

RECTIFIER J86227 OPERATING METHODS

1. GENERAL

1.01 This section covers the operation of the J86227A, J86227B, J86227C, and J86227D regulated-tube and semiconductor rectifiers.

1.02 This section is reissued to add information covering the output voltage regulation, the CR1 rectifier, excessive grid current, and procedures for making test connections.

1.03 All rectifiers are designed for use on 115 \pm 10 volts, 50 to 60 cycles except for the J86227D rectifiers which are designed for 117 \pm 6 volts, 50- to 60-cycle ac power service. The dc output is adjustable as shown in the following table.

RECTIFIER	VOLTS MIN-MAX	AMPERES MIN-MAX
J86227A,L1 & L3	290-310	0.10-0.22
J86227A,L2 & L4	200-300	0.02-0.10
J86227B,L1	290-310	0.10-0.22
J86227C,L1 & L2	290-310	0.10-0.21
J86227D,L1 & L2	290-310	0-0.23

Note: Using optional wiring and apparatus, the load range can be extended to between 0.10 and 0.23 ampere for J86227C rectifiers and between 0.10 and 0.26 ampere for J86227D rectifiers.

1.04 The over-all output voltage regulation over the current range specified in 1.03 is as follows.

RECTIFIER	REGULATION
J86227A,L1 & L3	\pm 1.0 Volt
J86227A,L2 & L4	\pm 0.8 Volt
J86227B,L1	\pm 1.0 Volt
J86227C,L1 & L2	\pm 0.8 Volt
J86227D,L1 & L2	\pm 0.3 Volt

These regulations hold to no load if Western Electric tubes are used.

1.05 *Caution: Voltages inside the rectifier case are over 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. The door switch, when open, disconnects only one side of the power supply, so that some ac terminals may be alive or at service voltage to ground. The door switch, when furnished, is provided for the protection of personnel and should not be made inoperative. Disconnect ac supply before opening cover to work inside of rectifier except as necessary to make tests.*

1.06 The instructions are based on drawings:

SD-81010-01 for J86227A,L1 and L3 and J86227B,L1

SD-81010-02 for J86227C,L1 and L2

SD-81010-03 for J86227A,L2 and L4

SD-81010-04 for J86227D,L1 and L2

For detailed description of the operation, see the corresponding circuit description.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	Insulated Switch Holder (see 6.04)
—	3-Inch C Screwdriver
TEST APPARATUS	
KS-14510 L1	Volt-Ohm-Milliammeter
—	General Radio Co Type W5MT Variac
—	Electron-Tube Test Set

3. OPERATION

Preparing to Start Initially

3.01 When putting the rectifier into service initially, check against the circuit drawing to see that:

- (a) Correct tubes are in the sockets.
- (b) Connections between TS1 and the T1 and T2 transformers are correct.
- (c) Proper F1 fuse is provided, when required, or proper service fuse is in supply circuit.
- (d) Either positive or negative output is grounded.
- (e) CR2 diode is connected in the circuit when CR1 plug-in rectifier replaces the V1 electron tube.

Initial Adjustments

3.02 Turn the ADJ VOLTS rheostat completely counterclockwise with a screwdriver and connect the ac power. The output voltage is indicated by the voltmeter, if provided, or may be measured through J1 and J2 pin jacks. Voltage will develop in about 20 seconds but should be allowed to stabilize for 3 minutes before making final adjustment to the desired value. Clockwise rotation of the ADJ VOLTS rheostat increases the voltage.

Routine Adjustments

3.03 For routine starting and stopping, it is only necessary to turn on or off the ac supply. Whenever any tube or CR1 plug-in rectifier is replaced, the output voltage should be checked and adjusted if necessary.

4. ROUTINE CHECKS

4.01 Aged or low electron tubes may be detected by checking the regulation performance of the rectifiers periodically as follows. Insert the Variac, etc, into the ac line input of the rectifiers. (See Fig. 1 and 2.) Operate for a few minutes at normal line voltage and then drop the line voltage to the lower limit. The output voltage and the output current should not change. If any change is observed,

check the electron tubes in that rectifier in any available electron-tube test set in accordance with its associated section. If a Variac is not available, check all rectifier electron tubes periodically in the electron-tube test set.

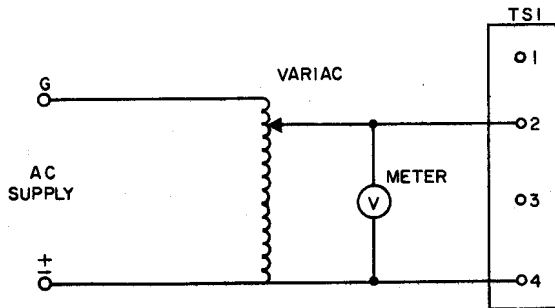


Fig. 1 - Test Circuit Connections for SD-81010-01, SD-81010-03, and SD-81010-04

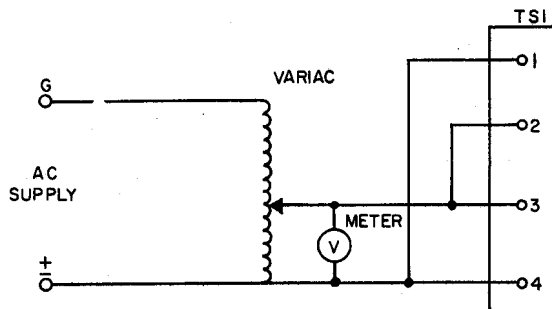


Fig. 2 - Test Circuit Connections for SD-81010-02

4.02 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

5. TROUBLES

5.01 The ADJ VOLTS rheostat is totally enclosed and should be replaced if it becomes defective in any respect.

5.02 Excessive grid current may be due to grid emission, defective insulation, or abnormally high gas content in a tube.

5.03 A defective V1 tube should be replaced with the 34B plug-in rectifier assembly (CR1) as shown on the associate schematic drawing.

Trouble Chart

5.04 Should any of the following troubles develop, it is suggested that the possible causes be checked in the order listed. If the trouble is not found, look for open connections.

TROUBLE	POSSIBLE CAUSE
(a) No dc voltage	Power failure
	Blown ac supply fuse or F1 fuse
	Failure of V1 or V2 tube
	C1, C2, C3, C4, C5, C6, C7, or C8 capacitor shorted
	Failure of CR1 plug-in rectifier
	ADJ VOLTS rheostat incorrectly set
	Low emission on V1 rectifier tube
	Rectifier overloaded
	Low ac line voltage
	V4 tube not functioning properly
(b) Low dc voltage	Aged V2 series tubes
	C9 or C12A capacitor shorted (all rectifiers except J86227D,L1 and L2)
	C9 or C11 capacitor shorted (J86227D,L1 and L4)
	V6 tube aged, voltage drop too high (J86227C,L1 and L2)
	Open in R12 or C11 (all rectifiers except J86227D,L1 and L2)
	Open R14 or C10 (J86227D,L1 and L2)
	ADJ VOLTS rheostat incorrectly set
	V5 tube aged, voltage drop too high
	High ac line voltage
	(c) High dc voltage

TROUBLE	POSSIBLE CAUSE
	V3 tube not functioning properly
	C10 or C12B capacitor shorted (all rectifiers except J86227D,L1 and L2)
	C10 capacitor shorted (J86227D,L1 and L2)
	Insufficient load
(d) Erratic dc voltage	Loose connection at ADJ VOLTS rheostat
	Variable arc drop V5 or V6
(e) High ripple	Flashing in V5 or V6
(f) Frequent blowing of F1 fuse	Flashover of rectifier tube

6. POINT-TO-POINT VOLTAGES

6.01 As long as the rectifier operates satisfactorily, point-to-point voltage values are not needed and are not operating requirements to be checked in routine. In case the rectifier output cannot be secured, these values may be useful in locating defective conditions.

6.02 High voltages are present within the rectifier and every precaution should be observed to avoid any contact with exposed metal parts or terminals when the rectifier is in operation. Door switches are provided on some designs. On later designs, the terminals and connections are covered or shielded to prevent accidental contact and to permit testing with the rectifier in operation, no door switch being provided.

Caution: When using any portable instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be connected at the instrument before making contact with the circuit to be tested. If connections are to be changed from one instrument range to another, the ac should first be disconnected from the equipment being tested or, if test picks are being used, they should be removed from the equipment under test.

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- 6.03 The readings given in Tables A through D are approximate and typical for a rectifier adjusted as indicated. The readings are measured with a KS-14510 L1 volt-ohm-milliammeter. The door switch, when furnished, does not disconnect both sides of the input power so that the terminals of the door switch and fuse if provided, as well as the transformer primary terminals, may be at voltage to ground.
- 6.04 The KS-14510 L1 meter is provided with both test clip leads and test pick leads. Wherever possible, the test clip leads should be used in making connections to leave the maintenance man free to observe the meter and to operate the door switch, when furnished. When it is necessary to use a test pick lead, the door switch should be operated with some insulating material to avoid grounding one hand. This insulating material may be a stick 5 or 6 inches long

with a depression in one end into which the switch plunger fits. The depression is to prevent the stick from accidentally slipping off the switch plunger.

6.05 Caution: The readings shown in the following tables are for typical rectifiers in good working condition. A defective rectifier with the power connected may have quite different voltages from those shown; therefore, it may be desirable to use a higher voltage range on the meter until readings indicate the proper range to use for the defective condition. Remove ac fuses before removing any protective guards behind the cover to work on the inside of the rectifier unit. A defect in the rectifier may leave a high voltage charge on a capacitor and other parts of the circuit with the power off (door switch released). The tube filaments may be connected to power even with the door switch released.

**Table A — J86227A,L1 and L3 and J86227B,L1 Rectifiers Adjusted to 300-Volt,
0.22-Ampere Output With 115-Volt, 60-Cycle Power Supply**

VOLTAGE ACROSS	METER CONNECTIONS				KS-14510 METER	
	+ TERM.		- TERM.		RANGE	READING (volts)
	APP	TERM.	APP	TERM.		
C5 & C6	C5	+	C6	—	600 DC	408 *
R3	V2	6	V2	7	12 DC	5.4
R4	V2	3	V2	7	12 DC	6.2
R14	TS2	5	V4	5	300 DC	136
R15	TS2	5	C10	Top	300 DC	130
R16	C10	Top	C9	Top	60 DC	18.8
R18, R21, R22	C9	Top	TS2	9	300 DC	148
R23	V2	7	TS2	5	3 DC	0.48
V2	V2	5	V2	7	300 DC	100
V5	V5	5	V5	2	300 DC	152
T1 Primary	T1	1	T1	2	300 AC	120
V1 Filament	T1	7	T1	8	12 AC	5
V2 Filament	T1	5	T1	6	12 AC	6.4
V3 & V4 Filament	T1	9	T1	10	12 AC	6.4
T2 Primary	T2	1	T2	2	300 AC	120
**1/2 T2 Secondary	T2	3 or 4	T2	5	600 AC	400 or 380
**1/2 T2 Secondary	T2	7 or 6	T2	5	600 AC	400 or 380

*Each individual C1, C2, C3, C4, C5, and C6 capacitor should have about half this voltage.

**Depending on whether 422A and 421A tubes or 5R4GY and 6AS7-G tubes are used in positions V1 and V2, transformer taps 4 and 6 or 3 and 7, respectively, are used.

Table B — J86227A, L2 and L4 Rectifiers Adjusted to 250-Volt, 0.1-Ampere Output With 115-Volt, 60-Cycle Power Supply

VOLTAGE ACROSS	METER CONNECTIONS				KS-14510 METER	
	+ TERM.		- TERM.		RANGE	READING (volts)
	APP	TERM.	APP	TERM.		
C1 & C2	T1	7	T2	4	600 DC	464 *
R14	V5	5	V4	5	300 DC	124
R15	V5	5	C10	Top	300 DC	123
R16	C10	Top	V5	2	300 DC	22
R18	V5	2	C7	Bottom	300 DC	100
R23	V2	3	V5	5	3 DC	0.36
V2	V2	5	V2	6	300 DC	104
V2	V2	2	V2	3	300 DC	101
V5	V5	5	V5	2	300 DC	149
T1 Primary	T1	1	T1	2	300 AC	119
V1 Filament	T1	7	T1	8	12 AC	4.9
V2 Filament	T1	5	T1	6	12 AC	6.3
V3, V4 Filament	T1	9	T1	10	12 AC	6.3
T2 Primary	T2	1	T2	2	300 AC	119
**1/2 T2 Secondary	T2	3 or 4	T2	5	600 AC	400 or 380
**1/2 T2 Secondary	T2	7 or 6	T2	5	600 AC	400 or 380

Table C — J86227C Rectifier Adjusted to 300-Volt, 0.21-Ampere Output With 115-Volt, 60-Cycle Power Supply

VOLTAGE ACROSS	METER CONNECTIONS				KS-14510 METER	
	+ TERM.		- TERM.		RANGE	READING (volts)
	APP	TERM.	APP	TERM.		
C1 & C2	T1	7	T2	5	600 DC	400
R1	T1	7	V3	5	300 DC	131
R3	V2	6	V2	7	12 DC	6.1
R4	V2	3	V2	7	12 DC	5.1
R13	V2	7	V6	5	60 DC	14.2
R14	V2	7	V4	5	300 DC	124
R15	V2	7	C10	Top	300 DC	121
R16	C10	Top	V5	2	60 DC	25.3
R17	V2	7	C12	3	60 DC	22.5
R18, R21	V4	4	R18	—	300 DC	147
V2	V2	2	V2	7	300 DC	106
V3	V3	5	V3	7	300 DC	96
V4	V4	5	V4	7	60 DC	22
V5	V5	5	V5	2	300 DC	144
V6	V6	5	V6	2	300 DC	106
V1 Filament	V1	2	V1	8	12 AC	4.8
V2 Filament	V2	7	V2	8	12 AC	6.2
V3, V4 Filament	T1	9	V3	4	12 AC	6.2
**1/2 T2 Secondary	T2	3 or 4	T2	5	600 AC	400 or 380
**1/2 T2 Secondary	T2	7 or 6	T2	5	600 AC	400 or 380

*Each individual C1, C2, C3, C4, C5, and C6 capacitor should have about half this voltage.

**Depending on whether 422A and 421A tubes or 5R4GY and 6AS7-G tubes are used in positions V1 and V2, transformer taps 4 and 6 or 3 and 7, respectively, are used.

Table D — J86227D Rectifier Adjusted to 300-Volt, 0.115- and 0.23-Ampere Output With 117-Volt, 60-Cycle Power Supply

VOLTAGE ACROSS	METER CONNECTIONS						KS-14510 METER		
	+ TERM.			- TERM.			VOLTS AT		
	APP	TERM.	APP	TERM.	RANGE	0.115 AMP	0.23 AMP		
Input	TS1	1	TS1	2	300 AC	117	117		
High Voltage Transformers }	T2	5	T2	6	600 AC	348	345		
	T2	6	T2	7	600 AC	347	343		
V1 Heater	V1	2	V1	8	12 AC	5.1	5.1		
V2 Heater	V2	7	V2	8	12 AC	6.5	6.5		
V3, V4 Heaters	V3	3	V3	4	12 AC	6.4	6.4		
Filter Condensers	C1	2	C1	1	600 DC	215	200		
	C2	2	C2	1	600 DC	215	200		
	C3	2	C3	1	600 DC	214	198		
	C4	2	C4	1	600 DC	215	200		
	C5	2	C5	1	600 DC	215	200		
	C6	2	C6	1	600 DC	214	200		
Unregulated DC	V2	2	TS2	9	600 DC	431	400		
V2	V2	2	V2	7	300 DC	134	104		
R3	V2	6	V2	7	12 DC	2.5	5.4		
R4	V2	3	V2	7	12 DC	3.6	6.1		
R1	V2	2	V3	5	300 DC	150	106		
R13	TS2	5	V3	6	12 DC	6.9	4.8		
R14	TS2	5	V4	4	300 DC	74	75		
R15	TS2	5	V3	2	300 DC	72	73		
V5	TS2	5	V5	2	300 DC	100	100		
R16	V3	2	V5	2	60 DC	27	26.5		
R17	V4	2	V5	2	12 DC	1.6	1.6		
R18	V5	2	TS2	9	300 DC	196	196		
V3	V3	5	V3	2	300 DC	58	70		
1/2 V4	V4	4	V4	2	60 DC	23.3	22.7		
1/2 V4	V4	6	V4	2	300 DC	98	98		

6.06 If a door switch is provided, either in the rectifier or in common with other equipment, the procedure for making measurements is as follows.

- (a) Remove the cover of the rectifier, releasing the door switch, thereby disconnecting the ac supply.
- (b) Remove the panel screws so that it may be swung out for access to the apparatus.
- (c) If a voltmeter is not part of the rectifier, either connect a voltmeter to the jacks in the rectifier panel or use a voltmeter connected to the output but mounted with the associated equipment.
- (d) Put the pin ends of the test leads in the meter, selecting the range indicated in the table.
- (e) Connect the test leads to the apparatus terminals shown in the tables.
- (f) Operate the door switch, keeping clear of other parts of the rectifier. The door switch may be associated with the complete equipment and not with the rectifier.
- (g) When the output voltmeter has stabilized, observe the voltage on the KS-14510 L1 meter.
- (h) Release the door switch.

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- (i) Wait 10 seconds to allow filter capacitors to discharge.
- (j) Remove the test leads from apparatus.
- (k) Proceed to make any other measurements repeating items (d) through (j).
- (l) Restore the panel screws and replace the cover.

6.07 If no door switch is provided, remove the cover, when furnished, and swing out the panel. Terminals are guarded by an insulating grid through which the test picks may be inserted for measuring voltages with the rectifier in operation.

6.08 The following table of tube-socket voltages are for J86227D rectifiers adjusted to 300-volt, 0.115- and 0.23-ampere output with 117-volt, 60-cycle power supply. The voltages are in volts dc as read between ground [(-) meter jack)] and the socket terminal number

indicated [(+) meter jack]. These readings were taken with the rectifier negative output grounded. Viewed from the rear, the socket terminals starting from the keyway or blank position are numbered clockwise. Due to the particular meter used, the readings are about 2 percent low.

Table E — Readings Made With KS-14510 Volt-Ohm-Milliammeter Using 600-Volt DC Range

TUBE	SOCKET TERMINAL NUMBER							
	1	2	3	4	5	6	7	8
At 0.115-Ampere Load								
V2	280	435	299	280		299		
V3	220	222			281	283		
V4		195	191	220		296	195	
AT 0.23-Ampere Load								
V2	293	406	302	288		302		
V3	219	221			294	285		
V4		195	191	220		295	195	