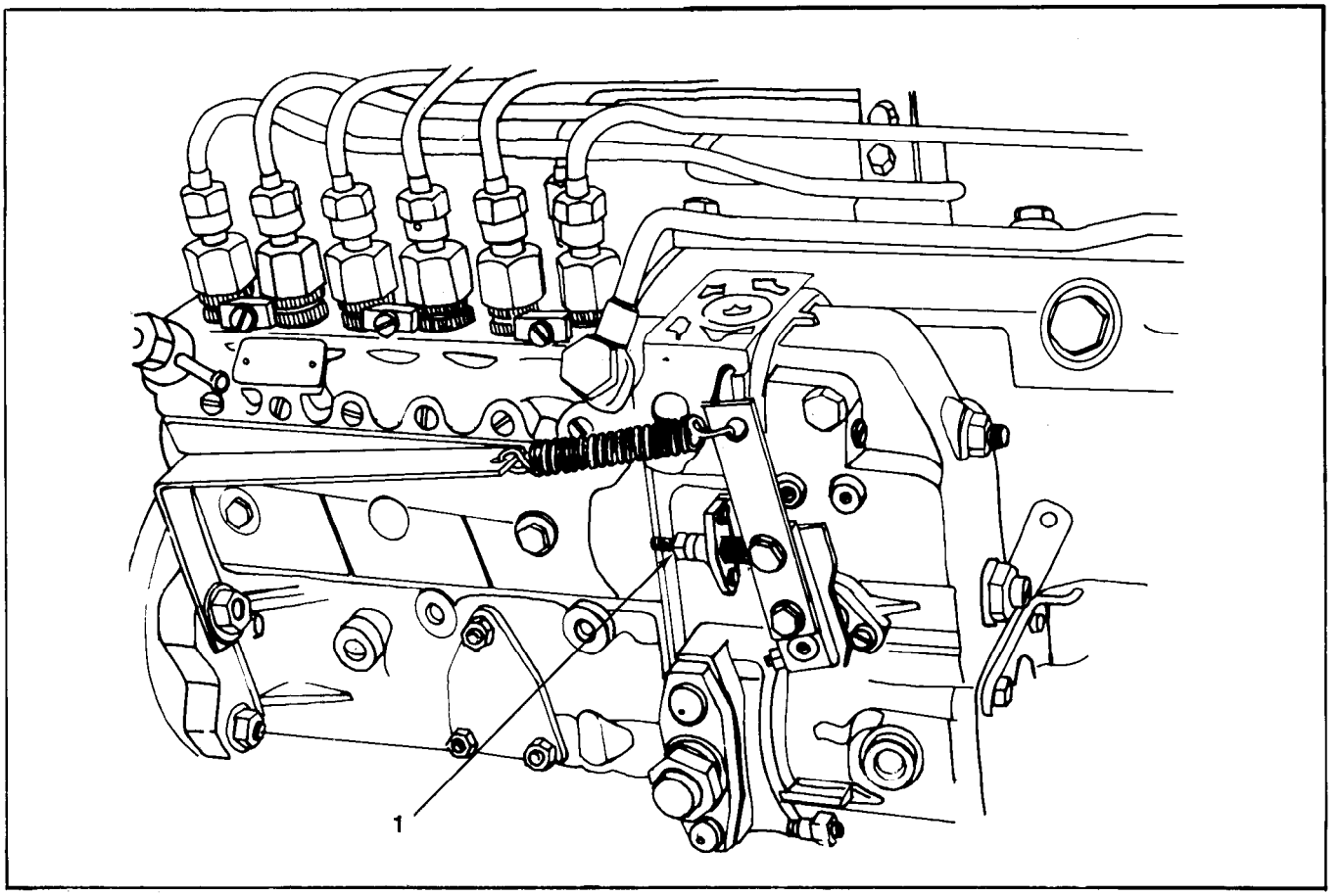
The loaded droop frequency may alternately be adjusted to the operating frequency at full load. Apply the full load to the generator set by closing the generator circuit breaker and then make adjustments to the fuel pump screw.

The stability of the frequency is not adjustable; it is present via the fuel pump.



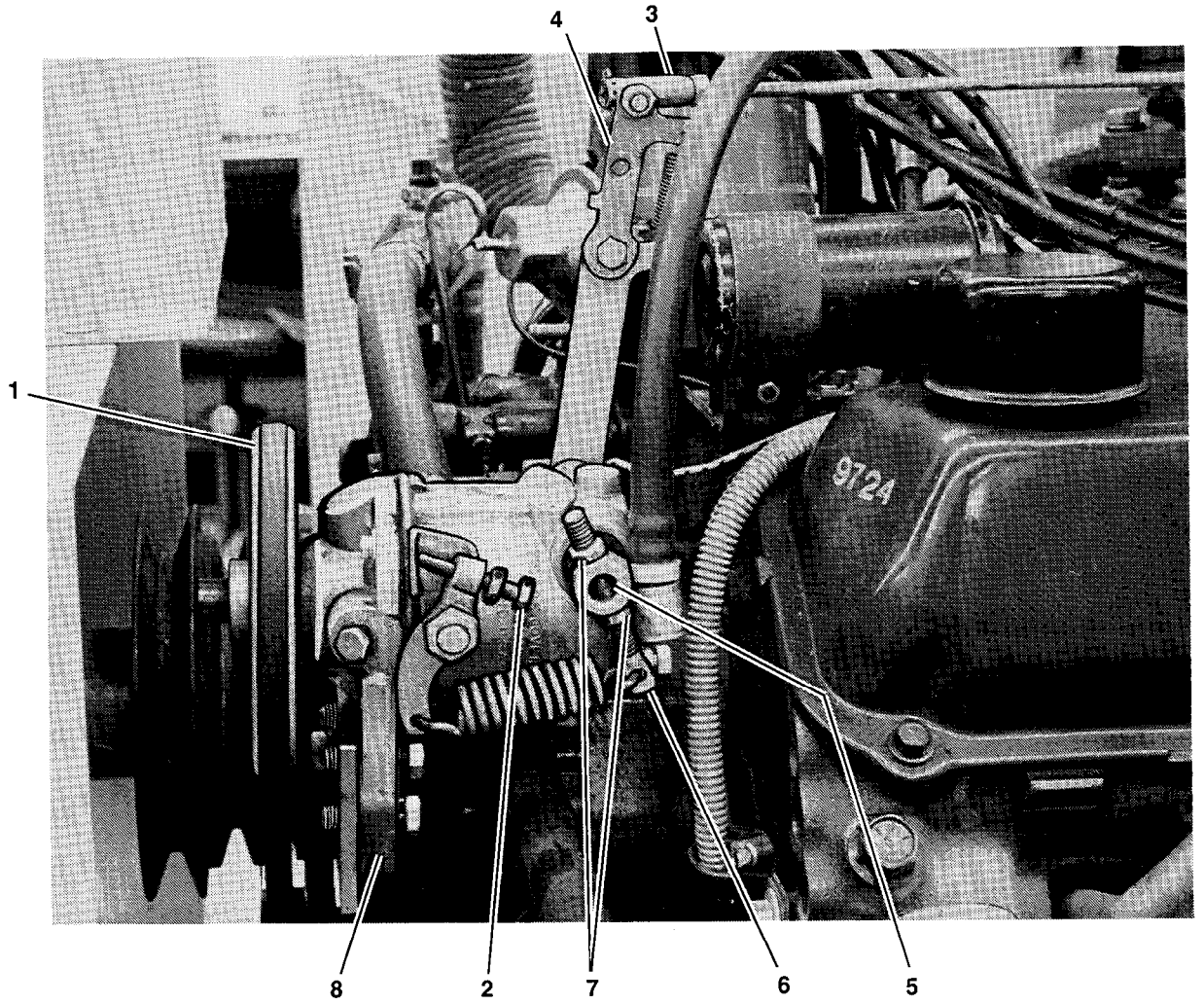
1. Adjustment Screw

Figure 7-1. Fuel Pump High Speed Screw (Cummins 4B and 6B Engines)



1. Adjustment Screw

Figure 7-2. Fuel Pump High Speed Screw (Cummins 6C Engine)



1. Governor Belt
2. Speed Adjustment
3. Throttle Linkage
4. Governor Arm
5. Pivot Point
6. Eyebolt Head
7. Sensitivity Adjustment
8. Governor Mounting

Figure 7-3. Governor Components and Adjustments

Mechanical Governor Adjustments — Gas/Gasoline

With the constant speed type governor, the throttle linkage is fixed at a definite length to establish a specific load speed of 1800 rpm (1500 rpm, 50 Hz models). No adjustment should be made to throttle linkage as any variation in speed causes frequency changes in output of the generator — for this reason only slight readjustment of speed is possible. If governor setting is too sensitive, hunting or speed surging will occur with changing load. If a considerable drop in speed is experienced when normal load is applied, the governor should be adjusted for greater sensitivity. If one of the governor settings is readjusted, the other should be readjusted since each has an effect on the other. The governor components and adjustments are shown in Figure 7-3. With the set running at full or rated load, make speed and sensitivity adjustments.

Governor Adjustment — cont'd.

Speed

Check speed with hand tachometer or frequency meter. Loosen locking nut on speed adjusting screw. Turn screw in clockwise direction to increase speed (and frequency) or in counterclockwise direction to decrease speed. Lock nut at new setting. Follow this adjustment with sensitivity (droop) adjustment.

Sensitivity

Test under normal load conditions. If readjustment is needed, proceed as follows. To make governor control more sensitive, loosen the nut at bottom of adjusting eyebolt and tighten the top nut thereby drawing the head of the eyebolt closer to the governor arm pivot point. To make governor control less sensitive, loosen the top nut and tighten the bottom nut to move the head of the eyebolt away from the pivot point. After sensitivity is correct, tighten the nut that was previously loosened to lock the eyebolt at the new setting. Recheck speed after sensitivity adjustment since changing this will also affect speed.

NOTE

A speed droop of 3 Hz or 90 rpm between no load and full load is normal.

United Technologies (Ambac/Bosch) Electric Governor Adjustments — Diesel and Gas/Gasoline

Some sets are equipped with United Technologies (Ambac/Bosch) Electric Governors. Since the governor is all electric, no mechanical drive or hydraulic connection is required. The system consists of a magnetic pickup to sense engine speed, an electronic control unit to control the current input to the throttle actuator, and an actuator to position the throttle. See Figures 7-4 through 7-6.

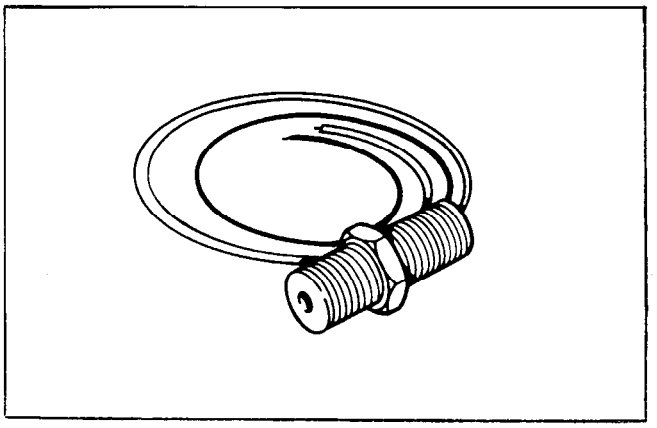


Figure 7-4. Magnetic Pickup

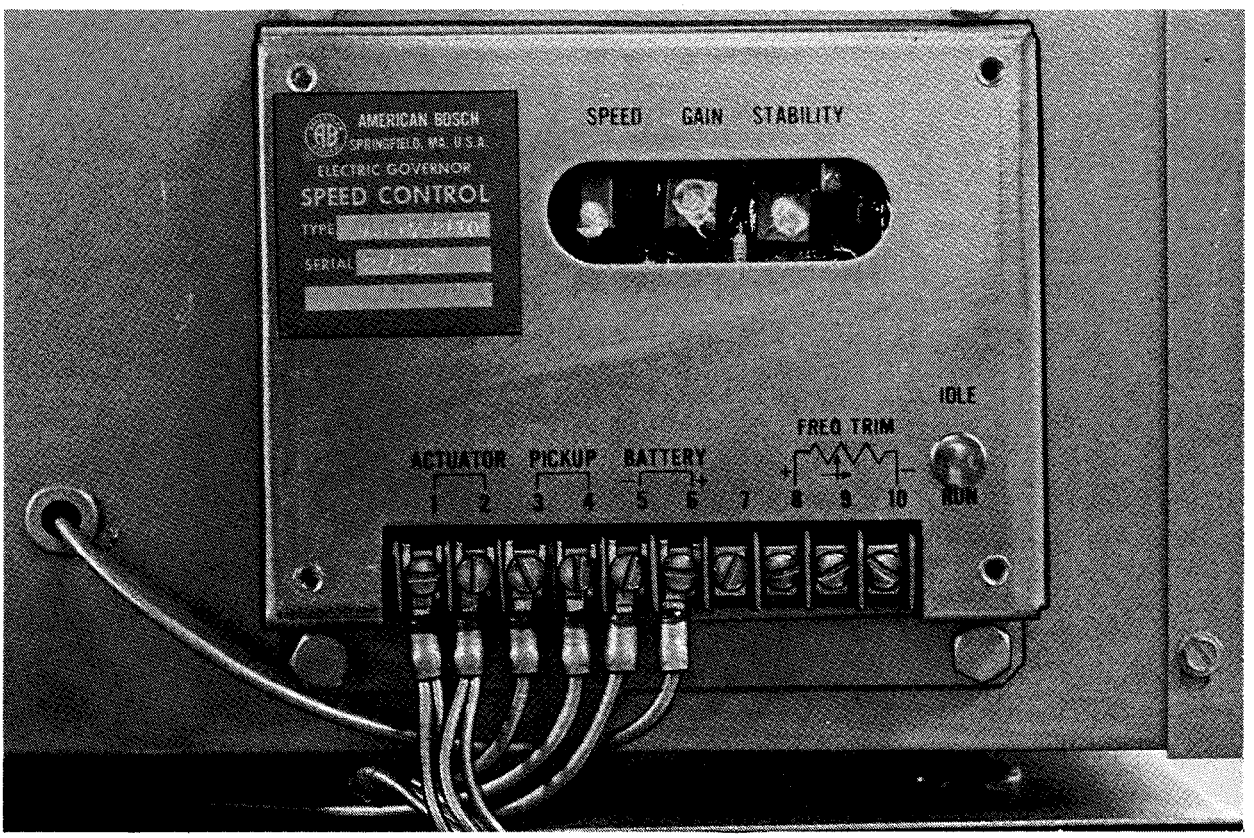


Figure 7-5. Control Unit

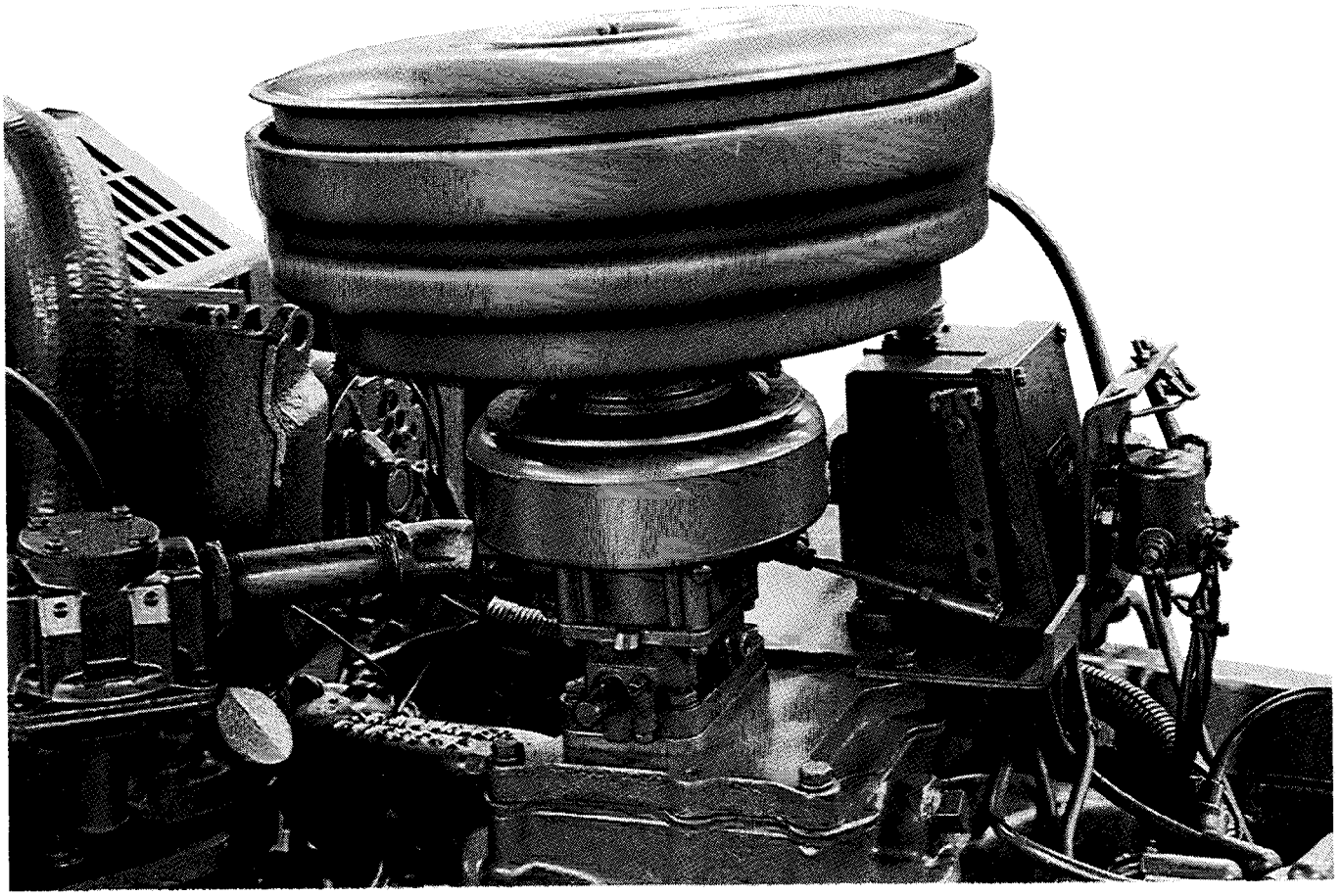


Figure 7-6. Throttle Actuator

Governor Control Unit Wiring Connections

Connect the wiring harness to the actuator. See Figure 7-7.

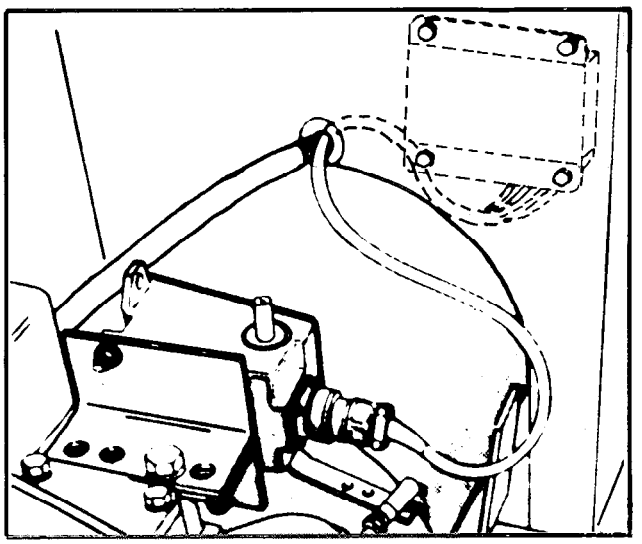


Figure 7-7. Wiring Harness Connection

Connect the wiring as illustrated in Figure 7-8.

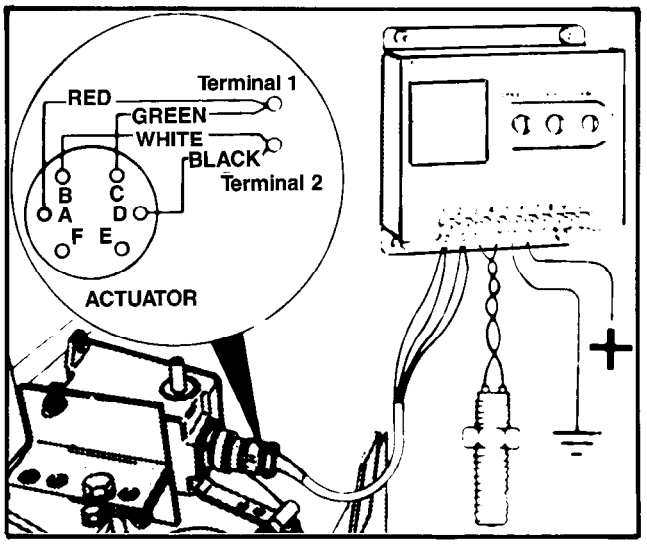


Figure 7-8. Control Unit Wiring

Actuator Linkage Adjustment

Position the fuel pump throttle lever in the full throttle position and the actuator in the idle position. Install the linkage and start the generator set. See Figure 7-9.

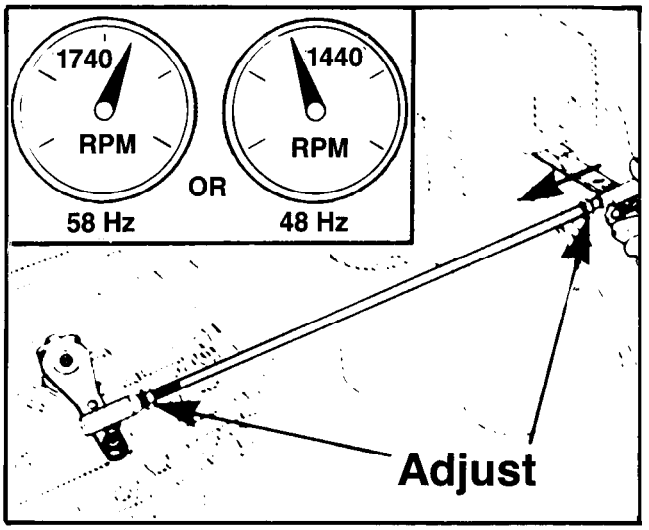


Figure 7-9. Linkage Adjustment

While holding the actuator arm in the idle position, adjust the linkage to obtain the following:

60 Hz Operation -
approximately 58 Hz, 1740 RPM

50 Hz Operation -
approximately 48 Hz, 1440 RPM

See Figure 7-10.

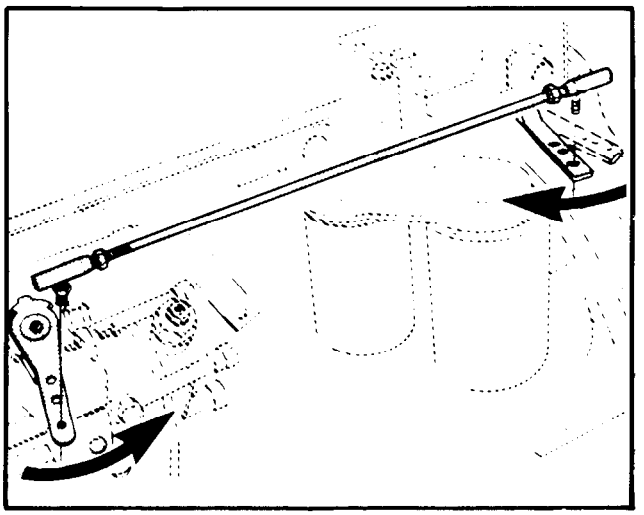


Figure 7-10. Linkage Adjustment - cont'd.

Adjust the high idle adjusting screw to allow for the excessive travel needed to maintain the maximum power required. See Figure 7-11.

A = (.025 inch) .635 mm

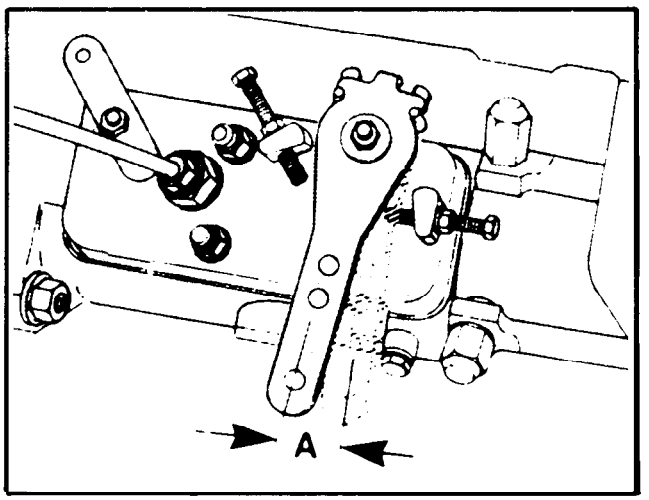


Figure 7-11. High Idle Adjustment Screw

Ensure all linkage and levers are securely tightened. See Figure 7-12.

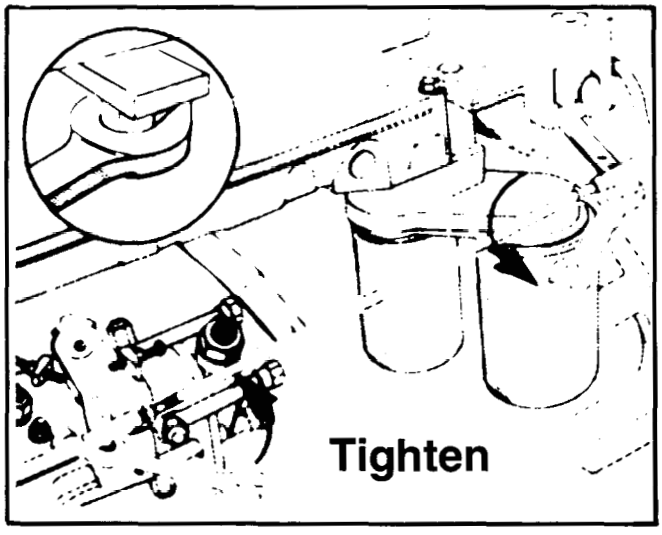


Figure 7-12. Tightening Linkage

Manually push the actuator to the full fuel position. See Figure 7-13. When released, it should return to the low idle position without binding or obstructions.

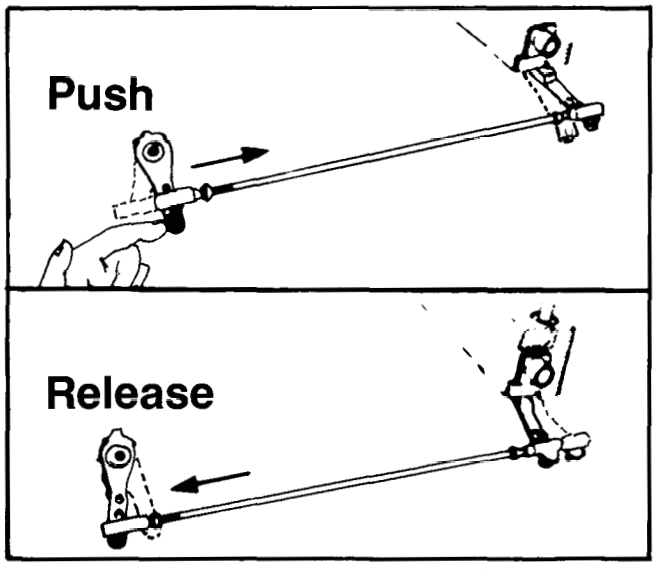


Figure 7-13. Actuator Position

Stability and Gain Adjustments

Set the STABILITY and GAIN controls to approximately midpoint. See Figure 7-14.

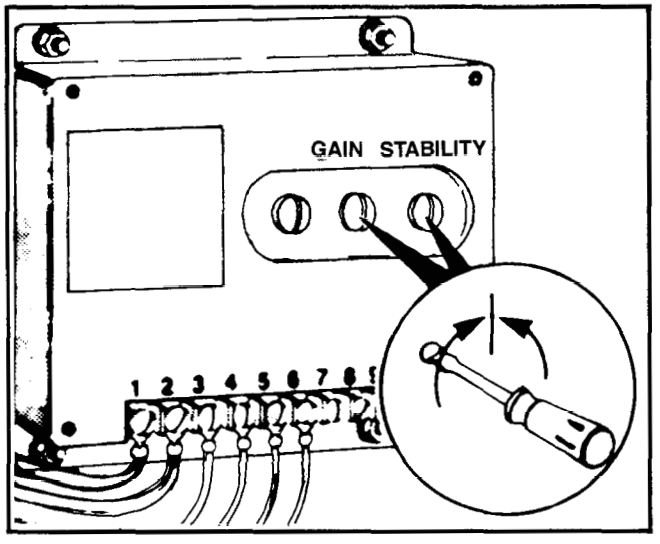


Figure 7-14. Control Unit Adjustment

Set the FREQUENCY TRIM CONTROL (if used) to approximately midpoint. See Figure 7-15.

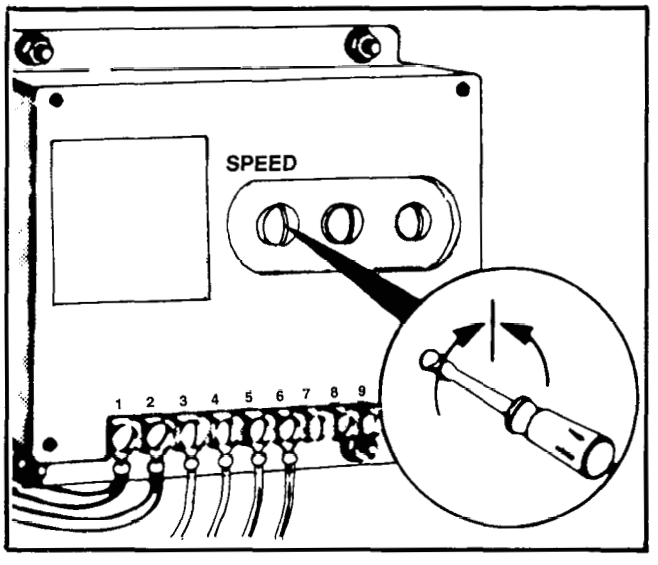


Figure 7-15. Control Unit Adjustment - cont'd.

Connect a frequency meter to controller terminals V0 and V7. See Figure 7-16. Additional views of controller terminals V0 and V7 are contained in Section 3, Controller Troubleshooting.

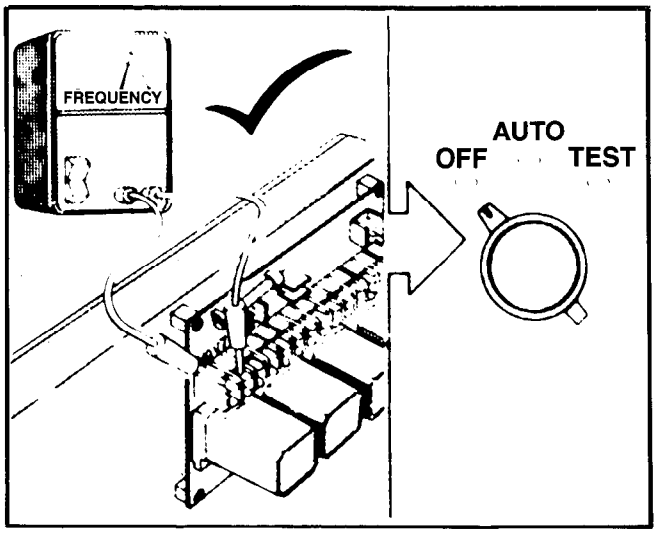


Figure 7-16. Frequency Meter Connection

Frequency Adjustment (Speed)

Start the generator set. Adjust to the desired frequency (50 or 60 Hz) by adjusting the SPEED potentiometer (pot). Rotate pot. clockwise to increase. See Figure 7-17.

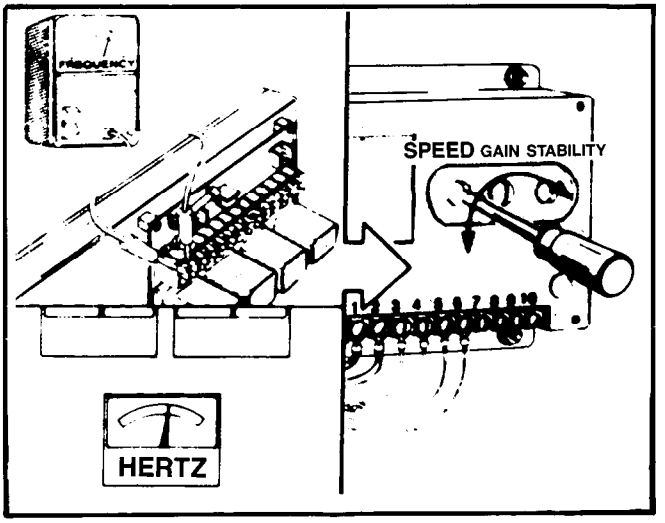


Figure 7-17. Frequency Adjustment

Performance Adjustments

Once the desired frequency is obtained (50 or 60 Hz), the two performance adjustments, GAIN and STABILITY, can be made as follows.

At no load, slowly rotate the GAIN adjustment on the SPEED CONTROL unit clockwise until the engine surges. IF SURGING DOES NOT OCCUR WITH THE GAIN ADJUSTMENT IN THE FULLY CLOCKWISE DIRECTION, MOVE THE FUEL LEVER TO INDUCE SURGING. Rotate the screw counterclockwise 30 degrees to regain stability. See Figure 7-18.

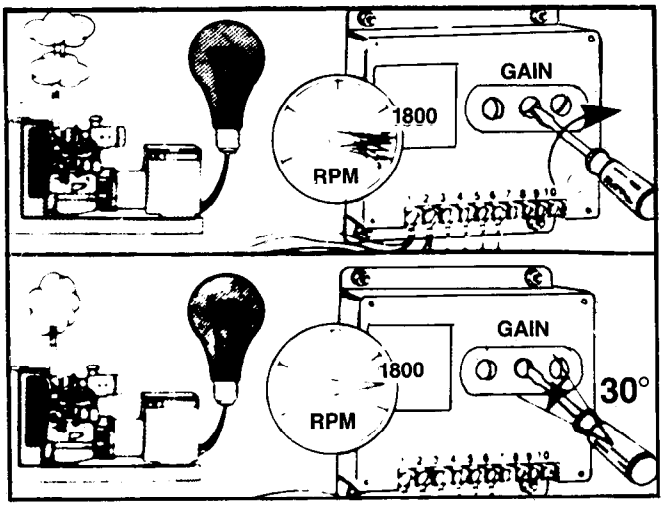


Figure 7-18. Performance Adjustments

Slowly rotate the STABILITY adjustment clockwise until surging returns. See Figure 7-19. Rotate the screw counterclockwise 30 degrees to regain stability.

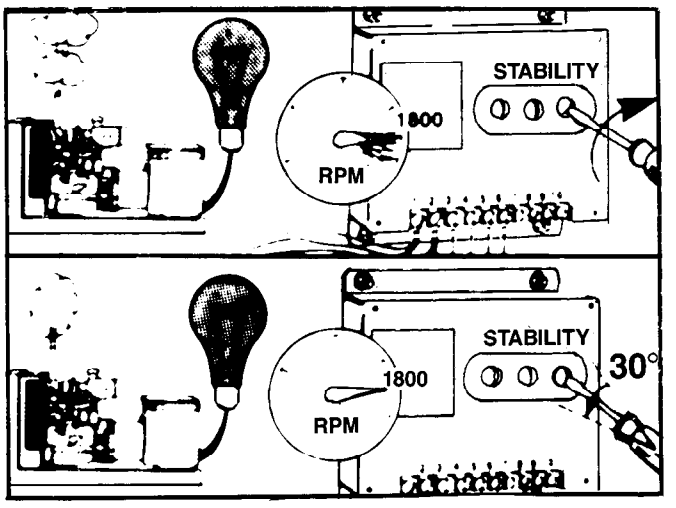


Figure 7-19. Performance Adjustments - cont'd.

Load may now be applied to the generator set. If necessary, repeat the first two steps until optimum performance is obtained. Normally, the critical condition for GAIN and STABILITY adjustment is at **no** load. See Figure 7-20.

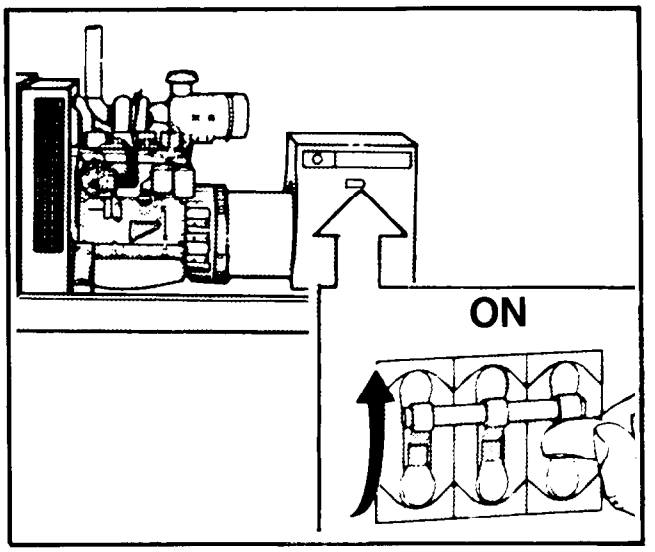


Figure 7-20. Applying Load to Generator

The optimum adjustment of both controls is in the maximum clockwise position where the best response and stability are obtained under all operating conditions. Backing off slightly from this position will allow for changing conditions that may affect the dynamic response of the engine. If a load bank and recorder are available, use them to make and verify performance. See Figure 7-21. If a stable system cannot be obtained, refer to the Troubleshooting Procedures in the Engine Service Manual.

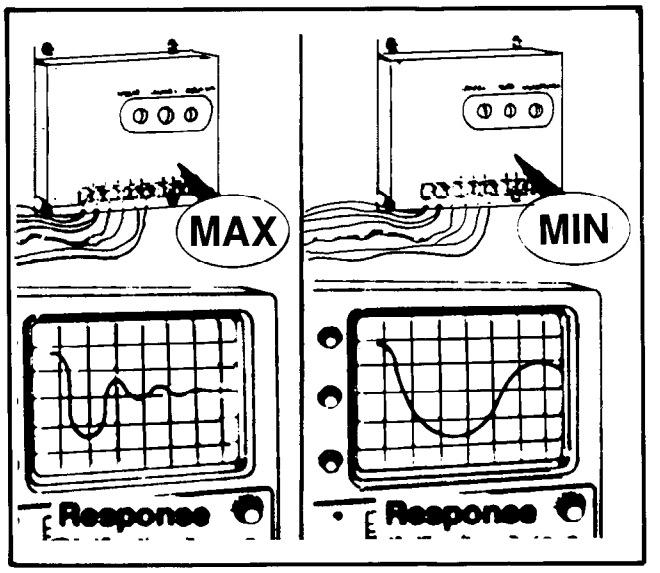


Figure 7-21. Final Adjustments

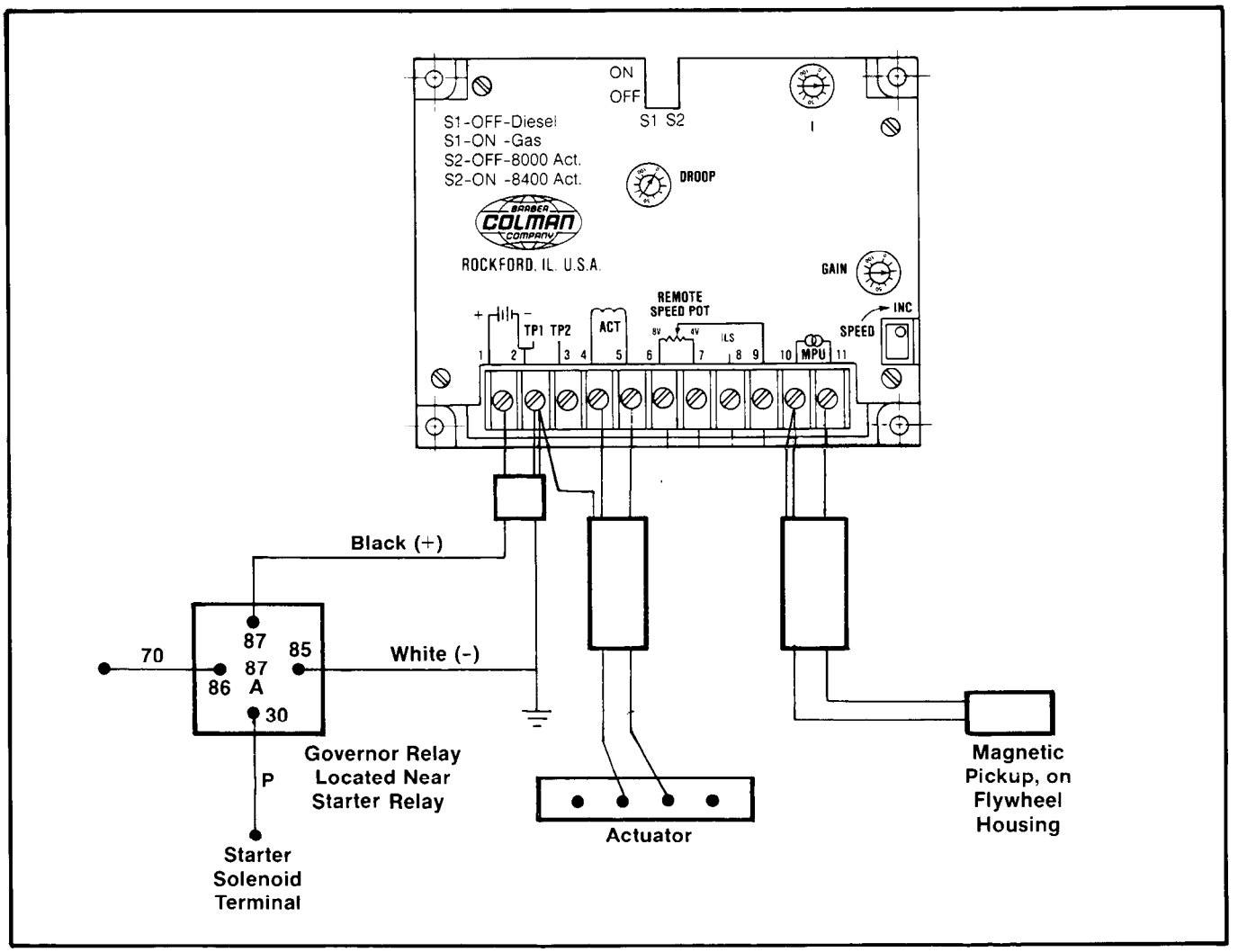


Figure 7-22. Control Unit Adjustments

1. Droop Pot.
2. 1 Pot.
3. Gain Pot.
4. Speed Pot.

Barber-Colman Electronic Governor Adjustments

Some sets are equipped with Barber-Colman Electronic Governors. Since this is an electronic device, no mechanical drive or hydraulic connection is required. The system consists of a magnetic pickup, an electronic control unit, and an actuator. The magnetic pickup monitors engine speed and transmits this information to the electronic control unit (Figure 7-22). The electronic control unit interprets the signal from the magnetic pickup to control current input to the throttle actuator. The throttle actuator adjusts the throttle position on the engine (Figure 7-23).

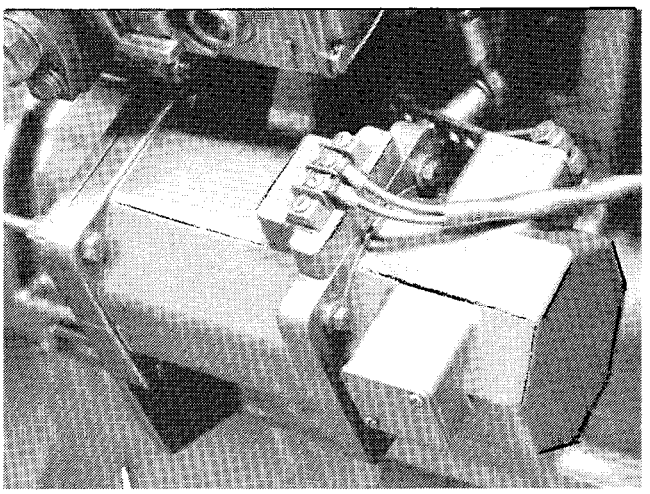


Figure 7-23. Throttle Actuator

Governor Adjustment — cont'd.

Later model Barber-Colman control units are equipped with switches S1 and S2. Prior to making governor adjustments, verify that S1 and S2 are in the proper position for your application. Switch S1 selects the controller response range based upon engine type. S1 should be in the OFF position for diesel powered generators. Set S1 to the ON position for gas/gasoline applications. Switch S2 matches the control unit to the governor actuator. In all cases, switch S2 must be in the OFF position. (Kohler FRII generators use the DYNA 8000 actuator.)

Preliminary Adjustments

1. Turn Generator Master Switch to OFF. Generator must not be operating.
2. Set the Control Unit I adjustment one division from zero and the Gain adjustment at the third division from zero.
3. For isochronous operation, set the droop adjustment counterclockwise to minimum position. For droop operation, set droop pot. to desired droop. Droop adjustment may be necessary with parallel generator operation.
4. Position actuator lever to hold fuel pump lever in STOP position when power is OFF. The actuator linkage must be adjusted for smooth, non-binding operation.

Final Adjustments

1. Move Controller Master Switch to RUN or TEST to start generator set.
2. Adjust the control unit speed pot. until the engine is operating at the desired rpm (50 or 60 Hz on frequency meter).
3. If governing is unstable, turn I and Gain pots. slightly counterclockwise.

NOTE

Except for the Speed pot., control unit pots. have internal stops at 0 and 100% positions.

4. Slowly turn the Gain adjustment pot. clockwise until the actuator lever wavers. (The actuator lever will waver faster than when the I pot. was adjusted.) Slowly turn Gain adjustment pot. counterclockwise until the actuator lever is stable.
5. Jog the actuator lever by hand. If the actuator lever wavers three to five times and then stabilizes, the Gain setting is correct. If the Gain setting is still incorrect, proceed to step 6.
6. Turn the Gain pot. one division counterclockwise. Turn I pot. fully clockwise and watch the actuator lever. If the actuator lever does not become unstable, jog it by hand.
7. When the actuator lever wavers, slowly turn the I pot. counterclockwise until the lever is stable.
8. Jog the actuator lever by hand. It should waver three to five times before stabilizing. The governor is now properly adjusted.

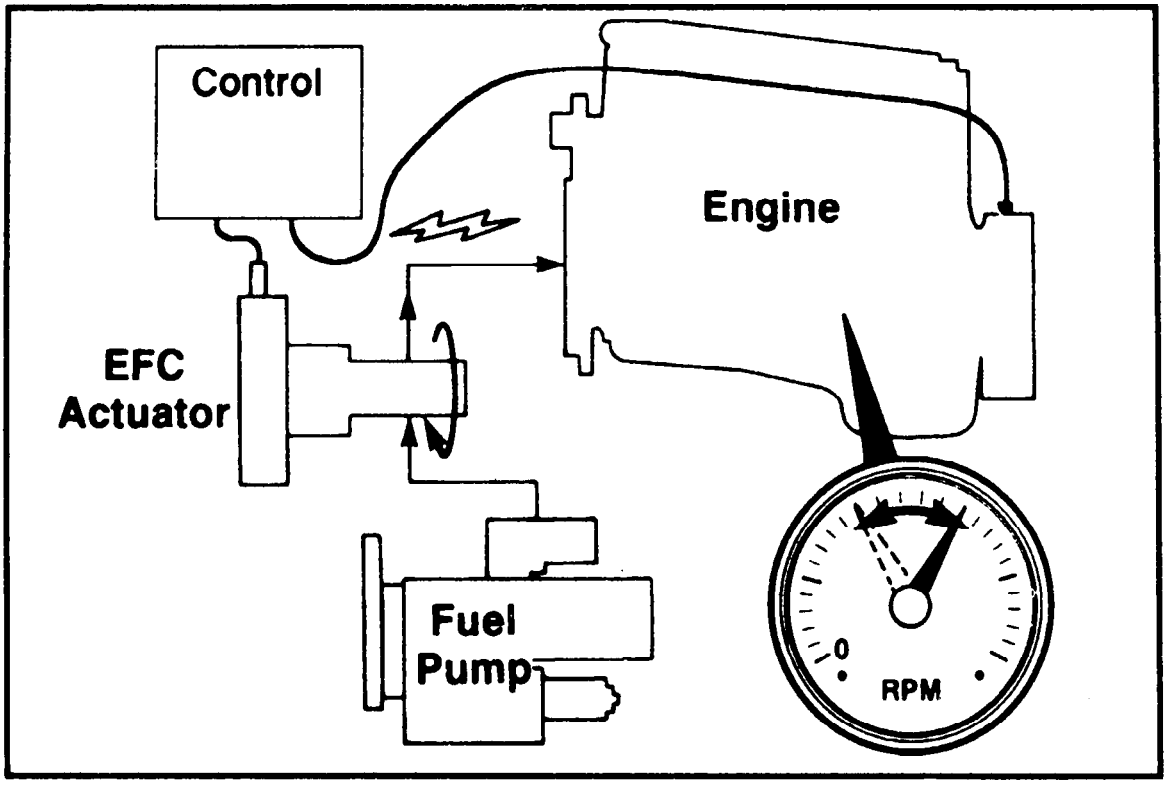


Figure 7-24. Electronic Governor Operation

Cummins EFC Electronic Governor Adjustments

Some sets are equipped with EFC Electronic Governors. Since this is an electronic device, no mechanical drive or hydraulic connection is required. The system consists of a magnetic pickup, an electronic control unit, and an actuator. The magnetic pickup monitors engine speed and transmits this information to the electronic control unit (Figure 7-24).

The electronic control unit interprets the signal from the magnetic pickup to control current input to the actuator. The actuator adjusts the throttle position on the engine. A change in current to the actuator makes the actuator shaft rotate which, in turn, regulates fuel flow and engine speed. All governor adjustments are made on the electronic control unit.

Preliminary Adjustments

Use preliminary adjustments to return control unit pots. to standard starting positions for final adjustments. Normally, preliminary adjustments are not necessary except when the control unit has been replaced. Reference Figure 7-25 for location of control unit adjustment pots.

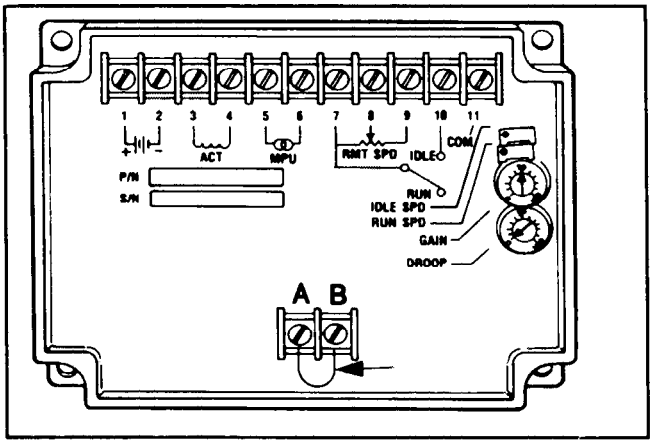


Figure 7-25. Electronic Governor Control Unit.

Idle Speed

1. Turn idle speed pot. counterclockwise to end (0-20 turns).
2. Turn idle speed pot. clockwise 10 turns. Idle speed pot. is now at mid-position.

Run Speed

1. Turn run speed pot. counterclockwise to end (0-20 turns).
2. Turn run speed pot. clockwise 10 times. Run speed pot. is now at mid-position.

Gain and Droop Controls

1. Turn gain pot. to mid-position (50) on scale.
2. Turn droop pot. fully counterclockwise for isochronous operation.

Final Adjustments

Governed Speed Adjustment

1. Disconnect generator set from load by tripping line circuit breakers or turning loads off. Start the generator set (see Section 2, "Local Starting").
2. Adjust control unit idle speed pot. until the engine is running at 600 to 650 rpm.
3. Generators which are to operate at 60 Hz full load must be adjusted to 60 Hz (1800 rpm) for isochronous operation. Adjust run speed pot. until no load speed is correct (60 Hz). Generators which are to operate at 50 Hz full load must be adjusted to 50 Hz (1500 rpm) for isochronous operation. Turn run speed pot. clockwise (faster) or counterclockwise (slower) to regular engine run speed. Reference controller frequency meter when making adjustments.
4. Close main line circuit breaker.

Droop Adjustment

The control unit droop adjustment pot. regulates generator frequency droop caused by increased load. For isochronous operation, the droop pot. must be turned fully counterclockwise. No further adjustment is necessary.

Parallel generator systems may require additional droop pot. adjustment (other than fully counterclockwise). Use the following formula to determine governor droop.

$$\frac{\text{High Idle Speed - Rated Speed}}{\text{Rated Speed}} \times 100\% = \text{Governor Droop}$$

Examples:

$$\frac{1890-1800}{1800} \times 100 = 5\% \text{ Droop}$$

$$\frac{1800-1800}{1800} \times 100 = 0\% \text{ (Isochronous)}$$

Droop Operation

Close the main line circuit breaker and apply the rated KW load. See Figure 7-26.

Check the frequency meter to make sure the full load governed speed is correctly set at 60 Hz or 50 Hz.

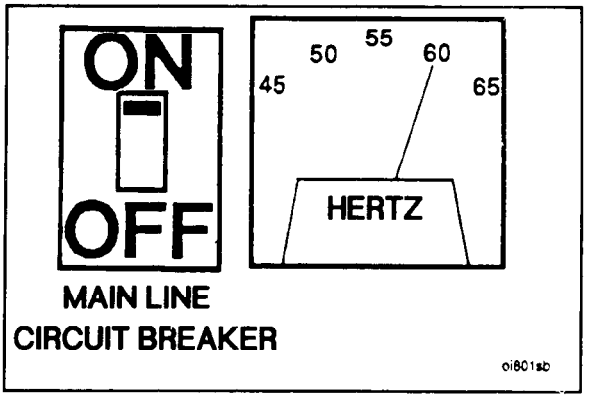


Figure 7-26. Circuit Breaker Position

1. If the frequency meter is less than 60 Hz or 50 Hz, more droop is present than desired.
2. Turn the droop potentiometer counterclockwise slowly until it is 60 Hz or 50 Hz. (Figure 7-27).

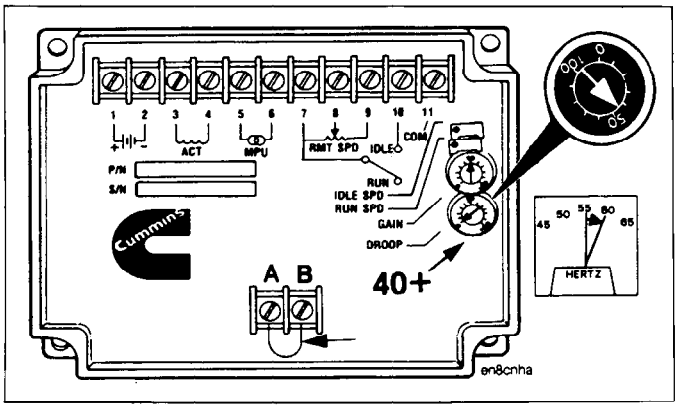


Figure 7-27. Droop Pot.

3. Open the main line circuit breaker and adjust the no load governed speed again to the correct setting. See Figure 7-28.

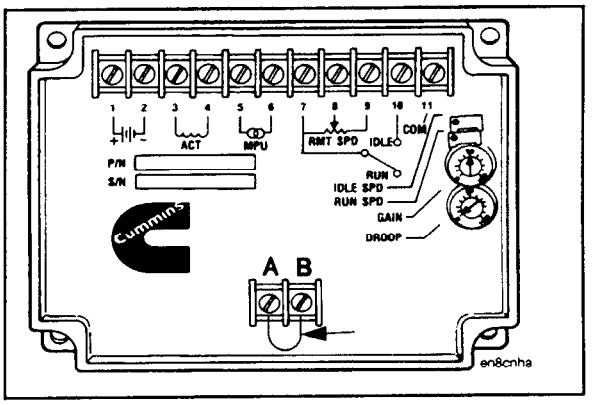


Figure 7-28. No Load Speed Adjust

4. Close the main line circuit breaker and apply the load. The frequency meter must read 60 Hz or 50 Hz.
5. If the frequency meter is not 60 Hz or 50 Hz, repeat the procedure. It will usually take two or three successive adjustments to obtain the correct frequency.
6. To calculate the operating (governed) speed under the available load for droop operation, when the full KW load is not available, use this formula.

$$S_{al} = S_{nl} - \left[\left(\frac{\text{Available KW Load}}{\text{Rated KW}}\right) \times \left(S_{nl} - S_{fl}\right)\right]$$

Where
S_{al} = Speed at Available KW Load
S_{fl} = Speed at Full KW Load
S_{nl} = Speed at No Load

Example
Available KW Load = 400
Rated KW = 500
Speed at Full KW Load = 1800
Speed at No Load = 1854

$$S_{al} = 1854 - \left[\left(\frac{400}{500}\right) \times (1854 - 1800)\right]$$

S_{al} = 1811 RPM

NOTE: The engine speed in RPM is equal to 30 times the frequency (Hz). At 60.0 Hz, the engine speed = 30 x 60 = 1800 RPM.

Gain Adjustment

The control unit gain adjustment pot. regulates the response time of governor to load changes.

1. Close main line circuit breaker and apply approximately 25% of the rated load.
2. If the engine speed is constant, turn gain pot. clockwise until engine speed is not constant.
3. Slowly turn gain pot. counterclockwise until a constant speed is attained.
4. Turn gain pot. counterclockwise an additional 1/2 division on scale.

NOTE

If the engine is not stable after the gain adjustment is made, install a jumper wire between control unit terminals A and B. See Figure 7-4.

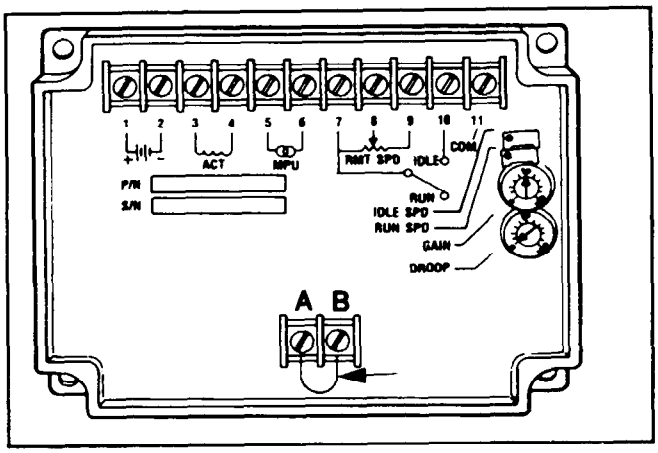


Figure 7-29. Electronic Governor Control Unit.

Section 8.
Accessories

Except for the safeguard breaker kit and the line circuit breaker kit, the following accessories are designed for installation on units with Dec-3 Microcomputer Controllers. Refer to the accessory connection diagram in Section 9 to aid in installation.

Remote Annunciator Kit (Decision Monitor)

A remote annunciator allows convenient monitoring of the sets condition from a location remote from the generator. Decision Monitors include alarm horn, alarm silence switch, lamp test and the same lamp indicators as the Dec-3 microcomputer controller, plus the following:

- **Line Power** — lamp lights when commercial utility power is in use.
- **Generator Power** — lamp lights when generator power is in use.

Audio-Visual (AV) Alarm Kit

An AV alarm warns the operator of fault shutdowns and pre-alarm conditions (except battery charger fault and low battery voltage) from a location remote from the generator. AV alarms include alarm horn, alarm silence switch and common fault lamp. See Figure 8-1.

NOTE

Any combination of remote annunciators and/or AV alarms totaling three may be connected to the generator controller.

Safeguard Breaker Kit

The safeguard breaker senses output current on each generator phase and will shut off the AC voltage regulator in the event of a sustained overload or short circuit. It is not a line circuit breaker and will NOT disconnect the generator from the load. See Figure 8-2.

⚠WARNING

HIGH VOLTAGE! Disconnect set form load by opening line circuit breaker, or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. The GENERATOR SAFEGUARD BREAKER MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER! If high voltage is transferred to load during test, personal injury and equipment damage may result.

Figure 8-1. Audio-Visual Alarm

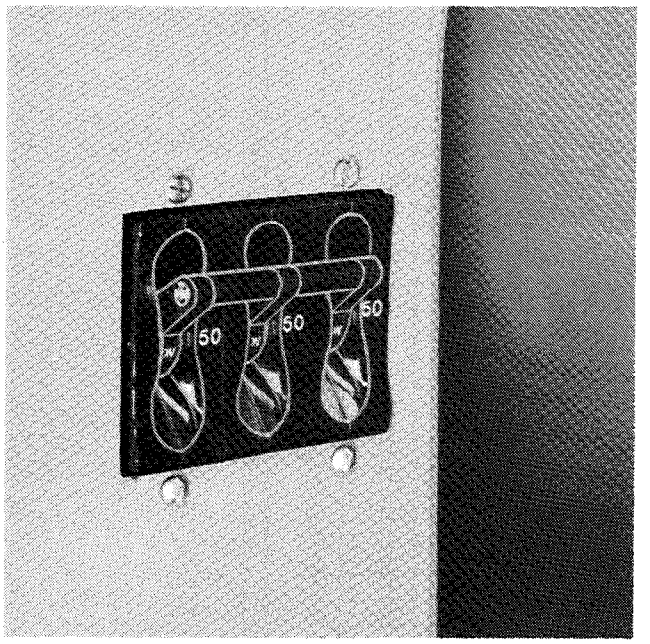


Figure 8-2. Safeguard Breaker

Line Circuit Breaker Kit

The line circuit breaker interrupts generator output in the event of an overload or short circuit. It should be opened manually to disconnect the generator from the load when servicing the generator set. See Figure 8-3.

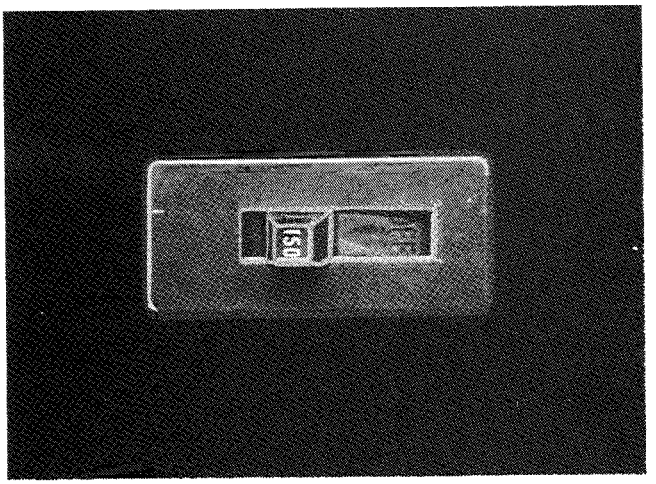


Figure 8-3. Line Circuit Breaker

Emergency Stop Kit

The emergency stop kit allows immediate shutdown of the set from a station remote from the generator (Figure 8-4). If the emergency stop switch is activated, the emergency stop lamp lights and the unit shuts down. The generator cannot be restarted until the emergency stop switch is reset (by replacing glass face) and the controller is reset by placing Generator Master Switch in the OFF/RESET position.

A remote emergency stop switch may be connected to the controller via terminals TB1 and 1A. The K4 relay (included with kit) must also be installed on the controller circuit board. When the emergency stop switch is activated contacts in the switch open to deenergize the K4 relay and shut down the generator.

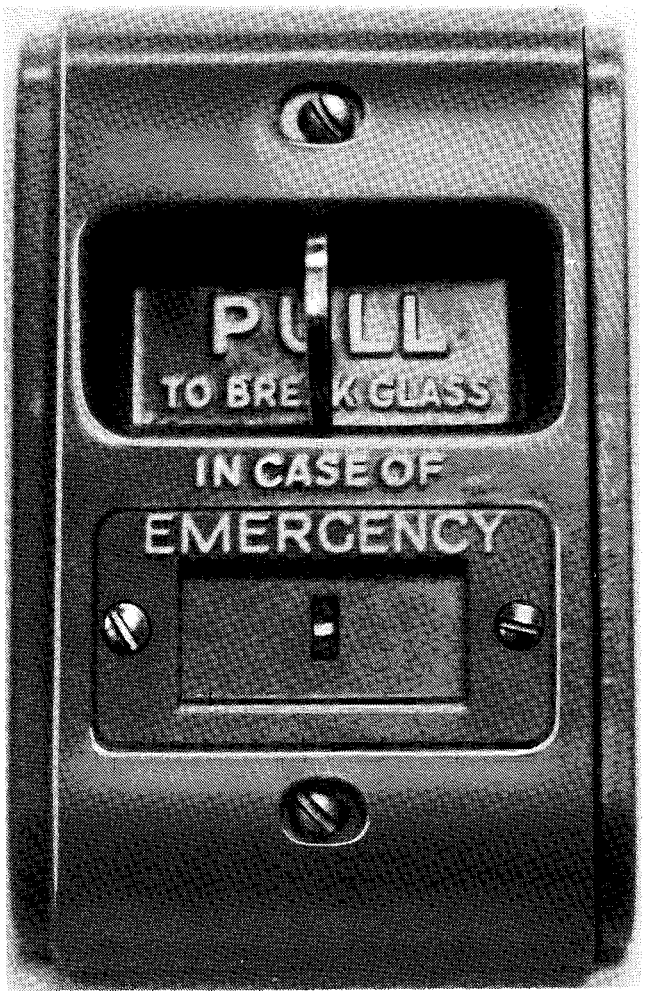
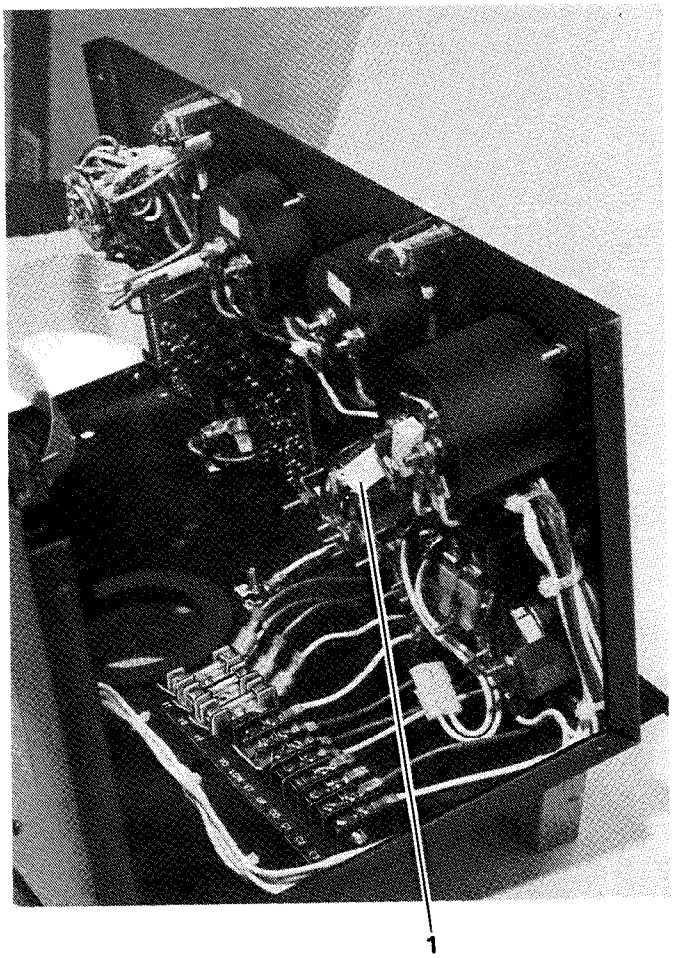


Figure 8-4. Emergency Stop Kit

Overvoltage Kit

The overvoltage circuit will cause immediate engine shutdown when it is triggered by a DC signal from an overvoltage shut-down option. The genset will automatically shut down if output voltage is 15 % above nominal voltage longer than one second. The overvoltage option connects to wire 30 in the controller. See Figure 8-5.



1. Overvoltage Option Connection

Figure 8-5. Overvoltage Connection

Isolated Alarm Contact Kit (12 and 24 Volts)

Function

The isolated alarm contact kit allows monitoring of the standby system and/or the ability to activate accessories from a location remote from the generator. Warning devices (lamps, audible alarms) and/or accessories are typically connected to the set's overspeed, overcrank, high engine temperature, low oil pressure and low water temperature functions.

Mounting

The Kohler isolated alarm contact kit can be mounted in any location, including on the generator set. If desired, more than one isolated alarm contact kit can be connected to the controller terminal strip. The contact kit can be used as an alternate or in conjunction with the Decision Monitor annunciator panel.

A total of three isolated alarm contact kits may be connected to the Dec-3 Microcomputer Controller.

Relay Contact Rating

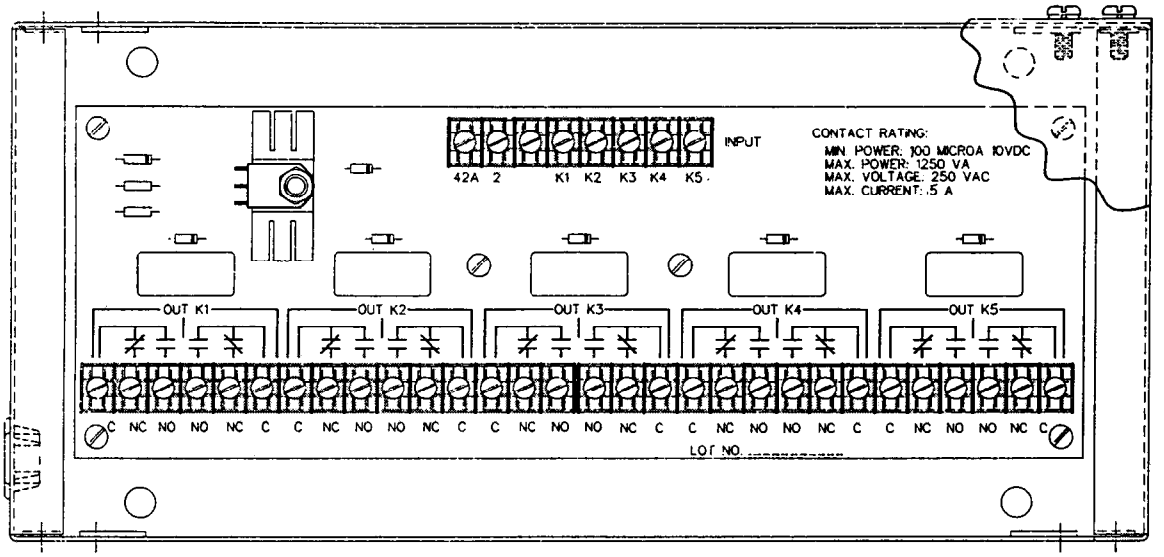
Maximum Switching Power ..... 1250 VA
Maximum Switching Voltage ..... 250 Volts AC
Maximum Switching Current ..... 5 Amps.
Minimum Switching Power ..... 100 Microamps.
10 Volts DC

⚠ WARNING

UNIT STARTS WITHOUT NOTICE! Units with Automatic Transfer Switches start automatically. Potential injury or electrocution can result. Turn Generator Master Switch on controller to OFF position and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to the generator.

Connection Requirements

Terminals 2 and 42A from annunciator terminal strip (TB1) in controller must be connected to provide an electrical source. The customer then has the choice of up to five functions (K1-5) to activate the appropriate accessories. See Figure 8-6 and the wiring diagram for standard connections and identification of alarm functions and terminal numbers.



Isolated Alarm Contact Kit
13 in. (L) x 5.9 in. (W) x 1.95 in. (H)
(33.02 cm x 14.98 cm x 4.95 cm)

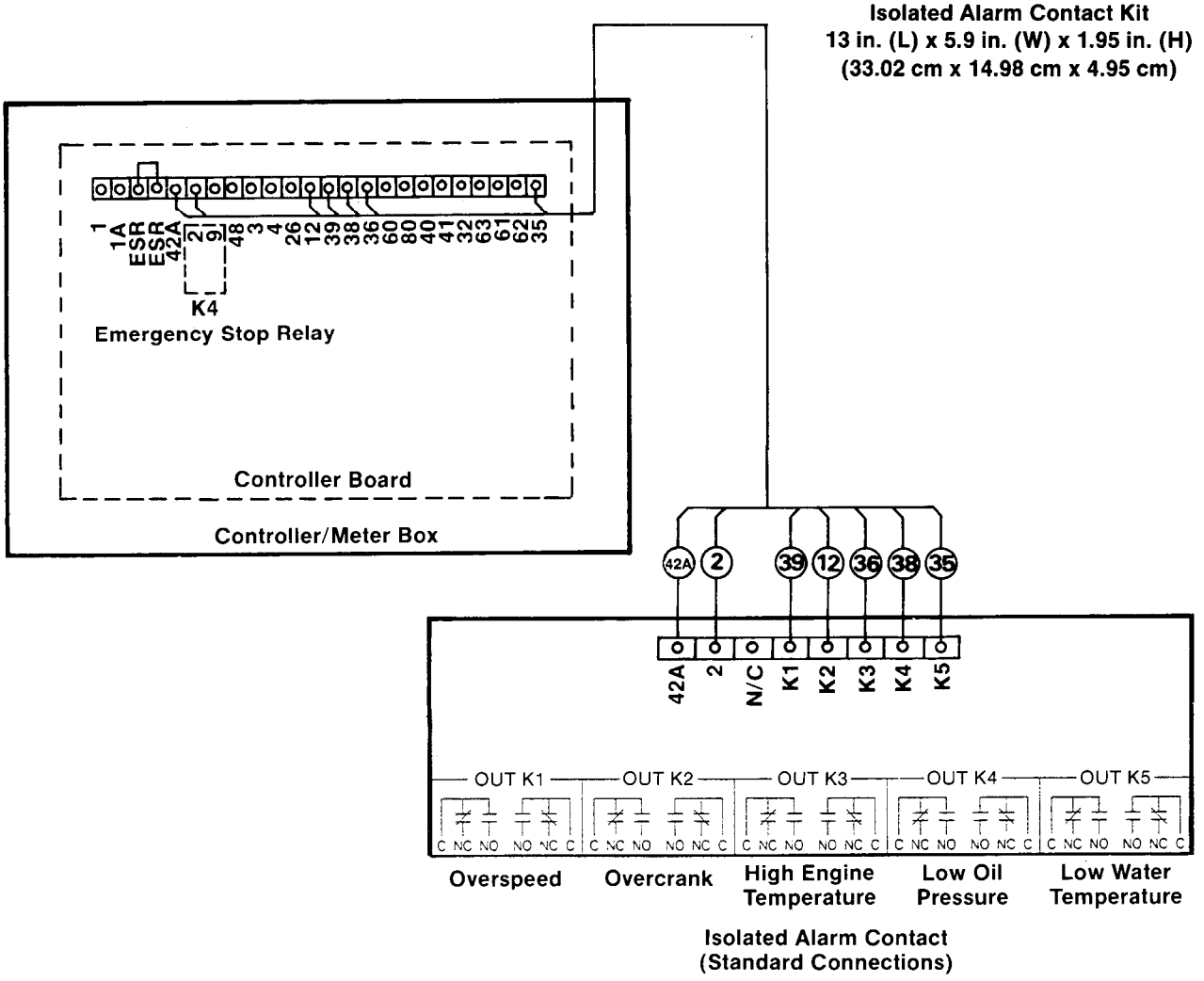


Figure 8-6. Isolated Alarm Contact Kit

Accessory Connection

The Dec-3 controller circuit board is equipped with a terminal strip for easy connection of generator set accessories. Alarms, battery chargers, remote switches, and other accessories can be direct-connected to the controller circuit board using 18 or 20 gauge stranded wire. With the controller circuit board panel lying flat, route accessory leads through the controller port and guide loops to the circuit board terminal strip. See Figure 8-7. The controller circuit board panel must be lying flat to ensure adequate slack in accessory leads. For specific information on accessory connections, refer to the accessory wiring diagram (Section 9) and the instruction sheet accompanying each kit.

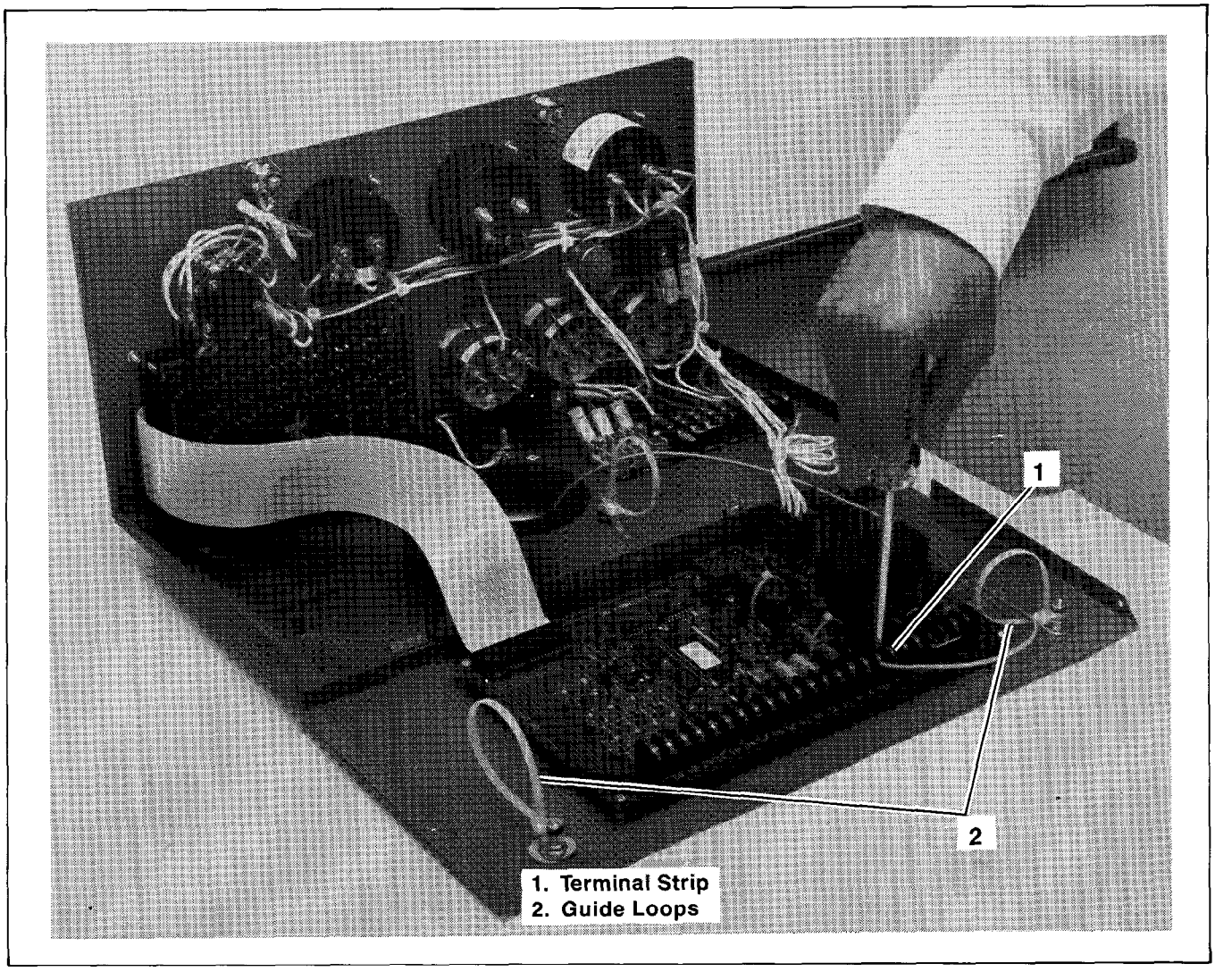


Figure 8-7. Connecting Accessory Leads

Section 9.
Wiring Diagrams

* Includes Overspeed Relay Controller Wiring Diagram
** Includes Dec-3 Microcomputer Controller Wiring Diagram

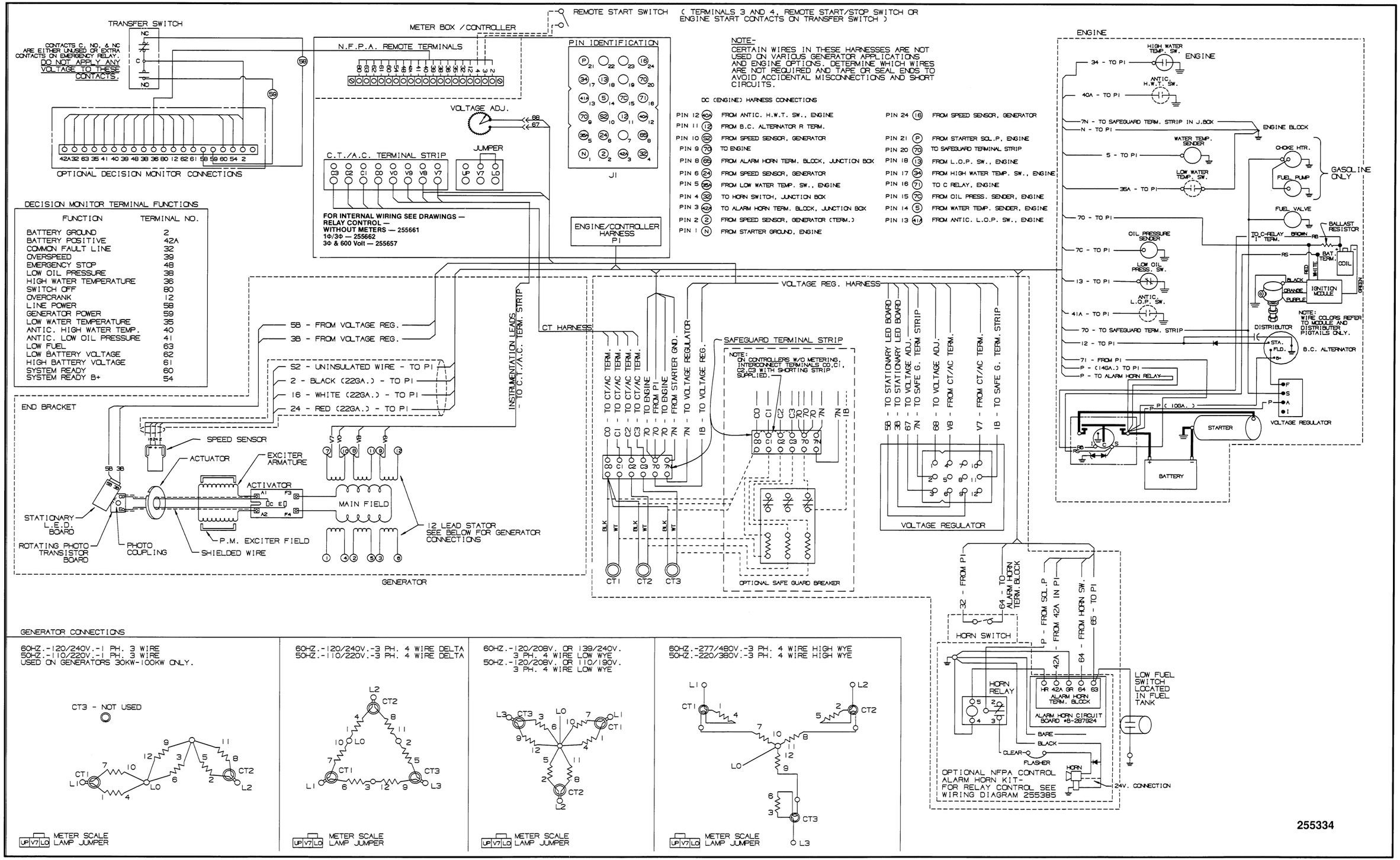


Figure 9-1. Ford LSG-423 Gas/Gasoline, 1-Phase/3-Phase (Standard FR Activator)

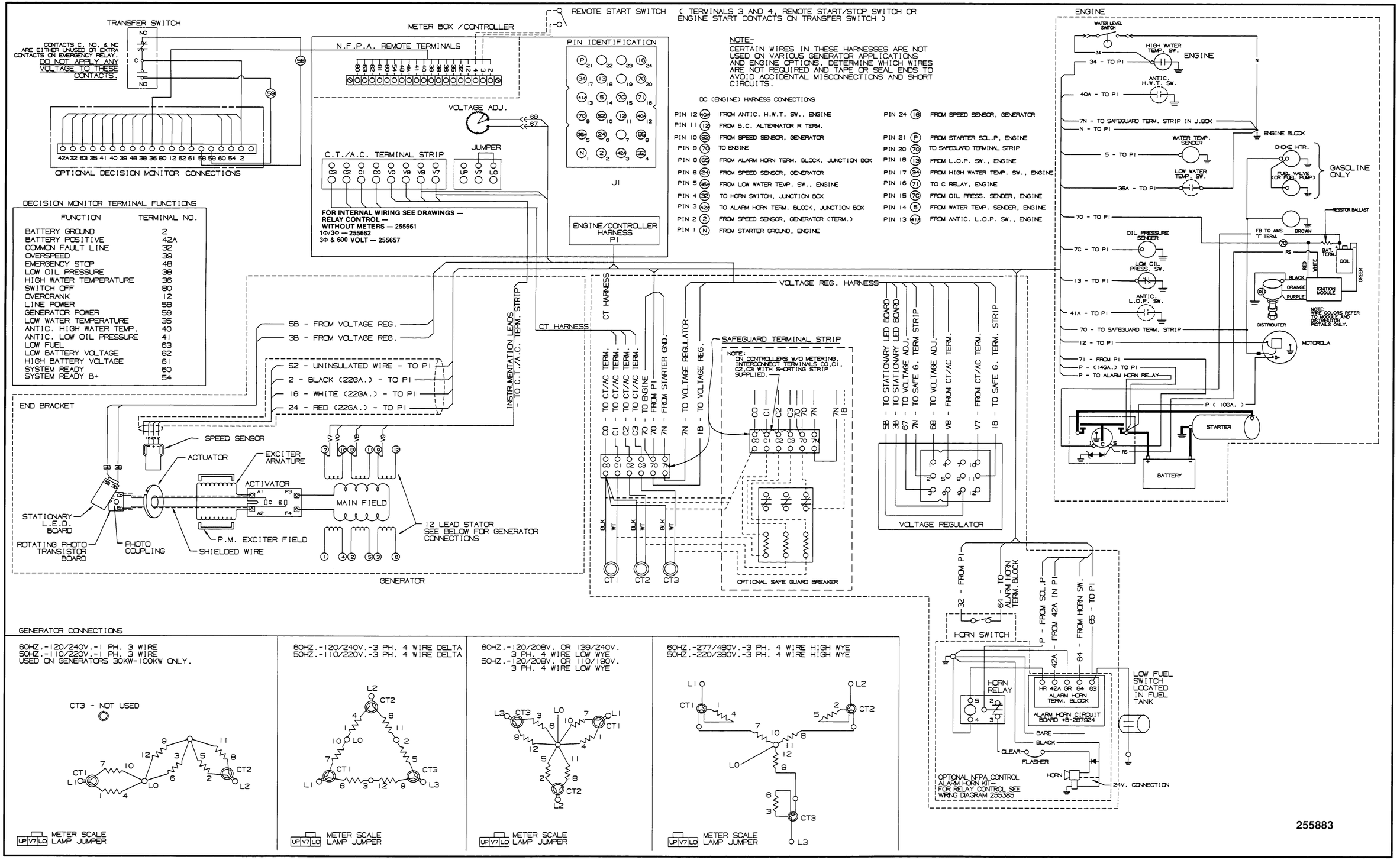


Figure 9-2. Ford CSG-649 Gas/Gasoline, 1-Phase/3-Phase (Standard FR Activator)

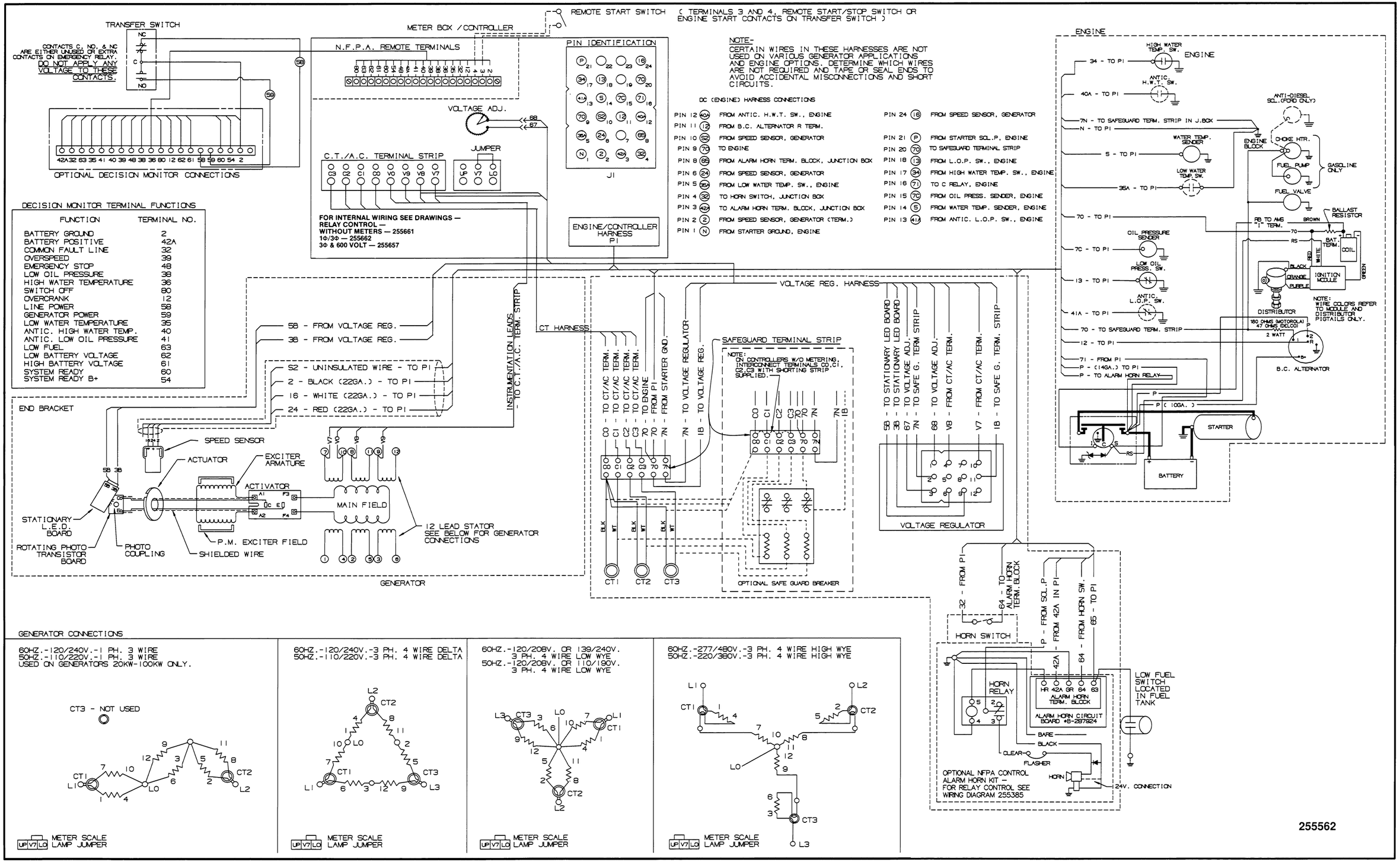


Figure 9–3. Ford LSG–875 Gas/Gasoline, 1–Phase/3–Phase (Standard FR Activator)

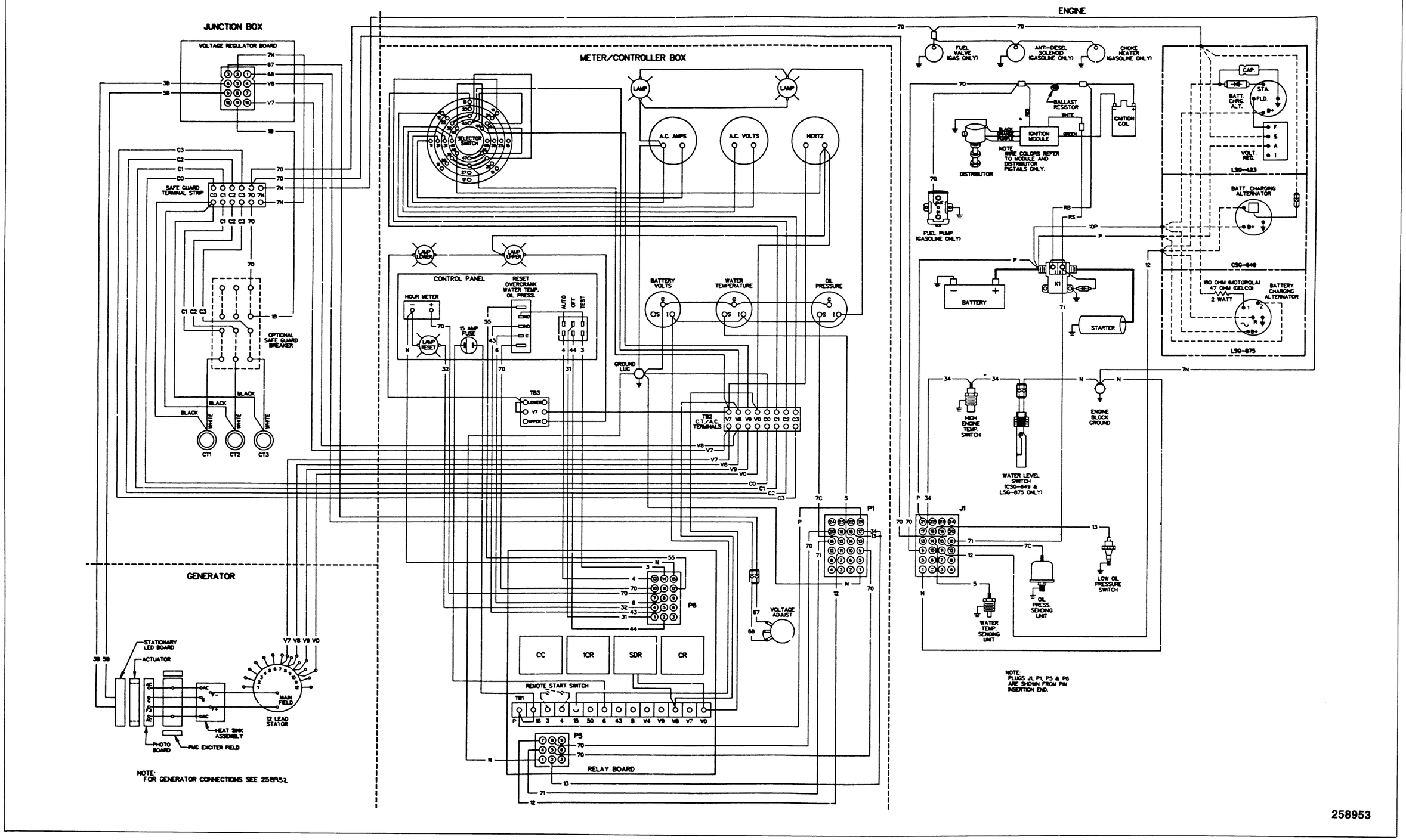


Figure 9-4. Ford Engines, Gas/Gasoline, 1-Phase/3-Phase (Split FR Activator)

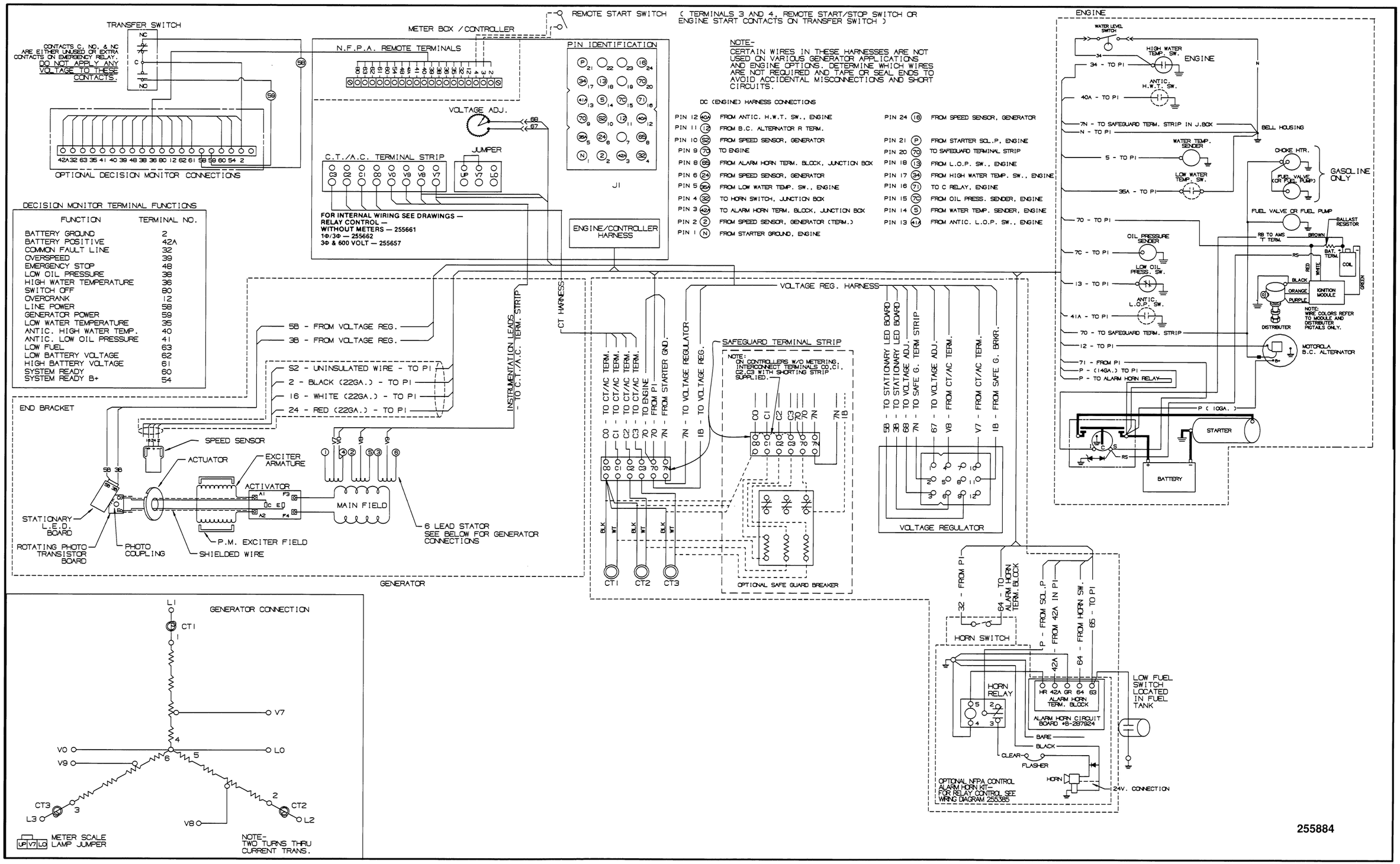


Figure 9–5. Ford CSG–649 Gas/Gasoline, 600–Volt (Standard FR Activator)

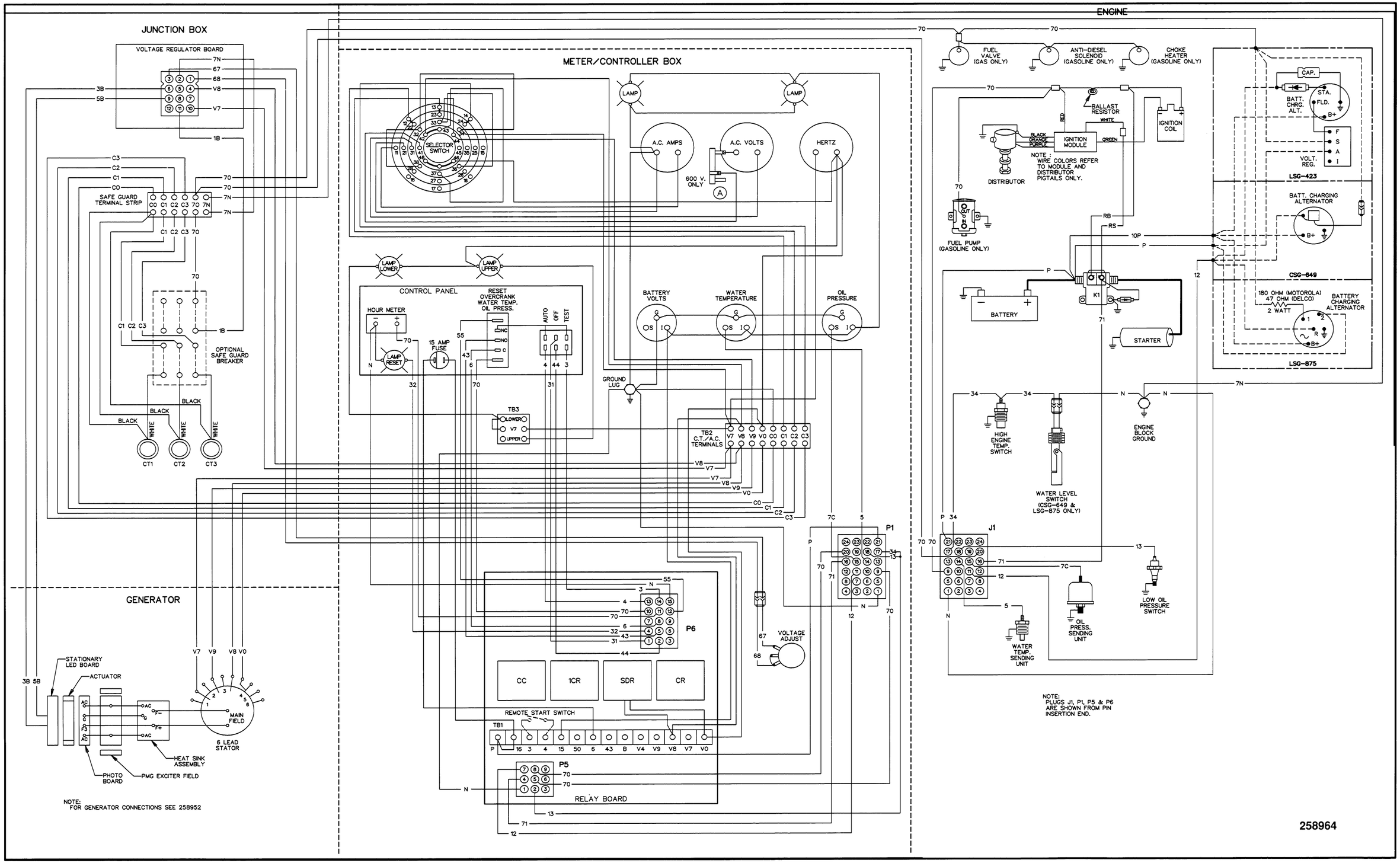


Figure 9-6. Ford Engines, Gas/Gasoline, 600-Volt (Split FR Activator)

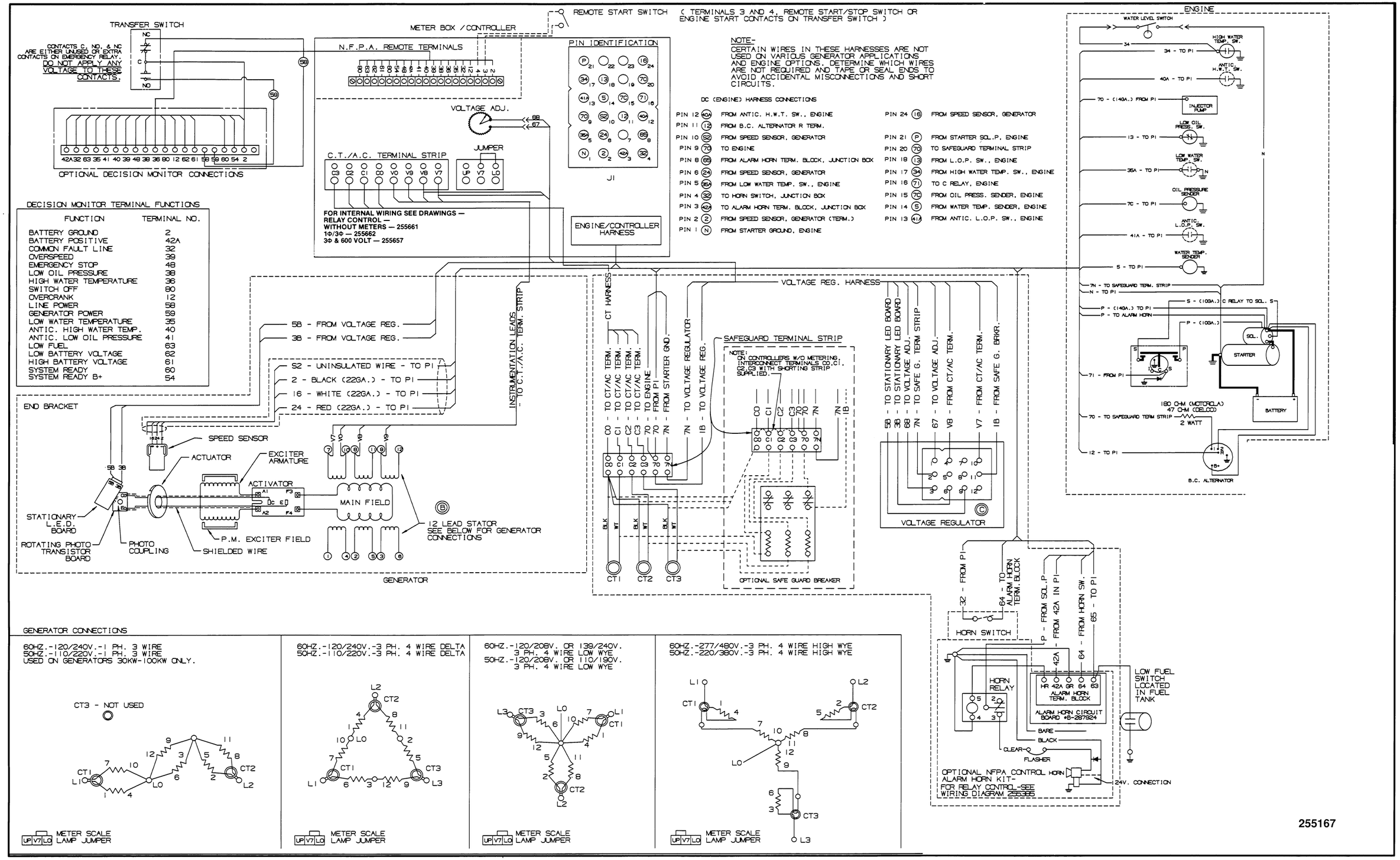


Figure 9–7. Cummins Engines, Diesel, 1–Phase/3–Phase (Standard FR Activator)

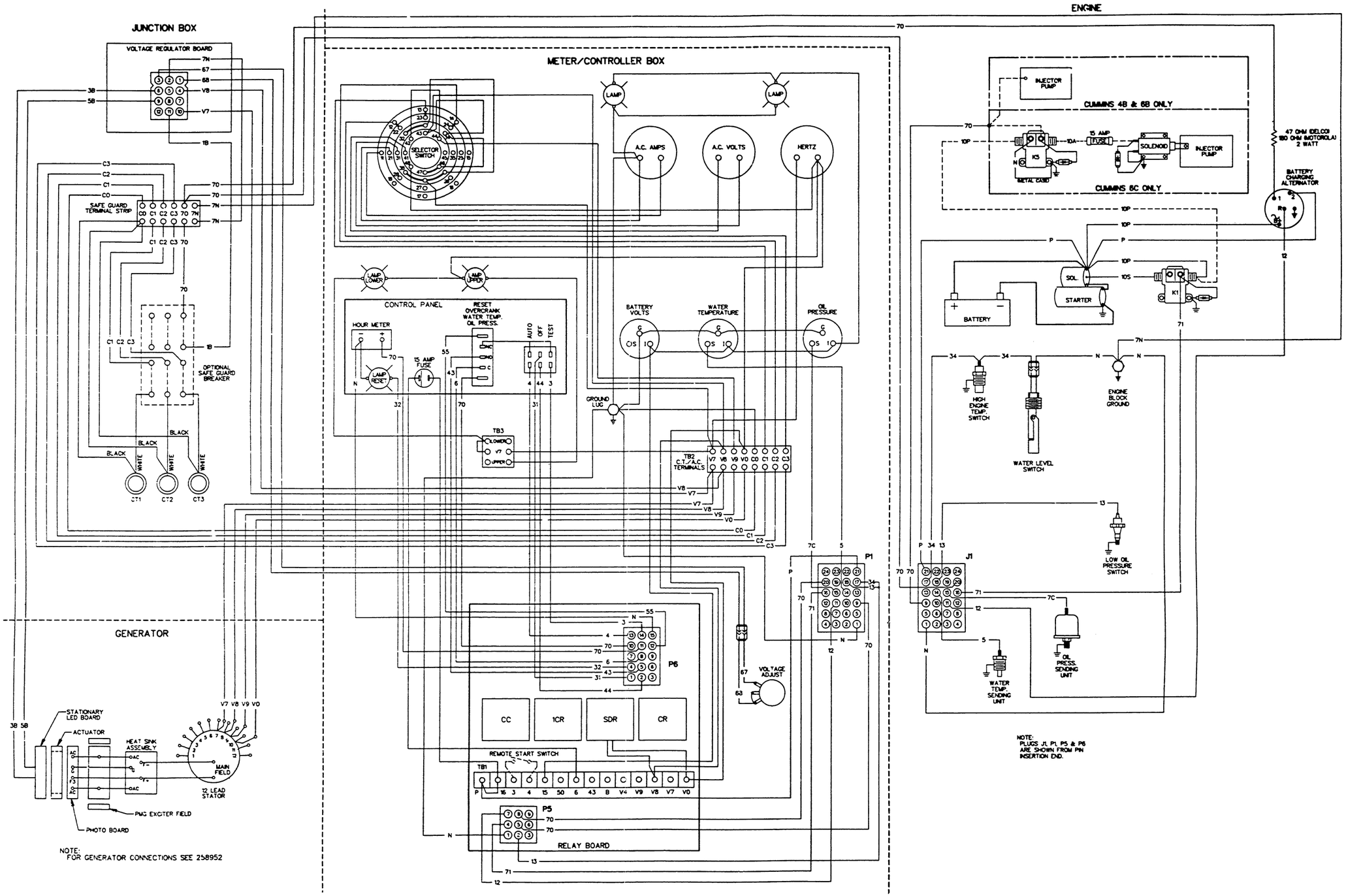


Figure 9-8. Cummins Engines, Diesel, 1-Phase/3-Phase (Split FR Activator)

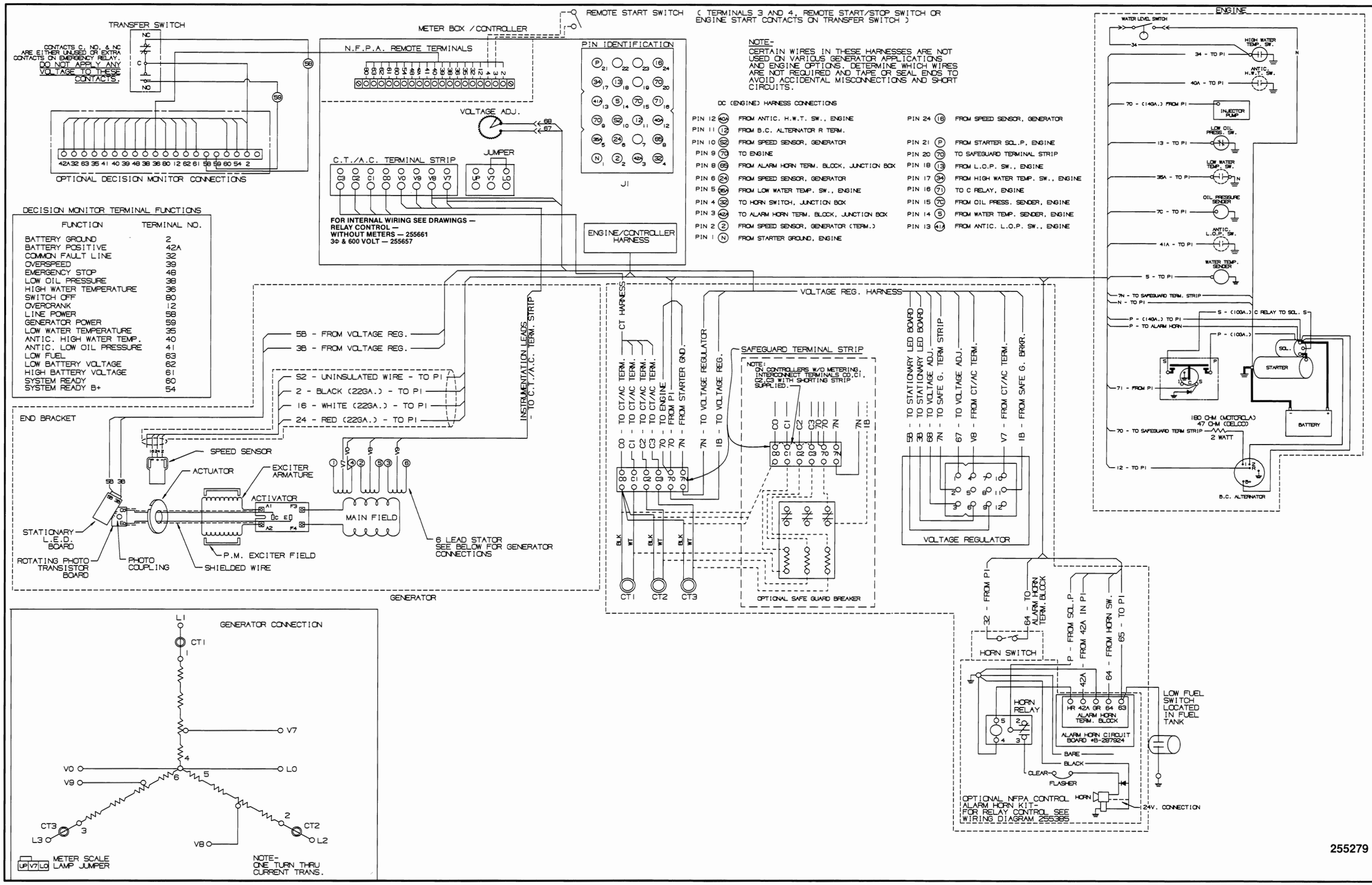


Figure 9–9. Cummins Engines, Diesel, 600–Volt (Standard FR Activator)

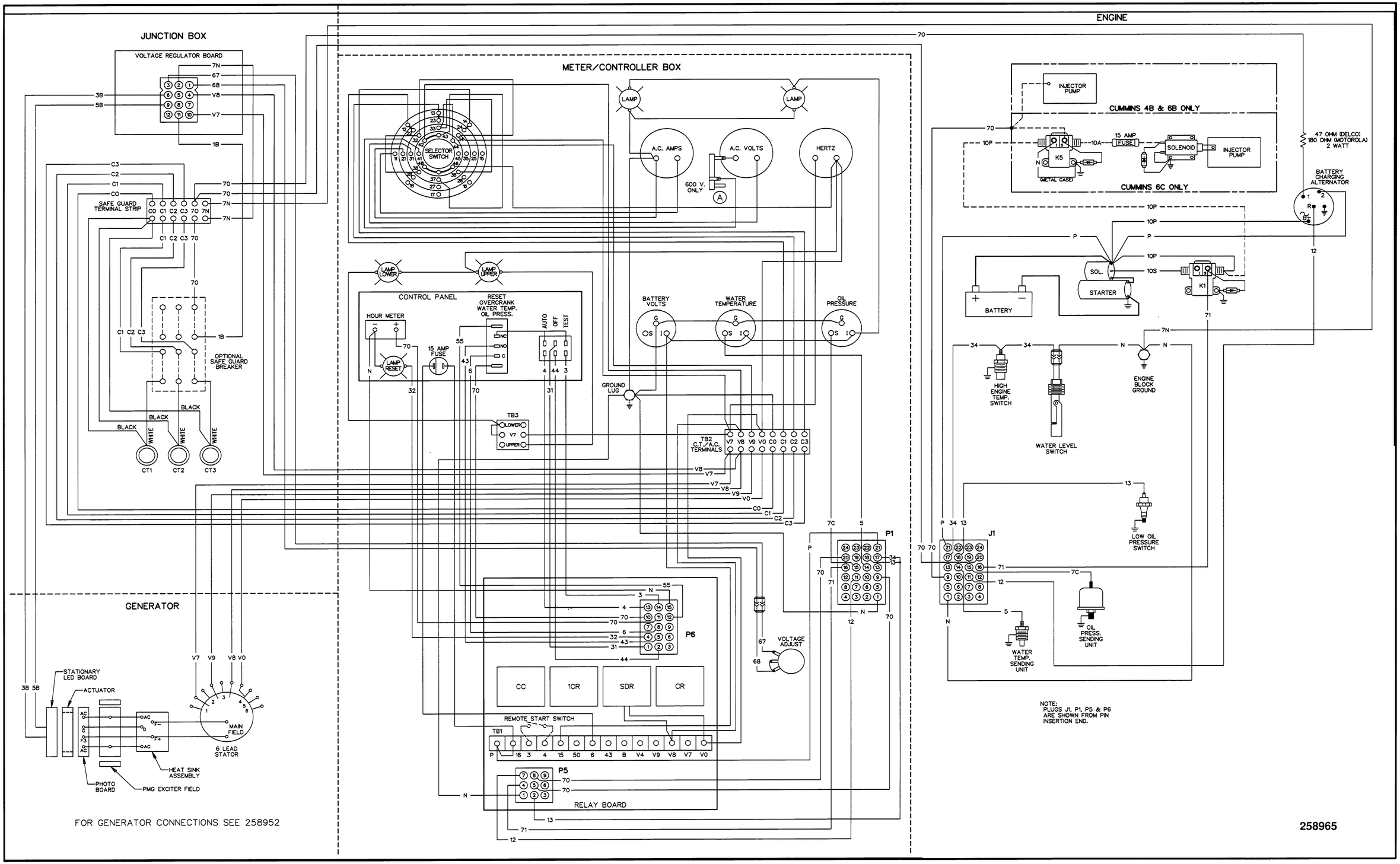
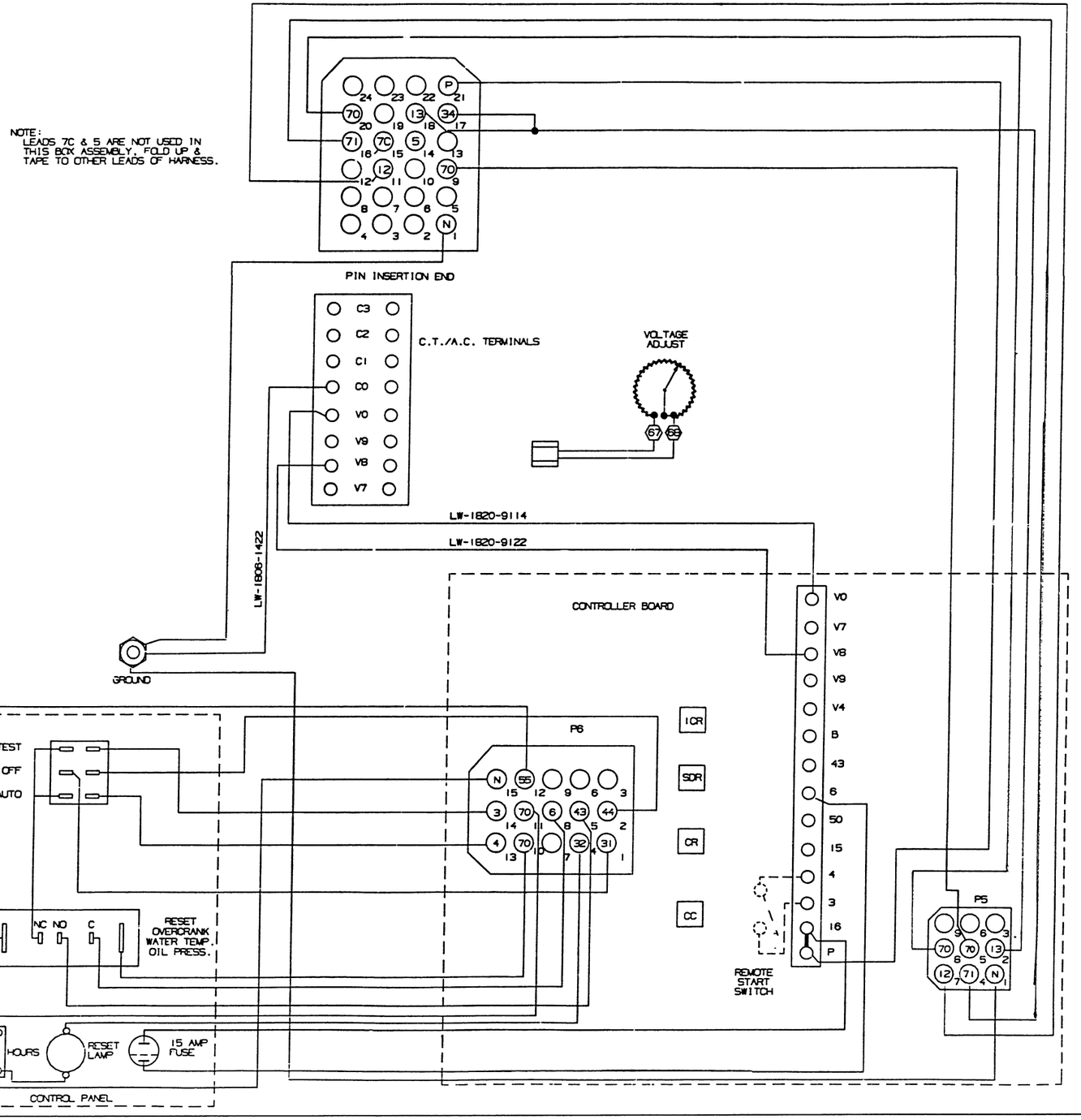


Figure 9–10. Cummins Engines, Diesel, 600–Volt (Split FR Activator)



255661

Figure 9-11. Relay Controller without Meters, 1-Phase/3-Phase

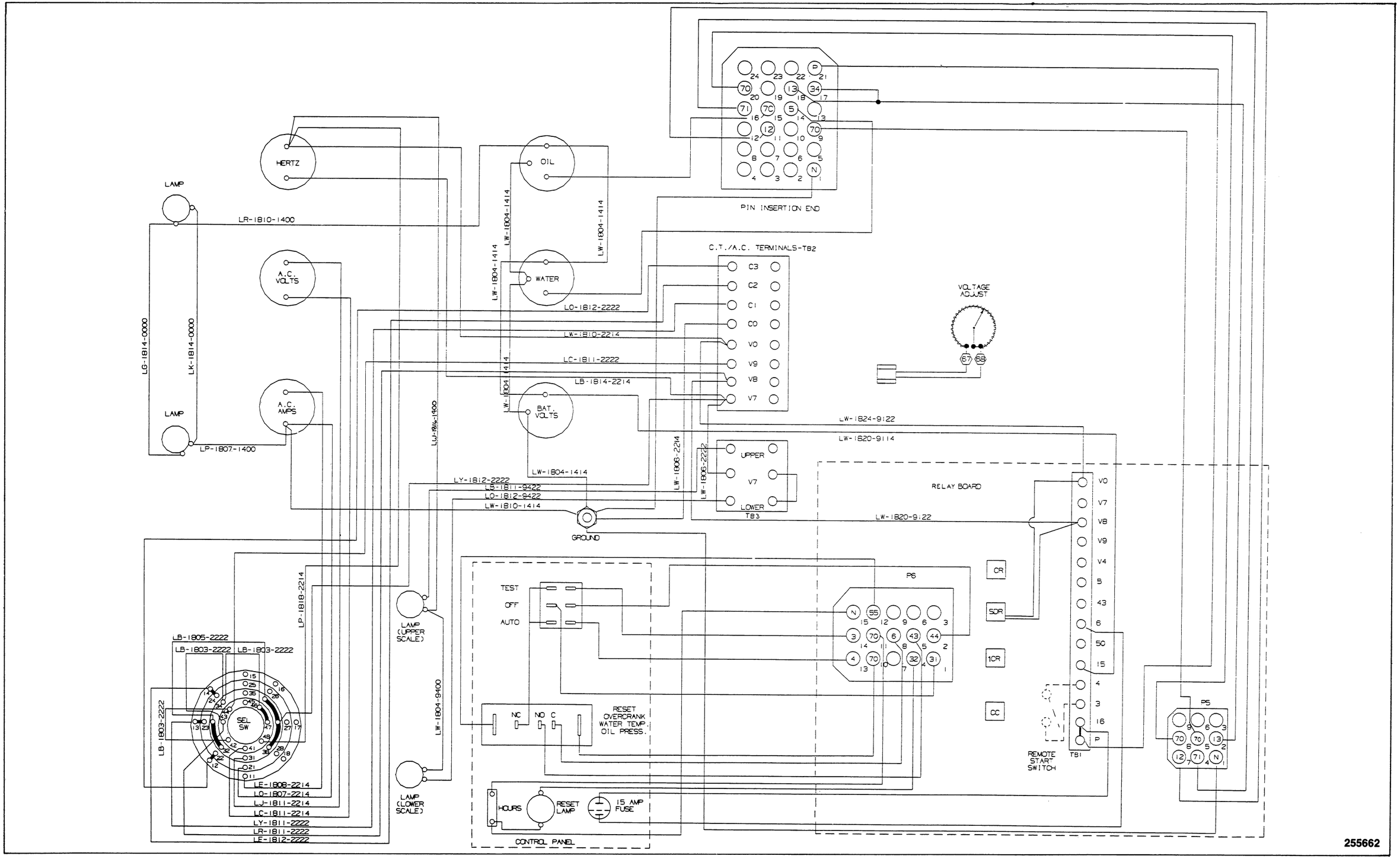


Figure 9-12. Relay Controller with Meters, 1-Phase/3-Phase

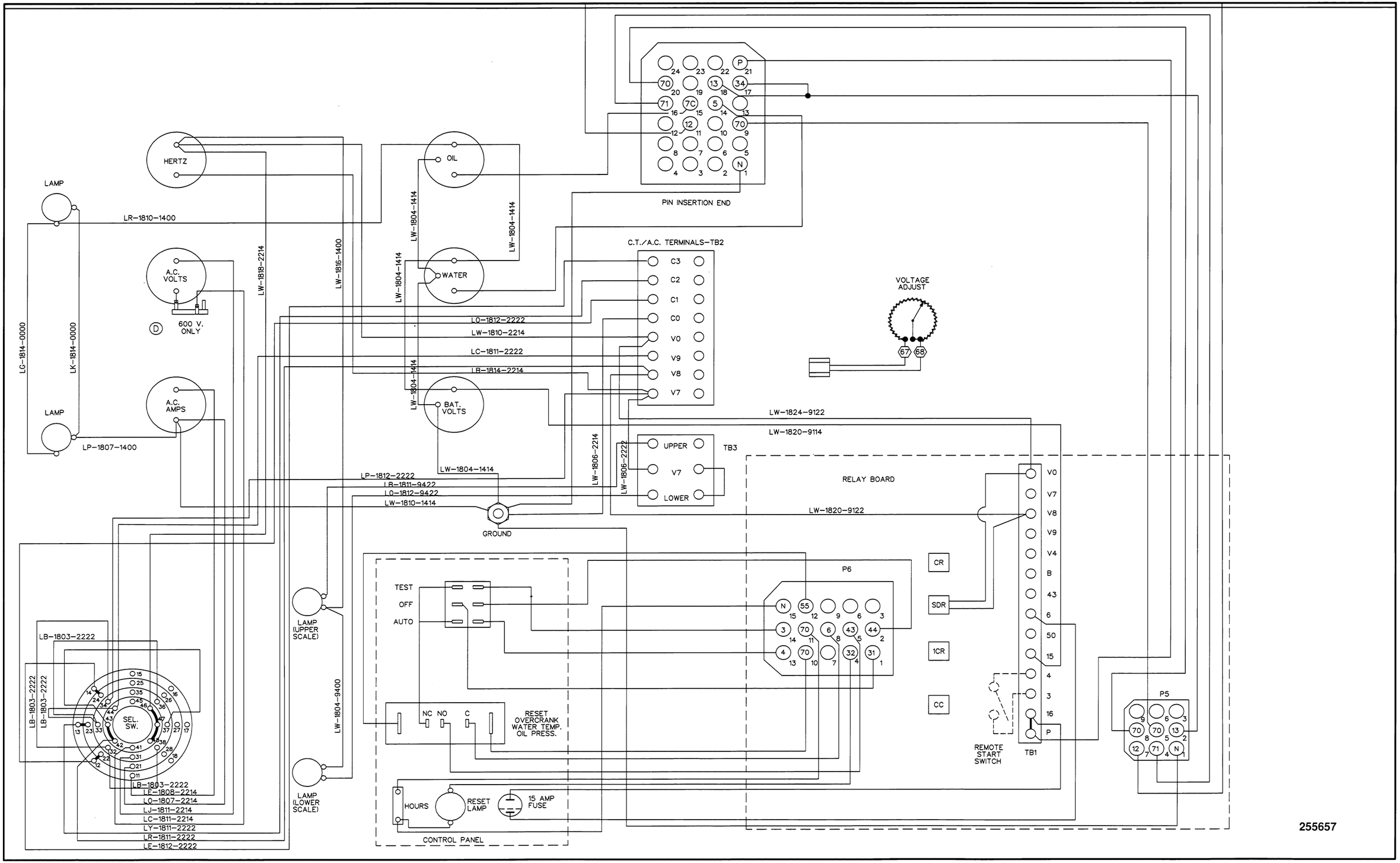


Figure 9–13. Relay Controller with Meters, 600–Volt

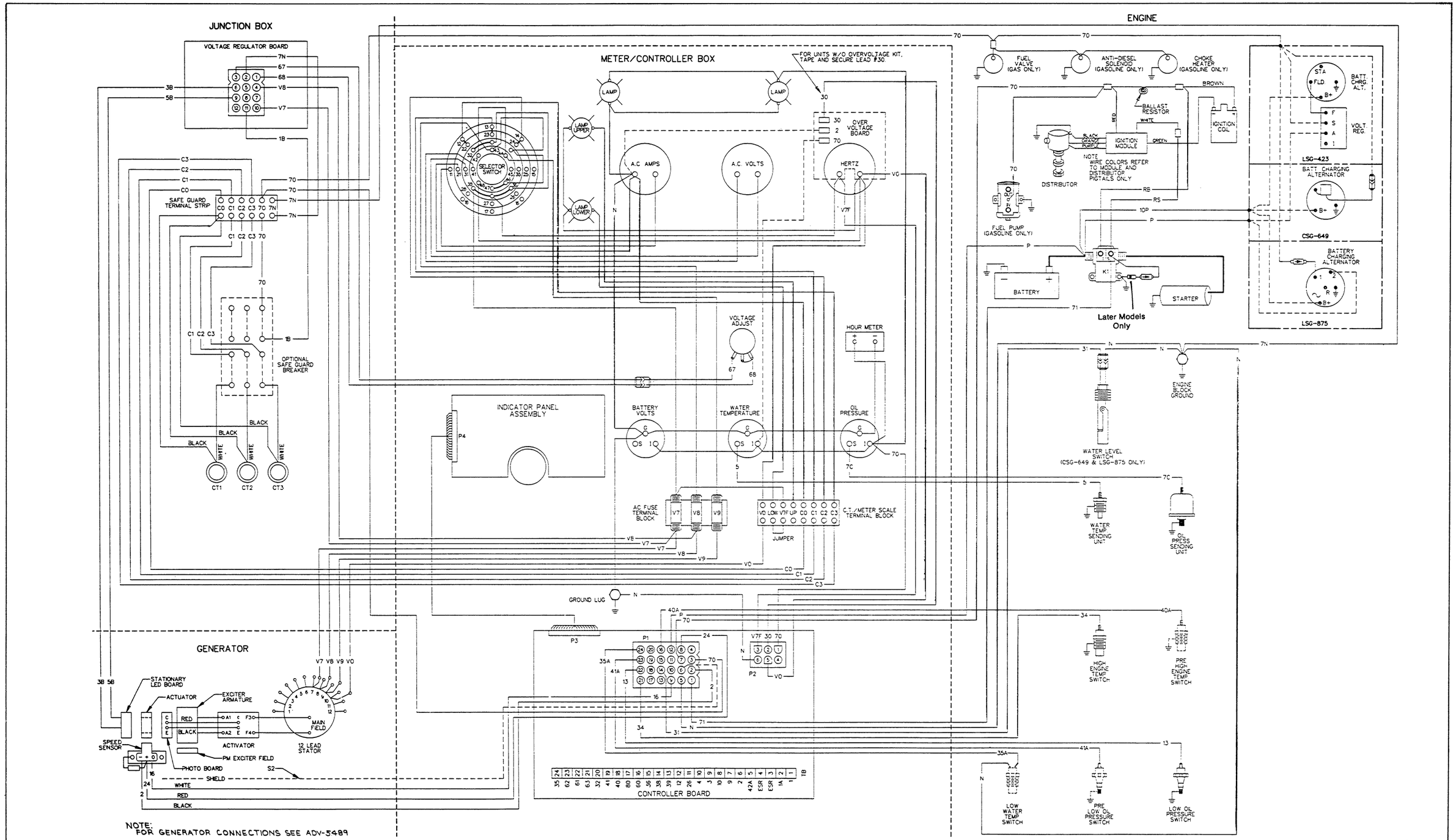


Figure 9-14. Ford Engines, Gas/Gasoline, 1-Phase/3-Phase (Standard FR Activator)

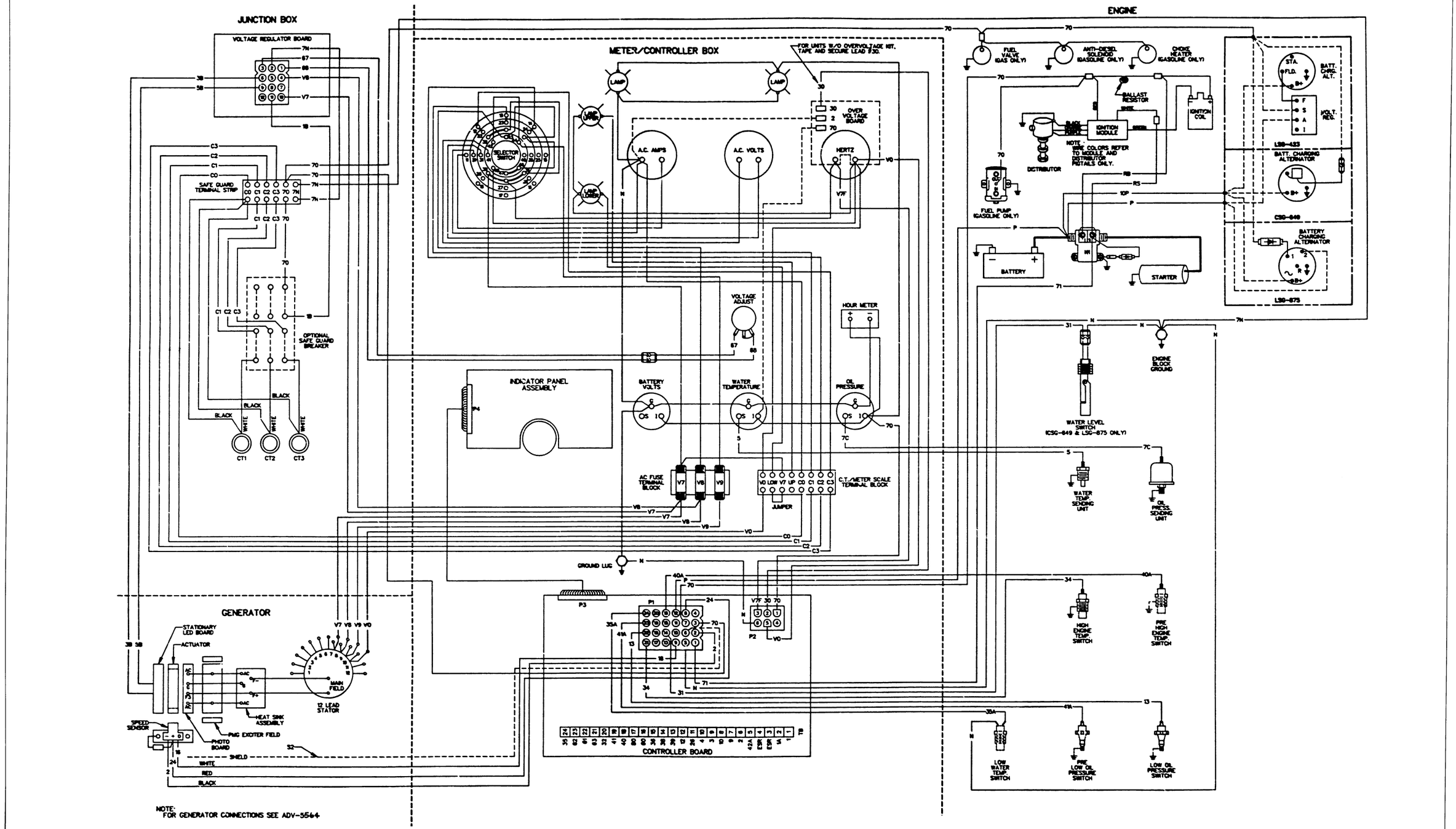


Figure 9-15. Ford Engines, Gas/Gasoline, 1-Phase/3-Phase (Split FR Activator)

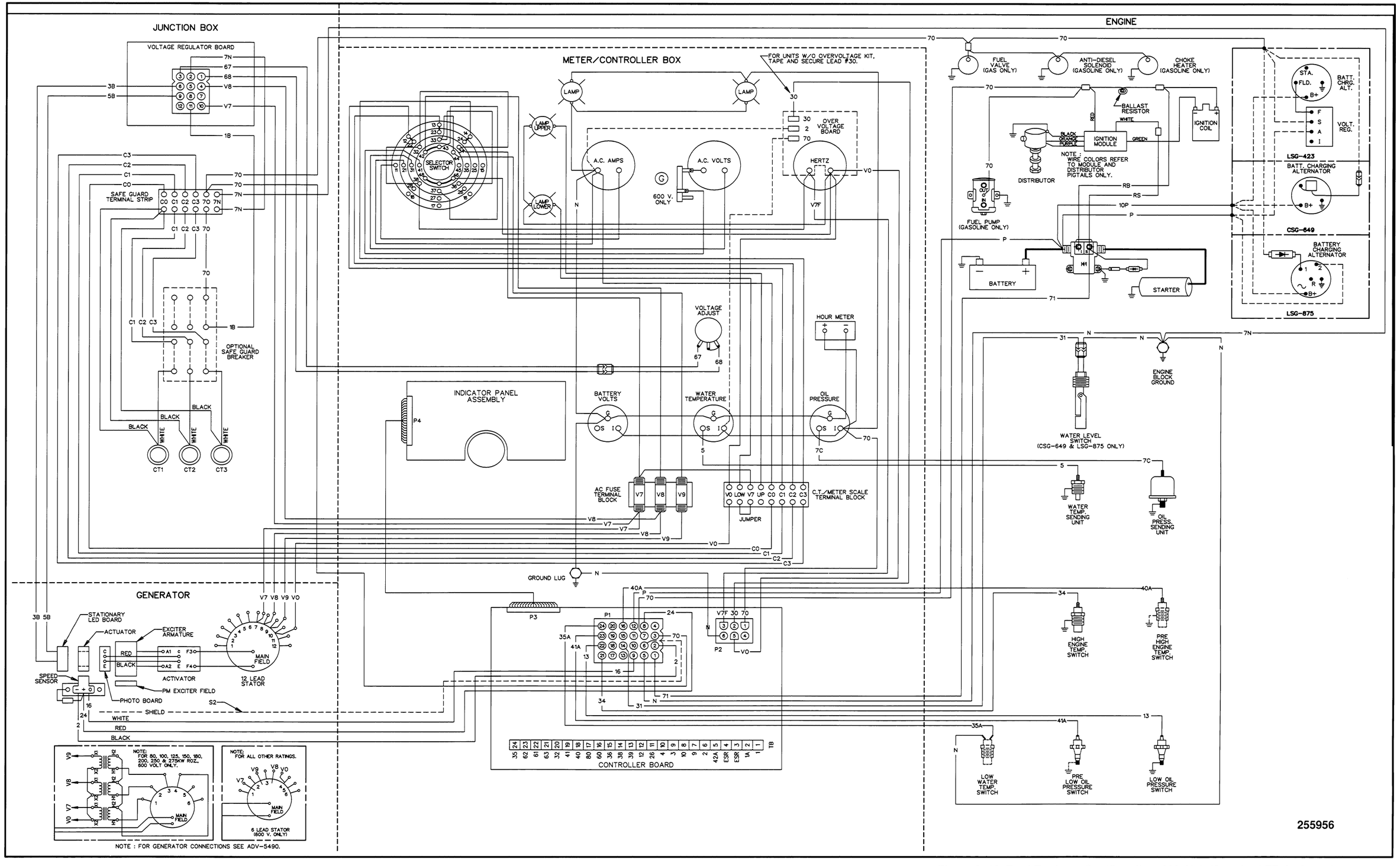


Figure 9–16. Ford Engines, Gas/Gasoline, 600–Volt (Standard FR Activator)

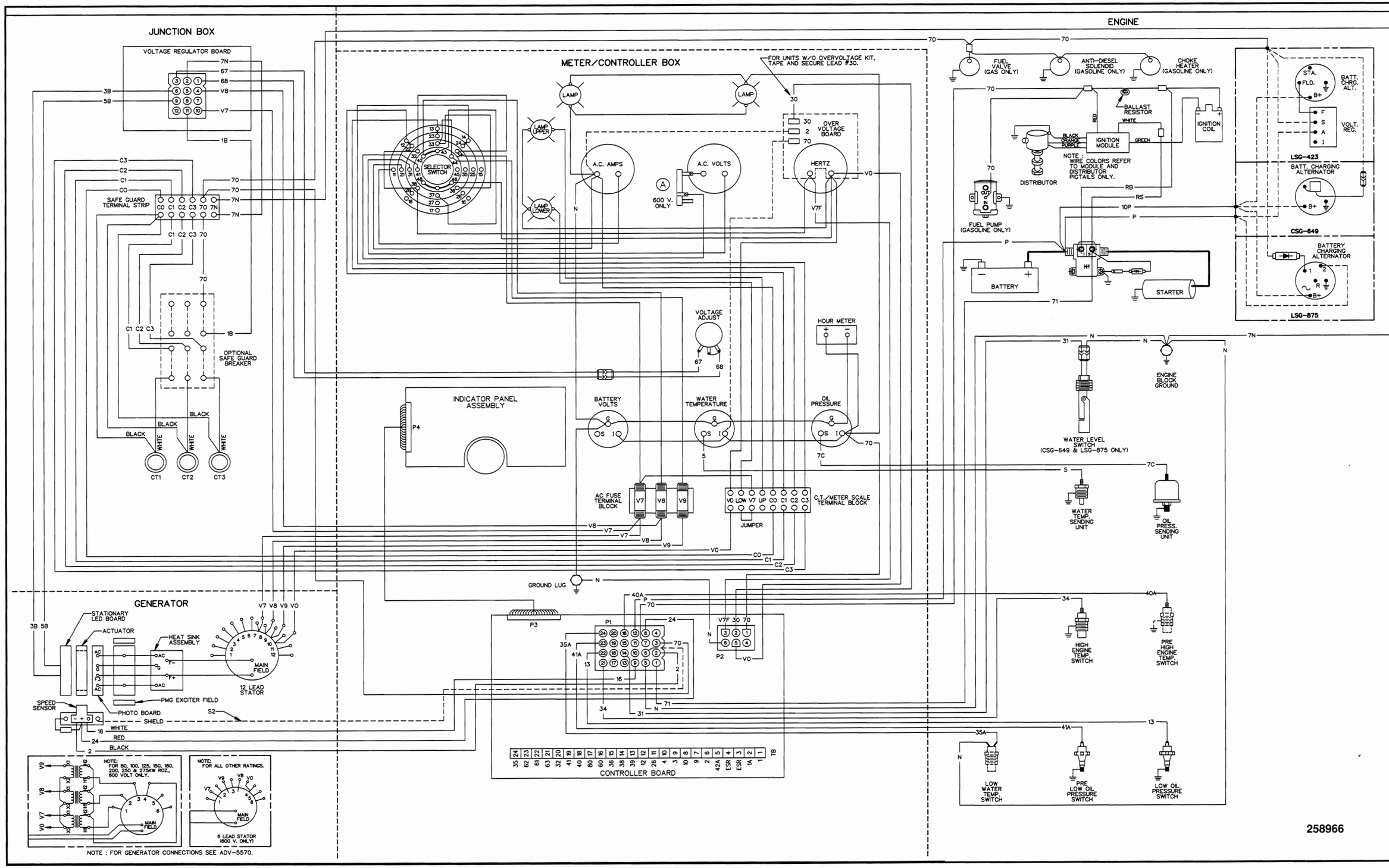
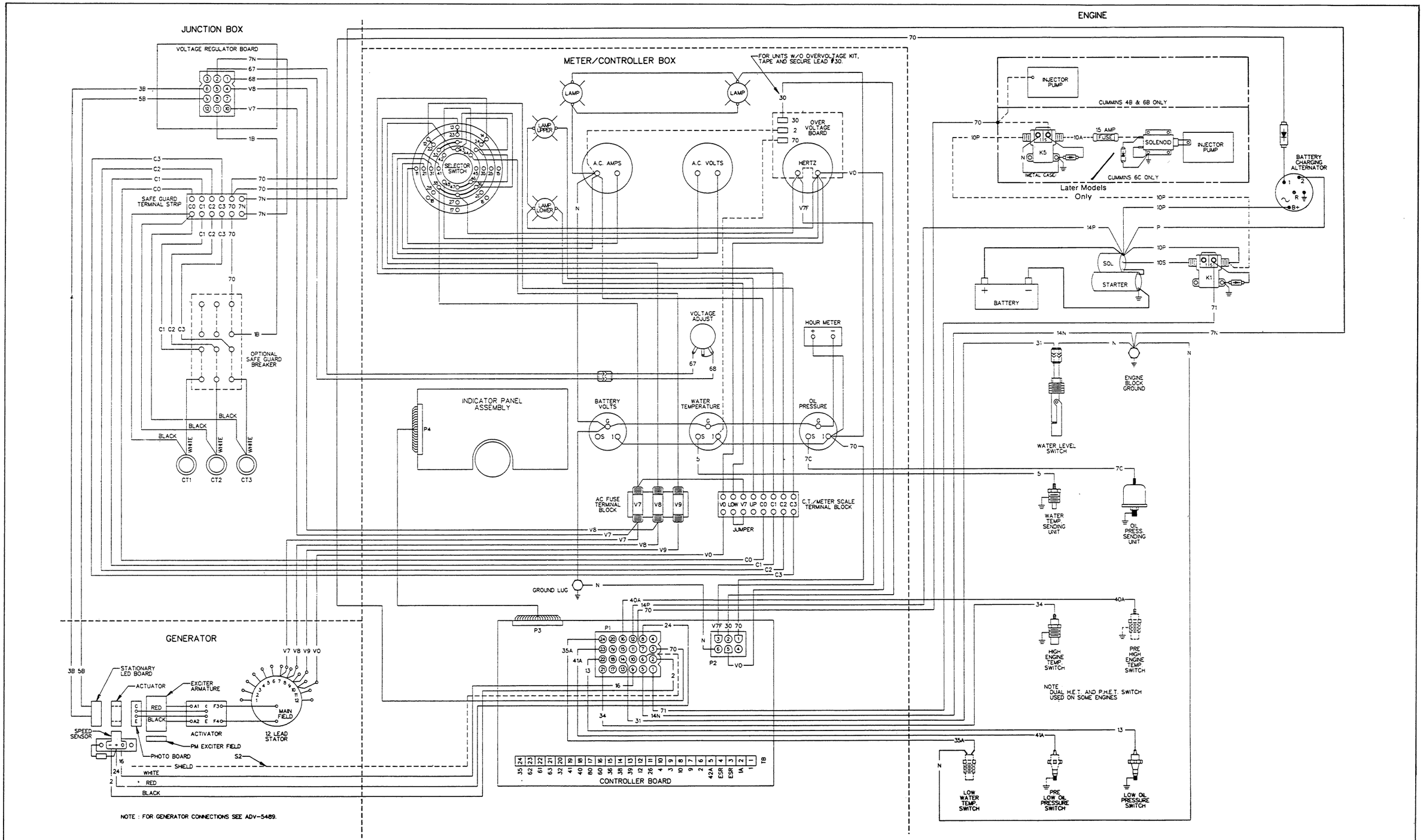


Figure 9–17. Ford Engines, Gas/Gasoline, 600–Volt (Split FR Activator)



255957

Figure 9-18. Cummins 4B, 6B, 6C Diesel, 1-Phase/3-Phase (Standard FR Activator)

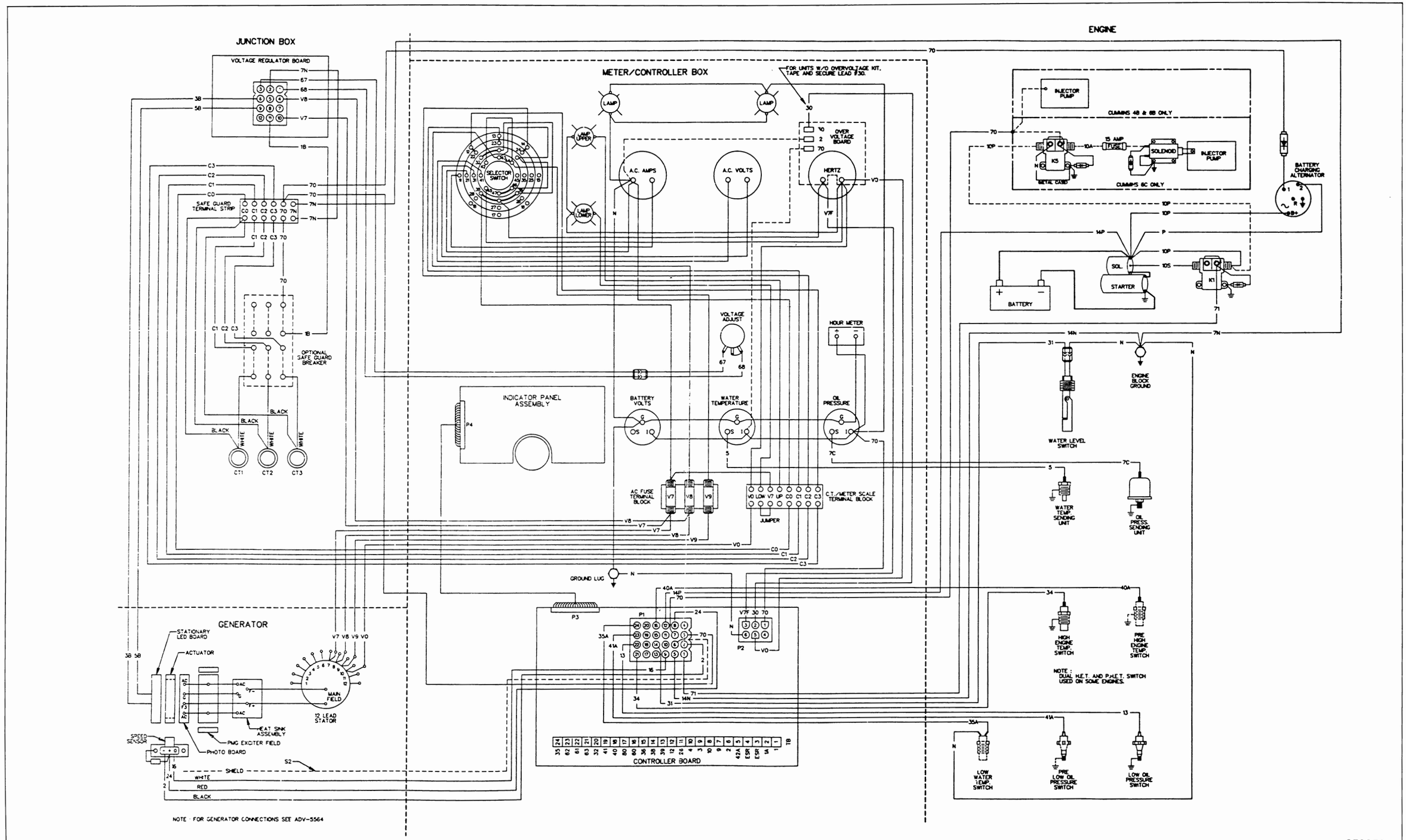


Figure 9-19. Cummins 4B, 6B, 6C Diesel, 1-Phase/3-Phase (Split FR Activator)

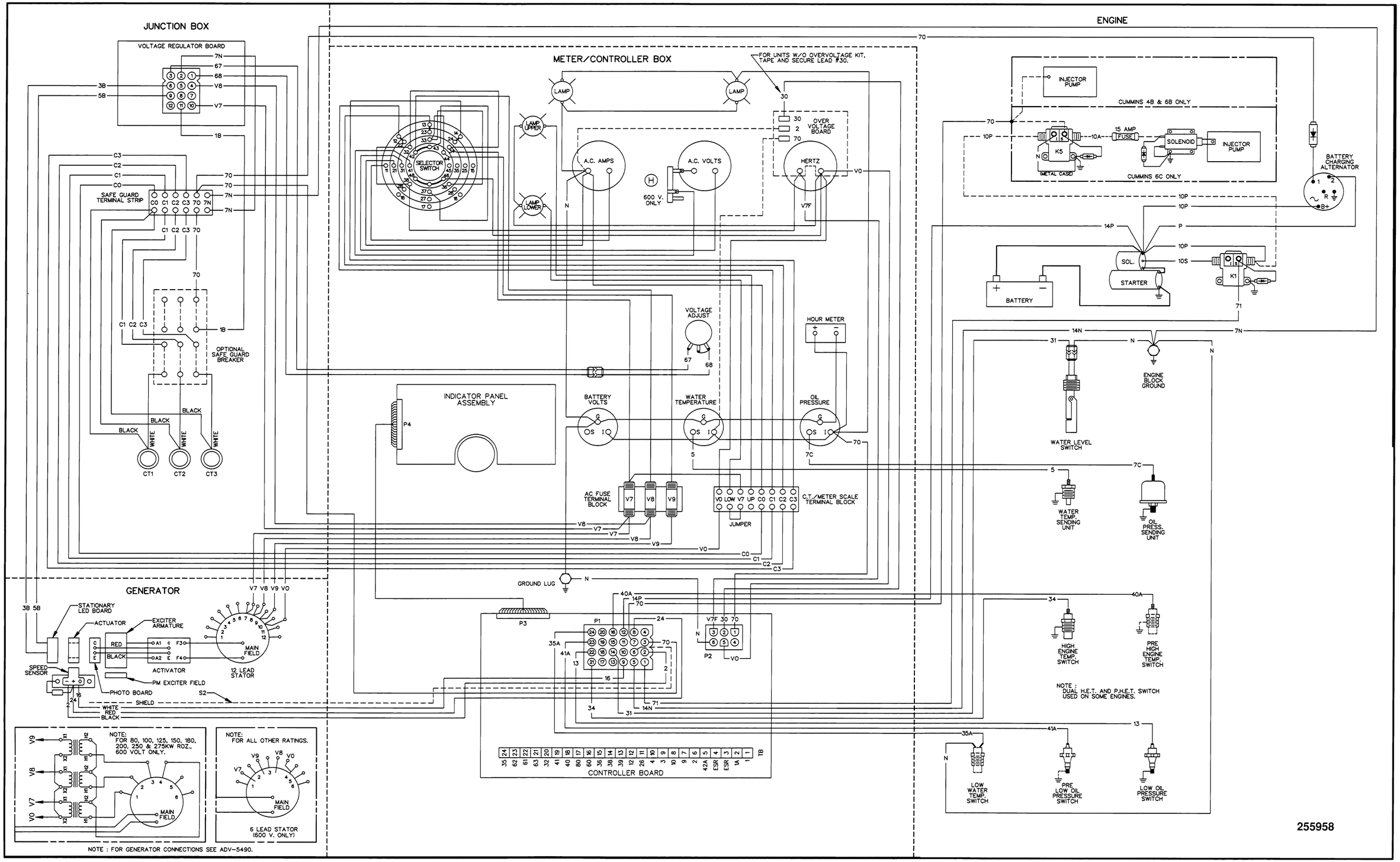


Figure 9–20. Cummins 4B, 6B, 6C Diesel, 600–Volt (Standard FR Activator)

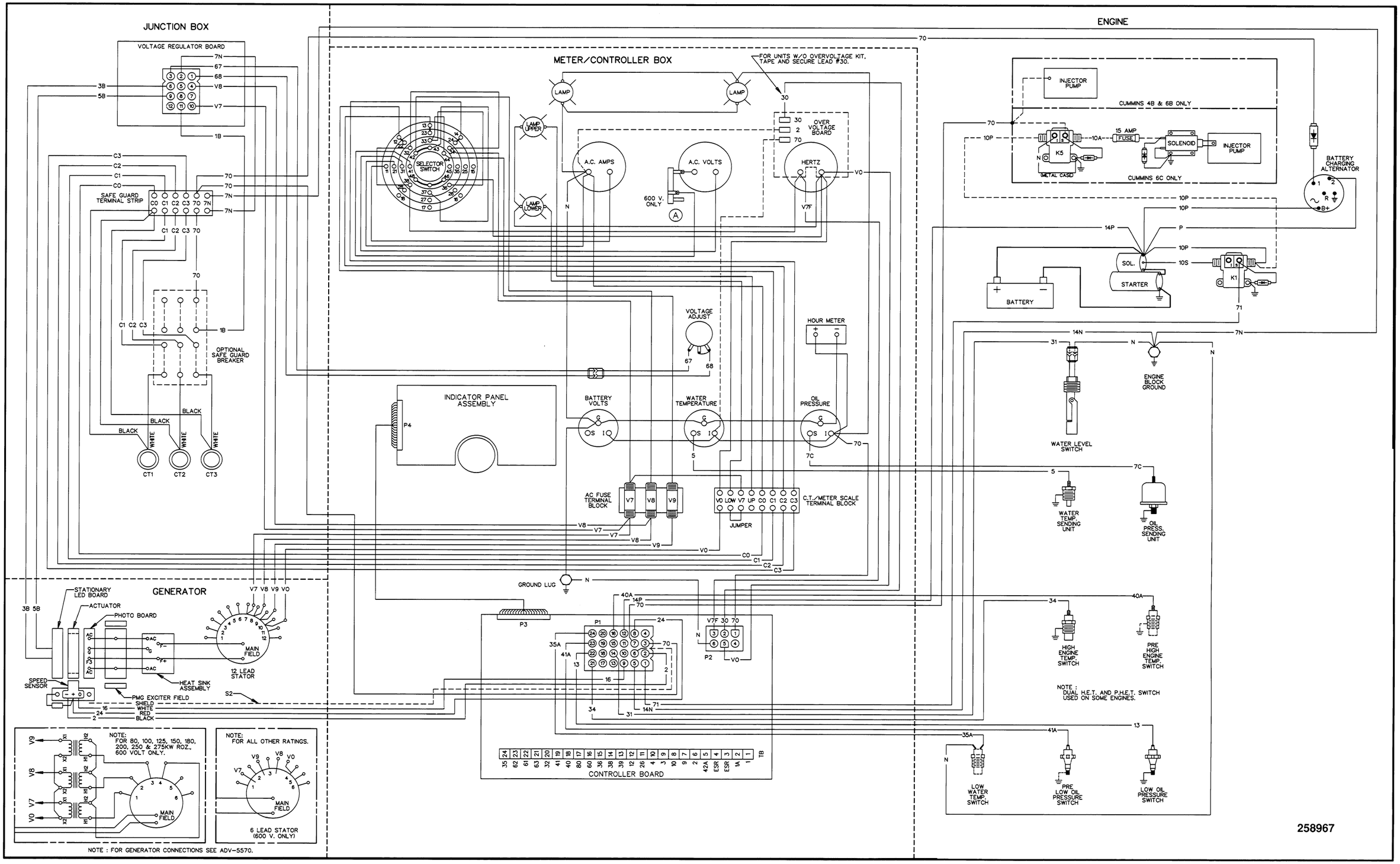


Figure 9–21. Cummins 4B, 6B, 6C Diesel, 600–Volt (Split FR Activator)

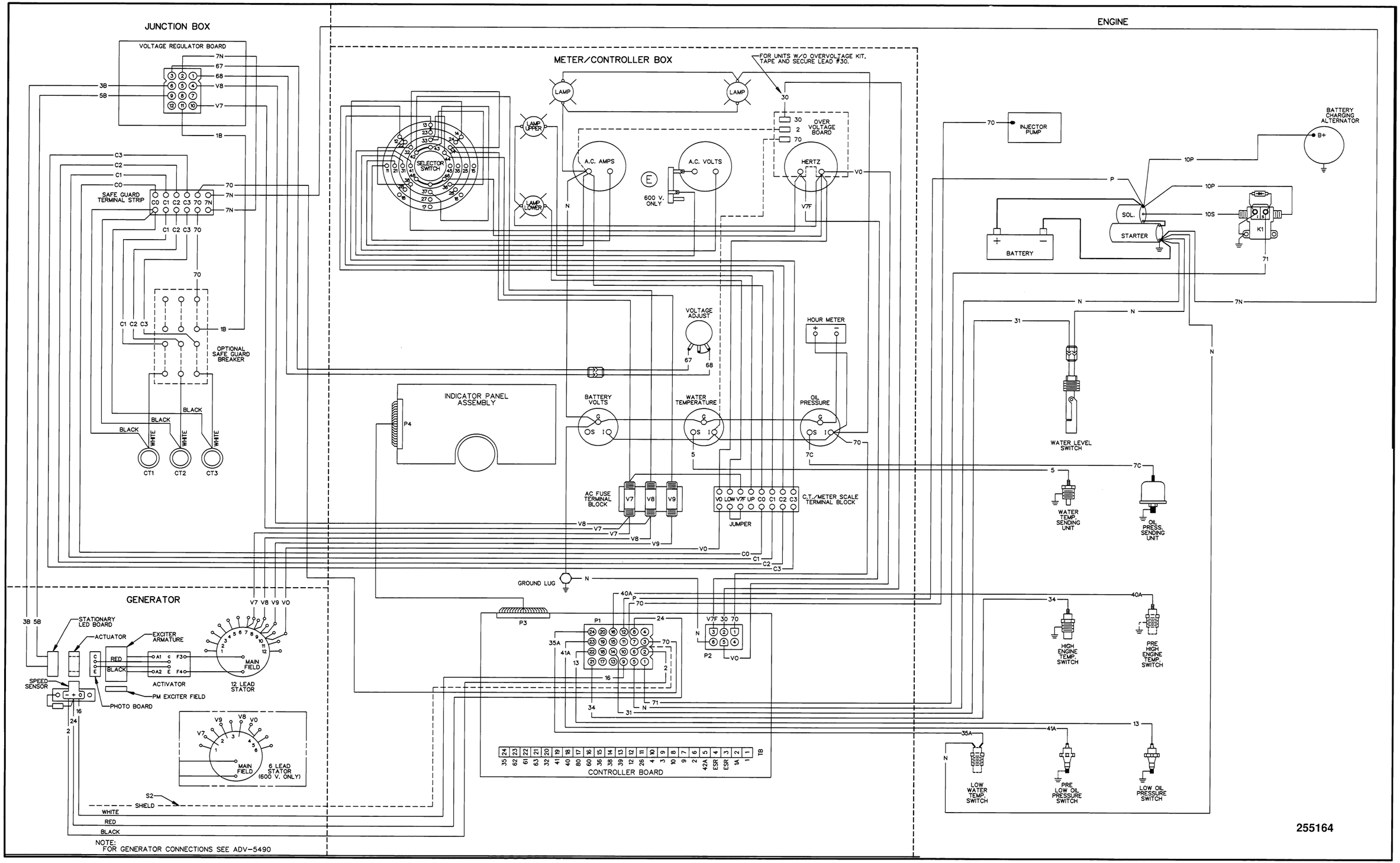


Figure 9–22. Cummins NT855 Diesel, 600–Volt(Standard FR Activator)

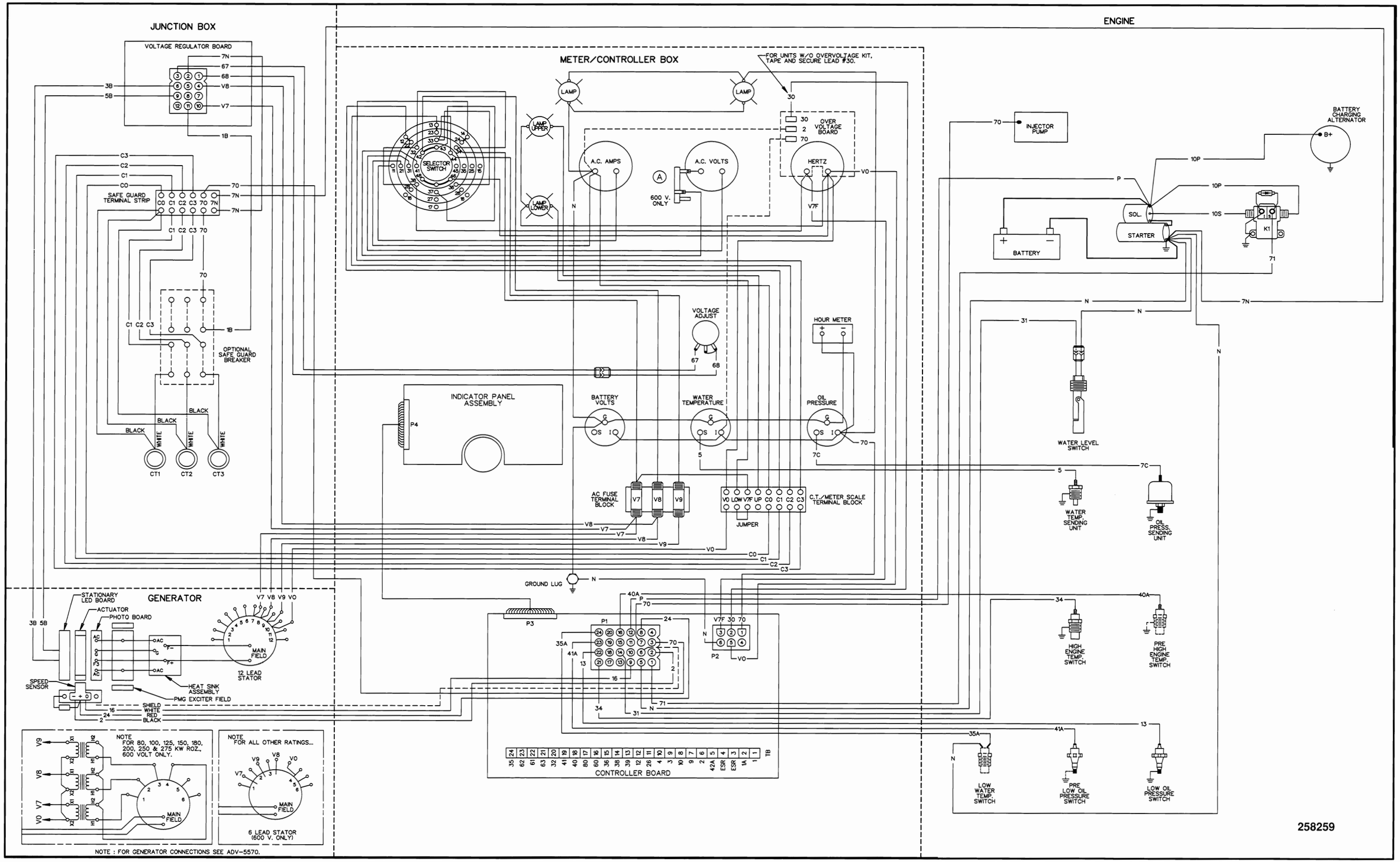
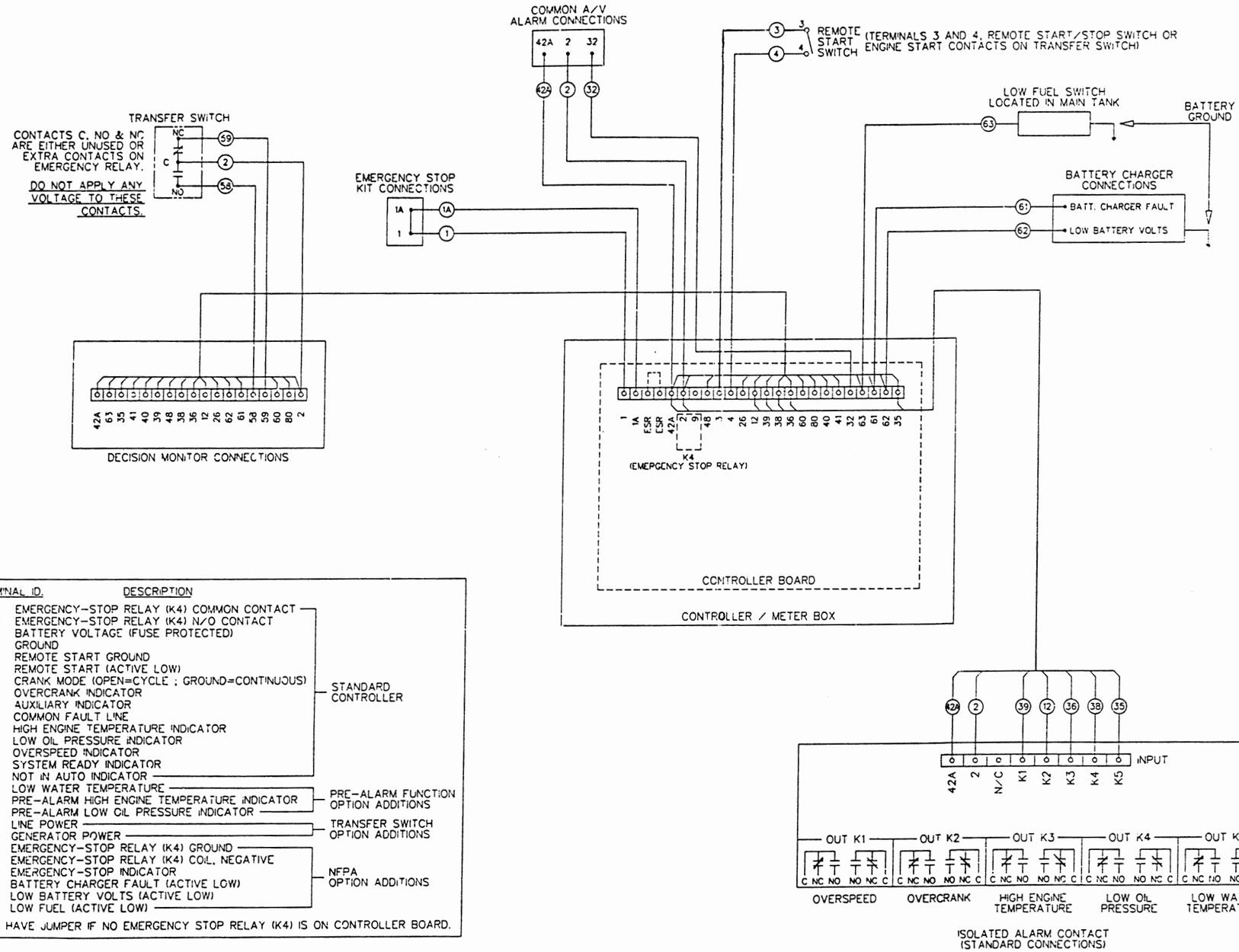


Figure 9–23. Cummins NT855 Diesel, 600–Volt (Split FR Activator)



TERMINAL ID.	DESCRIPTION	
*ESR	EMERGENCY-STOP RELAY (K4) COMMON CONTACT	STANDARD CONTROLLER
*ESR	EMERGENCY-STOP RELAY (K4) N/O CONTACT	
42A	BATTERY VOLTAGE (FUSE PROTECTED)	
2	GROUND	
3	REMOTE START GROUND	
4	REMOTE START (ACTIVE LOW)	
9	CRANK MODE (OPEN=CYCLE ; GROUND=CONTINUOUS)	
12	OVERCRANK INDICATOR	
26	AUXILIARY INDICATOR	
32	COMMON FAULT LINE	
36	HIGH ENGINE TEMPERATURE INDICATOR	
38	LOW OIL PRESSURE INDICATOR	
39	OVERSPEED INDICATOR	
60	SYSTEM READY INDICATOR	
80	NOT IN AUTO INDICATOR	
35	LOW WATER TEMPERATURE	PRE-ALARM FUNCTION OPTION ADDITIONS
40	PRE-ALARM HIGH ENGINE TEMPERATURE INDICATOR	
41	PRE-ALARM LOW OIL PRESSURE INDICATOR	
58	LINE POWER	TRANSFER SWITCH OPTION ADDITIONS
59	GENERATOR POWER	
1	EMERGENCY-STOP RELAY (K4) GROUND	NFPA OPTION ADDITIONS
1A	EMERGENCY-STOP RELAY (K4) COIL, NEGATIVE	
48	EMERGENCY-STOP INDICATOR	
61	BATTERY CHARGER FAULT (ACTIVE LOW)	
62	LOW BATTERY VOLTS (ACTIVE LOW)	
63	LOW FUEL (ACTIVE LOW)	

*MUST HAVE JUMPER IF NO EMERGENCY STOP RELAY (K4) IS ON CONTROLLER BOARD.

255828

Figure 9-24. Dec-3 Controller Accessory Connection

Tables and Formulas

Generator Output

Three-Phase Amperes — 0.8 Power Factor

kW	kVa	208-Volt	220-Volt	240-Volt	380-Volt	400-Volt	480-Volt	600-Volt
5	6.3	17.5	16.5	15.2	9.6	9.1	7.6	6.1
7.5	9.4	26.1	24.7	22.6	14.3	13.6	11.3	9.1
10	12.5	34.7	33	30.1	19.2	18.2	15.1	12
15	18.7	52	49.5	45	28.8	27.3	22.5	18
20	25	69.5	66	60.2	38.4	36.4	30.1	24
25	31.3	87	82.5	75.5	48	45.5	37.8	30
30	37.5	104	99	90.3	57.6	54.6	45.2	36
40	50	139	132	120	77	73	60	48
50	62.5	173	165	152	96	91	76	61
60	75	208	198	181	115	109	91	72
75	93.8	261	247	226	143	136	113	90
80	100	278	264	240	154	146	120	96
100	125	347	330	301	192	182	150	120
125	156	433	413	375	240	228	188	150
150	187	520	495	450	288	273	225	180
175	219	608	577	527	335	318	264	211
200	250	694	660	601	384	364	301	241
250	312	866	825	751	480	455	376	300
300	375	1040	990	903	576	546	451	361
350	438	1220	1155	1053	672	637	527	422
400	500	1390	1320	1203	770	730	602	481
500	625	1735	1650	1504	960	910	752	602
600	750	2080	1980	1803	1150	1090	902	721
700	875	2430	2310	2104	1344	1274	1052	842
800	1000	2780	2640	2405	1540	1460	1203	962
900	1125	3120	2970	2709	1730	1640	1354	1082
1000	1250	3470	3300	3009	1920	1820	1504	1202

Miscellaneous Electrical Formulae:

Power — A.C. Circuits:

$$\text{Power Factor} = \frac{\text{Watts}}{\text{Volts x Amperes}}$$

$$\text{Three-Phase Kilowatts} = \frac{\text{Volts x Amperes x Power Factor x } \sqrt{3}}{1000}$$

$$\text{Three-Phase Volt Amperes} = \text{Volts x Amperes x } \sqrt{3}$$

$$\text{Three-Phase Amperes} = \frac{746 \text{ x Horsepower}}{\sqrt{3} \text{ x Volts x Efficiency x Power Factor}}$$

$$\text{Single-Phase Kilowatts} = \frac{\text{Volts x Amperes x Power Factor}}{1000}$$

$$\text{Single-Phase Amperes} = \frac{746 \text{ x Horsepower}}{\text{Volts x Efficiency x Power Factor}}$$

TP-5262 2/90
PRINTED IN U.S.A.

KOHLER
GENERATORS

KOHLER CO., KOHLER, WISCONSIN 53044