TYPE O CARRIER TELEPHONE SYSTEM — REPEATERS
TESTS AND ADJUSTMENTS — GENERAL
HEATER SUPPLY VOLTAGE ADJUSTMENT AND ELECTRON TUBE TESTS

Power can be supplied to a repeater by a +130V power supply only or by a +130V and —48V power supplies. Optional wiring at the repeater is available for each arrangement. Figs. 2 and 3 show the two different arrangements available. If only a +130V supply is available, the FIL CUR potentiometer is used for adjustment. If +130V and —48V power supplies are available the FIL CUR and 48V potentiometers must be adjusted.

In the 0 system, the tubes in the components which are common to four or more channels are checked, if possible, on an in-service basis. Out-of-service testing is used for tubes in the single channel units and for tubes where in-service testing is impractical, but only when such tubes are suspected of being the cause of a trouble condition.

The following two methods of in-service tube testing are used for the 0 system repeaters.

(1) Space current history.

(2) Change in tube output with reduced heater power.

In-service tests should be used, where provided, as they are more reliable and minimize wear and tear on tube and socket.

The purpose of this test is to adjust the repeater power supply to the correct value and to test the electron tubes.

APPARATUS:

1 — Weston Model 931 Voltmeter or equivalent
1 — Hickok Tube Test Set per KS-15559, KS-15560 or KS-15750
1 — 2J Repeater Test Set
1 — Volt-Ohm-Milliammeter—KS-14510 L1 or L5

HEATER SUPPLY VOLTAGE ADJUSTMENT

STEP	PROCEDURE
	Heaters Supplied from — 48V Battery (Y Option) (Fig. 2)
1	Repeater mounting fuse panels are shipped with wiring (X option) to supply the tube heaters from the 130-volt supply. For installations using —48V battery, install Y option.
2	If the average battery supply voltage as applied to the repeater is not known, it may be determined as follows:

STEP	PROCEDURE
	Connect the voltmeter to terminal 2 of the 48V rheostat. Measure the voltage at five-minute intervals for three successive readings. The average of the readings is the average supply voltage.
3	Connect the voltmeter between —40V jack and GRD.
	Requirement: See Fig. 1 for requirement and adjust as described below:
	The voltage at the —40V jack should be 38.5 volts when the 48-volt supply is at its average value.
	Note: The actual meter reading required will depend on the relative magnitude of the battery voltage at the time of adjustment with respect to the average battery voltage. If the battery voltage at the time of adjustment differs from the average, a correction should be applied to the —38.5-volt requirement. The corrected voltage is shown in Fig. 1 in terms of the departure from average. The —40V voltage can be adjusted by means of the 48V potentiometer.
	Heaters Supplied from +130V Supply (X Option) (Fig. 3)
4	Fuse panels which are to supply heater current from 130-volt supply need no wiring changes.
5	The total current in the three heater strings of a repeater operated from a +130-volt supply should be adjusted so that the average current is 0.147 ampere. If the current is adjusted when the supply voltage is not at its average value, a correction must be made in the adjustment. No correction is needed when the +130V supply is obtained from the J86256B, L1 rectifier since the load is nearly constant and the ac supply voltage is regulated.
	Note: If information regarding the average battery voltage is not readily obtainable, an approximate adjustment may be made, except under emergency battery conditions by using the existing voltage as the average voltage.
6	Connect the KS-14510 L5 meter to the FIL CUR jacks with the meter on the 300V scale.
	Caution: When measuring with the KS-14510, L5 meter at the FIL CUR jacks, always keep the meter on the 300V scale until both the leads are actually in the jacks, then switch to the 0.3V scale to make the reading. Switch back to the 300V scale before removing the leads from the jacks. Since the FIL CUR jacks are 130 volts above ground, a momentary grounding of a lead to the panel may damage the meter if it is not on the 300V scale.
	Requirement: If the supply voltage is at its average value the current is adjusted by the FIL CUR potentiometer so that the needle stands at the red mark near the 0.275-volt scale reading with the meter on the 0.3-volt scale. Table I gives the distance in terms of the smallest scale division on the 0.3V ac-dc scale above or below the red mark which the meter should read with corresponding deviations from average supply voltage.

STEP	PROCEDURE

TABLE I

Deviation of Supply Voltage from Average Voltage	±3	±2	±1	0
Distance in Scale Divisions above or below Red Mark that Meter should read	±1.5	±1	± .5	0

Example for Table I: The supply voltage at the time of adjustment measured 132 volts. The average voltage is 129.5 volts, a difference of ±2.5 volts. From Table I, a difference of +2 corresponds to +1.0 division, and a difference of +3 corresponds to +1.5 divisions. Therefore, the current should be adjusted so that the meter needle stands a distance equal to 1-1/4 of the smallest divisions on the 0.3V ac-dc scale above the red mark.

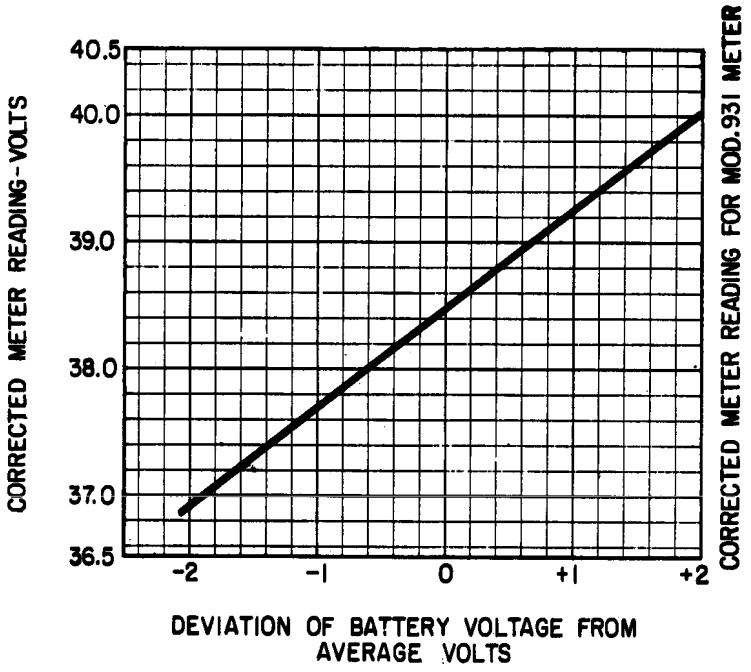

Fig. 1 — Heater Voltage Adjustment — Repeaters

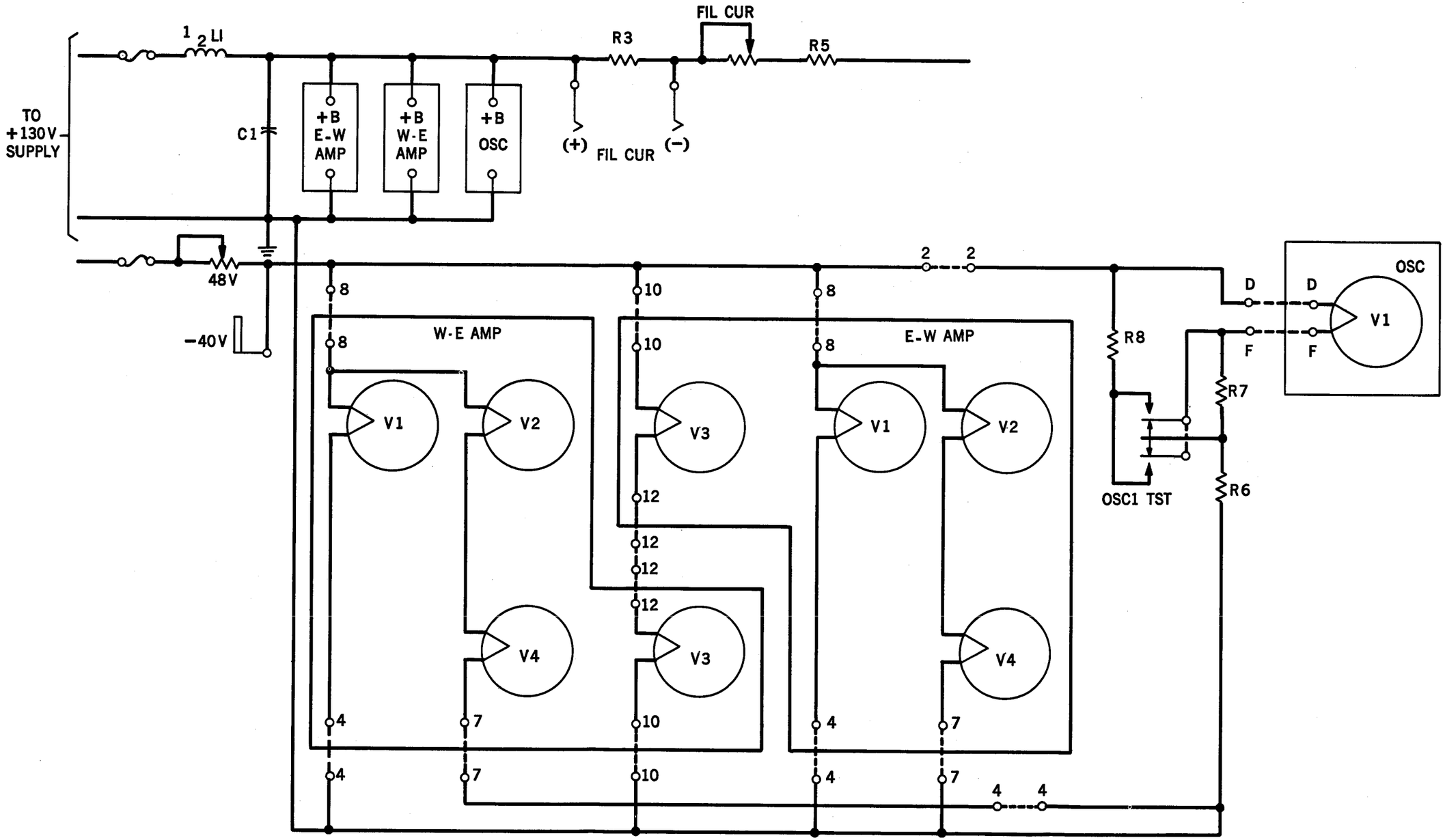

Fig. 2—Repeater Power Supply Circuit with Heaters Supplied from —48V Source

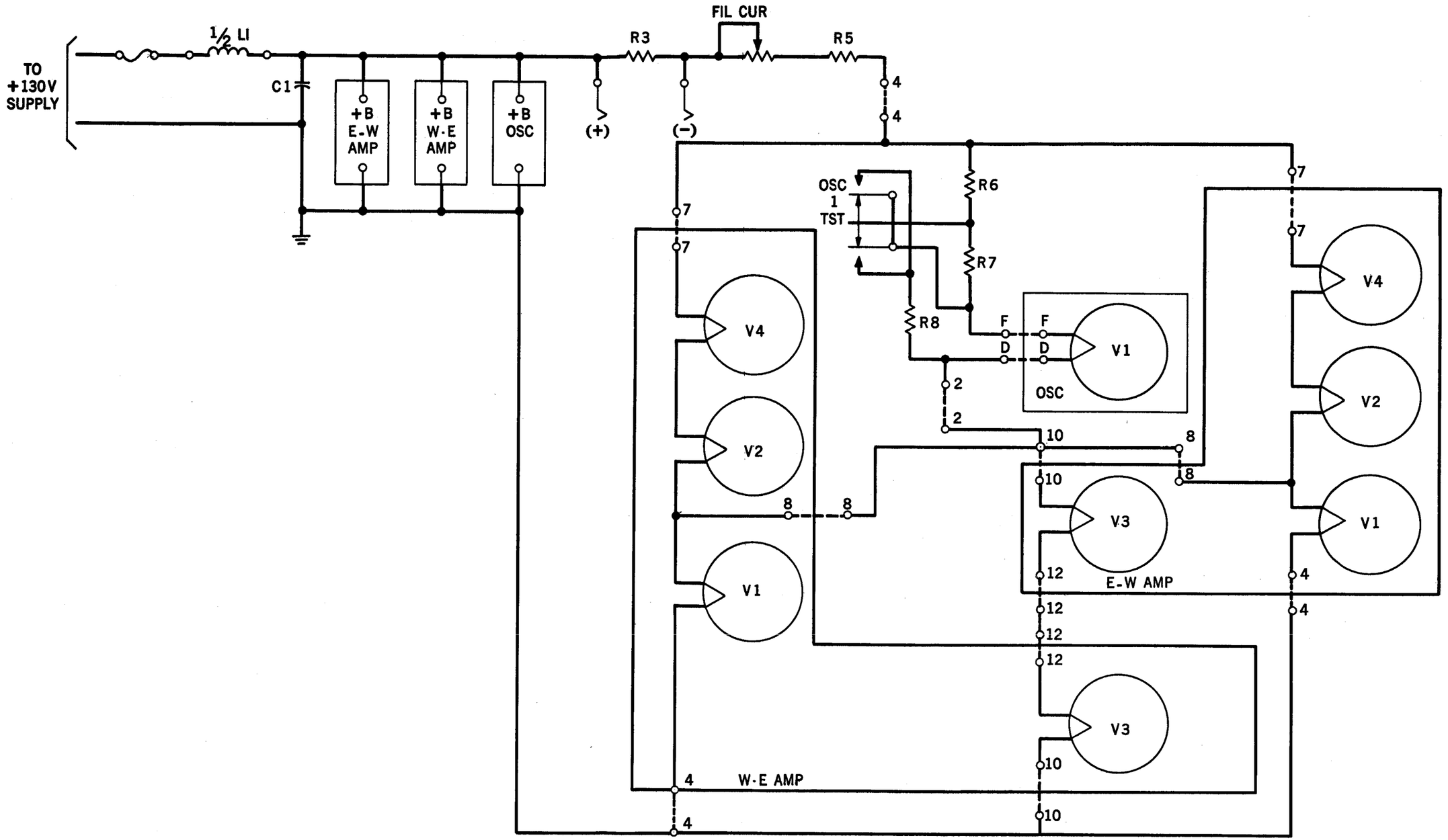

Fig. 3 — Repeater Power Supply Circuit with Heaters Supplied from +130V Source

ELECTRON TUBE TESTS	
STEP	**PROCEDURE**
	(A) Space Current History Method
	Note: This method is based on the fact that, after an initial period of stabilization, the space current in a tube gradually decreases over a long period of time and then falls rapidly to the end of its useful life. An attempt is made using the space current history method to discard the tubes just before the space current begins the rapid fall.
1	Read the voltage across the cathode resistor of the tube to be tested with the volt-ohmmeter not sooner than four days after applying voltages to the tube. (See Table II, Column 1.)
2	Subtract 0.52 volt from the value obtained and record for use as a reject value. Form E-4598, illustrated in Fig. 4, is recommended for this purpose.
3	On subsequent tests of the tubes, measure the voltage across the cathode resistor and compare with the reject value. If the voltage is equal to or smaller than the reject value, replace the tube with a new one. A new reject value must then be obtained as indicated in Step 1.
	(B) Change in Tube Output Method
	Note: This method is based on the fact that a tube near the end of its life will have a greater change in output when the heater power is reduced than will a good tube.
4	Connect the dbm jacks of the 2J repeater test set to ground and to the OUT jack on the repeater oscillator being tested. (See Column 2 in Table II.) The output of the unit should meet the requirement indicated in Table II.
5	Press the OSC 1 TST key or OSC 2 TST key, on the fuse panel whichever is associated with the unit being tested. Hold the key depressed thirty seconds while watching the output reading on the 2J repeater test set.
6	If the meter drops below the reject limit, release the key immediately in order not to interrupt service. The tube should be replaced as soon as the circuits using the unit can be turned down.
	(C) Out-of-Service Test Using Tube Tester
7	For the circuits indicated in Table II, Column 3, remove the tube under test and test with the tube tester using the limits as specified with the tube tester.

TABLE II

METHOD OF TUBE TESTS

UNIT	TUBE NO.	IN-SERVICE TEST		OUT-OF-SERVICE TEST	CONNECT METER TEST LEADS TO	LIMITS	
		COL 1 SPACE CURRENT HISTORY USING VOM	COL 2 OUTPUT VOLTAGE USING 2J	COL 3 KS-15559 OR KS-15560 TUBE TESTER		INITIAL	REJECT
Repeater Oscillator	V1		X		OUT Jk. & Grd.	.5 to 7.5 dbm	—1 dbm
Repeater Amplifier	V2	X			K2 and Grd.	1.2V to 2.2V	Initial minus .52
	V3	X			K3 and Grd.	1.3V to 2.4V	Initial minus .52
	V4			X	—	As Specified	

TUBE REJECT VOLTAGE

V2 _____

V3 _____

Fig. 4 – Form E-4598