RECTIFIER

J87434A

OPERATING METHODS

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1. GENERAL

1.01 The J87434A rectifier is designed for use in the 110A and 111A power plants. The rectifier operates from 208/240 volt, 60-cycle ac input and provides filtered and regulated 26 volts dc at 35 amperes maximum, to float a 12-cell battery.

1.02 Whenever this section is reissued, the reasons for reissue will be listed in this paragraph. This issue does affect the Equipment Test List.

1.03 This section is based on drawings SD-82395-01, Issue 1, 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.

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 regultion, 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 1.75 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 X. 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, 23 inches wide, and 12 inches deep.

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. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS	
KS-20599 L4	Digital Multimeter or
KS-8039	Volt-Milliammeter

3. OPERATION

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

(1) Operate the ON-OFF switch (S1) or circuit breaker (CB1) to OFF. Make sure that the plant connector (J1) is removed from circuit pack SP3 (Option W) and that the output circuit breaker (CB2) is 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.

(2) Rotate the OUT VOLTS ADJ control fully counterclockwise (ccw). Apply power to the input terminals of the rectifier.

(3) Connect the KS-20599 L4 digital multimeter, set to the 600-volt ac scale, to measure the ac voltage applied to the J87434A rectifier. Measure the voltage at the input terminals located inside the 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.

(4) Check that the regulation and control circuit fuses F1 (+V) and F2 (-V) are installed.

(5) Operate the ON-OFF switch (S1) (Option W) or the input circuit breaker (Option K) to ON to precharge the electrolytic capacitors of the rectifier.

(6) After 30 seconds, operate the output circuit breaker (CB2) to ON.

(7) Operate the ON-OFF switch (S1) to OFF.

(8) 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 3.01 have been completed.

(2) Adjust the manual OUT 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 output circuit breaker is operated to ON to connect the rectifier to the load.

(5) Operate the ON-OFF switch (Option W) or input circuit breaker (Option K) to ON.

(6) Adjust the manual OUT 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 turn-on before measuring and adjusting the output voltage (Option W).

(7) 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 is 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 is 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 is not reached, more rectifiers must be added to the plant to support the load.

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

3.03 ***Stopping:*** To stop the rectifier, operate the ON-OFF switch (Option W) or input circuit breaker (Option X) to OFF.

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

(1) Operate the ON-OFF switch (or the input circuit breaker) to OFF.

(2) Operate the output circuit breaker to OFF.

(3) Remove fuses F1 and F2.

(4) Disconnect the plug J1 from CP SP3 (Option W).

(5) 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

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.

Danger: 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.

4.01 ***Output Voltage Adjustment:*** Proceed as follows:

(1) Connect the KS-20599 L4 digital multimeter, set to the 100-volt dc scale, to the terminals of the battery.

(2) Check that the ON-OFF switch (or the input circuit breaker) is operated to ON and that the output circuit breaker is closed.

(3) Adjust the OUT VOLTS ADJ to obtain 26.04 volts at the battery terminals.

Note: Turning the OUT 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 OUT VOLTS ADJ control is turned cw.

(4) Leave the battery voltage adjusted to 26.04 volts dc. Remove the KS-20599 L4 digital multimeter leads.

4.02 ***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 ON-OFF switch (S1) is operated to ON and that the output circuit breaker is closed.

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

Requirement: The output dc ammeter (M1) should show a slight decrease. The output voltage measured on the KS-20599 L4 digital multimeter should show a decrease of approximately one-fourth volt.

(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 show a slight increase. The output voltage measured on the KS-20599 L4 digital multimeter should show an increase of approximately one-fourth volt.

(5) Release the test key.

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

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

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	(4) Selective high voltage shutdown circuit actuated (option W) by high voltage (HV) shutdown (ground) signal applied to pin W on P1 of CPS SP3.	(4) 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.	(a) 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.	(b) Replace CPS SP1.
	(c) Components on CPS SP4, in HV shutdown circuit, defective: IC1, R12, C11, R53.	(c) Replace CPS SP4.
	(6) Output circuit breaker tripped open.	(6) Check that load is ready to receive charge. Close output circuit breaker.
	(7) Rectifier/filter circuit components defective: CR3, CR4, L1, C3, C4, M1.	(7) Locate and replace defective components.
Output current low	(1) NL/FL switch in NL position (Option W).	(1) Release NL/FL switch (Option W).
	(2) OUT VOLTS ADJ (R13) out of adjustment or open.	(2) Readjust or replace OUT VOLTS ADJ (R13).
	(3) Defective components in regulation control circuit on CPS SP4.	(3) Replace CPS SP4.
	(4) Voltage walk-in circuit components defective on CPS SP3: C1, C2, R1, (Option W).	(4) Replace CPS SP3.

TROUBLE CHART (Contd)

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	(5) Ferro control circuit components defective.	(5) Check and replace defective components of control circuit inductor L2, resonant capacitor C1, RC network R1 C2, or triac Q1. Replace CPS SP4.
Output current high.	(1) NL/FL switch held in FL position. (Option W)	(1) Release NL/FL switch. Check to see if the switch is defective.
	(2) OUT VOLTS ADJ (R13) shorted or out of adjustment.	(2) Readjust or replace R13.
	(3) Current control circuit components defective on CPS SP4: R25, R17, R34, R40, IC1, CR8.	(3) Replace CPS SP4.
	(4) Ferro control circuit components defective.	(4) 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.*
Output current not limited to 35 amperes.	(1) Resistors R16 or R17 open (on each side of meter M1 shunt R18).	(1) Replace R16 or R17.
	(2) Defective components in current limiting circuit.	(2) Replace CPS SP4.
Rectifier will not restart (Option W).	(1) Restart circuit components defective. CR4, Q1, R4, R5, R6, R8, C4, RV1.	(1) Replace CPS SP3.
	(2) External restart leads disconnected. Restart switch defective. No closure across terminals B to C of J1 on CPS SP3.	(2) Repair external restart closure circuit.
Selective high voltage shutdown circuit inoperative	(1) Rectifier not delivering at least 1.75 amperes.	(1) 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).	(2) 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.	(3) Replace CPS SP4.
	(4) Components of high voltage shutdown circuit defective: Q4, JC3, C12, CR14, R43 on CPS SP4.	(4) Replace CPS SP4.
	(5) Components of high voltage shutdown circuit defective: Q2, R3, CR1, C1, R5, CR3, R4 on CPS 1 or CPS 2.	(5) Replace CPS 1 or CPS 2.
	(6) Defective components R11 or optoisolator U1 on CPS SP3 (Option W).	(6) Replace CPS SP3.
	(7) Defective components R47, R54, R37 on CPS SP4 (Option X or V).	(7) Replace CPS SP4.
Rectifier remote shutdown inoperative (Option W).	(1) External battery not connected.	(1) 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.	(2) Repair external shutdown circuit (TR circuit between pin a on J1 CPS SP3 and ground).
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.
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
No regulation. NL/FL test switch causes no change in output current (Option W).	(1) Defective NL/FL switch.	(1) Replace NL/FL switch.
	(2) Defective R4 or R5 across NL/FL switch.	(2) 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.	(3) Replace CPS SP4.
	(4) External voltage sense leads disconnected from load or from TB1 terminals R(+) and R(—).	(4) Check external voltage sense leads.