

J87435A, LISTS 1, 3, 10, AND 30

RECTIFIER

48 VOLTS, 35 AMPERES

OPERATING METHODS

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1. GENERAL

1.01 The J87435A rectifier is designed for use in the 110A, 111A, 131C, and 133B power plants. The J87435A, List 1 and 3, rectifiers operate from 208/240 volt, single phase, 60 ±3 Hz ac input. The J87435A, List 10 and 30, rectifiers operate from 110/127/220/237 volt, single phase, 60 ±3 Hz ac input. The J87435A rectifiers provide filtered and regulated 48 volts dc at 35 amperes output and will float a 12-cell battery.

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to emphasize the more significant changes.

- (a) To add S3 ENABLE/DISABLE switch to Option X
- (b) To add procedures for adjustment of current limit circuit
- (c) To add procedures for checking TR shutdown and high voltage shutdown (HV)
- (d) To add new List 10 and 30 to J87435A rectifier
- (e) To update the section in general.

This reissue does affect the Equipment Test List.

1.03 This section is based on drawings SD-82396-01, Issue 2A, and CD-82396-01, Issue 1. If this section is to be used with equipment or apparatus that is associated with a later issue of the drawing, reference should be made to the SD and CD to determine the extent of the changes and the manner in which the section may be affected.

1.04 A rectifier equipped with Option X includes the following circuits required for use on customer premises: rectifier, ferroresonance control, 12-volt dc power supply, current limit, fuse alarm, high voltage shutdown, backup high voltage shutdown, circuit board installation check, and manual start and stop. Option X also includes a S3 ENABLE/DISABLE switch. This switch was added to the circuit to permit routine maintenance of the rectifier without transmitting an alarm.

1.05 A rectifier equipped with Option W has all the features of the rectifier with Option X, plus the following circuits required for use in central offices: remote shutdown and start, walk-in, auxiliary power supply, and regulation test key NO LOAD/FULL LOAD.

1.06 The rectifiers have the following additional features: automatic crossover to internal sense should the external leads open, capability of floating 24 lead-acid cells at 2.17 volts per cell plus a 2-volt battery feed loop drop between the rectifier and the point of regulation, manual adjustment of output volts, visual indication of rectifier failure, test jacks for reading output volts at the point of regulation, output current ammeter, and fuse failure shutdown.

Note: The high voltage shutdown feature is dependent upon the rectifier delivering a load

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current of at least 1.50 amperes. In addition, Option W requires a high voltage signal from the plant control bay. Option X requires high voltage to be present at the output of the rectifier.

1.07 The output polarity of the rectifier is determined by wiring Options Y and Z. Option Y is required for those applications in which the negative side of the battery is grounded. Option Z is required for those applications in which the positive side is grounded.

1.08 Regulation is obtained by the use of a controlled ferroresonant regulator, consisting of a ferroresonant transformer and an electronic control circuit. The control circuit acts upon the transformer to provide output voltage regulation against input voltage, frequency, and load current variations.

1.09 The rectifier is rack mounted and is 14 inches high, 21.25 inches wide, and 12 inches deep and weighs 150 lbs.

1.10 To simplify maintenance, the circuits associated with alarm, power control, voltage regulation, current limiting, voltage walk-in, and restart are mounted on replaceable circuit packs. Input and output power connections, filter capacitors, and printed circuit packs are accessible through a door in the front of the cabinet. Other circuit components are accessible by removing four screws and raising the front panel.

1.11 Keep ventilating passages of the rectifier unobstructed to ensure adequate cooling during operation.

1.12 If the rectifier is held in stock or otherwise out of service for a period exceeding 30 months, the polarized electrolytic capacitors should be checked and serviced in accordance with Bell System Practice 032-110-701.

2. APPARATUS

2.01 List of Tools and Test Apparatus

TOOLS	DESCRIPTION
◆R-2443	3-Inch Screwdriver

R-1005	Jewelers Screwdriver
WIAP	Test Cord (2)◆

TEST APPARATUS

KS-20599, L4	Digital Multimeter or
KS-8039	Volt-Milliammeter (or equivalent)

3. OPERATION

3.01 **Preparing to Start:** Prepare the rectifier for service as follows.

- (1) Operate the POWER ON-OFF switch (S1) or input circuit breaker (CB1) to OFF.
- (2) ◆Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.
- (3) Operate the DC OUTPUT circuit breaker (CB2) to OFF.◆

Danger: Voltages inside the rectifier may exceed 150 volts to ground. Avoid all contact with terminals. Do not allow the test pick to touch two metal parts at the same time since destructive and dangerous short circuits may occur.

- (4) ◆Disconnect the plant control connector (J1) from circuit pack SP3 (Option W).◆
- (5) ◆Remove the SP4 circuit pack from the rectifier.◆
- (6) Rotate the OUTPUT VOLTS ADJ control fully counterclockwise (ccw). Apply power to the input terminals of the rectifier.
- (7) Connect the KS-20599, L4, digital multimeter, set to the ◆1000-volt◆ ac scale, to measure the ac voltage applied to the J87435A rectifier. Measure the voltage at the input terminals located on the left-rear side of the rectifier cabinet.

Requirement: The input ac voltage should measure as follows:

RECTIFIER	NOMINAL VOLTAGE	LIMITS (Volts)
J87435A Lists 1 or 3	208 (L1 or L3 Option S)	184 to 220
J87435A Lists 1 or 3	240 (L1 or L3 Option S)	212 to 254
J87435A Lists 10 or 30	110 (L10 or L30 Option R)	94 to 121
J87435A Lists 10 or 30	127 (L10 or L30 Option R)	108 to 140
J87435A Lists 10 or 30	220 (L10 or L30 Option V)	187 to 242
J87435A Lists 10 or 30	237 (L10 or L30 (Option V)	202 to 260

- (8) ♦Reinsert the SP4 circuit pack in the rectifier.♦
 - (9) Check that the regulation and control circuit fuses F1 (+V) and F2 (-V) are installed.
 - (10) ♦Operate the S3 ENABLE/DISABLE switch, if equipped, to ENABLE.♦
 - (11) Operate the POWER ON-OFF switch (S1) (Option W) or the input circuit breaker (Option X) to ON to precharge the electrolytic capacitors of the rectifier.
 - (12) After 30 seconds, operate the DC OUTPUT circuit breaker (CB2) to ON.
 - (13) Operate the POWER ON-OFF switch (S1) to OFF.
 - (14) ♦Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.♦
 - (15) Connect the plant connector (J1) to the CPS SP3 (Option W) board.
- 3.02 Starting:** To place the rectifier in service, proceed as follows:
- (1) Verify that the procedures of paragraph 3.01 have been completed.
 - (2) Adjust the manual OUTPUT VOLTS ADJ to the minimum voltage ccw position.
 - (3) Connect the KS-20599, L4, digital multimeter, set to the 100-volt dc scale, to the terminals of the battery.
 - (4) Verify that the DC OUTPUT circuit breaker is operated to ON to connect the rectifier to the load.
 - (5) ♦Operate the S3 ENABLE/DISABLE switch, if equipped, to ENABLE.♦
 - (6) Operate the POWER ON-OFF switch (Option W) or input circuit breaker (Option X) to ON.
 - (7) Adjust the manual OUTPUT VOLTS ADJ so that the voltage read at the battery terminals is 52.08 volts (2.17 volts per cell).
- Note:** The rectifier has a walk-in feature that causes the output dc voltage to increase gradually. Wait at least 30 seconds after turnon before measuring and adjusting the output voltage (Option W).
- (8) If the meter reads above 52.08 volts and there are other rectifiers on the line, they should be adjusted down until 52.08 volts are reached. The rectifier put in service should be adjusted until it picks up load.
- Note:** If the rectifier goes into current limit and 52.08 volts are not reached, do not adjust

the rectifier any further. Allow time for the batteries to charge until the rectifier drops out of current limit. If the rectifier does not drop out of current limit after some time and 52.08 volts are not reached, more rectifiers must be added to the plant to support the load.

- (9) Remove the test leads of the KS-20599, L4, digital multimeter from the battery.

3.03 Stopping: To stop the rectifier, proceed as follows:

- (1) Operate the POWER ON-OFF switch (Option W) or input circuit breaker (Option X) to OFF.
- (2) Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.

3.04 Taking the Rectifier Out of Service: To take the rectifier out of service, proceed as follows:

- (1) Operate the POWER ON-OFF switch (or the input circuit breaker) to OFF.
- (2) Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.
- (3) Operate the DC OUTPUT circuit breaker (CB2) to OFF.
- (4) Remove fuses F1 and F2.
- (5) Disconnect the J1 plug from CP SP3 (Option W).
- (6) Remove the associated ac input fuses from the power service cabinet.

Danger: *Battery voltage is still present on the output terminals of the rectifier as long as the rectifier is connected to the dc bus bars of the plant and the connector (J1) is plugged into the CPS SP3 board.*

4. ROUTINE CHECKS AND ADJUSTMENTS

Danger 1: *All power should be disconnected before attempting maintenance in the power sections of the rectifier. The battery should be disconnected when the rectifier is shut down for extended peri-*

ods or for maintenance. Be careful not to short circuit the battery or sensing terminals.

Danger 2: *Voltages inside the rectifier may exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time since destructive and dangerous short circuits may occur.*

Caution: *Routine checks and adjustments are intended to detect and correct defects and abnormal operating conditions that may cause service interruptions. Routine checks should be made only when they will not interfere with service.*

4.01 Routine checks are intended to detect defects particularly in infrequently operating parts of the equipment, and insofar as possible, to guard against circuit failures which interfere with service. Checks and adjustments, other than those required by trouble conditions, should be performed during a period when there will be a minimum interference to service. If the rectifier does not meet the testing requirements, go to Part 5.

4.02 Periodically check the output float voltage on the associated power plant voltmeter when the unit is operating on voltage control. If the voltage is not correct, readjust the rectifier float voltage as outlined in paragraph 4.10.

4.03 If the relays are mounted on circuit boards, they must be checked and the circuit board replaced in case of malfunction. If possible, periodically check all other relays for condition of contacts, making sure that they are in accordance with the circuit requirement table and Bell System Practices which apply.

Danger: *When using a portable instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be properly connected to the instrument before making any contact with the circuit to be tested. If connections are to be changed from one instrument range to another, the power should first be disconnected from equipment being tested, or if test*

picks are being used, they should be removed from the equipment under test.

4.04 Current Limiting Circuit: Proceed as follows:

- (1) Verify that DC OUTPUT circuit breaker is in ON position.
- (2) On each rectifier in the power plant not being tested, operate the DC OUTPUT circuit breaker to OFF until 35 amperes is indicated on the rectifier's OUTPUT CURRENT ammeter being tested.

Note: If current is too low for the above test, operate input circuit breaker (CB1) or POWER ON-OFF switch on rectifiers being tested to OFF for one to two minutes. This will allow the battery voltage to drop. Operate input circuit breaker or POWER ON-OFF switch to ON to restart rectifier. It should now be possible to complete the current limit check.

- (3) If OUTPUT CURRENT ammeter does not indicate 35 amperes, adjust R25 potentiometer on SP4 circuit pack until 35 amperes is indicated on OUTPUT CURRENT ammeter.
- (4) If OUTPUT CURRENT ammeter still does not indicate 35 amperes, replace SP4 circuit pack and repeat test.

Caution: *Circuit packs should not be removed or inserted with voltages present. Before removing a circuit pack, turn off the rectifier, remove the regulation (RB) fuse from the plant, and operate the DC OUTPUT circuit breaker to OFF. After replacing a circuit pack, operate the POWER ON-OFF to ON then operate the DC OUTPUT circuit breaker to ON. The regulation fuse may then be installed (if the control cable is connected).*

4.05 Check Walk-In Feature (Option W): Proceed as follows:

Note: The rectifier must be delivering at least 25 amperes.

- (1) Operate the input circuit breaker or POWER ON-OFF switch to OFF.
- (2) Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.

- (3) Wait one minute.
- (4) Operate the S3 ENABLE/DISABLE switch, if equipped, to ENABLE.
- (5) Operate the input circuit breaker or POWER ON-OFF switch to ON.

Requirement: The current does not return to its original value instantly. Full current load may require up to one minute.

- (6) Operate all DC OUTPUT circuit breakers to ON on rectifiers that were operated during subparagraph 4.04(2).

4.06 Voltage Regulation Check (Option W): Proceed as follows:

- (1) Connect the KS-20599, L4, digital multimeter, set to the 100-volt dc scale, to test jacks REG(+) and (-).
- (2) Check that the POWER ON-OFF switch (S1) is operated to ON and that the DC OUTPUT circuit breaker is closed.
- (3) Operate the test key NL/FL (S2) to the NL position.

Requirement: The output dc current measured on the OUTPUT CURRENT ammeter (M1) should indicate a slight decrease. The output voltage measured on the KS-20599, L4, digital multimeter should indicate a decrease of approximately 1/4 volt.

Note: In a working plant and depending on the office load, the current may drop to zero.

- (4) Operate the test key NL/FL (S2) to the FL position.

Requirement: The output dc current measured on the OUTPUT CURRENT ammeter (M1) should indicate a slight increase. The output voltage measured on the KS-20599, L4, digital multimeter should indicate an increase of approximately 1/4 volt.

Note: If office load is greater than 35 amperes and rectifier is producing less than 35 amperes, rectifier may go to current limiting.

- (5) Release the test key.

- (6) Remove the test leads of the KS-20599, L4, digital multimeter from test jacks REG (+) and (-).

4.07 **Prepare Rectifier for Control Tests:**

- (1) Operate the associated ac circuit breaker or fuse to OFF.
- (2) Operate the input circuit breaker (CB1) or the POWER ON-OFF switch to OFF.
- (3) Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.
- (4) Operate the DC OUTPUT (CB2) circuit breaker to OFF.
- (5) **List 3 and List 30 only:** Disconnect the J1 plant control connector from the P1 plant control plug. This is done by unscrewing the J1 connector. Connect a jumper between pin X of the P1 plant control plug and battery (charge lead terminal).
- (6) **List 1 and List 10 Only:** Disconnect all plant leads or straps connected to the TS-2 terminal board.
- (7) Rotate OUTPUT VOLTS ADJ potentiometer fully ccw.
- (8) Operate the associated ac circuit breaker or fuse to ON.
- (9) Operate the S3 ENABLE/DISABLE switch, if equipped, to ENABLE.
- (10) Operate the input circuit breaker (CB1) or the POWER ON-OFF switch to ON.
- (11) Operate the DC OUTPUT (CB2) circuit breaker to ON.
- (12) **List 1 and List 10:** Connect the KS-20599, L4, digital multimeter, set to the 100-volt scale, between terminal 7 (-) and terminal 8 (+) of the TS-2 terminal board.

Note: This connection is necessary because false output voltage readings appear at the REG test jacks when the plant regulation leads are disconnected.

- (13) **List 3 and List 30:** Connect the KS-20599, L4, digital multimeter, set to the 100-volt dc

scale, between the lug at the upper part of the large heat sink (+) and the anode of CR3 (-). The anode has the heavy white lead connected to it.

Note: This connection is necessary because output voltage cannot be read at the REG test jacks with J1 disconnected.

- (14) Check that the POWER ON-OFF switch (or the input circuit breaker) is operated to ON and that the DC OUTPUT circuit breaker is closed.

4.08 **Shutdown Feature—Plant TR Lead (List 3 and List 30 only):**

- (1) Verify steps in paragraph 4.07 have been completed.
- (2) Connect a jumper between pin **a** of P1 plant control plug and ground lead of the battery.

Requirement: The rectifier should shut down but the RECT FAIL lamp should remain extinguished.

- (3) Disconnect the jumper between pin **a** of P1 plant control plug and ground.

Requirement: The rectifier restarts.

4.09 **Shutdown Feature—High Voltage Shutdown (HV) (List 3 and List 30 Only):**

- (1) Verify steps in paragraph 4.07 have been completed.
- (2) Rotate the OUTPUT VOLTS ADJ potentiometer ccw until rectifier's OUTPUT CURRENT ammeter indicates 0 amperes.

- (3) Connect a jumper between pin U of P1 plant control plug and ground.

Requirement: The rectifier continues to operate but indicates no current.

- (4) Rotate the OUTPUT VOLTS ADJ potentiometer cw until rectifier's OUTPUT CURRENT ammeter indicates approximately 5 amperes.

Requirement: The rectifier will shut down and the RECT FAIL lamp is lighted.

- (5) Disconnect the jumper between pin U of P1 plant control plug and ground.

- (6) Connect a jumper between pins B and C of P1 plant control plug.

Requirement: The rectifier restarts and the RECT FAIL lamp is extinguished.

- (7) Disconnect the jumper from pins B and C of P1 plant control plug.

4.10 Output Voltage Adjustment (Lists 1, 3, 10, and 30):

- (1) Verify steps in paragraph 4.07 have been completed.
- (2) Rotate the OUTPUT VOLTS ADJ cw to obtain 52.08 volts indication on digital multimeter.

Note: Turning the OUTPUT VOLTS ADJ control clockwise (cw) causes the output voltage to increase rapidly up to the terminal voltage of the battery. Above this level, the voltage increases slowly and the charging current increases rapidly as the OUTPUT VOLTS ADJ control is turned cw.

4.11 Restore Rectifier to Service: To restore rectifier to service, proceed as follows:

- (1) Operate the associated ac circuit breaker or fuse to OFF.
- (2) Operate the input circuit breaker (CB1) or POWER ON/OFF switch to OFF.
- (3) Operate the S3 ENABLE/DISABLE switch, if equipped, to DISABLE.
- (4) Operate the DC OUTPUT (CB2) circuit breaker to OFF.
- (5) ♦Remove the associated regulation fuse from the plant.♦
- (6) **List 1 and List 10:** Reconnect all plant leads or straps, that were disconnected, to correct terminals of the TS-2 terminal board.
- (7) **List 3 and List 30:** Disconnect the jumper from pin X of the P1 plant control connector and battery (charge lead terminal).

- (8) Connect the P1 plant control plug to the J1 plant control connector.

- (9) Operate the associated ac circuit breaker or fuse to ON.

- (10) Operate the S3 ENABLE/DISABLE switch, if equipped, to ENABLE.

- (11) Operate the input circuit breaker (CB1) or the POWER ON-OFF switch to ON.

- (12) Operate the DC OUTPUT (CB2) circuit breaker to ON.

- (13) ♦Install the associated regulation fuse in the plant.♦

- (14) Connect the KS-20599, L4, digital multimeter, to the 100-volt dc scale, to the REG (+) and (-) test jacks.

- (15) Verify that digital multimeter indicates 52.08 volts dc. Adjust OUTPUT VOLTS ADJ, if necessary.

Note: The meter now indicates battery voltage. This is the actual output voltage of the rectifier.

- (16) Disconnect the digital multimeter from test jacks.

- (17) Replace front cover of rectifier if no other tests are to be made.

5. TROUBLES

5.01 The possible causes of troubles in the rectifier and the corrective actions to be taken are given in the following chart. In addition to the action specified, check for loose and open connections. Check for short circuits due to foreign matter lying across wiring terminals.

5.02 If the trouble is not corrected by following the trouble charts, refer to the circuit schematic drawing for further information. Refer to Section 032-173-301 for testing, replacing, and storing circuit packs and semiconductor devices.

TROUBLE CHART

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
<p>A. No output. Rect Fail lamp illuminated.</p>	<p>(1) No input power. Ac power failure.</p> <p>(2) Input fuses operated in ac power service cabinet.</p> <p>(3) Fuse F1 or F2 for alarm and control circuit operated.</p> <p>(4) Input power relay K1 does not close (Option W) due to:</p> <p>(a) Relay K1 defective</p> <p>(b) Diode CR6 across coil of K1 shorted.</p> <p>(c) Auxiliary power supply defective.</p> <p>(d) TR relay K2 on CPS SP3 operated. Remote shutdown ground signal on terminal u of P1 on CPS SP3.</p> <p>(e) RFA relay K3 on CPS SP3 operated.</p> <ul style="list-style-type: none"> • Fuse F1 or F2 operated or removed. • Backup high voltage shutdown circuit actuated by excessive output voltage (59.8 volts or more). Manual OUTPUT VOLTS ADJ set too high. • Circuit pack not properly installed. • Selective high voltage shutdown circuit actuated (Option W) by high voltage (HV) shutdown (ground) signal applied to pin W on P1 of CPS SP3. 	<p>Locate and correct fault. Restore input power.</p> <p>Locate and correct cause of operated fuse. Replace operated fuse.</p> <p>Replace fuse. If fuse operates a second time, replace circuit pack CP1 (CPS SP3) or CP2 (CPS SP4).</p> <p>Check coil of relay K1. Check contacts 5 and 7 for make.</p> <p>Replace CPS SP3.</p> <p>Replace CPS SP3.</p> <p>Remove unwanted ground signal from remote shutdown circuit TR.</p> <p>Replace circuit pack CP1, CP2, CPS SP3 or CPS SP4. Replace fuse.</p> <p>Adjust manual OUTPUT VOLTS ADJ for output less than 60 volts dc.</p> <p>Inspect and install circuit pack properly.</p> <p>Eliminate HV shutdown (ground) signal. Restart rectifier.</p>

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
<p>A. No output. Rect Fail lamp illuminated. (Contd)</p>	<p>(5) Input power circuit breaker CB1 will not stay closed. (Option X) due to:</p> <p>(a) Fuse F1 or F2 operated or removed.</p> <p>(b) Components on HV shutdown PC board CP1 defective. Q1, Q2, CR1, CR2, CR3, associated resistors.</p> <p>(c) Components on CPS SP4, in HV shutdown circuit, defective: IC1, R12, C11, R53.</p> <p>(6) Output circuit breaker tripped open.</p> <p>(7) Rectifier/filter circuit components defective: CR3, CR4, L1, C3, C4, M1.</p>	<p>Correct cause of trouble. Replace fuse F1 or F2.</p> <p>Replace CPS SP1.</p> <p>Replace CPS SP4.</p> <p>Check that load is ready to receive charge. Close output circuit breaker.</p> <p>Locate and replace defective components.</p>
<p>B. Output current low</p>	<p>(1) NL/FL switch in NL position (Option W).</p> <p>(2) OUTPUT VOLTS ADJ (R13) out of adjustment or open.</p> <p>(3) Defective components in regulation control circuit on CPS SP4.</p> <p>(4) Voltage walk-in circuit components defective on CPS SP3: C1, C2, R1, (Option W).</p> <p>(5) Ferro control circuit components defective.</p>	<p>Release NL/FL switch (Option W).</p> <p>Readjust or replace OUTPUT VOLTS ADJ (R13).</p> <p>Replace CPS SP4.</p> <p>Replace CPS SP3.</p> <p>Check and replace defective components of control circuit inductor L2, resonant capacitor C1, RC network R1, C2, or TRIAC Q1. Replace CPS SP4.</p>
<p>C. Output current high</p>	<p>(1) NL/FL switch held in FL position. (Option W).</p> <p>(2) OUTPUT VOLTS ADJ (R13) shorted or out of adjustment.</p>	<p>Release NL/FL switch. Check to see if the switch is defective.</p> <p>Readjust or replace R13.</p>

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
C. Output current high (Contd)	<p>(3) Current control circuit components defective on CPS SP4, R25, R17, R34, R40, IC1, CR8.</p> <p>(4) Ferro control circuit components defective.</p>	<p>Replace CPS SP4.</p> <p>Check and replace defective components of control circuit: inductor L2, resonant capacitor C1, RC network R1, C2, TRIAC Q1. Replace CPS SP4.</p> <p><i>DANGER: There are high voltages present in this area of the circuit.</i></p>
D. Output current not limited to 35 amperes.	<p>(1) Resistors R16 or R17 open (on each side of meter M1 shunt R18).</p> <p>(2) Defective components in current limiting circuit.</p>	<p>Replace R16 or R17.</p> <p>Replace CPS SP4.</p>
E. Rectifier will not restart (Option W).	<p>(1) Restart circuit components defective. CR4, Q1, R4, R5, R6, R8, C4, RV1.</p> <p>(2) External restart leads disconnected. Restart switch defective. No closure across terminals B to C of J1 on CPS SP3.</p>	<p>Replace CPS SP3.</p> <p>Repair external restart closure circuit.</p>
F. Selective high voltage shutdown circuit inoperative.	<p>(1) Rectifier not delivering at least 1.75 amperes.</p> <p>(2) External high voltage shutdown signal (ground) is not applied to CPS SP3 J1 terminal u (Option W).</p> <p>(3) Components of current monitoring circuit defective: R14, R15 at meter M1 shunt R18, IC1, R29, R12, R53, C11, CR15, R35, Q4, and R14 on CPS SP4.</p>	<p>Operation is normal. Circuit operates only when output current is 1.75 amperes or more.</p> <p>Check external high voltage shutdown signal connections. Repair as required.</p> <p>Replace CPS SP4.</p>

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
F. Selective high voltage shutdown circuit inoperative. (Contd)	<p>(4) Components of high voltage shutdown circuit defective: Q4, JC3, C12, CR14, R43 on CPS SP4.</p> <p>(5) Components of high voltage shutdown circuit defective: Q2, R3, CR1, C1, R5, CR3, R4 on CPS1 or CPS 2.</p> <p>(6) Defective components R11 or opto-isolator U1 on CPS SP3 (Option W).</p> <p>(7) Defective components R47 R54, R37 on CPS SP4 (Option X).</p>	<p>Replace CPS SP4.</p> <p>Replace CPS 1 or CPS 2.</p> <p>Replace CPS SP3.</p> <p>Replace CPS SP4.</p>
G. Rectifier remote shutdown inoperative (Option W).	<p>(1) External battery not connected.</p> <p>(2) On shutdown, ground closure not applied to terminal u of J1 of CPS SP3.</p>	<p>Connect battery to terminal X of J1 on CPS SP3.</p> <p>Repair external shutdown circuit. (TR circuit between pin a on J1 of CPS SP3 and ground).</p>
H. Walk-in circuit disabled. Output current appears suddenly when power is applied (Option W).	Walk-in circuit components defective. R1, R2, R3, R7 CR3 on CPS SP3.	Replace CPS SP3.
I. Backup high voltage shutdown circuit inoperative. Does not shut down at 59.8 volts.	Backup high voltage shutdown circuit components defective (Option W): R3, R6, R7, CR2, Q2, CR1 on CPS 2. In addition, Q1, R2, R1 on CPS 1 (Option X).	<p>Replace CPS 2 (Option W).</p> <p>Replace CPS 1 (Option X).</p>
J. No regulation. NL/FL test switch causes no change in output current (Option W).	<p>(1) Defective NL/FL switch.</p> <p>(2) Defective R4 or R5 across NL/FL switch.</p>	<p>Replace NL/FL switch.</p> <p>Check and replace defective resistors.</p>

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
<p>J. No regulation. NL/FL test switch causes no change in output current (Option W). (Contd)</p>	<p>(3) Defective components in voltage regulation circuit on CPS SP4: IC1, IC2, Q2, Q3, R1, R2, R3, R4, R5, R6, R8, R30, R31, R28, R36, R50, CR2, CR3, CR12, RV4, CR22, C6.</p> <p>(4) External voltage sense leads disconnected from load or from TB1 terminals R(+) and R(-).</p>	<p>Replace CPS SP4.</p> <p>Check external voltage sense leads.</p>