INSTALLATION INSTRUCTIONS

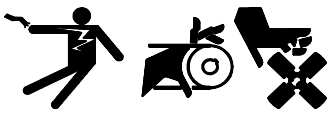
Original Issue Date: **11/98**
Model: **20–300 kW**
Market: **Industrial**
Subject: **Voltage Regulator Kits 326930, GM24494, GM24495, and GM24496**

Kit	Engine Electrical System	Phase Sensing
326930	12	3
GM24494	24	3
GM24495	12	1
GM24496	24	1

Use the following procedure to replace an existing voltage regulator with one of the RMS sensing voltage regulators. Refer to the wiring diagram shown in Figure 1. Observe the following safety precautions while installing the kit.

Safety Precautions

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ WARNING

Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Installing the photo transistor circuit board. Hazardous voltage can cause severe injury or death. Ensure that the foil side of the photo transistor circuit board, the end of the shaft, and the threaded holes are clean and free of metal particles and chips. Metal debris may short-circuit the photo transistor circuit board and cause hazardous voltage in the generator set. Do not reconnect the generator set to the load until the AC voltmeter shows the correct output.

Installation

1. Place the generator set master switch in the OFF position.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery(ies), negative (-) lead first.
4. Remove the junction box rear and right-side panels.
5. Disconnect the 12-pin wiring harness connector from the existing voltage regulator circuit board.

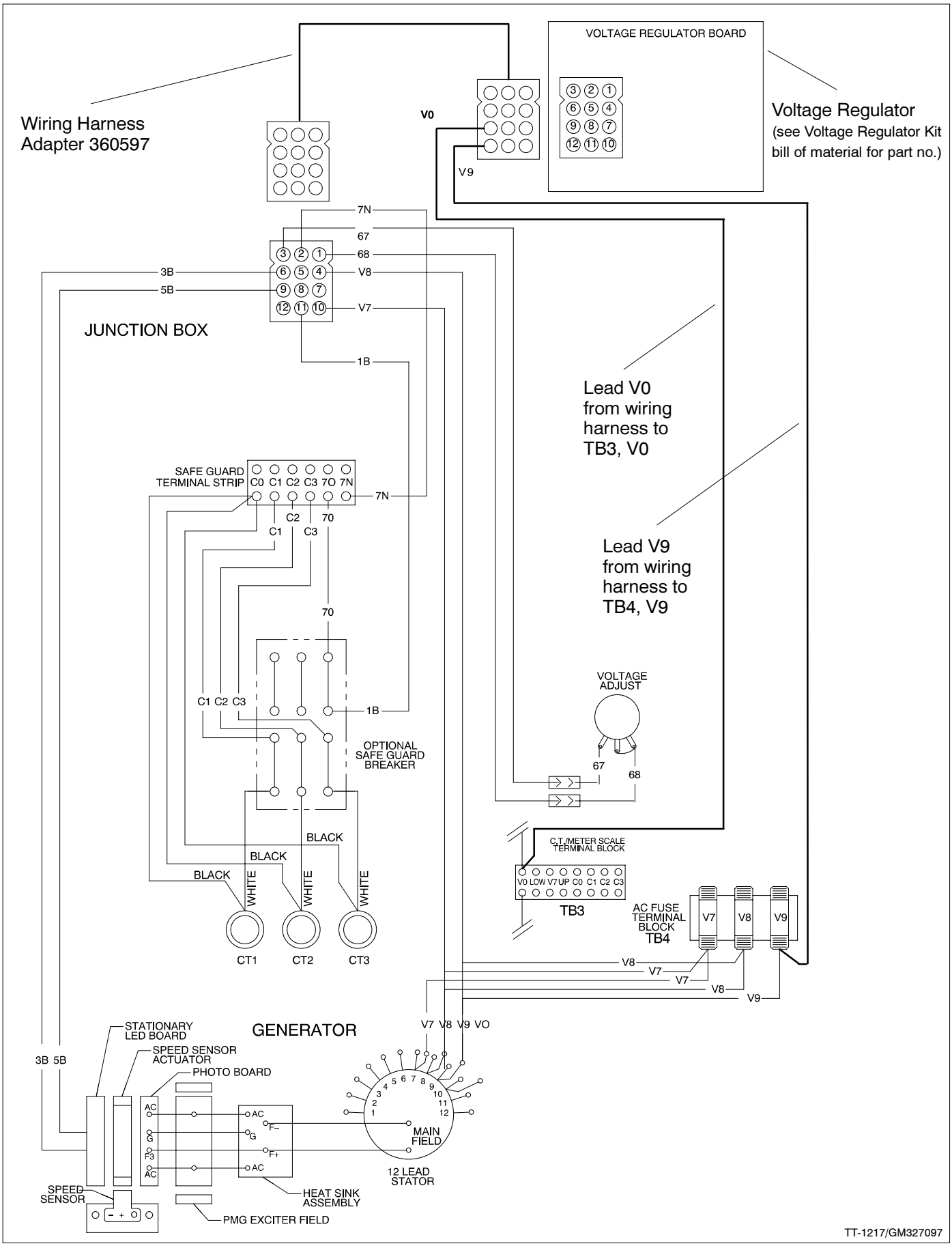


Figure 1 Wiring Diagram

6. Disconnect the circuit board standoffs or vibromounts securing the voltage regulator circuit board to the junction box and remove the circuit board. See Figure 2.

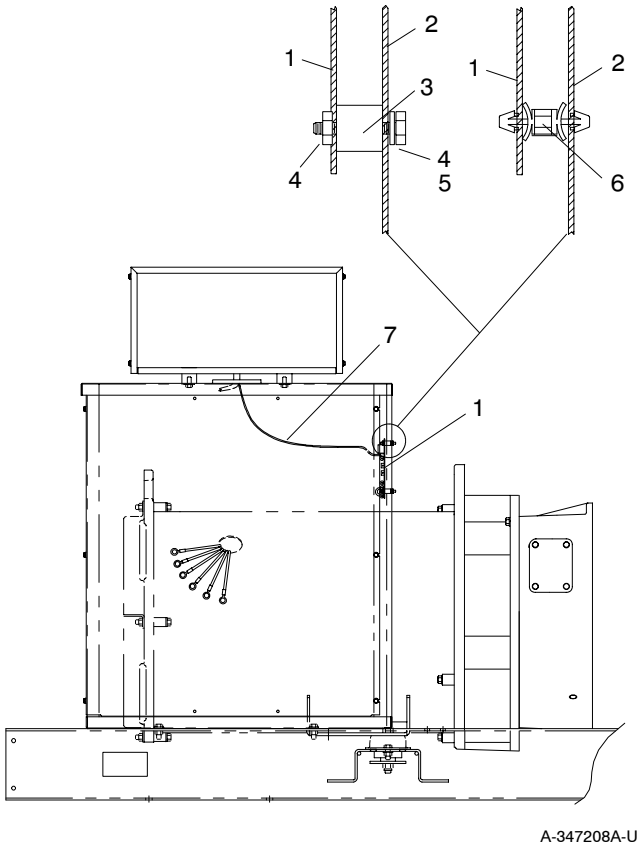
7. Install new circuit board standoffs (360459) or vibromounts (282829) on the new voltage regulator circuit board.

8. Install the new voltage regulator circuit board with standoffs or vibromounts in the junction box where the original circuit board was removed. When using vibromounts, secure using the lock washers (X-22-7) and nuts (X-72-4).

9. Connect the existing voltage regulator wiring harness 12-pin connector to the wiring harness adapter (360597). See Figure 3.

10. Connect the wiring harness adapter 12-pin connector with leads to the voltage regulator circuit board. See Figure 3.

11. Remove the controller cover.



1. Voltage regulator circuit board
2. Junction box
3. Voltage regulator circuit board vibromount (282829)
4. Nut (X-72-40)
5. Lockwasher (X-22-7)
6. Voltage regulator circuit board standoff (360459)
7. Voltage regulator wiring harness

Figure 2 Voltage Regulator Location

12. Route the two loose leads (V0 and V9) from the adapter harness 12-pin connector along the original voltage regulator wiring harness into the controller box. Secure the leads to the voltage regulator wiring harness with cable ties (X-468-2).

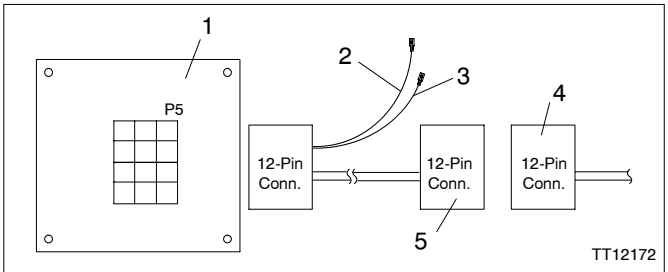
13. Disconnect lead V9 from the AC fuse terminal block (TB4).

14. Connect the V9 lead from the adapter harness to TB4 where the lead was disconnected from in step 13.

15. Connect the original V9 lead disconnected in step 13 to the piggyback terminal of the adapter harness lead V9 installed in step 14. See Figure 4.

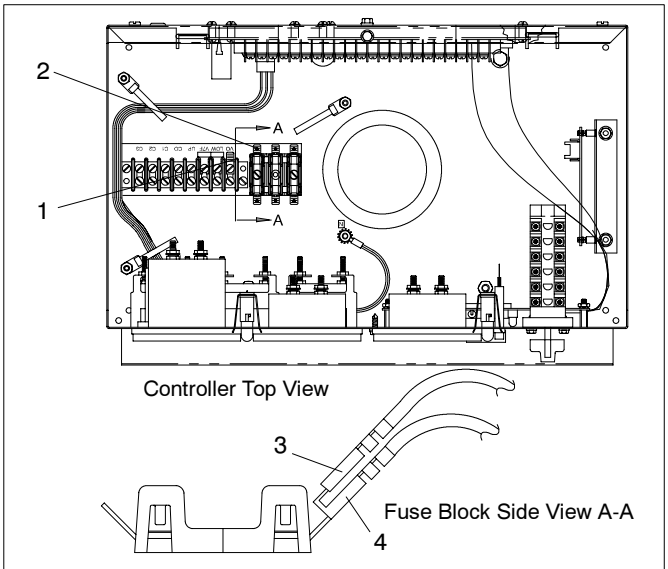
16. Disconnect lead V0 from the current transformer (CT)/meter scale terminal block (TB3).

17. Connect the V0 lead from the adapter harness to TB3 where the lead was disconnected from in step 16.



1. Voltage regulator circuit board
2. Lead V0
3. Lead V9
4. Existing voltage regulator wiring harness 12-pin connector
5. Voltage regulator adapter harness

Figure 3 Voltage Regulator Connections



1. TB3 V0 terminal
2. TB4 V9 terminal
3. Original terminal connection
4. Adapter harness lead connection

Figure 4 Controller Lead Connections

18. Connect the original V0 lead disconnected in step 16 to the piggyback terminal of the adapter harness lead V0 installed in step 17. See Figure 4.

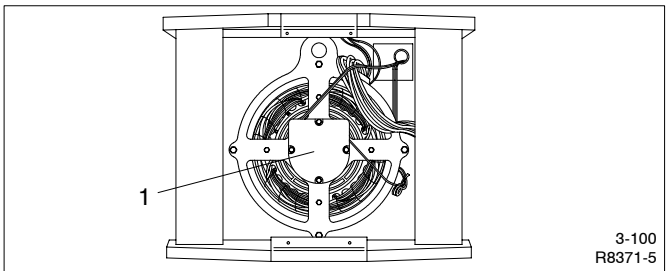
19. Reinstall the controller cover.

20. Remove the screws securing the LED board cover to the end bracket. See Figure 5.

21. Remove two screws securing the photo transistor board and the magnetic actuator to the rotor. Save the mounting screws. See Figure 6.

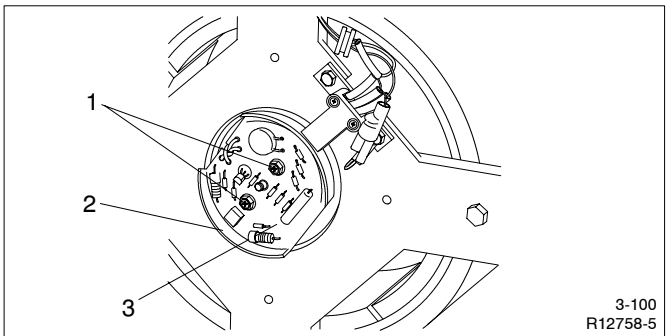
22. Locate the silicon controlled rectifier (SCR) assembly on the back of the alternator rotor through the alternator end bracket. See Figure 7.

    Note: On smaller kW generator sets it may be necessary to remove the alternator end bracket to gain access to the SCR leads.



1. Photo transistor/LED board cover

Figure 5 Panels Removed



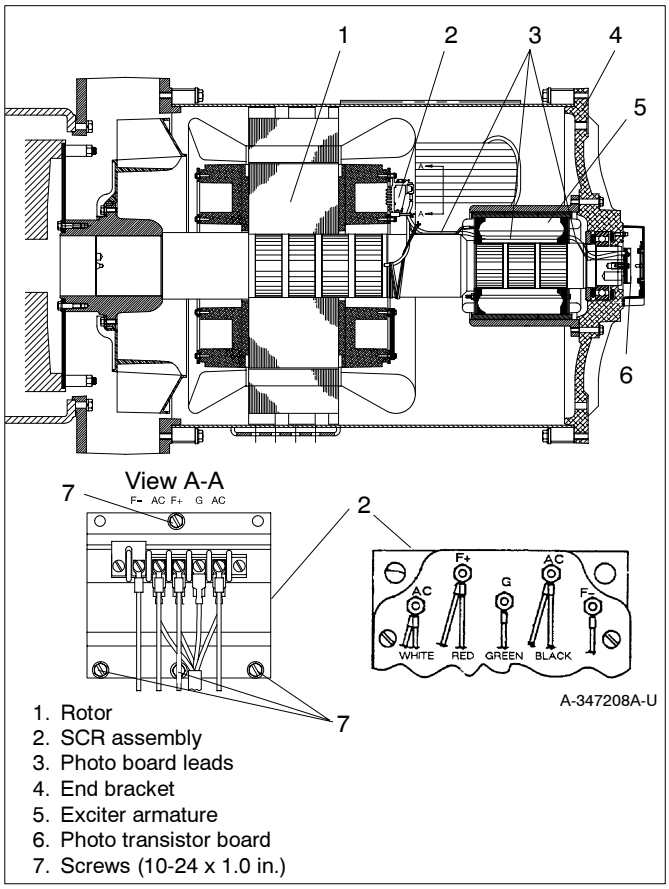
1. Screws
2. Magnetic actuator
3. Photo transistor board

Figure 6 End Bracket

23. Disconnect the five photo transistor board leads (F–, F+, G, and two AC leads) connected to the SCR assembly. See Figure 7 and Figure 8.

24. Cut the ring terminals connected to the end of the photo transistor leads disconnected in step 23. Discard the ring terminals.

25. Remove the photo transistor board assembly.



1. Rotor
2. SCR assembly
3. Photo board leads
4. End bracket
5. Exciter armature
6. Photo transistor board
7. Screws (10-24 x 1.0 in.)

Figure 7 Rotor Assembly, Side View

SCR Terminal	Lead Connection(s)
F-	Rotor field lead
AC	White lead and exciter armature lead
F+	Red lead and rotor field lead
G	Green lead
AC	Black lead and exciter armature lead

Figure 8 SCR Lead Connections

26. Install the new photo transistor board (B-360418). Route the photo transistor board leads through the magnetic actuator cup as shown in Figure 9.

27. Route the photo transistor board lead through the hole in the rotor shaft and then through the exciter laminations to exit near the SCR assembly. See Figure 7.

28. Secure the magnetic actuator and the photo transistor board to the end of the rotor shaft using the two screws removed in step 21. Torque the hardware to 1.1 Nm (10 in. lb.). See Figure 10.

29. Cut off the excess photo transistor board lead wire, leaving enough wire to reach the SCR assembly.

30. Strip 50-75 mm (2-3 in.) of the gray insulator jacket from the photo transistor board leads.

31. Strip 6 mm (1/4 in.) of insulation from the photo transistor board leads.

32. Secure the photo transistor board leads to the rotor shaft with the cable tie (X-468-3). See Figure 7.

33. Crimp #8 electrical terminals (X-283-7) to the photo transistor board leads.

34. Reconnect the photo transistor board leads to the SCR. See Figure 8 for lead connections. Torque the SCR connections to 0.9 Nm (8 in. lb.) maximum.

35. Reinstall the LED board cover. See Figure 5.

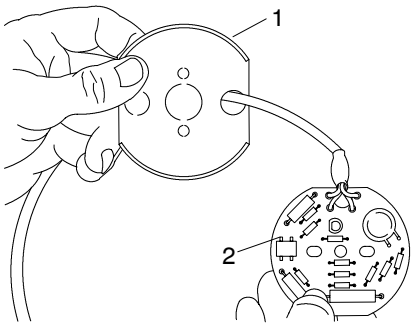
36. Reinstall the junction box right-side and rear panels.

37. Check that the generator master switch is in the OFF position.

38. Reconnect the generator set engine starting battery, negative (-) lead last.

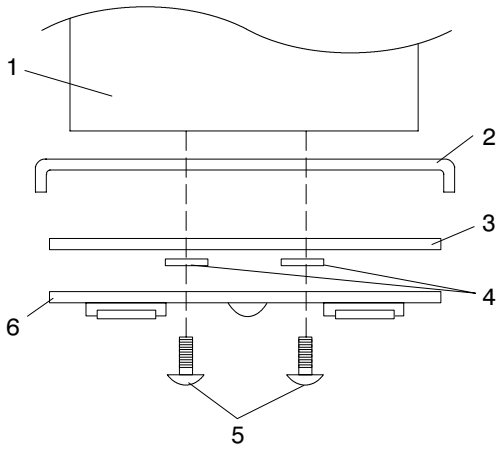
39. Reconnect the power to the battery charger, if equipped.

40. Use the following procedure to adjust the voltage regulator.



1. Magnetic actuator
2. Photo transistor board

Figure 9 Installing Photo Transistor Board



1. End of rotor shaft
2. Magnetic actuator cup
3. Insulator board
4. Insulator washers
5. Mounting screws
6. Photo transistor board

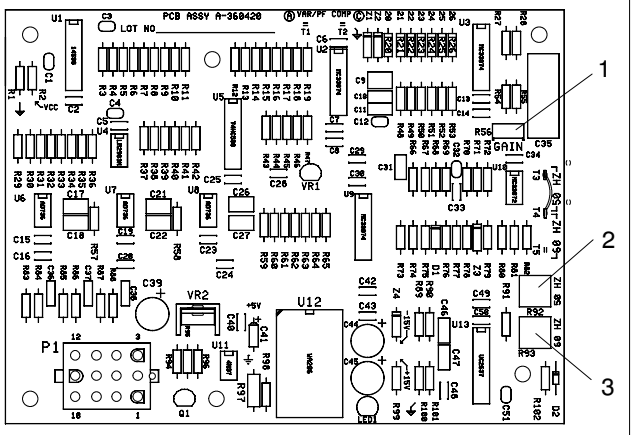
Figure 10 Photo Transistor Board Mounting

Automatic Voltage Regulator Operation and Adjustment

The automatic voltage regulator (AVR) monitors output voltage magnitude and frequency to supply current to the stationary LED board. The AVR circuit board includes volts/Hz and stability adjustment potentiometers. The two potentiometers labeled 50 Hz and 60 Hz are for underfrequency unloading or volts-per-hertz (V/Hz). The potentiometer labeled gain adjusts the stability. The V/Hz adjustment is factory set and normally requires no further adjustment. If replacement of the controller circuit board or operation of the generator under extreme loads results in voltage instability, adjust the potentiometers according to the procedure following. See Figure 11.

Stability Potentiometer. Fine tunes voltage regulator to reduce light flicker.

V/Hz Potentiometer. This adjustment determines the engine speed (Hz) at which the generator output voltage begins to drop.



1. Stability potentiometer
2. 50 Hz voltage adjustment potentiometer
3. 60 Hz voltage adjustment potentiometer

Figure 11 AVR Circuit Board

Adjustment Procedure:

1. Turn the generator set master switch to the OFF/RESET position.
2. Connect a 100-watt light bulb across terminals V0 and V7 on the controller terminal strip or across the terminals on the controller frequency meter.
3. Start the generator set. With the generator running at no load, observe light bulb flicker. Excessive light bulb flicker indicates poor stability.
4. Adjust the stability using the gain potentiometer to obtain minimum flicker.
5. Use the controller voltage adjustment potentiometer (or remote voltage adjustment potentiometer) to adjust the generator set while running under normal load (if required).
6. Adjust the engine speed to the desired cut-in frequency (factory setting is 56.5–57.0 Hz for 60 Hz models or 46.5–47.0 Hz for 50 Hz models) as measured on a frequency meter. See the generator set service manual governor section for more information on engine adjustment.
7. Rotate the appropriate V/Hz adjustment potentiometer (50 or 60 Hz) clockwise until the voltage level begins to drop (as measured on a voltmeter). When set to these specifications, the generator will attempt to maintain normal output until the engine speed drops below the frequency set in the previous step (as load is applied).
8. Adjust the engine speed to obtain a full load engine speed of 1800 rpm (60 Hz) or 1500 rpm (50 Hz).
9. Use the controller voltage adjustment potentiometer (or remote voltage adjustment potentiometer) to make final adjustments to the generator while running under normal load.
10. Readjust the stability using the gain potentiometer (if necessary).

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

Automatic Voltage Regulator Testing

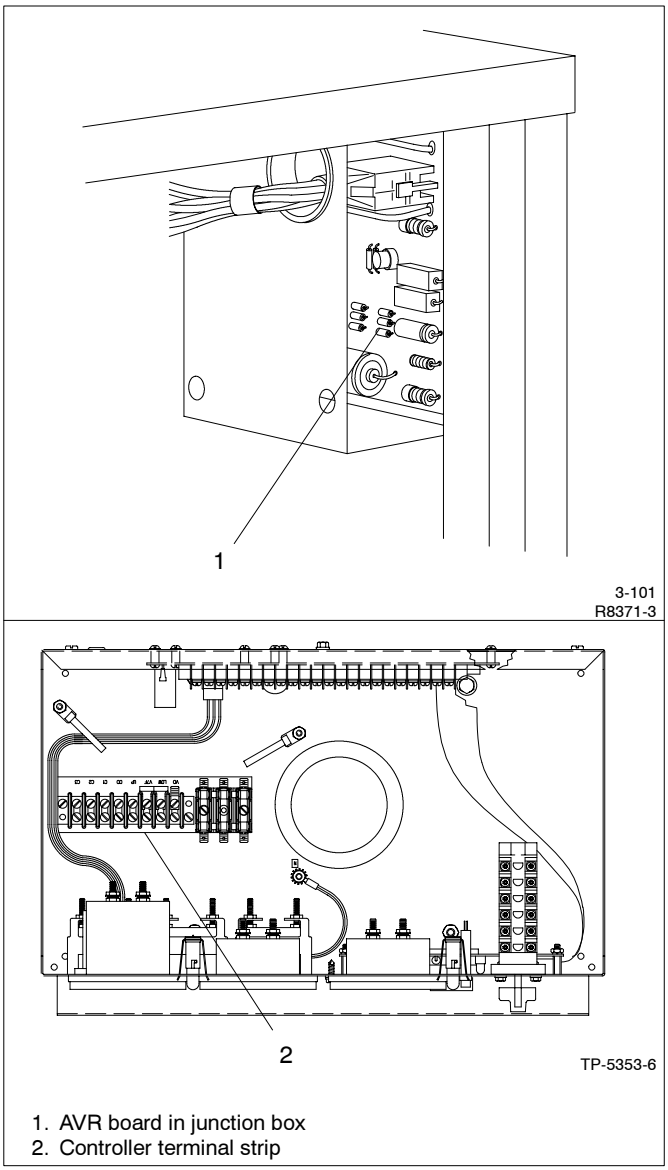
With the safeguard breaker closed (if equipped):

1. Disconnect the wiring harness connector from the voltage regulator and check for continuity between the voltage sensing leads V7 and V8 (pins 4 and 10). See Figure 12. If this circuit is open, repair or replace. An open circuit normally results in a high voltage or overvoltage condition. Check the 15-amp fuse (if equipped).

2. If there is continuity between V7 and V8, check for continuity in the voltage adjustment circuit (leads 67 and 68). With the harness disconnected check the resistance between pins 1 and 3. This resistance should change as the voltage adjust rheostat is turned. Repair or replace inoperative components as necessary. An inoperative voltage adjust rheostat usually results in a nonadjustable voltage.

3. Check for battery voltage at the voltage regulator harness plug (pins 2 and 11) with the generator set running. If there is not a voltage reading, check the safeguard circuit breaker. If battery voltage is not present, there should be a very low voltage at the main output leads.

4. While the generator set is running, check for approximately 0.5–1.0 volts DC output at terminals 3B (+) and 5B (-) on the LED board or separate 3B/5B connector and check for 8 volts (approximately) at the connector. If voltage is not measured at the connector, check for open or short circuits in the wiring back to the voltage regulator. If a fault exists in the voltage regulator wiring, repair or replace as necessary. If the voltage regulator wiring tests good, replace the voltage regulator. Low voltage at the LED circuit board may cause a low output voltage fault.



1. AVR board in junction box
2. Controller terminal strip

Figure 12 AVR and Controller Connections

Voltage Regulator Kits

Kit: 326930, 12-Volt, 3-Phase		
Qty.	**Description**	**Part Number**
6	Washer, lock	X-22-7
12	Nuts	X-72-4
4	Terminal, ring #8	X-283-7
6	Tie, cable	X-468-2
1	Tie, cable	X-468-3
6	Vibromount	282829
6	Standoff, circuit board	360459
1	Adapter, wiring harness	360597
1	PCB assy, activator photo	B-360418
1	PCB assy, voltage regulator, 3-phase, 12-volt	A-360420

Kit: GM24494, 24-Volt, 3-Phase		
Qty.	**Description**	**Part Number**
6	Washer, lock	X-22-7
12	Nuts	X-72-4
4	Terminal, ring #8	X-283-7
6	Tie, cable	X-468-2
1	Tie, cable	X-468-3
6	Vibromount	282829
6	Standoff, circuit board	360459
1	Adapter, wiring harness	360597
1	PCB assy, activator photo	B-360418
1	PCB assy, voltage regulator, 3-phase, 24-volt	A-360757

Kit: GM24495, 12-Volt, 1-Phase		
Qty.	**Description**	**Part Number**
6	Washer, lock	X-22-7
12	Nuts	X-72-4
4	Terminal, ring #8	X-283-7
6	Tie, cable	X-468-2
1	Tie, cable	X-468-3
6	Vibromount	282829
6	Standoff, circuit board	360459
1	Adapter, wiring harness	360597
1	PCB assy, activator photo	B-360418
1	PCB assy, voltage regulator, 1-phase, 12-volt	A-360800

Kit: GM24496, 24-Volt, 1-Phase		
Qty.	**Description**	**Part Number**
6	Washer, lock	X-22-7
12	Nuts	X-72-4
4	Terminal, ring #8	X-283-7
6	Tie, cable	X-468-2
1	Tie, cable	X-468-3
6	Vibromount	282829
6	Standoff, circuit board	360459
1	Adapter, wiring harness	360597
1	PCB assy, activator photo	B-360418
1	PCB assy, voltage regulator, 1-phase, 24-volt	A-360801