CHAPTER 2

TROUBLESHOOTING

Warning: **When servicing the tube tester, be very careful of the high voltages. Always disconnect the tube tester from the power source before removing the chassis from the case. Before touching any exposed portion of the circuitry with the power off, short-circuit the part to ground to dissipate any residual charge which may be retained by a capacitor.**

12. General Instructions

Troubleshooting at fourth and fifth echelon maintenance levels includes all the techniques outlined for organizational maintenance (TM 11–6625–316–12) and any special or additional techniques required to isolate a defective part. The field and depot maintenance procedures are not complete in themselves but are supplemented by the procedures described in TM 11–6625–316–12. The systematic troubleshooting procedure, which begins with the checks that can be performed at an organizational level, must be completed by means of additional localizing and isolating techniques.

13. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective tube tester is to localize the fault to the circuit responsible for abnormal operation. The second step is to isolate the fault to the defective part that is responsible for the abnormal condition. Some faults, such as a burned-out resistor, can often be located by sight or smell. The majority of faults, however, must be localized by checking resistances.

b. Localization. The tube tester can be used to check pilot lamps, diode tubes, amplifier tubes for transconductance (G_m), gas, and leakage between tube elements, and to check tubes for shorts. The first step in localizing troubles is to determine the circuit or circuits at fault by the following methods:

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits. All meter readings and other visual signs should be observed to try to localize the fault to a particular circuit.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The equipment performance checklist (TM 11–6625–316–12) is a good operational test.

c. Isolation. The checks listed below will aid in isolating the trouble. After the trouble has been isolated to a particular circuit, isolate the trouble within that circuit to a particular part.

(1) *Voltage and resistance measurements.* Use the schematic diagram (fig. 26) to find the value of the components. Use voltage and resistance measurements (pars. 15–18 and figs. 11–13) to find the value for normal readings; compare them with readings taken.

(2) *Troubleshooting chart.* The symptoms listed in the troubleshooting chart (par. 17c) will aid in localizing trouble to a component part.

(3) *Intermittent troubles.* In all these tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble may often be made to appear by tapping or jarring the equipment. Check the wiring and connections to the tube tester.

14. Tools and Test Equipment Required

The following chart lists the tools and test equipment required for troubleshooting the tube tester, the associated technical manuals, and the assigned common names.

Tool or test equipment	Technical manual	Common name
Tool Equipment TK–21/G		Tool equipment
Meter Test Set TS–632A/GSM–1	TM 11–2535B	Test meter
Multimeter AN/URM–105	TM 11–6625–203–12–35	Multimeter
Test Set, Electron Tube AN/USM–31	Navships 91734	Tube tester
Voltmeter, Meter ME–30A/U	TM 11–6625–320–12	Voltmeter

15. Checking Filament and High-Voltage Circuits for Opens and Short Circuits

(figs. 3, 4, 11, 12, and 13)

Trouble in Test Set, Electron Tube TV–2(*)/U often can be detected by checking the dc resistance of the filament, plate, screen, bias, and signal supply circuits (fig. 11–13) before power is applied to the unit. Take all measurements with the multimeter; proceed as follows:

a. Preparation.

(1) Disconnect the power cord from the ac supply.
(2) Remove the chassis from the case, and then remove the tubes.
(3) Set PLATE-SCREEN RANGE switch S3 to position G.
(4) Depress PRESS TO TEST P4 switch S19 to its locking position.
(5) Set the SHORT TEST switch to OPER. position.
(6) Set the FUNCTION switch to TEST position.
(7) Set the PRESS TO TEST P1, P2, P3, P5, and P6 switches to neutral position.
(8) Set all SELECTORS switches to 0 position.
(9) Set the FILAMENT RANGE switch to OFF position.

b. Filament Circuit.

(1) Measure the dc resistance between terminals 3 and 22 at the secondary of transformer T1 (fig. 3 and 12).
(2) The resistance should be about 20 ohms. An infinite reading indicates that there is an open secondary winding or a faulty connection at one of the terminals.
(3) To detect a break, check the dc resistance from terminal to terminal. If the resistance is zero across any two terminals, the circuits across the winding are short-circuited or the winding itself is short-circuited.

c. Plate Supply Circuit.

(1) Measure the dc resistance between terminal 34 of the 5-volt heater winding 33–35 of transformer T2 (fig. 4 and 12) and ground.
(2) The resistance should be 250,000 ohms. If the resistance is low or zero, the plate high-voltage circuit is grounded.

d. Screen Supply Circuit.

(1) Measure the dc resistance between pin 7 of tube V3 (fig. 11) and ground.
(2) The resistance should be between 9,500 and 12,000 ohms; this depends on the setting of SCREEN fine control R54. If the resistance reading is very high or infinite, potentiometer R54 or bleeder resistor R55 is open. If the resistance reading is very low or zero, the screen supply is short-circuited.
(3) Check filter capacitors C4A and C4B and screen supply (dc load) windings 15–25 of transformer T2 for possible short circuits.

e. Bias Supply Circuit.

(1) Measure the resistance between pin 1 or 6 and pin 7 (ground) of tube V2 (fig. 11). With BIAS RANGE switch S2 in the 50 (50-volt) position, the resistance should be approximately 7,000 ohms. With BIAS RANGE switch S2 in another position, the resistance will be considerably lower, but it should be several thousand ohms. If the resistance is very high or infinite, the wiring may be open or one of the bias voltage-divider resistors R34, R26, R27, or R28 or BIAS fine control R29 may be open. If the resistance is very low or zero, the bias supply is short-circuited.
(2) Check filter capacitor C3 and the wiring to bias supply rectifier tube V2 for short circuits.

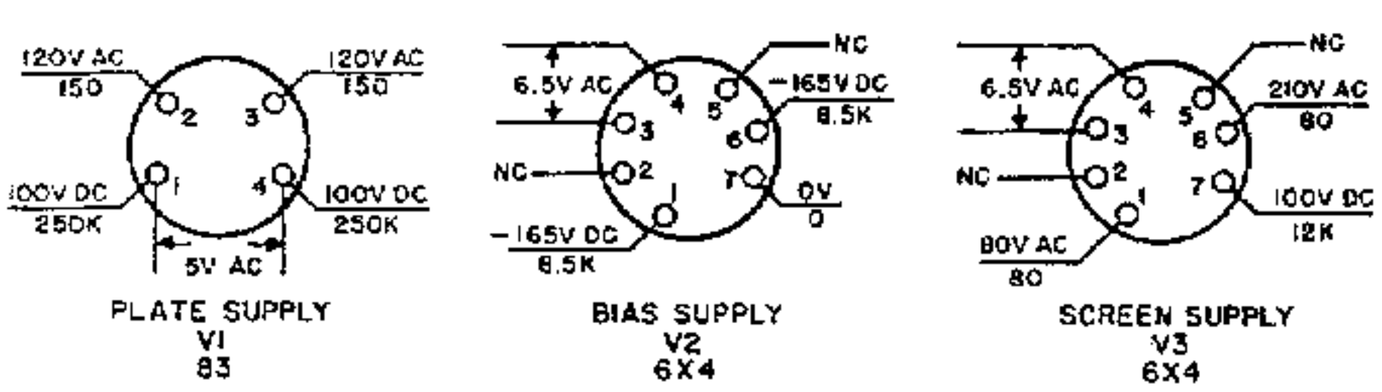
f. Signal Supply Circuit.

(1) Measure the dc resistance between terminals 29 and 30 of the signal supply

winding of transformer T2 (figs. 4 and 12).

(2) The resistance should be approximately 9 ohms. If the resistance is high (over 1,000 ohms), the signal winding is open. If the resistance is very low or zero, the winding is short-circuited or the ac voltage-divider circuit across the winding is short-circuited.

(3) Check the wiring to SIGNAL meter M4, SIGNAL-V.R. potentiometer R46A, and resistors R47, R49, and R50 for possible short circuits.



SWITCH OR CONTROL	POSITION
SHORT TEST	OPER
FUNCTION	TEST
ALL SELECTORS	0
FILAMENT RANGE	.625
FILAMENT	ADJUST FOR .625V ON FILAMENT VOLTS METER
BIAS RANGE	A
BIAS	FULLY COUNTERCLOCKWISE
PLATE-SCREEN RANGE	N
PLATE	ADJUST FOR 100V ON PLATE METER
SCREEN	FULLY COUNTERCLOCKWISE
GM-SIGNAL RANGE	A
SHUNT	D
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL.
SIGNAL-V.R.	ADJUST FOR RED LINE ON SIGNAL METER.

NOTES:
1. AC VOLTAGE MEASUREMENTS TAKEN WITH 1,000 OHMS-PER-VOLT METER. DC VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT METER.
2. VOLTAGE MEASUREMENTS ABOVE LINE, RESISTANCE MEASUREMENTS BELOW LINE.
3. ALL MEASUREMENTS WITH EXCEPTION OF FILAMENT VOLTAGES TAKEN BETWEEN POINTS INDICATED AND GROUND.
4. NO TUBE IN TEST SOCKETS.
5. SWITCH AND CONTROL POSITIONS AS SHOWN ON CHART.

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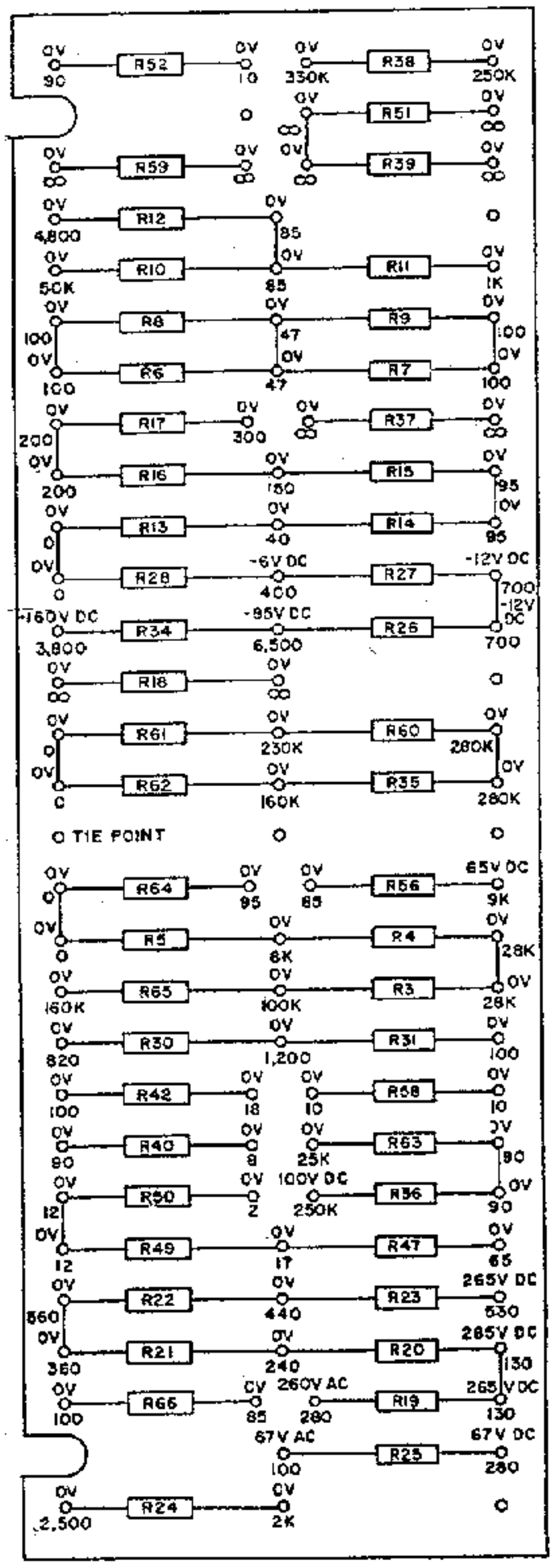
Figure 11. Tube socket voltage and resistance diagram.

Figure 12. Chasis voltage and resistance diagram.
(Located in back of manual)



NOTES:

1. VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT METER.
2. VOLTAGE MEASUREMENTS ABOVE LEAD LINE, RESISTANCE MEASUREMENTS BELOW LEAD LINE.
3. ALL MEASUREMENTS TAKEN BETWEEN POINTS INDICATED AND GROUND.
4. NO TUBE IN TEST SOCKETS.
5. ON THE TV-2A/U, RESISTORS R40 AND R42 ARE MOUNTED ON THE REAR OF THE CHASSIS.
6. SWITCH AND CONTROL POSITION:

SWITCH OR CONTROL	POSITION
SHORT TEST	OPER
FUNCTION	TEST
ALL SELECTORS	O
FILAMENT RANGE	.625
FILAMENT	ADJUST FOR .625V ON FILAMENT VOLTS METER
BIAS RANGE	A
BIAS	FULLY COUNTER-CLOCKWISE
PLATE-SCREEN RANGE	N
PLATE	ADJUST FOR 100 V ON PLATE METER
SCREEN	FULLY COUNTER-CLOCKWISE
GM-SIGNAL RANGE	A
SHUNT	D
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL
SIGNAL-V.R.	ADJUST FOR RED LINE ON SIGNAL METER

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Figure 13. Resistor mounting board voltage and resistance diagram.

16. Voltage Measurements

(figs. 11, 12, and 13)

a. Measure the tube socket voltage with the multimeter. Refer to the tube socket diagram (fig. 11) for voltages normally present. Be sure that the switches and controls are set as indicated in the *Notes* column on figure 11.

b. Measure the voltage at the test points on the front, rear, and top of the chassis with the multimeter. Refer to figures 11 and 12 for typical voltages. Be sure that the switches and controls are set as indicated in the *Notes* column on figures 11 and 12.

c. Measure the voltage at the test points on the resistor mounting board (fig. 13) with the multimeter. Be sure that the switches and controls are set as indicated in the *Notes* column on figure 13.

17. Localizing Troubles

a. General. In the troubleshooting chart (*c* below), procedures are outlined for isolating troubles to a particular component part. Voltage and resistance measurements are shown in figures 11–13. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary.

b. Use of Chart. The troubleshooting chart is designed to supplement operational checks that can be performed at an organizational level. If previous operational checks have resulted in reference to a particular item of the chart, go directly to th. eferenced item. If no operational symptoms are known, begin with step 1 of the equipment performance checklist (TM 11–6625 –316–12) and proceed until a symptom of trouble appears.

c. Troubleshooting Chart (fig. 26).

Step	Symptom	Probable trouble	Correction
1	PILOT lamp I1 does not light and tube tester fails to operate.	Fuse F1 or F2 defective or burned out.	Check fuses F1 and F2. Replace as necessary. If replaced fuse burns out, check plate supply (terminals 3–14 of transformer T2) and capacitors C3 and C4 for short circuits.
		PILOT lamp I1 defective	Check lamp I1 and replace if necessary.
		Power cord defective	Check power cord and connector and replace if necessary.
2	PILOT lamp I1 lights but FILAMENT VOLTS meter M1 does not indicate.	FILAMENT VOLTS meter M1 defective.	Check meter M1 and replace if necessary.
		Filament transformer T1 (fig. 3) defective.	Check resistance of T1 (par. 18). Replace 1 if necessary.
		FILAMENT RANGE switch S1 defective.	Check switch S1. Replace switch S1 if necessary.
3	PILOT lamp I1 lights but PLATE meter M5, SCREEN VOLTS meter M6, GRID BIAS VOLTS meter M2, and SIGNAL meter M4 do not indicate.	Power transformer T2 primary winding open or short-circuited.	Check primary windings of transformer T2 (figs. 4 and 12, par. 18b). Repair defective wiring or replace transformer if necessary.
4	With FUNCTION switch S4 in TEST position and PLATE-SCREEN RANGE switch S3 in any position but OFF, PLATE meter M5 indicates zero plate voltage.	Plate supply tube V1 defective	Replace V1.
		PLATE meter M5 defective	Check meter M5 and replace if necessary.
		PLATE-SCREEN RANGE switch S3 defective.	Check switch S3 and replace if necessary.
		Transformer T2 secondary winding 3–14 open.	Replace T2.
5	GRID BIAS VOLTS meter M2 does not indicate.	Bias supply tube V2 defective.	Replace V2.
		GRID BIAS VOLTS meter M2 defective.	Check meter M2 and replace if defective.

16. Voltage Measurements

(figs. 11, 12, and 13)

a. Measure the tube socket voltage with the multimeter. Refer to the tube socket diagram (fig. 11) for voltages normally present. Be sure that the switches and controls are set as indicated in the *Notes* column on figure 11.

b. Measure the voltage at the test points on the front, rear, and top of the chassis with the multimeter. Refer to figures 11 and 12 for typical voltages. Be sure that the switches and controls are set as indicated in the *Notes* column on figures 11 and 12.

c. Measure the voltage at the test points on the resistor mounting board (fig. 13) with the multimeter. Be sure that the switches and controls are set as indicated in the *Notes* column on figure 13.

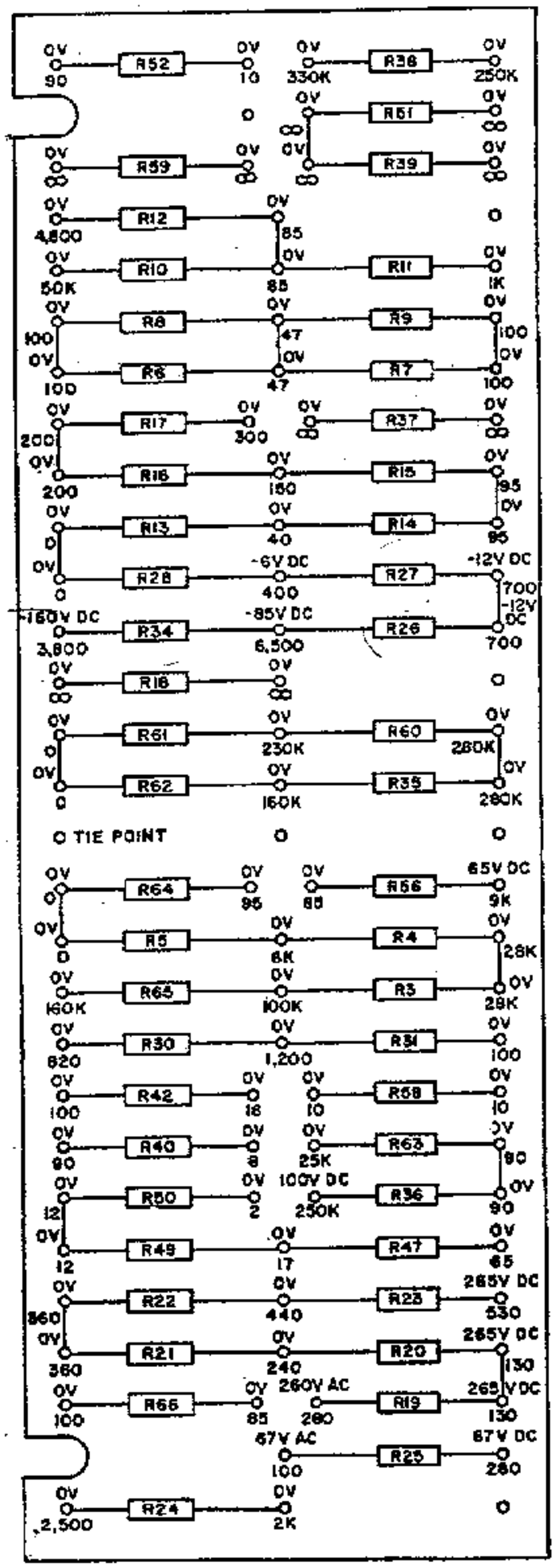
17. Localizing Troubles

a. General. In the troubleshooting chart (*c* below), procedures are outlined for isolating troubles to a particular component part. Voltage and resistance measurements are shown in figures 11–13. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary.

b. Use of Chart. The troubleshooting chart is designed to supplement operational checks that can be performed at an organizational level. If previous operational checks have resulted in reference to a particular item of the chart, go directly to th. eferenced item. If no operational symptoms are known, begin with step 1 of the equipment performance checklist (TM 11–6625 –316–12) and proceed until a symptom of trouble appears.

c. Troubleshooting Chart (fig. 26).

Step	Symptom	Probable trouble	Correction
1	PILOT lamp I1 does not light and tube tester fails to operate.	Fuse F1 or F2 defective or burned out.	Check fuses F1 and F2. Replace as necessary. If replaced fuse burns out, check plate supply (terminals 3–14 of transformer T2) and capacitors C3 and C4 for short circuits.
		PILOT lamp I1 defective	Check lamp I1 and replace if necessary.
		Power cord defective	Check power cord and connector and replace if necessary.
2	PILOT lamp I1 lights but FILAMENT VOLTS meter M1 does not indicate.	FILAMENT VOLTS meter M1 defective.	Check meter M1 and replace if necessary.
		Filament transformer T1 (fig. 3) defective.	Check resistance of T1 (par. 18). Replace 1 if necessary.
		FILAMENT RANGE switch S1 defective.	Check switch S1. Replace switch S1 if necessary.
3	PILOT lamp I1 lights but PLATE meter M5, SCREEN VOLTS meter M6, GRID BIAS VOLTS meter M2, and SIGNAL meter M4 do not indicate.	Power transformer T2 primary winding open or short-circuited.	Check primary windings of transformer T2 (figs. 4 and 12, par. 18b). Repair defective wiring or replace transformer if necessary.
4	With FUNCTION switch S4 in TEST position and PLATE-SCREEN RANGE switch S3 in any position but OFF, PLATE meter M5 indicates zero plate voltage.	Plate supply tube V1 defective	Replace V1.
		PLATE meter M5 defective	Check meter M5 and replace if necessary.
		PLATE-SCREEN RANGE switch S3 defective.	Check switch S3 and replace if necessary.
		Transformer T2 secondary winding 3–14 open.	Replace T2.
5	GRID BIAS VOLTS meter M2 does not indicate.	Bias supply tube V2 defective.	Replace V2.
		GRID BIAS VOLTS meter M2 defective.	Check meter M2 and replace if defective.



NOTES:

1. VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT METER.
2. VOLTAGE MEASUREMENTS ABOVE LEAD LINE, RESISTANCE MEASUREMENTS BELOW LEAD LINE.
3. ALL MEASUREMENTS TAKEN BETWEEN POINTS INDICATED AND GROUND.
4. NO TUBE IN TEST SOCKETS.
5. ON THE TV-2A/U, RESISTORS R40 AND R42 ARE MOUNTED ON THE REAR OF THE CHASSIS.
6. SWITCH AND CONTROL POSITION:

SWITCH OR CONTROL	POSITION
SHORT TEST	OPEN
FUNCTION	TEST
ALL SELECTORS	G
FILAMENT RANGE	.626
FILAMENT	ADJUST FOR .625V ON FILAMENT VOLTS METER
BIAS RANGE	A
BIAS	FULLY COUNTER-CLOCKWISE
PLATE-SCREEN RANGE	N
PLATE	ADJUST FOR 100 V ON PLATE METER
SCREEN	FULLY COUNTER-CLOCKWISE
GM-SIGNAL RANGE	A
SHUNT	G
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL
SIGNAL-V.R.	ADJUST FOR RED LINE ON SIGNAL METER

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Figure 13. Resistor mounting board voltage and resistance diagram.

Step	Symptom	Probable trouble	Correction
		Bias supply filter capacitor C3 short-circuited.	Replace C3.
		Transformer T2 secondary winding 26–28 open.	Replace T2.
6	SCREEN VOLTS meter M6 does not indicate.	Screen supply tube V3 defective.	Replace V3.
		SCREEN VOLTS meter M6 defective.	Check meter M6 and replace if necessary.
		Screen supply filter capacitor C4 short-circuited.	Replace C4.
		Screen voltage multiplier resistor R56 or SCREEN voltage potentiometer R54 open.	Replace defective resistor or potentiometer.
		Transformer T2 secondary winding 15–25 open.	Replace T2.
7	SIGNAL meter M4 does not indicate.	SIGNAL meter M4 defective.	Check meter M4 and replace if defective.
		Signal voltage divider resistor R47, R49, R50 or SIGNAL-V.R. potentiometer R46A open.	Replace defective resistor or potentiometer.
		Transformer T2 secondary winding 29, 30 open.	Replace T2.
8	No change in voltage indication or incorrect indication on PLATE meter M5 and SCREEN VOLTS meter M6 when PLATE-SCREEN RANGE switch S3 is rotated.	PLATE-SCREEN RANGE switch S3 defective.	Check switch S3 and replace if necessary.
9	FILAMENT VOLTS meter M1 indicates but tube under test does not warm up.	Tube under test defective.....	Check filament continuity of tube under test.
		FIL- or FIL+ Selectors switch S6 and S7 or SHORT TEST switch S11 defective.	Replace S6, S7, or S11 as necessary.
10	With GRID SELECTORS switch S8 in position B, PLATE SELECTORS switch S15 in position A, and all other SELECTORS switch at 0, and with the A- and B- electrical clips short-circuited, FIL. CONT. SHORT lamp I2 does not light in any position of SHORT TEST switch S11.	FIL CONT. SHORT lamp I2 defective.	Replace lamp I2 if necessary.
		SHORT TEST switch S11 defective.	Check switch S11 and replace if necessary.
		Wiring in short test circuit defective.	Check wiring and repair as necessary.
		Voltage-divider resistor R60 or bias supply bleeder resistor R35 open.	Replace defective resistor.
		PLATE potentiometer R45 incorrectly adjusted.	Adjust R45 so that the index marking on the knob lines up exactly with the index marking on the panel.
11	With tube tester adjusted for transconductance (G_m) test and PRESS TO TEST P4 switch S19 in locked position, PERCENT QUALITY meter M3 does not give proper indication.	PERCENT QUALITY meter M3 defective.	Check meter M3 and replace if defective.
		Quality meter damping capacitor C2 short-circuited.	Replace C2.
		Shunt resistor R30, R31, R40, or R42 or GM CENTERING potentiometer R44 or	Replace defective resistor or potentiometer.

Step	Symptom	Probable trouble	Correction
		SHUNT potentiometer R33 open.	
		GM-SIGNAL RANGE switch S5 or PRESS TO TEST P4 switch S19 defective.	Check switches S5 and S19 and replace if necessary.
12	With GM-SIGNAL RANGE switch S5 in F position, PERCENT QUALITY meter M3 does not give proper indication.	Resistor R40 or R42 in transconductance (G_m) test network or GM CENTERING potentiometer R44 defective.	Replace defective resistor or potentiometer.
13	With PRESS TO TEST P6 switch S21 depressed, indication on PERCENT QUALITY meter M3 drops to zero.	Wiring in grid circuit open....	Check wiring and repair if defective.
		Resistor R58 defective.....	Replace defective resistor.
14	With tube tester adjusted for emission test and PRESS TO TEST P2 switch S17 depressed, PERCENT QUALITY meter M3 does not indicate.	Wiring in plate or meter circuit open.	Check wiring and repair if defective.
		One of the current-limiting resistors R19 through R25 in plate circuit defective.	Replace defective resistor.
		Shunt resistor R30, R31, R40, R42, or GM CENTERING potentiometer R44 defective.	Replace defective resistor or potentiometer.
15	With tube tester adjusted for voltage-regulator test and PRESS TO TEST P5 switch S20 depressed, neither PECENT QUALITY meter M3 nor PLATE meter M5 indicate.	SHUNT potentiometer R33 defective.	Replace defective potentiometer.
		SCREEN potentiometer R54 or SIGNAL-V.R. potentiometer R46A defective.	Replace defective potentiometer.
		Screen supply filter capacitor C4 short-circuited.	Replace C4.
		FUNCTION switch S4 defective.	Check switch S4 and replace if necessary.
16	Operation of SIGNAL-V.R. control R46 does not affect indication on PLATE meter M5.	SIGNAL-V.R. potentiometer 46B defective.	Replace defective potentiometer.
		Signal voltage divider resistor R47, R49, or R50 defective.	Replace defective resistor.
17	With PRESS TO TEST P1 switch S16 depressed and a tube known to be good being tested, FIL. CONT. SHORT lamp I2 does not light.	FIL. CONT. SHORT lamp I2 defective.	Replace defective lamp.
		SHORT TEST switch S11 defective.	Check switch S11 and replace if necessary.
18	With tube tester adjusted for interelement leakage test, no deflection can be obtained on PLATE meter M5 when there is leakage between two or more elements of tube under test.	FUNCTION switch S4 defective.	Check switch S4 and replace if necessary.
		Multiplier resistor R38 defective.	Replace defective resistor.

18. Dc Resistances of Transformers T1 and T2 (fig. 3, 4, and 12)

The dc resistances of filament transformer T1 and power transformer T2 windings are listed below. Measure the resistances with the transformer disconnected from the circuit.

a. Filament Transformer T1 (fig. 3).

Terminals	Resistance (ohms)
1–2	11.9
3–4	2.9
4–5	5.3
5–6	1.34
6–7	Less than 1
7–8	Less than 1
8–9	Less than 1
9–10	Less than 1
10–11	Less than 1
11–12	Less than 1
12–13	Less than 1
13–14	Less than 1
14–15	Less than 1
15–16	Less than 1
16–17	Less than 1
17–18	Less than 1
18–19	Less than 1
19–20	Less than 1
20–21	Less than 1
21–22	Less than 1

b. Power Transformer T2 (figs. 4 and 12).

Terminals	Resistance (ohms)
1–2	2.3
3–4	7.4
4–5	18.45
5–6	9.7
6–7	4.2
7–8	2.3
8–9	3.6
10–11	9.9
11–12	10.2
12–13	20.0
13–14	8.2
15–16	12.8
16–17	13.6
17–18	16.7
18–19	13.6
19–20	18.9
20–21	19.1
21–22	14.0
22–23	17.2
23–24	14.2
24–25	13.5
26–27	128.1
27–28	129.0
29–30	9.1
31–32	Less than 1
33–34	Less than 1
34–35	Less than 1

CHAPTER 4

FIFTH ECHELON FINAL TESTING

24. Purpose of Final Testing

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation, equivalent to that of new equipment.

25. Test Equipment Required for Final Testing

In addition to the test equipment listed in paragraph 14, the following items are required for final testing:

Item	Quantity
Variable Transformer CN–16/U	1
Resistor, 3,000 ohms, ±1%, 1 watt	1
Resistor, 450,000 ohms, ±1%, 1 watt	1
Resistor, 550,000 ohms, ±1%, 1 watt	1

26. Test Facilities

All tests should be conducted under the following conditions:

a. Test should be made at room temperature.

b. The equipment should be *ON* at least 20 minutes before tests are made.

c. Input voltage should be 115 volts ±10 percent, 60 cycles, single phase.

d. Voltmeter, Meter ME–30A/U should be calibrated to an accuracy of ±0.5 percent error, for making ac voltage measurements. VTVM

e. Multimeter AN/URM–105 should be calibrated to an accuracy of 1 percent error, for making dc voltage measurements. 1000 Ohms/Volt VOM

27. Modification Work Orders

The performance standards listed in the tests (par. 28–39) assume that the modification work orders listed below have been performed. A listing of current modification work orders will be found in DA Pam 310–4.

MWO No.	Date	Priority	Echelon	Location of MWO marking	Remarks
MWO 11–6625–316–45/1	28 December 1959	Urgent	4	Near the nomenclature plate on the front panel.	None.
MWO 11–6625–316–45/2	13 May 1960	Normal	4	Near the nomenclature plate on the front panel.	Equipment modified per MWO SIG 11–2661–1, 28 September 1955, need not be remodified. Test Sets TV–2/U and TV–2A/U previously modified in accordance with MWO 11–266–1, 25 February 1958, need not be remodified.

28. Bias Voltage Test

(A, fig. 21)

a. Set the GRID switch to position 5.

b. Set the BIAS and PLATE fine control fully clockwise.

c. Set the GM-SIGNAL RANGE switch to position A and all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

d. Connect the Multimeter AN/URM–105 between pin 5 of the OCTAL tube test socket and a ground test point (mounting screw) on the tube tester.

e. Set the ON-OFF switch to the ON position.

f. The GRID BIAS VOLTS meter reads full scale on ranges 50, 10, and 5.

g. The voltage measured on the AN/URM–105 will be equal to the voltage indicated on the GRID BIAS VOLTS meter on all ranges ±2.5 percent error.

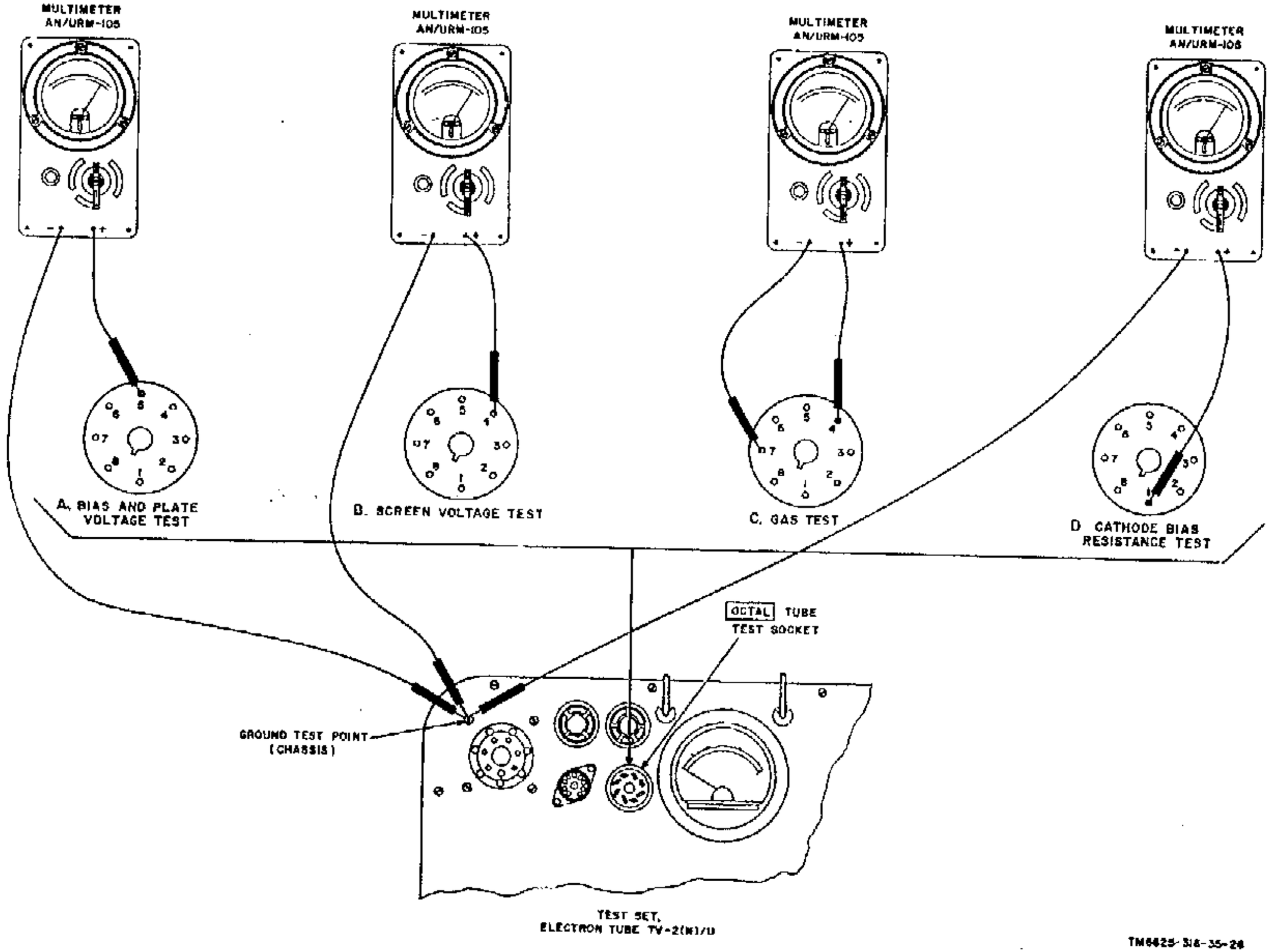


Figure 21. Voltage, gas and resistance tests.

29. Plate Voltage Test
(A, fig. 21)

a. Set the PLATE switch to position 5.

b. Depress the PRESS TO TEST P4 switch to its locked position.

c. Set the GM-SIGNAL RANGE switch to position A and all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

d. Connect the AN/URM–105 between pin 5 of the OCTAL tube test socket and a ground test point (mounting screw) on the tube tester.

e. Set the ON-OFF switch to the ON position.

f. Adjust the PLATE fine control, and set the PLATE-SCREEN RANGE switch to read its corresponding voltage on the PLATE meter as follows:

PLATE-SCREEN RANGE switch position	Voltage
G	250
H	250
J	250
K	125
L	125
M	125
N	90
P	60
Q	62.5
R	35 ac
S	20 ac

g. The voltages measured on the AN/URM–105 will be equal to the voltages indicated on the PLATE meter ±2.5 percent error at each dc point, and ±5 percent error at each ac point.

30. Screen Voltage Test
(B, fig. 21)

a. Set the SCREEN switch to position 4.

b. Depress the PRESS TO TEST P4 switch to its locked position.

c. Set the PLATE fine control in position as indicated in paragraph 29*f*, the GM-SIGNAL RANGE switch to position A, and all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

d. Connect the AN/URM–105 between pin 4 of the OCTAL tube test socket and a ground test point (mounting screw) on the tube tester chassis.

e. Set the ON-OFF switch to the ON position.

f. Adjust the SCREEN fine control, and set the PLATE-SCREEN RANGE switch to read its corresponding voltage on the SCREEN VOLTS meter as follows:

PLATE-SCREEN RANGE switch position	Voltage
G	225
H	180
J	135
K	180
L	135
M	90
N	90
P	45

g. The voltages measured on the AN/URM–105 will be equal to the voltages indicated on the SCREEN VOLTS meter ±5 volts error at each point.

31. Signal Voltage Test
(A, fig. 22)

a. Set the PLATE-SCREEN RANGE switch to position S.

b. Set the GM-SIGNAL RANGE switch to position A.

c. Set the PLATE fine control fully clockwise.

d. Set all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

e. Set the ON-OFF switch to the ON position.

f. Adjust the SIGNAL-V.R. fine control so that the SIGNAL meter indicator deflects to the redline.

g. Set the BIAS RANGE switch to position 10.

h. Set the GRID switch to position 5.

i. Adjust the BIAS fine control so that the GRID BIAS VOLTS meter indicates 5 volts.

j. Set the ON-OFF switch to the OFF position.

k. Connect the ME–30A/U between pin 5 of the OCTAL tube test socket and a ground test point (mounting screw) on the tube tester.

l. Set the ON-OFF switch to the ON position.

m. Set the GM-SIGNAL RANGE switch to position A, B, C, D, or E to read .25, .25, .25, .5, or 2.5 volts ac, respectively. The ME–30A/U indicates ±5 percent error at each point.

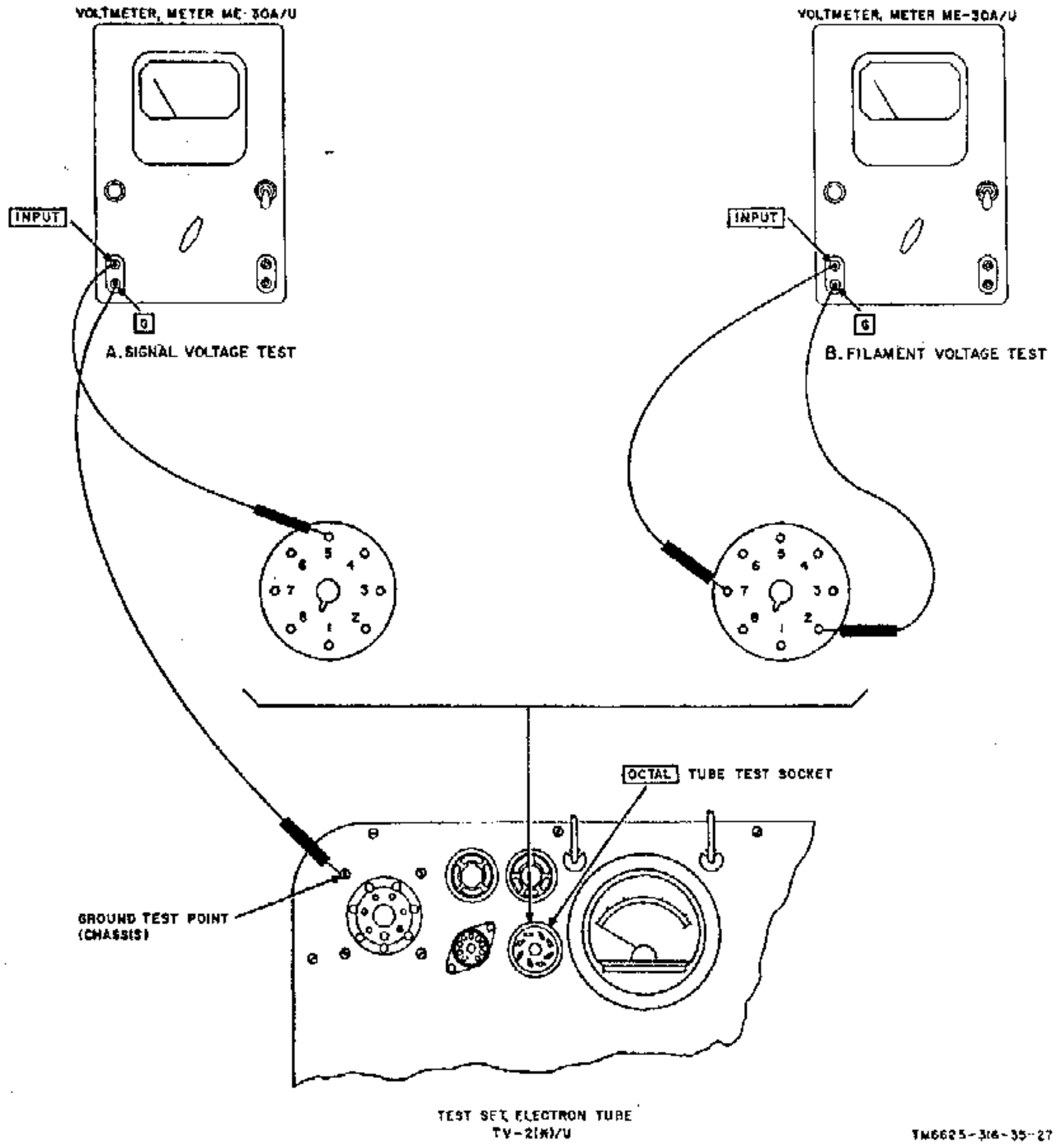


Figure 22. Signal and filament voltage tests.

32. Filament Voltage Test

(B, fig. 22)

a. Set the FIL— switch to position 7.

b. Set the FIL+ switch to position 2.

c. Set the GM-SIGNAL RANGE switch to position A and all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

d. Connect the ME–30A/U between pins 2 and 7 of the OCTAL tube test socket.

e. Set the ON-OFF switch to the ON position.

f. Set the FILAMENT RANGE switch to each of its 19 voltage positions, and adjust the FILAMENT fine control for the exact corresponding voltage on the FILAMENT VOLTS meter.

g. The voltages measured on the ME–30A/U will be equal to the voltages indicated on the FILAMENT VOLTS meter ±6 percent error at each point.

33. Gas Test

(C, fig. 21)

Caution: **Be sure that the power switch is in the OFF position before performing the gas test.**

a. Set the GRID switch to position 4.

b. Set the CATHODE switch to position 7.

c. Set the FUNCTION switch to position VR.

d. Set the GM-SIGNAL RANGE switch to position A and all other switches and controls to their neutral or OFF position (vertical position for switches, extreme counterclockwise position for controls).

e. Connect the AN/URM–105 between pins 4 and 7 of the OCTAL tube test socket.

f. The AN/URM–105 indicates a resistance of 180,000 ohms ±10 percent error when the PRESS TO TEST P6 switch is depressed.

34. Leakage Test

a. Set the tube tester up according to the tube test data roll chart, to test tube 6V6.

b. Insert the 6V6 tube and perform the inter-element leakage (LK) test.

c. Remove the 6V6 tube and insert a 450,000-ohm resistor between pins 4 and 8 of the OCTAL tube test socket.

d. Set the SHORT TEST switch to position Y.

e. Set the ON-OFF switch to the ON position.

f. The PLATE meter indicates to the right of the 0.5-megohm point.

g. Set the ON-OFF switch to the OFF position.

h. Remove the 450,000-ohm resistor and insert a 550,000-ohm resistor in its place.

i. Set the ON-OFF switch to the ON position.

j. The PLATE meter indicates to the left of the 0.5-megohm point.

35. Short Test

a. Set the tube tester up according to the tube test data roll chart, to test tube 6V6.

b. Insert a 3,000-ohm resistor between pins 3 and 7 of the OCTAL tube test socket.

c. Set the ON-OFF switch to the ON position.

d. The FIL. CONT. SHORT lamp glows continuously when the SHORT TEST switch is set to positions V, W, and Z.

e. Set the ON-OFF switch to the OFF position.

f. Remove the 3,000-ohm resistor and insert it between pins 4 and 8 of the OCTAL tube test socket.

g. Set the ON-OFF switch to the ON position.

h. The FIL. CONT. SHORT lamp glows continuously when the SHORT TEST switch is set to positions Y and Z.

i. Set the ON-OFF switch to the OFF position.

j. Remove the 3,000-ohm resistor and insert it between pins 5 and 8 of the OCTAL tube test socket.

k. Set the ON-OFF switch to the ON position.

l. The FIL. CONT. SHORT lamp glows continuously when the SHORT TEST switch is set to positions X and Z.

36. Cathode Bias Resistance Test

(D, fig. 21)

Caution: **Be sure that the power switch is in the OFF position before performing the cathode bias resistance test.**

a. Set the CATHODE switch to position 1.

b. Connect the AN/URM–105 between pin 1 of the OCTAL tube test socket and a ground test point (mounting screw) on the tube tester chassis.

c. The resistance reading of the AN/URM–105 is 47, 94, 141, 188, or 288 ohms when the BIAS RANGE switch is set to position A, B, C, D, or E, respectively, ±10 percent error at each point.

37. Filament Continuity Test

a. Check a IL4 tube known to have a closed filament.

b. The FIL. CONT. SHORT lamp glows when checking for filament continuity.

c. Check a 1L4 tube known to have an open filament.

d. The FIL. CONT. SHORT lamp does not glow when checking for filament continuity.

38. Shunt Control Test
(fig. 23)

a. Set the PLATE switch to position 5.

b. Set the SUPPRESSOR switch to position 8.

c. Set the PLATE-SCREEN RANGE switch to position S.

d. Set the GM-SIGNAL RANGE switch to position E.

e. Set the SHUNT fine control to position 10.

f. Set the PLATE fine control fully clockwise.

g. Set all other switches and controls to their neutral or OFF positions (vertical position for switches, extreme counterclockwise position for controls).

h. Connect the test cords of the TS–682A/GSM–1 to the COMMON and 5MA jacks on the test meter.

i. Connect the test cord from the COMMON jack, on the test meter, to pin 8, of the OCTAL tube test socket, on the tube tester.

j. Connect the test cord from the 5MA jack, on the test meter, to pin 5, of the OCTAL tube test socket, on the tube tester.

k. Set the ON-OFF switch to the ON position.

l. With the PRESS TO TEST P2 switch depressed, adjust the DIRECT CURRENT COARSE CONTROL and the DIRECT CURRENT FINE CONTROL, on the test meter until the PERCENT QUALITY meter, on the tube tester indicates full scale.

m. The TS–682A/GSM–1 indicates 4.92 milliamperes dc ±5 percent error.

n. Set the ON-OFF switch to the OFF position.

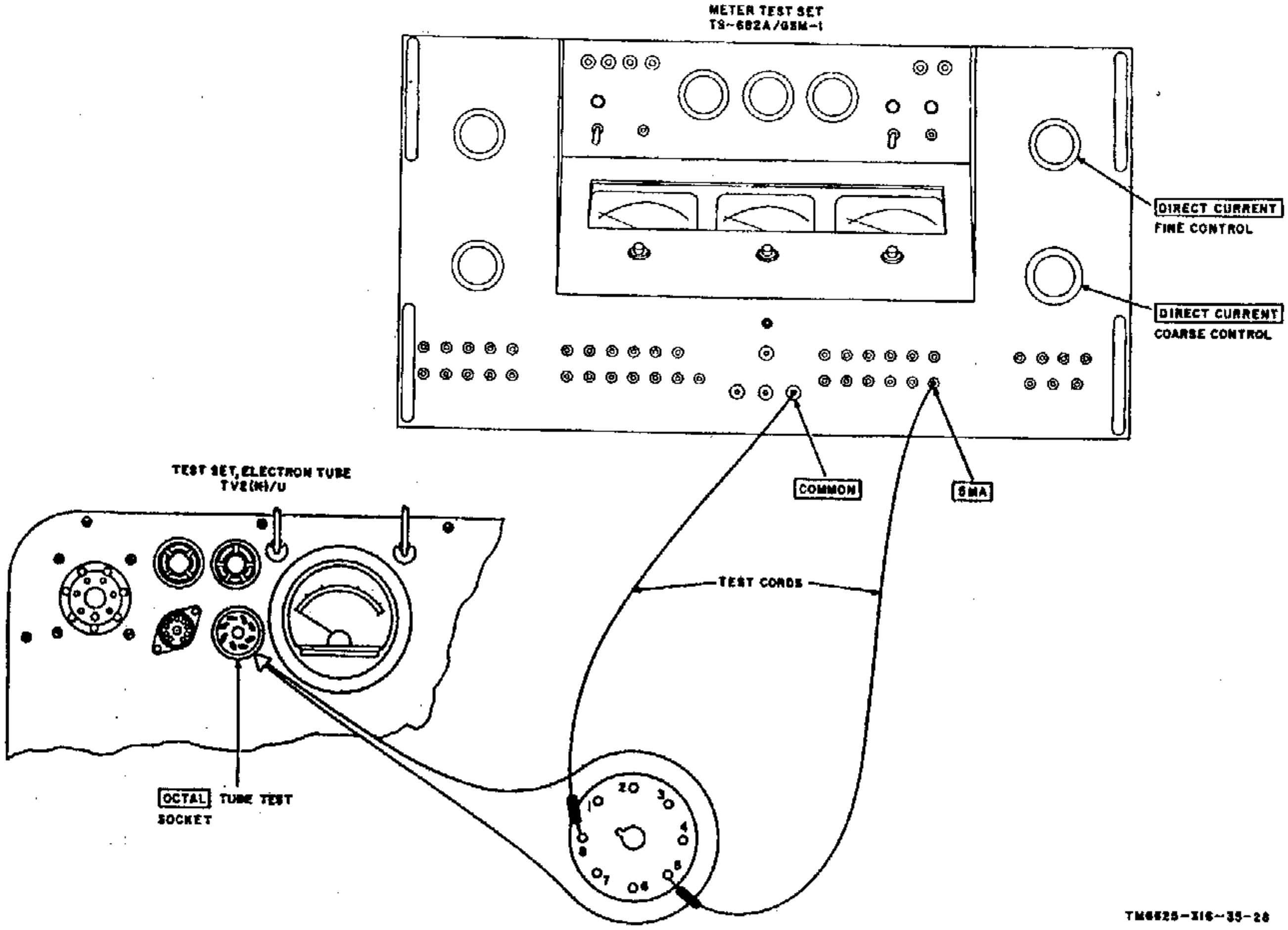
o. Remove the test cord on the 5MA jack, and connect it to the 1MA jack, on the TS–682A/GSM–1.

p. Set the SHUNT fine control to position 90.

q. Set the ON-OFF switch to the ON position.

r. With the PRESS TO TEST P2 switch depressed, adjust the DIRECT CURRENT COARSE CONTROL and the DIRECT CURRENT FINE CONTROL, on the TS–682A/GSM–1 until the PERCENT QUALITY meter, on the tube tester indicates full scale.

s. The TS–682A/GSM–1 indicates 0.605-milliampere dc ±5 percent error.



TM6525-X16-35-28

Figure 23. Shunt control test.

39. Final Performance Test

a. Use the TV–2(*)/U and Test Set, Electron Tube AN/USM–31 to measure and record the mutual conductance of each tube listed in *e* below.

b. Use the FILAMENT, PLATE, SCREEN, and BIAS voltages derived from the TV–2(*)/U tube test data roll chart, for their corresponding setting on the AN/USM–31.

c. Calculate and record the mutual conductance by multiplying the rated mutual conductance listed in *e* below, times the percent quality value indicated for each tube on the PERCENT QUALITY meter of the TV–2(*)/U.

d. The calculated mutual conductance of each tube measured on the TV–2(*)/U will be equal to the mutual conductance measured on the TRANSCONDUCTANCE meter on the AN/USM–31, ±10 percent error.

e. Tubes and rated mutual conductance for the tubes to be checked are as follows:

Tube type	Rated mutual conductance
3E29	8,500 micromhos
6A6	3,100 micromhos
6AT6	1,200 micromhos
6V6	4,100 micromhos
7C7	1,300 micromhos
12AU7	3,100 micromhos
36	900 micromhos
41	2,200 micromhos
45	2,100 micromhos
955	2,200 micromhos
5840	5,000 micromhos
5873	2,900 micromhos

Figure 24. MIL-STD resistor color code markings.
(Located in back of manual)

Figure 25. MIL-STD capacitor color code markings.
(Located in back of manual)

Figure 26. Test Set, Electron Tube TV–2(*)/U, schematic diagram.
(Located in back of manual)

Figure 27. Test Set, Electron Tube TV–2(*)/U, chassis and resistor mounting board wiring diagram.
(Located in back of manual)

Figure 28. Test Set, Electron Tube TV–2(*)/U, control and instrument panel, wiring diagram.
(Located in back of manual)

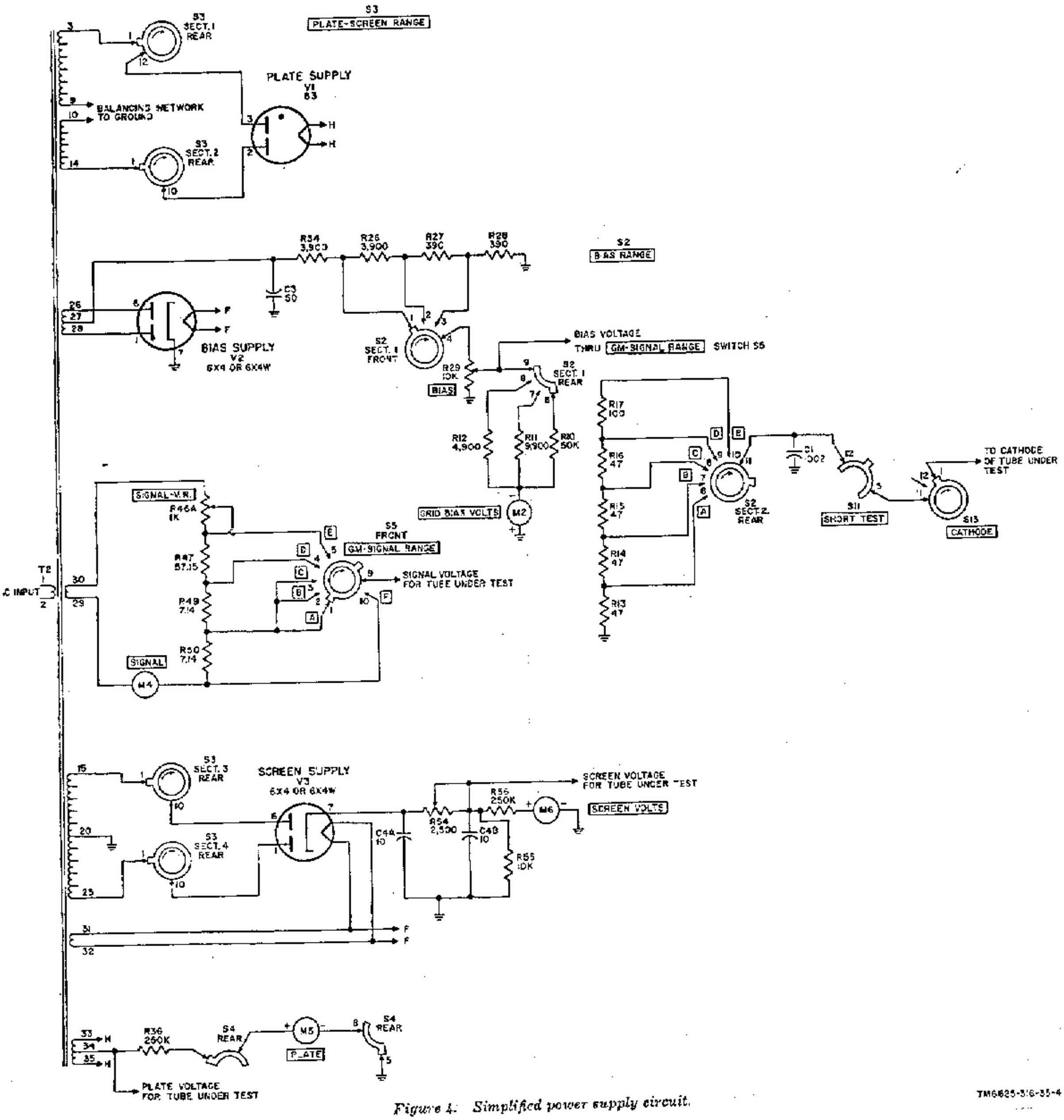


Figure 4. Simplified power supply circuit.

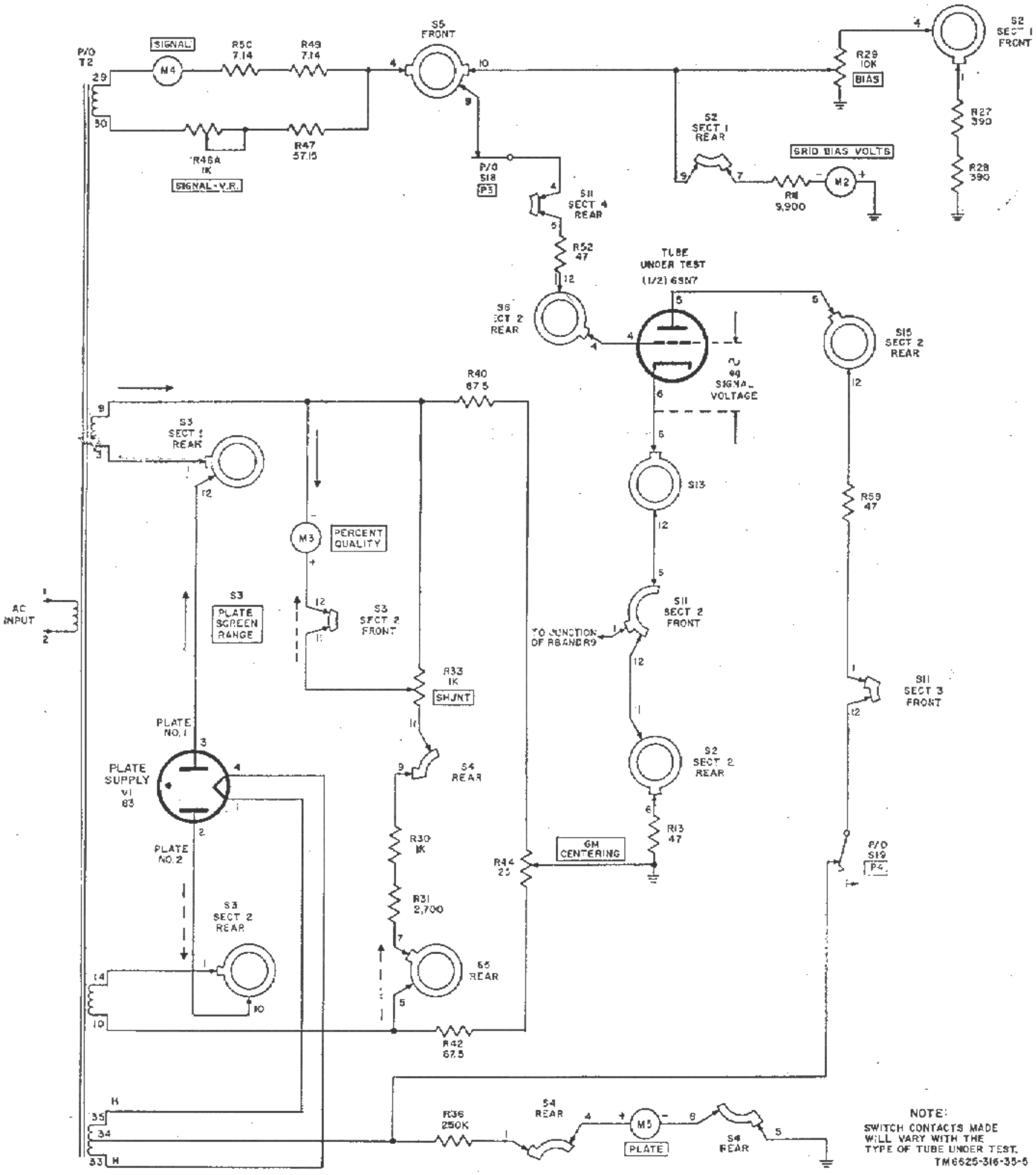
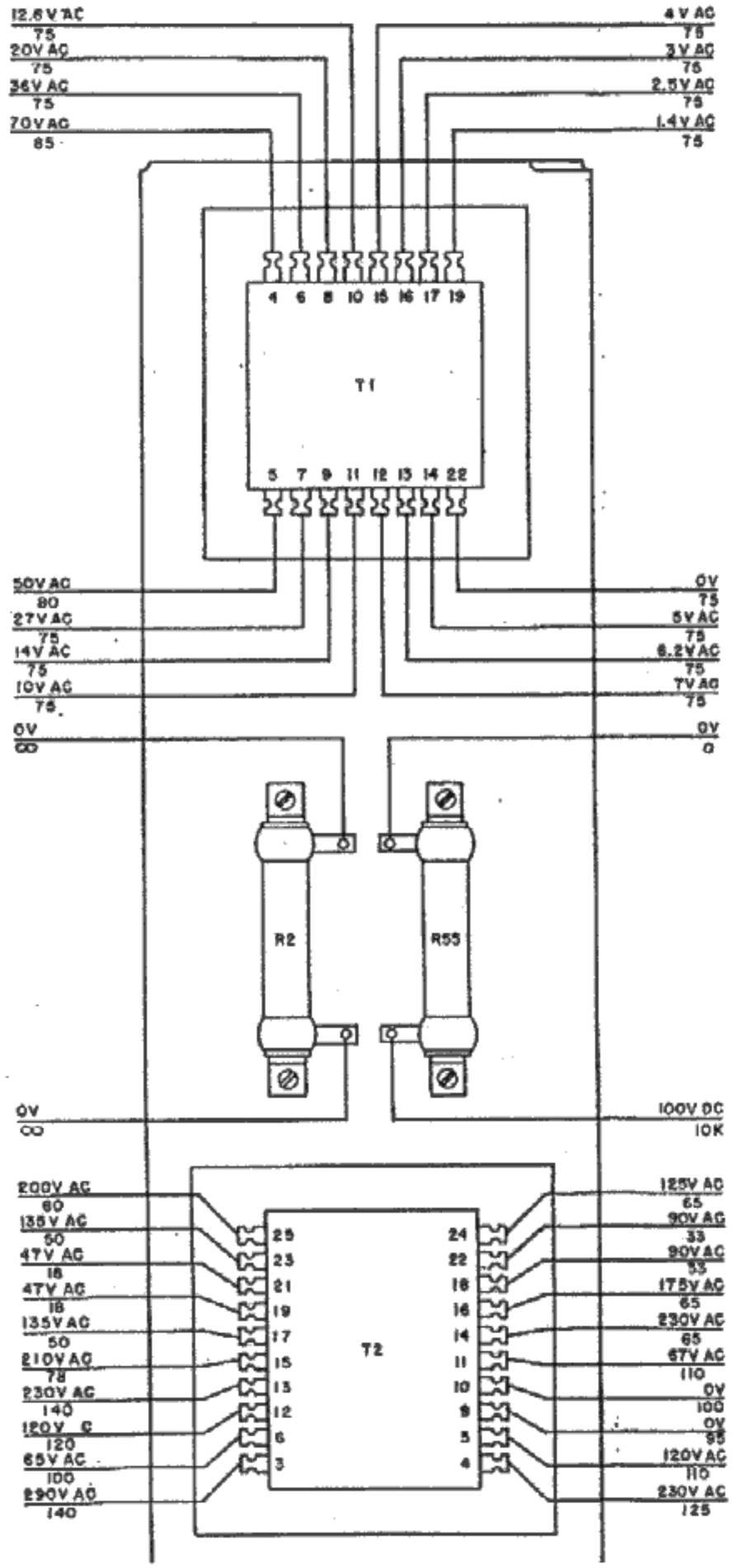
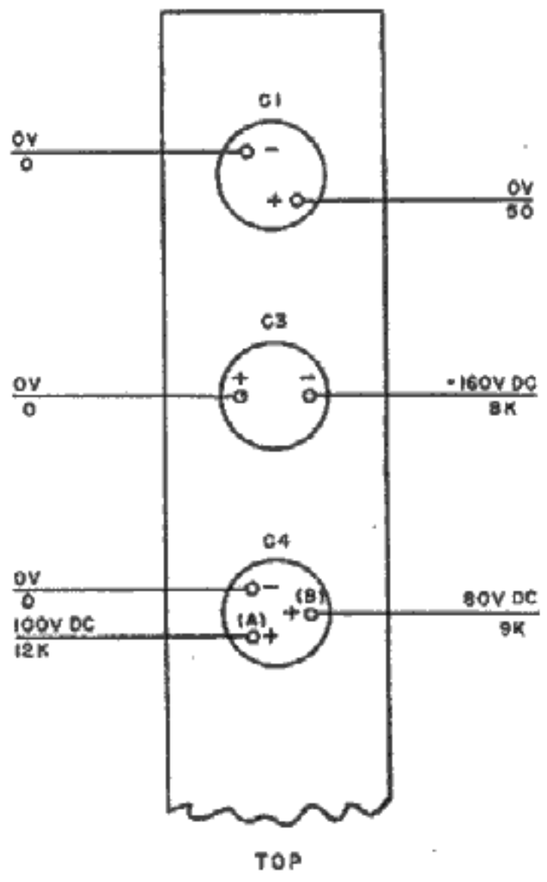
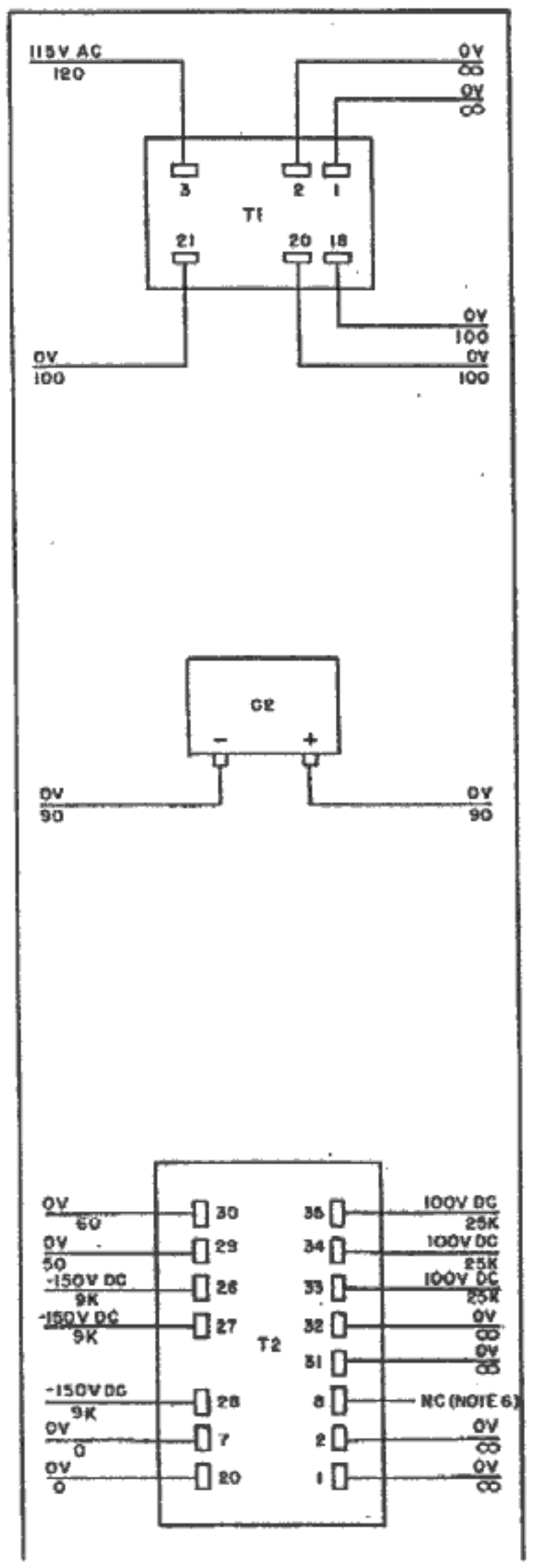


Figure 5. Transconductance measurement circuit of Test Set, Electron Tube TV-2(*)/U.







NOTES:

1. AC VOLTAGE MEASUREMENTS TAKEN WITH 1,000 OHMS-PER-VOLT METER. DC VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT METER.
2. VOLTAGE MEASUREMENTS ABOVE LINE, RESISTANCE MEASUREMENTS BELOW LINE.
3. ALL MEASUREMENTS TAKEN BETWEEN POINTS INDICATED AND GROUND.
4. NO TUBE IN TEST SOCKETS.
5. SWITCH AND CONTROL POSITIONS:

SWITCH OR CONTROL	POSITION
SHORT TEST	OPER
FUNCTION	TEST
ALL SELECTORS	0
FILAMENT RANGE	.625
FILAMENT	ADJUST FOR .625V ON FILAMENT VOLTS METER
BIAS RANGE	A
BIAS	FULLY COUNTERCLOCKWISE
PLATE-SCREEN RANGE	N
PLATE	ADJUST FOR 100V ON PLATE METER
SCREEN	FULLY COUNTERCLOCKWISE
GM-SIGNAL RANGE	A
SHUNT	Q
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL.
SIGNAL-V.R.	ADJUST FOR RED LINE ON SIGNAL METER

6. ON TV-2C/U ONLY, TERMINAL 8 OF T2 IS USED. REFER TO SCHEMATIC DIAGRAM.

20. Zero Adjustment of PERCENT QUALITY Meter

When the procedures in paragraph 19 have been completed, adjust the PERCENT QUALITY meter to zero. This adjustment should be made each time before testing any tube for transconductance (GM). Proceed as follows:

a. Turn the GM-SIGNAL RANGE switch to the F position.

b. Depress the PRESS TO TEST P4 switch to its locking position. Reset controls to give the exact meter readings specified in the METER SETTING columns of the tube test data sheet.

c. Adjust the GM CENTERING control until the pointer of the PERCENT QUALITY meter is set exactly to zero on the scale.

d. Release the P4 switch.

28. Procedure for Reading Plate Current (Less than 50 Milliamperes) of Triode Tubes

a. Perform the operations indicated in paragraphs 15, 16, and 19.

b. Set all selector switches as indicated on the tube test data chart with the exception of the PLATE and SCREEN selector switches.

c. Operate the PLATE selector switch to the 0 position.

d. Operate the SCREEN selector switch to the position designated for the PLATE selector switch.

e. Operate the GM-SIGNAL RANGE switch to the F position.

f. Adjust the SCREEN fine control until the voltage specified on the chart for the PLATE meter is indicated on the SCREEN VOLTS meter.

Note. It may be necessary to operate the PLATE-SCREEN RANGE switch to a new setting, moving the switch in a counterclockwise direction, so that the SCREEN VOLTS meter can indicate the voltage specified for the PLATE meter.

g. Adjust all other fine controls as required on the tube test data chart for the tube under test.

h. Turn the SIGNAL-VR fine control to its maximum counterclockwise position.

i. Operate the FUNCTION switch to the VR position.

j. Operate the SHUNT control to 0.

k. Depress the PRESS TO TEST P5 switch. Be sure the proper voltages for the tube being tested appear on all other meters. Note the reading on the 0- to 50-milliampere (ma) scale on the PLATE meter.

l. Release the PRESS TO TEST P5 switch.

m. When the test is completed, operate the ON-OFF power switch to the OFF position, remove the tube under test from the test socket, and return all switches and controls to their safety positions (par. 15*d*).

Pentodes and beam power tubes may be tested in this method if a 100 Ohm, 1 W resistor is connected across the plate and screen pins of the tube under test.