J87434A, LISTS 1 AND 3
RECTIFIER
24 VOLTS, 35 AMPERES
OPERATING METHODS

CONTENTS PAGE

1. GENERAL

1.01 The J87434A rectifier is designed for use in the 110A, 111A, ▶130A, 131C, and 132A◀ power plants. The rectifier operates from 208/240 volt, single phase, 60 ±3 Hz ac input and provides filtered and regulated 24 volts dc at 35 amperes output. The J87434A rectifier 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 (Option X)

(b) To add procedure for adjustment of current limit circuit

(c) To add procedure for checking TR shutdown and high voltage shutdown (HV)

(d) To update the section in general.

This reissue does affect the Equipment Test List.

1.03 This section is based on drawings SD-82395-01, Issue 2A, and CD-82395-01, 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 has an ENABLE/DISABLE switch which permits 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 12 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 load 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 in 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 130 pounds.

1.10 To simplify maintenance; the circuit 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 C Screwdriver
R-1005	Jewelers Screwdriver
W1AP	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 S3 ENABLE/DISABLE switch, if equipped, to DISABLE.◀

(2) Operate the POWER ON-OFF switch (S1) or input circuit breaker (CB1) to OFF.

(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 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 J87434A rectifier. Measure the voltage at the input terminals located on the left side of the rectifier cabinet.

Requirement: The input ac voltage should measure 184 to 220 volts ac for the nominal 208-volt circuit or 212 to 254 volts for the nominal 220-volt circuit.

(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 (Op-

tion 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 connect (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 26.04 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 26.04 volts and there are other rectifiers on the line, they should be adjusted down until 26.04 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 26.04 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 26.04 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 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 interface 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 ***Check 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 rectifier 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 ***Check Voltage Regulation (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 Test:***

(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 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 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:*** 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 regulations leads are disconnected.

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

tween 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 output circuit breaker is closed.

4.08 ***Shutdown Feature—Plant TR Lead (List 3 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 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 (List 1 and 3):***

(1) Verify steps in paragraph 4.07 have been completed.

(2) Rotate the OUTPUT VOLTS ADJ cw to obtain 26.04 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:*** Reconnect all plant leads or straps, that were disconnected, to correct terminals of the TS-2 terminal board.

(7) ***List 3:*** 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, set to the 100 volt dc scale, to the REG (+) and (−) test jacks.

(15) Verify that digital multimeter indicates 26.04 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
A. No output. Rect Fail lamp illuminated	(1) No input power. AC power failure.	Locate and correct fault. Restore input power.
	(2) Input fuses operated in ac power service cabinet	Locate and correct cause of operated fuse. Replace operated fuse.
	(3) Fuse F1 or F2 for alarm and control circuit operated.	Replace fuse. If fuse operates a second time, replace circuit pack CP1 (CPS SP3) or CP2 (CPS SP4).
	(4) Input power relay K1 does not close (Option W) due to:	
	(a) Relay K1 defective.	Check coil of relay K1. Check contacts 5 and 7 for make.
	(b) Diode CR6 across coil of K1 shorted.	Replace CPS SP3.
	(c) Auxiliary power supply defective.	Replace CPS SP3.
	(d) TR relay K2 on CPS SP3 operated. Remote shutdown ground signal on terminal u of P1 on CPS SP3.	Remove unwanted ground signal from remote shutdown circuit TR.
	(e) RFA relay K3 on CPS SP3 operated.	
	• Fuse F1 or F2 operated or removed.	Replace circuit pack CP1, CP2, CPS SP3, CPS SP4. Replace fuse.
	• Backup high voltage shutdown circuit actuated by excessive output voltage (29.9 volts or more). Manual OUTPUT VOLTS ADJ set too high.	Adjust manual OUTPUT VOLTS ADJ for output less than 30 volts dc.
	• Circuit pack not properly installed.	Inspect and install circuit pack properly.

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	• Selective high voltage shutdown circuit actuated (option W) by high voltage (HV) shutdown (ground) signal applied to pin W on P1 of CPS SP3.	Eliminate HV shutdown (ground) signal. Restart rectifier.
	(5) Input power circuit breaker CB1 will not stay closed. (Options X and V) due to:	
	(a) Fuse F1 or F2 operated or removed.	Correct cause of trouble. Replace fuse F1 or F2.
	(b) Components on HV shutdown PC board CP1 defective. Q1, Q2, CR1, CR2, CR3, associated resistors:	Replace CPS SP1.
	(c) Components on CPS SP4, in HV shutdown circuit, defective: IC1, R12, C11, R53.	Replace CPS SP4.
	(6) Output circuit breaker tripped open.	Check that load is ready to receive charge. Close output circuit breaker.
	(7) Rectifier/filter circuit components defective: CR3, CR4, L1, C3, C4, M1.	Locate and replace defective components.
B. Output current low	(1) NL/FL switch in NL position (Option W).	Release NL/FL switch (Option W).
	(2) OUTPUT VOLTS ADJ (R13) out of adjustment or open.	Readjust or replace OUTPUT VOLTS ADJ (R13).
	(3) Defective components in regulation control circuit on CPS SP4.	Replace CPS SP4.
	(4) Voltage walk-in circuit components defective on CPS SP3: C1, C2, R1, (Option W).	Replace CPS SP3.

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	(5) Ferro control circuit components defective.	Check and replace defective components of control circuit inductor L2, resonant capacitor C1, RC network R1 C2, or triac Q1. Replace CPS SP4.
C. Output current high.	(1) NL/FL switch held in FL position. (Option W)	Release NL/FL switch. Check to see if the switch is defective.
	(2) OUTPUT VOLTS ADJ (R13) shorted or out of adjustment.	Readjust or replace R13.
	(3) Current control circuit components defective on CPS SP4: R25, R17, R34, R40, IC1, CR8.	Replace CPS SP4.
	(4) Ferro control circuit components defective.	Check and replace defective components of control circuit: inductor L2, resonant capacitor C1, RC network R1, C2 triac Q1. Replace CPS SP4. *Danger: There are high voltages present in this area of the circuit.*
D. Output current not limited to 35 amperes.	(1) Resistors R16 or R17 open (on each side of meter M1 shunt R18).	Replace R15 or R17.
	(2) Defective components in current limiting circuit.	Replace CPS SP4.
E. Rectifier will not restart (Option W).	(1) Restart circuit compoments defective. CR4, Q1, R4, R5, R6, R8, C4, RV1.	Replace CPS SP3.
	(2) External restart leads disconnected. Restart switch defective. No closure across terminals B to C of J1 on CPS SP3.	Repair external restart closure circuit.
F. Selective high voltage shutdown circuit inoperative	(1) Rectifier not delivering at least 1.75 amperes.	Operation is normal. Circuit operates only when output current is 1.75 amperes or more.

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	(2) External high voltage shutdown signal (ground) is not applied to CPS SP3 J1 terminal u (Option W).	Check external high voltage shutdown signal connections. Repair as required.
	(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.	Replace CPS SP4.
	(4) Components of high voltage shutdown circuit defective: Q4, JC3, C12, CR14, R43 on CPS SP4.	Replace CPS SP4.
	(5) Components of high voltage shutdown circuit defective: Q2, R3, CR1, C1, R5, CR3, R4 on CPS 1 or CPS 2.	Replace CPS 1 or CPS 2.
	(6) Defective components R11 or optoisolator U1 on CPS SP3 (Option W).	Replace CPS SP3.
	(7) Defective components R47, R54, R37 on CPS SP4 (Option X or V).	Replace CPS SP4.
G. Rectifier remote shutdown inoperative (Option W).	(1) External battery not connected.	Connect battery to terminal X of J1 on CPS SP3.
	(2) On shutdown, ground closure not applied to terminal u on J1 of CPS SP3.	Repair external shutdown circuit (TR circuit between pin a on J1 CPS SP3 and ground).
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 29.9 volts.	Backup high voltage shutdown circuit components defective (Option W) R3, R6, R7, CR2, Q2, CR1 on CPS 2, and in addition Q1, R2, R1 on CPS 1. (Option X).	Replace CPS 2 (Option W). Replace CPS 1 (Option X).

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
J. No regulation. NL/FL test switch causes no change in output current (Option W).	(1) Defective NL/FL switch.	Replace NL/FL switch.
	(2) Defective R4 or R5 across NL/FL switch.	Check and replace defective resistors.
	(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.	Replace CPS SP4.
	(4) External voltage sense leads disconnected from load or from TB1 terminals R(+) and R(—).	Check external voltage sense leads.