J86223 VOLTAGE REGULATOR
OPERATING METHODS

1. GENERAL

1.01 This section covers the operation of a regulator for 6.3-volt a-c and d-c regulated filament supplies. It was designed to provide stable filamant voltages for the 44A transmission measuring system used in conjunction with transmission testing in type "L" carrier systems. The regulator may be used to furnish any one of three combinations of outputs:

	Outputs	A-C Volts	A-C Amp.	D-C Volts	D-C Amp.
(1)	3	6.3	1.5		
(2)	2	6.3	1.5		
	1			6.3	0.3-0.6
(3)	1	6.3	1.5		
	2			6.3	0.3-1.0

In the third combination, 1.0 ampere d-c may be obtained by allowing an increase in the a-c output voltage above 6.3 volts.

The regulation maintains the output voltage within ±1 per cent for line variations of ±8.7 per cent with fixed loads. The power service required is 105-125 volts at 50 to 60 cycles. The regulator is suitable for use in room temperatures from 50F to 104F

> Caution: Voltages inside the regulator case are over 150 volts to ground and between terminals. 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. Disconnect a-c supply before working on regulator except as necessary to make tests.

1.02 Routine checks should be made during a period when they will cause the least service reaction.

1.03 In this section the term capacitor is used for apparatus coded as either a capacitor or a condenser and the term resistor is used for apparatus coded either as a resistor or a resistance.

1.04 These instructions are based on drawing SD-81001-01. For detailed description of the operation see the associated circuit description.

1.05 For the care of electrolytic capacitors see Section 032-110-701.

1.06 Information in this section is arranged under the following headings:

1.07 List of Tools and Test Apparatus (Equivalents may be substituted, if desired)

Meter, M9B
Screwdriver, cabinet, 3"

2. OPERATION

How the Regulator Works (See Fig. 1 - Functional Schematic)

2.01 The regulator operating on alternating current furnishes regulated alternating current which is used directly for filament power or which is supplied to a disc rectifier assembly to produce filtered direct current for filaments. The direct current is regulated by the regulated a-c supply for the rectifier.

2.02 Regulation of the a-c supplies for filament is secured by means of a saturable reactor L1 having two coils (1-3 and 4-6) in series with the a-c lines, and on the same magnetic structure a third coil (7-8), which controls the saturation with direct current. This direct current is obtained from rectifier tube V2 under control of amplifier tube V1 which responds to very slight changes in a-c output voltage in such a way as to cause a correction of the output voltage.

2.03 The a-c voltage across the primary (1-2) of transformer T3, and therefore across terminals (1-2) of transformer T2, induces in the section (5-7) of T2 a voltage which is constantly compared with the voltage across thermistor RT1. This voltage is practically constant due to the inherent characteristics of the thermistor. The difference in these voltages is applied between the cathode and grid 4 of tube V1 which causes changes in the current flow through R2. The resultant

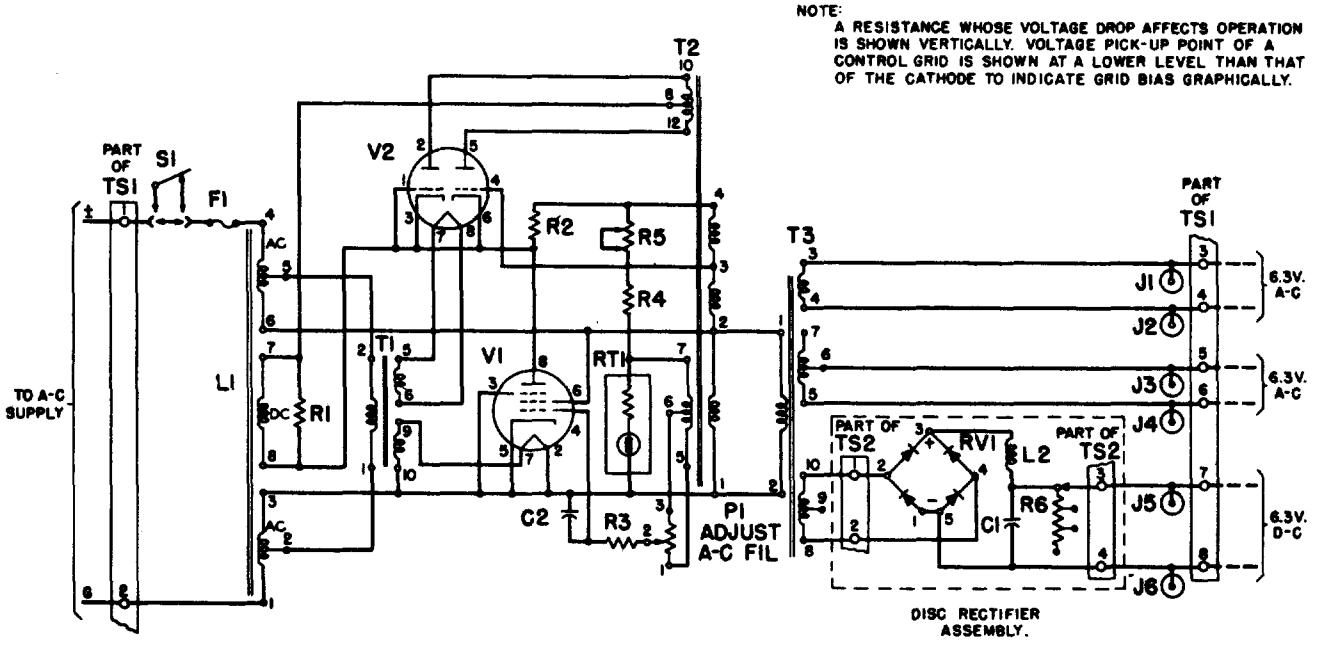

Fig. 1 - Functional Schematic

voltage drop across R2 is compared with the voltage across (3-4) of transformer T2, and the difference is applied between the cathode and grid 4 of tube V2. The resultant current is added to that from the unregulated half of tube V2 to provide more or less d-c saturating current in L1. Increasing this current increases saturation and reduces the voltage drop in the a-c coils of L1, thereby increasing the a-c output voltage.

2.04 For example, if the line voltage increases, the voltage on winding 5-7 of T2 increases making the voltage from grid 4 to cathode 5 of V1 more negative. This reduces the current through V1 and resistor R2. The voltage across R2 is reduced while the voltage across winding 3-4 of T2 is increased, both changes making the effective voltage from grid 4 to cathode 6 of V2 more negative. The increased grid bias on V2 reduces the current through one half of V2, effectively reducing the saturation in L1 and, as explained above, reducing the voltage applied to T3. In this way the regulator corrects nearly all the line voltage change.

2.05 Transformer T1 connected to taps in reactor L1 provides partially regulated supplies for the filaments of the tubes in the a-c regulator. Transformer T3 provides closely regulated alternating current for external a-c filament loads and for the disc rectifier assembly.

2.06 Regulated d-c supply for filament is shown in Fig. 1 at terminals 7 and 8 of terminal strip TS1. A second d-c supply is secured if another disc rectifier assembly is similarly connected between transformer T3 terminals 5-7 and terminal strip TS1 terminals 5 and 6, instead of the connections shown. The various possible combinations of output are supplied according to the list number of the equipment. The disc rectifier is the usual type for full-wave rectification and its output is filtered by choke coil L2 and capacitor C1.

Preparing to Start Initially

2.07 When putting the regulator into service initially, check against the circuit drawing to see that:

(a) Correct tubes are in the sockets.

(b) Proper fuse F1 is provided.

(c) Proper power service voltage is provided.

(d) Intended filament loads are connected to terminals of terminal strip TS1.

Initial Adjustments

2.08 Turn ADJUST AC FIL. completely counterclockwise with a screwdriver and connect the a-c power. The output voltages will develop in 10-15 seconds but should be allowed to stabilize for about 5 minutes before making adjustments to the desired values. Further small changes may occur in the course of 2 hours. Clockwise rotation of the rheostat increases the

voltages. The 6.3-volt filament output may be checked with a portable a-c voltmeter at jacks J1 and J2. The d-c output values may be checked with a portable d-c voltmeter at jacks J5 and J6 if the regulator is equipped to supply direct current. Adjustment of the ADJUST AC FIL rheostat affects all outputs. Tapped resistor R6 is provided to permit some adjustment of a d-c output independently of the a-c output, to adjust for the particular load used and to compensate for aging of the rectifier discs.

2.09 Resistor R5 is tapped to provide adjustment of the current in thermistor RT1 to 25 ±1 milliampere. This adjustment is made at the factory for normal line voltage and need not be checked for line voltages within the range of 105-125 volts.

Routine Adjustments

2.10 For routine starting and stopping, it is only necessary to turn on or off the a-c supply. Whenever any tube is replaced, the output voltages should be checked and adjusted, if necessary.

3. ROUTINE CHECKS

3.01 Routine checks of the vacuum tubes can be made with a vacuum tube tester to determine when a tube is poor and needs to be replaced.

4. TROUBLES

4.01 The voltage drop across thermistor RT1 increases with age. When the voltages of the a-c output cannot be kept at the regulated values and ADJUST AC FIL rheostat has been turned completely counterclockwise, the thermistor should be replaced.

4.02 The a-c and d-c voltages are interdependent so that adjustments must be made for the voltage of any preferred load.

4.03 The ADJUST AC FIL rheostat is totally enclosed and should be replaced if it becomes defective in any respect.

Trouble Chart

4.04 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
6.3 Volts A-C	
No voltage.	Power failure. Blown a-c supply fuse, fuse F1. Door switch open.
Low voltage.	ADJUST AC FIL rheostat incorrectly set. Low emission from tube V2. Tube V1 out of circuit or not functioning properly. Low a-c power service voltage.
High voltage.	ADJUST AC FIL rheostat incorrectly set. Aged thermistor RT1. Tube V1 not functioning properly. High a-c power service voltage.
Erractic voltage.	Loose connection at ADJUST AC FIL rheostat or tube sockets.
6.3 Volts D-C	
Low voltage.	Aged varistor RV1. Using wrong tap on resistor R6. Capacitor C1 shorted. Overload
High voltage.	Using wrong tap on resistor R6. Load too small.
Excessive ripple	Capacitor C1 aged or open-circuited.

5. POINT-TO-POINT VOLTAGES

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

5.02 High voltages are present within the regulator and every precaution should be observed to avoid any contact with exposed metal parts or terminals when the regulator is in operation.

> Caution: When using any portable instrument, 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 a-c input should first be disconnected from the equipment being tested.

5.03 The readings given in the table are approximate and typical for a regulator adjusted as indicated in 5.06. The

readings are measured with an M9B meter which is provided with test leads. Connecting the M9B meter to observe readings does not appreciably affect the output. The door switch 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. The time required for the output voltage to stabilize after the door switch is operated is approximately 20 seconds.

5.04 The M9B 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 operate the door switch. 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 of the switch plunger.

5.05 The procedure for making measurements is as follows:

Caution: The readings shown in the following table are for a typical regulator in good working condition. A defective regulator with the power connected (door switch operated) may have quite different voltages than those shown. Therefore, it may be desirable to use a higher voltage jack in the meter until readings indicate the proper jack to use for the defective condition.

(a) Remove the cover of the regulator, releasing the door switch, thereby disconnecting the a-c supply.

(b) Put the pin ends of the test leads in the meter jacks indicated in the table for the reading desired.

(c) Connect the test leads to the apparatus terminals shown in table.

(d) Operate the door switch keeping clear of other parts of the regulator. The door switch may be associated with the complete equipment and not with the regulator.

(e) When the output has stabilized, observe the volts on M9B meter.

(f) Release the door switch.

(g) Remove the test leads from the apparatus.

(h) Proceed to make any other measurements, repeating items (b) to (g).

(i) Replace the cover.

5.06 Table of Point-to-point Voltages: Regulator adjusted to 1.5-ampere a-c output on each of three pairs of output terminals with 115-volt, 60-cycle power supply.

Voltage Across	Measurements Made: From App.	From Term.	+To App.	+To Term.	M9B Meter *: Jack	Toggle Switch	Reading Volts
L1	L1	1	L1	2	30	AC	12.1
L1	L1	1	L1	3	30	AC	22.1
L1	L1	4	L1	5	30	AC	12.5
L1	L1	4	L1	6	30	AC	22.4
Output	Jack	J1	Jack	J2	15	AC	6.4
Output	Jack	J3	Jack	J4	15	AC	6.4
Output	Jack	J5	Jack	J6	15	AC	6.3
RT1	T2	7	T2	1	300	AC	Stamped on RT1
T1 Prim	T1	1	T1	2	150	AC	96
T1 Sec, V1 Fil	T1	9	T1	10	15	AC	6.9
T1 Sec, V2 Fil	T1	5	T1	6	15	AC	6.5
T2 Prim	T2	1	T2	2	150	AC	82
T2 Sec	T2	1	T2	3	150	AC	96
T2 Sec	T2	1	T2	4	300	AC	189
T2 Sec	T2	3	T2	4	150	AC	89
T2 Sec	T2	5	T2	6	150	AC	46
T2 Sec	T2	6	T2	7	150	AC	47
T2 Sec	T2	8	T2	10	300	AC	253

Voltage Across	Measurements Made: From App.	From Term.	+To App.	+To Term.	M9B Meter *: Jack	Toggle Switch	Reading Volts
T3 Sec	T3	5	T3	7	15	AC	9
T3 Sec	T3	8	T3	10	15	AC	9

Note: *The M9B meter has an accuracy of ±5 per cent on alternating current and ±2 per cent on direct current

+"To Term" should be connected to -V jack of meter.

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