DEPARTMENT OF THE ARMY TECHNICAL MANUAL **TM 11-6625-316-35**

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER **TO 33AA21-4-12**

FIELD AND DEPOT MAINTENANCE MANUAL

TEST SETS, ELECTRON TUBE TV-2/U, TV-2A/U, TV-2B/U, AND TV-2C/U

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

SEPTEMBER, 1961

TAGO 1428A-September

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 290-volt plate and screen supply circuits, or on the 115-volt ac line connections. Serious injury or death may result from contact with these points.

DON'T TAKE CHANCES!

Field and Depot Maintenance

TEST SETS, ELECTRON TUBE

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 6 *February 1964*

TM 11–6625–316-35, 8 September 1961, is changed as follows:

Page 37, paragraph 29. Make the following changes:

Subparagraph *f,* "Voltage" column, item 8. Delete "60" and substitute: 90.

Delete the last two items in their entirety.

Subparagraph g. Delete everything after "±2.5 percent".

Add subparagraph *h* after subparagraph g.

h. Check positions R and S as follows:

(1) Release PRESS TO TEST switch P4 from the operate position.

(2) Switch the multimeter to AC and connect a 3,000-ohm load resistor across the multimeter.

(3) Set the PLATE-SCREEN RANGE switch to position R.

(4) When PRESS TO TEST switch P2 is depressed, the multimeter should indicate 38 volts ac ±5 percent and the PLATE meter 35 volts ac.

(5) Rotate the PLATE-SCREEN RANGE switch to position S.

(6) When PRESS TO TEST switch P2 is depressed, the multimeter should indicate 12 volts ac ± 5 percent and the PLATE meter 20 volts ac.

Page 40, paragraph 38. Make the following changes:

Subparagraph *c.* Delete "S" and substitute: H.

Subparagraph *g.* After the word "set" add: the power switch and.

Subparagraph *i.* Delete "pin 8" and substitute: pin 5.

Subparagraph *j.* Delete "pin 5" and substitute: pin 8.

Subparagraphs *k, n,* and *q.* After the words "set the" add: test meter BATTERY.

Page 41, figure 23. Change test leads from Meter Test Set TS–682A/GSM–1 to OCTAL tube test socket so that one test lead is from COMMON to pin 5 and one test lead is from 5 MA to pin 8.

Page 44, figure 26 (Foldout, 1st part). In the top right corner of the illustration, on Switch S2, Section 2, front, add a connection line from Contact 11 to the upper (ungrounded) end of capacitor C 1.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12–31 requirements for Field Maintenance Instructions for (OV-1) AO-1 and (OH-13) H-13 aircraft.

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No. 11–6625-316-35
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No. 33AA21–4–1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

WASHINGTON 25, D. C., 8 *September 1961*

Field and Depot Maintenance Manual

TEST SETS, ELECTRON TUBE

TV-2/U, TV-2A/U, TV-2B/U, AND TV-2C/U

	Paragraph	Page
CHAPTER 1. THEORY		
Section I. General		
Scope	1	3
Internal differences in models	2	3
II. Unit theory		
Block diagram	3	4
Power supply circuits	4	6
Transconductance test circuit	5	9
Emission measuring circuit	6	10
Gas test circuit	7	11
Voltage regulator and thyratron tube test circuit	8	12
Short test circuit	9	13
Filament continuity test circuit	10	14
Leakage test circuit	11	14
CHAPTER 2. TROUBLESHOOTING		
General instructions	12	16
Organization of troubleshooting procedures	13	16
Tools and test equipment required	14	16
Checking filament and high-voltage circuits for opens and short circuits	15	17
Voltage measurements	16	20
Localizing troubles	17	20
Dc resistances of transformers T1 and T2	18	22
3. FOURTH ECHELON REPAIRS		
Parts replacement techniques	19	24
Lowering chassis	20	25
Removal and replacement of transformers	21	31
Removal and replacement of resistor mounting board	22	31
Removal, mounting, and replacement of tube test data roll chart	23	31

***This manual, together with TM 11-6625-316-12, supersedes TM 11-2661, 11 May 1955, including C 4, 8 November 1957; C 5, 21 April 1958; and C 6, 15 May 1959.**

Paragraph Page

Chapter 4. FIFTH ECHELON FINAL TESTING

Purpose of final testing 24 34
Test equipment required for final testing 25 34
Test facilities 26 34
Modification work orders 27 34
Bias voltage test 28 34
Plate voltage test 29 37
Screen voltage test 30 37
Signal voltage test 31 37
Filament voltage test 32 39
Gas test 33 39
Leakage test 34 39
Short test 35 39
Cathode bias sesistance test 36 39
Filament continuity test 37 39
Shunt control test 38 40
Final performance test 39 42

APPENDIX. REFERENCES 43

CHAPTER 1

THEORY

Section 1. GENERAL

1. Scope

a. This manual covers field and depot maintenance for Test Sets, Electron Tube TV-2/U, TV-2A/U, TV–2B/U and TV-2C/U. It includes instructions to fourth and fifth echelons for troubleshooting, testing, aligning, and repairing the equipment; replacing maintenance parts; and repairing specified maintenance parts. It also lists tools, materials, and test equipment for fourth and fifth echelon maintenance. There are 110 maintenance functions allocated to third echelon. Detailed functions of the equipment are covered in paragraphs 3 through 11.

b. The complete technical instructions for this equipment includes TM 11–6625-316-12 and TM 11–6625-316-35P.

c. Forward comments concerning this manual to the Commanding Officer, U.S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N. J.

Note. For applicable forms and records, see paragraph 2, TM 11-6625-316-12.

2. Internal Differences in Models

On the TV-2B/U and the TV–2C/U, an antiparasitic ferrite bead (fig. 1) is attached to one of the leads going to each terminal of the test sockets to prevent the tube under test from oscilhating. On the TV-2/U, resistor R 1 is 250 ohms; on TV-2A/U, TV–2B/U, and TV–2C/U, R1 is 300 ohms. On the TV–2C/U, resistors, R24 and R25 are connected differently to transformer T2. Refer to figure 26. For external differences, see TM 11–6625-316–12.

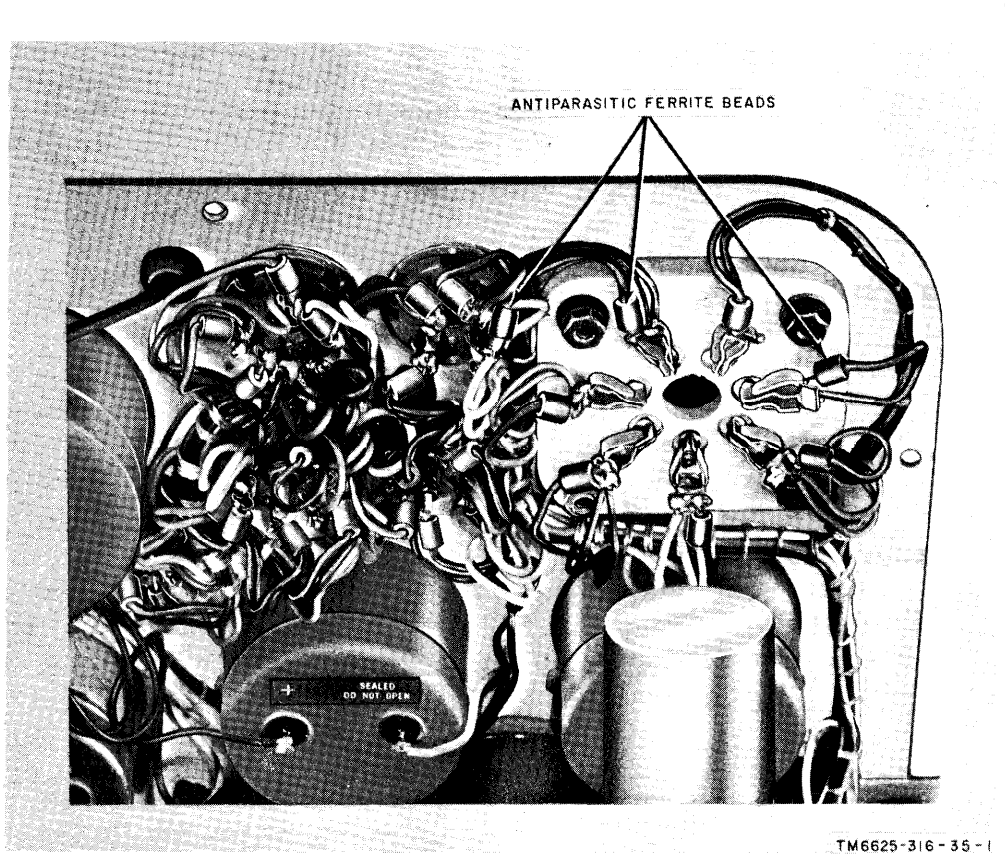


Figure 1. Antiparasitic ferrite beads (used on TV-2B/U and TV-2C/U), typical application.

Section II. UNIT THEORY

3. Block Diagram
(fig. 2)

Test Set, Electron Tube TV-2(*)/U consists of a power supply for the electrodes of the tube to be tested and seven tube-testing circuits. These are a transconductance (G,,,) test circuit, an emission test circuit, a gas test circuit, a voltage-regulator tube test circuit, a filament continuity test circuit, a short test circuit, and a leakage test circuit. SELECTORS and RANGE switches permit application of proper test voltages to the tube under test. Indicating meters and an indication lamp display the test results. The functional interrelation of the principal circuits and parts of the tube tester is shown in the block diagram. A complete schematic diagram is shown in figure 26.

a. Power Supply. The power supply consists of five supply voltage circuits.

(1) The filament supply provides 19 different filament voltages, that range from 0.625 to 117 volts alternating current (vat). FILAMENT VOLTS meter Ml indicates the filament voltage supplied to the tube. Full-wave rectifier tube VI provides unfiltered, pulsating direct current (de) voltage for the plate of the tube under test. Full-wave rectifier V3 furnishes filtered dc voltage for the screen of the tube under test.

(2) PLATE meter M5 and SCREEN VOLTS meter M6 indicate the plate and screen voltages that are supplied to the tube under test.

(3) Grid bias voltage is supplied to the tube under test by full-wave rectifier tube V2. The bias voltage is indicated by grid BIAS volts meter M2.

(4) The potentials made available by the power supply are fed to the various test sockets through seven electrode Selectors switches, and to the tube test circuits through test position press to test switches P1 through P6.

b. Transconductance (G,,,) Test Circuit. This circuit gives an indication of the overall merit of amplifier tubes under simulated operating conditions by measuring the transconductance (G,,,) of the tube under test. Indication in percent quality is shown on PERCENT QUALITY meter M3. The test is selected by operating PRESS TO TEST P4 switch S19.

c. Emission Test Circuit. The quality of diode detectors, vacuum-tube rectifiers, and multielement tubes is checked by measuring the dc emission under static conditions. PRESS TO TEST P2 switch S17 is used to check diode emission; P2 switch S17 and P3 switch S18 are used simultaneously for multigrid emission.

d. Gas Test Circuit. This circuit is used to check the presence of excessive amounts of gas in vacuum-type tubes by indicating the shift in the operating points of the tubes because of gas current in the grid circuit. The test is performed by operating PRESS TO TEST P6 switch S21 with the transconductance test.

e. Voltage-Regulator Tube Test Circuit. The quality of voltage-regulator tubes, gas rectifier tubes, and other gas-filled tubes is determined by measuring the regulation of the tube under test under varying load conditions. The voltage drop across the tube under minimum and maximum load conditions is indicated on PERCENT QUALITY meter M3. PRESS TO TEST P5 switch S20 selects the voltage regulator test.

f. Filament Continuing Test Circuit. This test provides visual indication of the continuity check of the filament of hot cathode tubes, ballast tubes, indicator lamps, and other filament-type devices. If the filament of the device under test is continuous, FIL. CONT. SHORT indicator lamp 12 will light. The test is selected by operating PRESS TO TEST P1 switch S16.

g. Short Test Circuit. Interelectrode shorts in the tube under test are detected by this circuit, which is basically the same as the filament continuity test circuit. A short between any two elements of the tube will light FIL. CONT. SHORT indicator lamp 12. SHORT TEST switch S11 is used to select any tube electrode and test it for shorts to all other elements.

h. Leakage Test Circuit. Leakage between the elements of an electron tube is detected by this circuit, which is essentially a simple ohmmeter circuit. The leakage between the elements of the tube is indicated in megohms on PLATE meter M5. Each position of the SHORT TEST switch selects one element of the tube for measuring the leakage to all other elements.

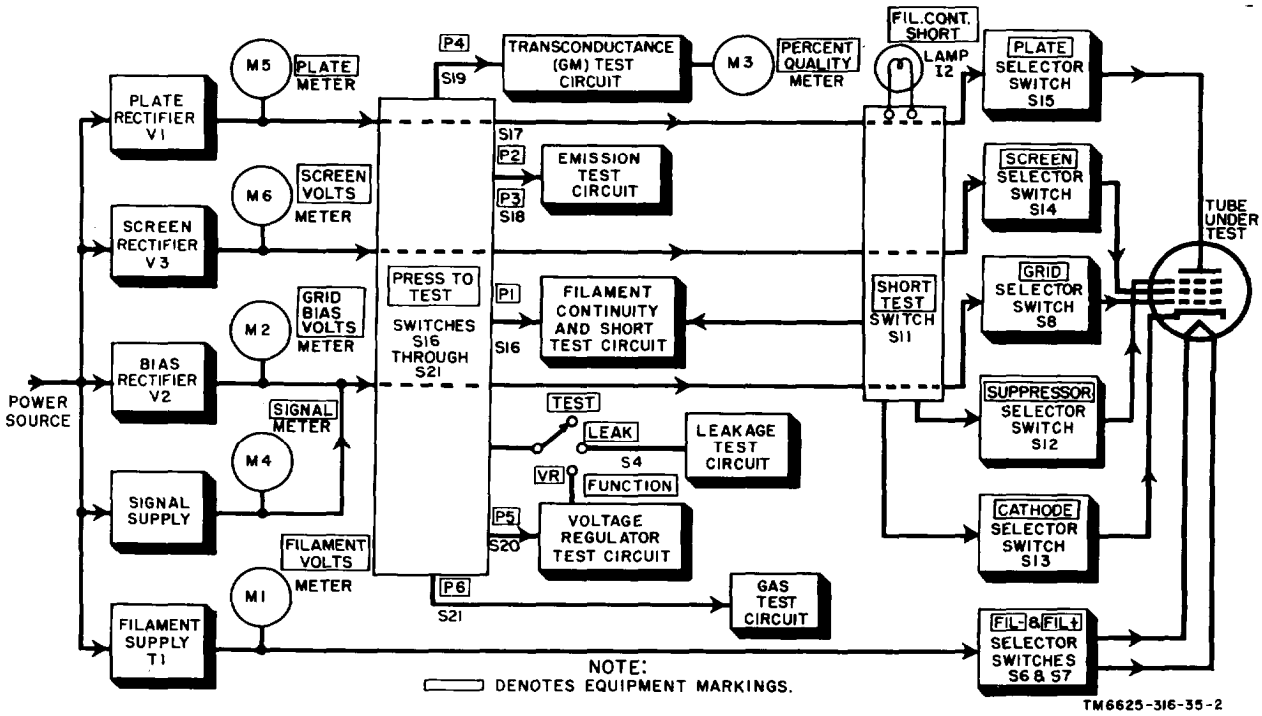


Figure 2. Test Set, *Electron Tube TV-2(*)/U, block diagram.*

4. Power Supply Circuits

a. General. Input power for the primary of filament transformer T1 (fig. 3) is fed through power switch S9, line fuses F1 and F2, and FILAMENT rheostat R1. Input power for the primary of power transformer T2 (fig. 3 and 4) is fed through power switch S9, line fuses F1 and F2, and PLATE potentiometer R45. R1 and R45 are used to adjust actual filament and plate voltages, respectively, to the reference value given in the tube test data roll chart. Resistor R18 limits the amount of current to indicator lamp 11 and resistor R2 is the filament primary shunt resistor (fig. 3).

b. Filament Transformer T1. Secondary winding 3–22 of filament transformer T1 (fig. 3) has 20 terminals nominally rated to 117 volts ac with the use of terminal 22 as the reference. Any one of these voltages can be selected and fed to the tube under test by setting FILAMENT RANGE switch S1 to the position corresponding to the desired filament voltage. The voltage selected is indicated on FILAMENT VOLTS meter Ml. The proper FILAMENT VOLTS meter multipliers, resistors R65, R3, R4, R5, and R64, are connected into the meter circuit through the rear of section 1 of switch S1. Resistor network R6, R7, R8, and R9 places the filament and cathode of the tube under test to the same dc potential.

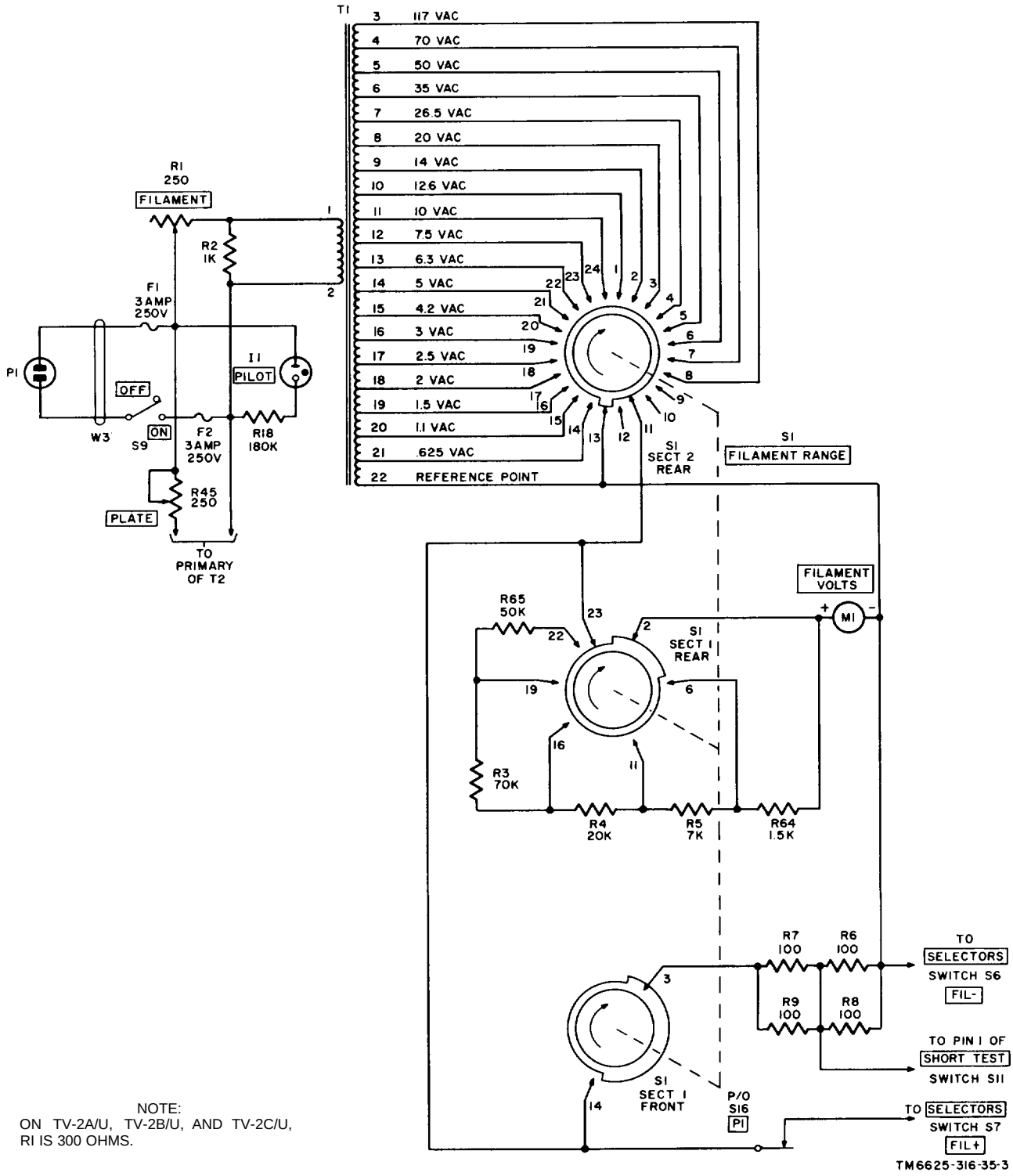
c. *Power Transformer T2.* Power transformer T2 (fig. 4) has six secondary windings: winding 3-14, split between terminals 9 and 10 for the plate supply rectifier; winding 15-25 for the screen supply rectifier; winding 26–28 for the bias supply rectifier; two filament windings, 33-35 and 31–32, to heat the filaments of the 83 rectifier tube V1 and the 6X4 or 6X4W rectifier tubes V2 and V3 respectively, and signal supply winding 29-30 to provide ac signal voltage to the grid of the tube under test. PLATE-SCREEN RANGE switch S3 is used to select the required voltage range by selecting various taps or combinations of taps on the plate and screen windings up to a maximum of 250 volts dc.

d. Plate Supply. Plate rectifier tube V1 (fig. 4) is an 83 mercury-vapor rectifier tube connected in a full-wave rectifier circuit. Winding 3-14 of transformer T2, which feeds the plates of tube Vl, is split into two parts to permit proper interconnection of the transconductance (G,,,) test circuit (par. 5). The dc output voltage for the plate of tube under test is taken from center tap 34 of the 5-volt filament winding 33-35 of transformer T2. PLATE meter M5 indicates the dc output voltage.

e. Screen Supply. Screen supply rectifier tube V3 (fig. 4) is a 6X4 or a 6X4W electron tube, connected in a full-wave rectifier circuit. The plates of tube V3 are connected to winding 15-25 of transformer T2 through sections 3 and 4 (rear) of PLATE-SCREEN RANGE switch S3; the dc output voltage for the screen of tube under test is taken from the common cathode. A ripple filter, that consists of capacitors C4A and C4B and SCREEN potentiometer R54, is connected across the output of tube V3. Potentiometer R54 also permits adjustment of dc screen voltage within the limits set by switch S3. The screen voltage selected is indicated on SCREEN VOLTS meter M6, which is connected to the filter output through multiplier resistor R56. Bleeder resistor R55 improves the voltage regulation of the screen supply.

f. Bias Supply. Bias supply rectifier tube V2 (fig. 4) is also a 6X4 or a 6X4W tube, connected in a full-wave rectifier circuit. In this case, however, the normally positive dc cathode of the tube is grounded, and places center tap 27 of bias voltage winding 26–28 of transformer T2 at a negative potential with respect to ground. The dc bias output voltage, therefore, is taken from center tap 27. Capacitor C3 filters the ac ripple. A bleeder and voltage divider, which consists of resistors R34, R26, R27, and R28, is connected across the output of tube V2. A choice of —50, —10, or —5 volts fixed bias is available through corresponding settings of BIAS RANGE switch S2. Section 1 (rear) of switch S2 connects the proper multiplier resistor (R10, R11, or R12) in series with GRID BIAS VOLTS meter M2 for each range selected. BIAS potentiometer R29 provides fine control of the bias voltage. If required, cathode-biasing resistors R13 through R17 are connected into the cathode circuit of the tube under test through positions A, B, C, D, and E of switch S2; capacitor C1 bypasses these cathode-biasing resistors.

g. Signal Supply. Ac signal voltage winding 29-30 of transformer T2 (fig. 4) is shunted by a voltage divider that consists of SIGNAL-V.R. potentiometer R46A and resistors R47, R49, and R50. A signal voltage of 2.5, 0.5, or 0.25 volts ac, selected by GM-SIGNAL RANGE switch S5, is provided to the tube under test. In positions A, B, and C of switch S5, the signal voltage supplied is 0,25 volt; in position D, the signal voltage is 0.5 volt; in position E, the signal voltage is 2.5 volts; in position F, the voltage is zero. Fine control of the signal supply voltage is provided through potentiometer R46A. The correct signal voltage for the tube under test is obtained by adjusting this control until the SIGNAL meter M4 deflects to the redline at the 35 milliampere (ma) calibration.



NOTE:
ON TV-2A/U, TV-2B/U, AND TV-2C/U, R1 IS 300 OHMS.

Figure 3. Simplified filament power supply circuit.

Figure 4. Simplified power supply circuit.
(Located in back of manual)

5. Transconductance Test Circuit

(figs. 5 and 26)

a. In an amplifier tube, a small change in grid voltage causes a large change in plate current. The greater the change in plate current produced by a given change in the applied grid potential (ac signal), the better the performance of the tube as an amplifier if other characteristics remain constant. The amount of plate current change ($_{p}$) produced by a grid voltage change (ΔE_g) will give the measure of the quality of a tube which can be used to compare other tubes. This quality figure of a tube is called mutual conductance or grid-plate transconductance (G_m) and may be defined by:

$$G_m = \frac{\Delta I_p}{\Delta E_g} = \frac{\text{Change in plate current produced (microampere) (plate voltage kept constant)}}{\text{Change in grid voltage producing change in plate current (volts)}}$$

Mutual conductance is measured in micromhos. The rated value of mutual conductance in micromhos for each tube type represents the transconductance at the optimum point of the tube's characteristics. The characteristics of a tube, designated by a series of curves, are used in the design of electron tube circuits to get the best possible performance from a tube.

b. The quality test circuit of Test Set, Electron Tube TB-2(*)/U, shown in figure 5, measures the mutual conductance of electron tubes. Because a figure of merit of the relative performance of a tube is more valuable than the actual value of mutual conductance, the scale of PERCENT QUALITY meter M3 is calibrated directly in percent quality of the rated mutual conductance. The actual value of mutual conductance of the tube under test can be obtained by multiplying the value indicated on the scale of meter M3 by the rated value of mutual conductance of the tube:

$$\text{Mutual conductance } (G_m) = \frac{\text{Percent quality x rated value of } G_m \text{ (micromhos)}}{100}$$

c. The transconductance measuring circuit used in Test Set, Electron Tube TV-2(*)/U consists essentially of a simple full-wave rectifier circuit, that uses plate supply rectifier tube V1 and split plate voltage winding 3-14 of power transformer T2. Various plate voltages are selected by PLATE-SCREEN RANGE switch S3 through sections 1 and 2. Terminals 9 and 10 of transformer T2 are connected to the PERCENT QUALITY meter M3. Quality SHUNT potentiometer R33, connected in parallel with meter M3, permits adjustment of meter sensitivity. The rear section of GM-SIGNAL RANGE switch S5 connects quality meter multiplier resistors R30 and R31 in series with meter M3. The center-tapped resistance network that consists of resistors R40 and R42 and GM CENTERING potentiometer R44 are placed in parallel with meter M3. The center tap of potentiometer R44 is connected to ground and to the cathode of the tube under test to maintain the proper balance of resistance in this network, and to adjust for zero deflection of meter M3. The tube under test is the load of the rectifier circuit. Fixed or cathode bias, as well as various signal voltages, is applied to the grid of the tube under test through GM-SIGNAL RANGE switch S5.

d. When plate No. 1 of tube VI is at an instantaneous positive potential, plate No. 2 is at an instantaneously negative potential; electron flow is through resistor R40 and potentiometer R44 to the tube under test, as indicated by the solid arrows in figure 5 (press to test switch S19 is open). This would cause meter M3 to deflect in one direction. During the next half-cycle of the ac signal voltage, plate No. 1 is at a negative potential while plate No. 2 is at a positive potential; electron flow is through resistor R42 and potentiometer R44 to the tube under test, as indicated by the broken arrows. This would cause meter M3 to deflect in the opposite direction. Equal currents flow in the directions of both the solid and broken arrows. Because meter M3 is incapable of following the equal and opposite positive and negative deflections at the power line frequency, however, the pointer remains at zero. Therefore, when the current that flows through resistor R40 and potentiometer R44 is exactly equal to the current that flows through resistor R42 and potentiometer R44, they will balance out and meter M3 will not deflect. If the currents are not exactly equal, potentiometer R44 is used to achieve this balanced condition.

e. In addition to the dc bias voltage normally present, an ac signal voltage is applied to the grid of the tube under test (press to test switch

S19 is closed). During the first half-cycle of the input voltage when plate No. 1 of tube V1 is positive, the ac signal voltage also swings the grid of the tube under test to a positive potential. The plate current is increased and more current flows through resistor R40 and potentiometer R44. As a result, the deflection on the scale of meter M3 is greater than in the absence of the signal voltage. During the next half-cycle when plate No. 2 of tube V1 is positive, the signal voltage will swing the instantaneous voltage at the grid of the tube under test to a negative potential. The plate current is decreased and less current flows through resistor R42 and potentiometer R44. Consequently, the deflection of meter M3 is now in the opposite direction and is less than in the absence of the ac signal voltage. During each succeeding half-cycle, the current is now opposite and unequal, and the meter reading will be proportional to the difference in current between two half-cycles. The same unbalance in current exists during each succeeding cycle and thus, over a period of time, the meter reading will be proportional to the average value of the difference in instantaneous currents produced by the ac grid signal voltage. Meter M3 indicates the plate current changes caused by applied grid voltage changes, or the mutual conductance.

f. During operation, PERCENT QUALITY meter M3, shunt resistors R40 and R42, and potentiometer R44 are switched into the circuit by operating FUNCTION switch S4 to the TEST position and depressing PRESS TO TEST P4 switch S19. PRESS TO TEST P4 switch S19 applies plate and screen voltages to the tube under test. Ac signal voltages are applied to the grid of the tube by the front of GM-SIGNAL RANGE switch S5, while the rear of switch S5 connects the proper multiplier resistors in series with quality SHUNT potentiometer R33 for each signal voltage range. When in position F, switch S5 removes signal voltage from the tube under test to permit zero adjustment of meter M3 by GM CENTERING potentiometer R44. (In position F, no signal voltage is applied, but SIGNAL meter M4 still will deflect.) Various values of either cathode or fixed bias can be applied to the grid of the tube under test by bias range switch S2.

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

6. Emission Measuring Circuit
(figs. 6 and 26)

a. An emission test performed on rectifier tubes and diode sections of multielement tubes will indicate whether the tube can provide a sufficient number of electrons for satisfactory operation under normal service. The emission or saturation current of a two-element tube can be measured if all electrons emitted by the cathode are drawn to the plate. Emission falls off as a tube wears out, therefore, low emission is indicative of the end of the normal life of a tube. The test for emission is limited, because it does not test the tube under normal operating conditions, but only for static voltages. Residual gas current, nonuniform cathodes, and other faults may supply normal emission current when the tube actually is in an unsatisfactory condition. Some tubes will operate satisfactorily after emission has dropped far below the original or rated value.

b. A simplified schematic diagram of the emission measuring circuit of Test Set, Electron Tube TV-2(*)/U is shown in figure 6. The circuit is a simple series circuit with the tube under test, and the meter circuit serves as a load for the applied ac voltages. One-half of the high-voltage plate supply of power transformer T2 provides ac test voltages from taps 3, 6, and 7 (3, 6, 7, and 8 on TV–2C/U). These voltages are selected by the settings of PLATE-SCREEN RANGE switch S3 through section 1. Current-limiting resistors R19 through R25, connected in series with the tube under test, limit the total current to a safe value. The total current in the "circuit is determined by the series-limiting resistors selected, the resistance of the tube under test, and the resistance of the meter circuit. Because the tube under test rectifies the current, PERCENT QUALITY meter M3 is used to measure the emission. Quality SHUNT potentiometer R33, connected across meter M3, permits adjustment of meter sensitivity and limits the total current. Meter multiplier resistors R30 and R31 can be connected in series with meter M3 through GM-SIGNAL RANGE switch S5.

c. For diodes, depressing PRESS TO TEST P2 switch S17 applies voltage to the tube under test and emission current is read in percent quality of the rated value on PERCENT QUALITY meter M3.

d. For multigrid tubes, the control and screen grids are connected to the plate while the suppressor grid is tied to the cathode; the tube them functions as a diode. When PRESS TO TEST P3 switch S18 is depressed at the same time as P2 switch S17, emission current is read in percent quality of the rated value on PERCENT QUALITY meter M3.

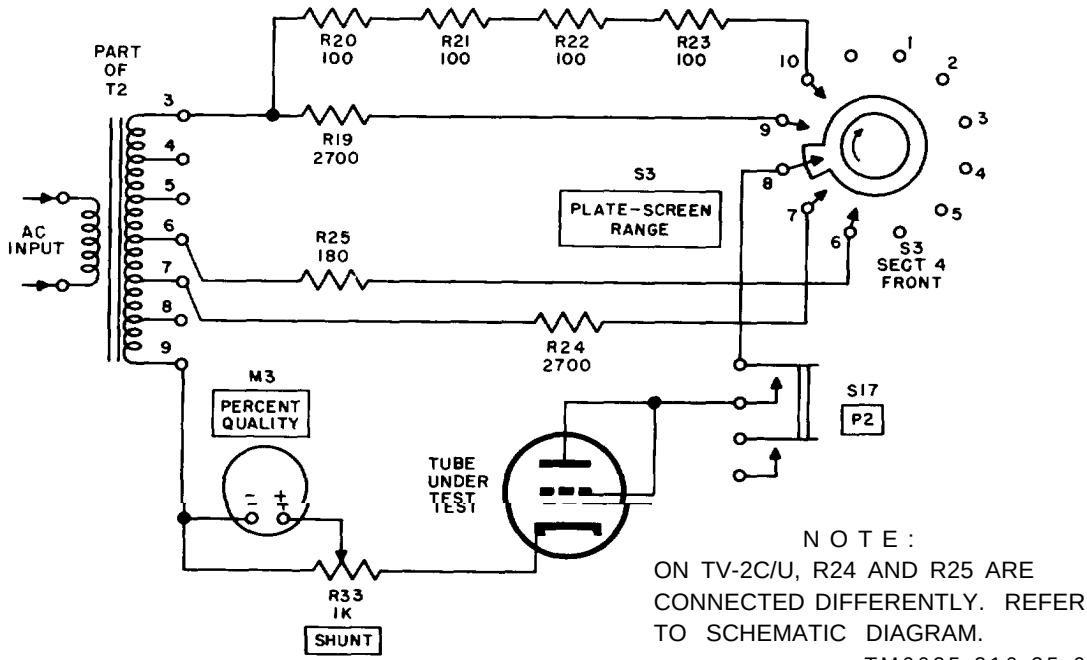


Figure 6. *Emission measurement circuit of Test Set, Electron Tube TV-2(*)/U, Simplified Schematic diagram.*

7. Gas Test Circuit

(figs. 7 and 26)

a. A gas test performed' on an amplifier-type tube will detect an excessive amount of gas in the tube. A gassy tube will not function correctly. Ionization of residual gas in a tube causes grid current to flow, and thus changes the grid-bias voltage and other operating characteristics of a tube.

b. The gas test circuit of Test Set, Electron Tube TV–2(*)/U is part of the transconductance test circuit (par. 5) only parts involving the grid circuit are shown in the simplified schematic diagram (fig. 7). Plate current through the tube under test has a certain value, which depends on the plate and grid voltages set up for the transconductance test of the tube (par. 5). Depress PRESS TO TEST P6 switch S21 to insert resistor R58 into the grid circuit of the tube under test. If the tube is gassy, the source of grid-bias voltage C will cause current to flow through the grid circuit in the direction indicated by the arrows (fig. 7). The gas current develops a voltage drop across resistor R58, which tends to place the grid end of the resistor at a positive potential and reduce the negative grid bias; an increase in plate current results. This increase in plate current is indicated on PERCENT QUALITY meter M3. The pointer of meter M3 will move less than three-scale divisions if the tube under test has a negligible gas content.

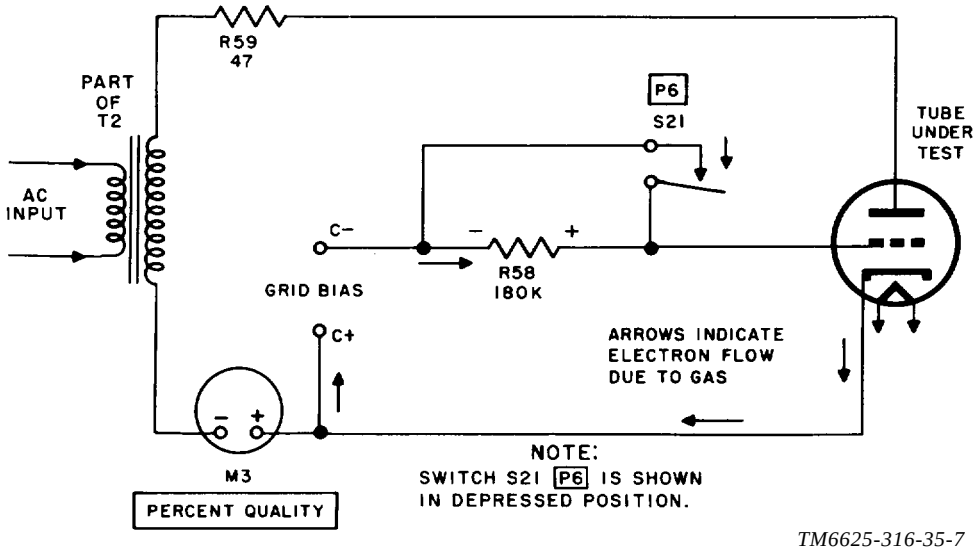


Figure 7. Gas test circuit of Test Set, Electron Tube TV-2(*)/U, simplified schematic diagram

8. Voltage Regulator and Thyraton Tube Test Circuit

(figs. 8 and 26)

a. Voltage-regulator tubes, gas-filled rectifier tubes, and thyratron tubes must have low-voltage regulation to perform efficiently. A test that measures the voltage drop across a tube under test can be used to determine the regulation of the tube under varying load conditions. By measuring the voltage drop of the tube under minimum and maximum load conditions, the regulation of the tube in volts can be obtained by using the following equation:

$$\text{Regulation} = E^{max} - E^{min}$$

In this formula, E^{max} and E^{min} represents the voltage drops across the tube under maximum and minimum load conditions.

b. The voltage regulator and thyratron tube test circuit used in Test Set, Electron Tube TV-2(*)/U is shown in figures 8 and 26. Filtered voltage taken from bleeder resistor R55 of the screen supply circuit is fed to the plate of the tube under test through PRESS TO TEST P5 switch S20 and SIGNAL-V.R. potentiometer R46B. The voltage drop across the tube is measured by PERCENT QUALITY meter M3, which is placed in parallel with quality SHUNT potentiometer RX3. The load current through the tube under test is indicated on PLATE meter M5. Tube V 1 is used as a meter rectifier for meter M5 when the plate voltage is either 20 or 35 volts ac. The total amount of load current depends on the resistance network of the meter and the setting of potentiometer R46B. With SIGNAL-V.R. potentiometer R46B, PLATE potentiometer R45, and SCREEN potentiometer R54 adjusted for the minimum and maximum load currents specified for the tube under test, the voltage drop across the tube is indicated on meter M3 for each load condition. Minimum limits for the tube under test are specified in the tube test data roll chart.

c. In the case of thyratron tubes and gas triodes, a bias voltage normally is applied to the grid of the tube under test which is at a sufficiently negative voltage to prevent ionization of the gas in the tube. As grid bias is reduced, a critical voltage, called striking voltage, is reached. At this point, the electrons emitted from the cathode gain sufficient energy to ionize the gas within the tube. At the striking point, all gas in the tube is suddenly ionized and a large gas current, which is no longer controlled by the grid bias voltage, results. The important characteristic of gas triodes, therefore, is the striking voltage of the tube.

d. To measure the striking voltage of gas triodes, BIAS potentiometer R29 and BIAS RANGE switch S2 are adjusted until the tube under test strikes. This is indicated by a flow

of plate current and a reduced voltage drop across the tube. The ionization or striking voltage of the tube under test is indicated on GRID BIAS VOLTS meter M2.

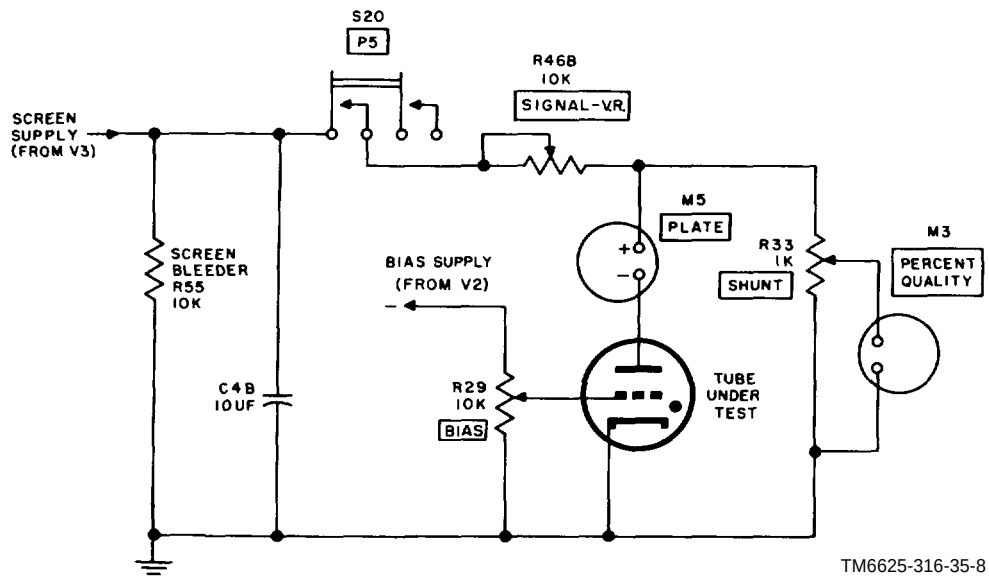


Figure 8. Voltage regulator and thyratron tube test circuit of Test Set, Electron Tube TV-2(*)/U, Simplified schematic diagram.

9. Short Test Circuit

(figs. 9 and 26)

a. A simplified schematic diagram of the circuit used for detecting interelement shorts in the tube under test is shown in figure 9. A portion of the bias voltage is taken from bias rectifier tube V2 and applied to a bridge network formed by resistors R35, R60, R61, and R62. The voltage at point 1 is constant and depends only on the bias supply voltage and on the values of resistors R35 and R62. The voltage at point 2 is a function of the bias supply voltage and the values of resistors R60 and R61. When no elements of the tube under test are short-circuited, the difference in potential between points 1 and 2 is below the striking voltage of FIL. CONT. SHORT lamp 12. When there is a short circuit between elements of the tube under test, the voltage at point 2 is reduced. Because the voltage at point 1 is constant, the difference in potential at points 1 and 2 is increased until FIL. CONT. SHORT lamp 12 lights. Actually, an effective resistance of 3,000 ohms or less across resistor R61 is sufficient to light the FIL. CONT. SHORT lamp.

b. When PRESS TO TEST P1 switch S16 is in its normal unoperated position and FUNCTION switch S4 is in the TEST position, SHORT TEST switch S11 is connected across resistor R61. Selection of any one of the electrodes, except the filament in the tube under test, is made through the front portion of section 1 of switch S11. If a short circuit exists between the filament and any other element of the tube, the rear of section 1 of switch S11 completes the circuit to ground, and thus shorts out resistor R61 and causes FIL. CONT. SHORT lamp 12 to light. The selection of the cathode of the tube under test by the f rent of section 1 of switch S11 will test for a short circuit between the cathode and filament.

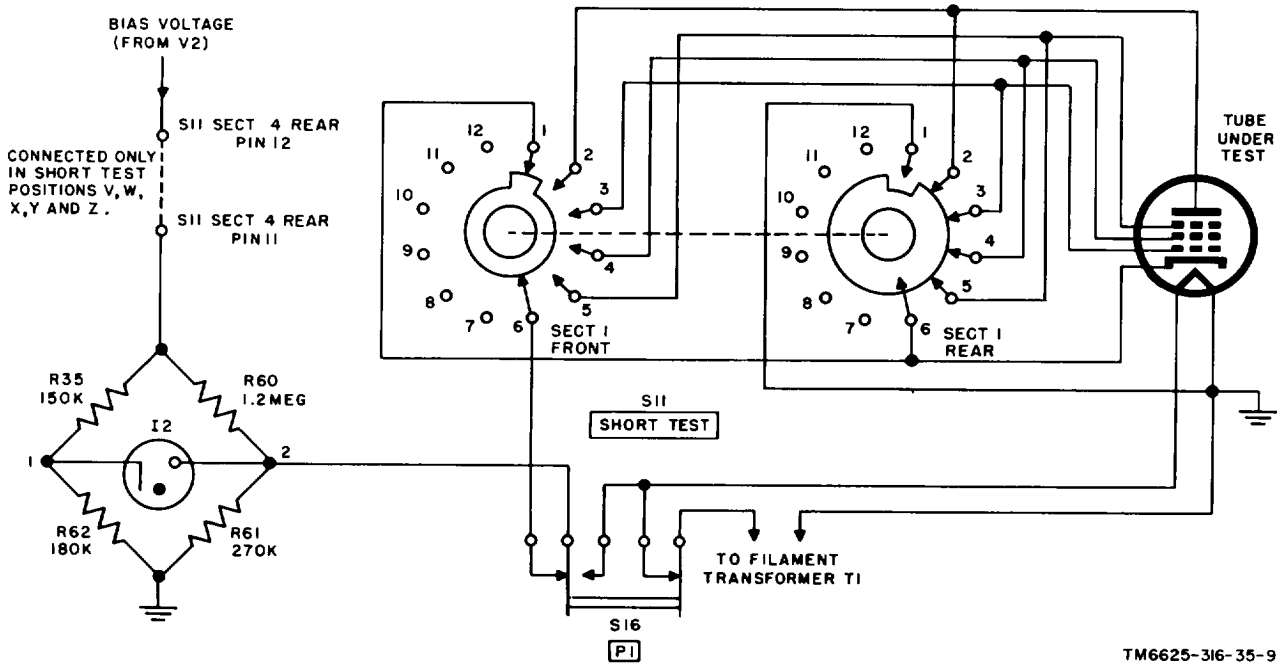


Figure 9. Short and filament continuing test circuit of Test Set, Electron Tube TV-2(*)/U, simplified schematic diagram.

10. Filament Continuity Test Circuit

The filament continuity test circuit of Test Set, Electron Tube TV-2(*)/U provides visual indication of filament continuity of hot-cathode electron tubes, ballast tubes, and indicator lamps. The action of this circuit is identical with that of the short test circuit (par. 9) ; a simpli. fied schematic diagram is shown in figure 9. The operation of PRESS TO TEST PI switch S16 connects the filament or filaments of the tube under test across resistor R61 and removes filament voltage from the tube. If the filament is closed, its low resistance, placed in parallel with FIL. CONT. SHORT lamp 12, will increase the voltage across lamp 12 and the lamp will light. If the filament of the tube under test is open, the voltage across lamp 12 is too low for the lamp to light.

11. Leakage Test Circuit

(figs. 10 and 26)

In Test Set, Electron Tube TV-2(*)/U, a conventional ohmmeter circuit measures the interelement leakage resistance in a tube under test. A simplified schematic diagram of this circuit is shown in figure 10. When FUNCTION switch S4 is in the LEAK position, a portion of the bias voltage from tube V2 is applied to the tube under test through SHORT TEST switch S11 and PLATE meter M5. Resistor R38 is a series-multiplier for meter M5, which serves as an ohmmeter. Any element of the tube under test can be selected by switch S11. If low leakage resistance exists between the element selected and any other element of the tube, leakage current completes the series circuit and meter MS indicates the equivalent leakage resistance in megohms. If there is no leakage, meter M5 will not deflect; this will indicate a high resistance. The scale of meter M5 is not designed to indicate a very low leakage resistance of a few hundred ohms or less. However, such a partially short-circuited condition can be detected by performing the short test (par. 9).

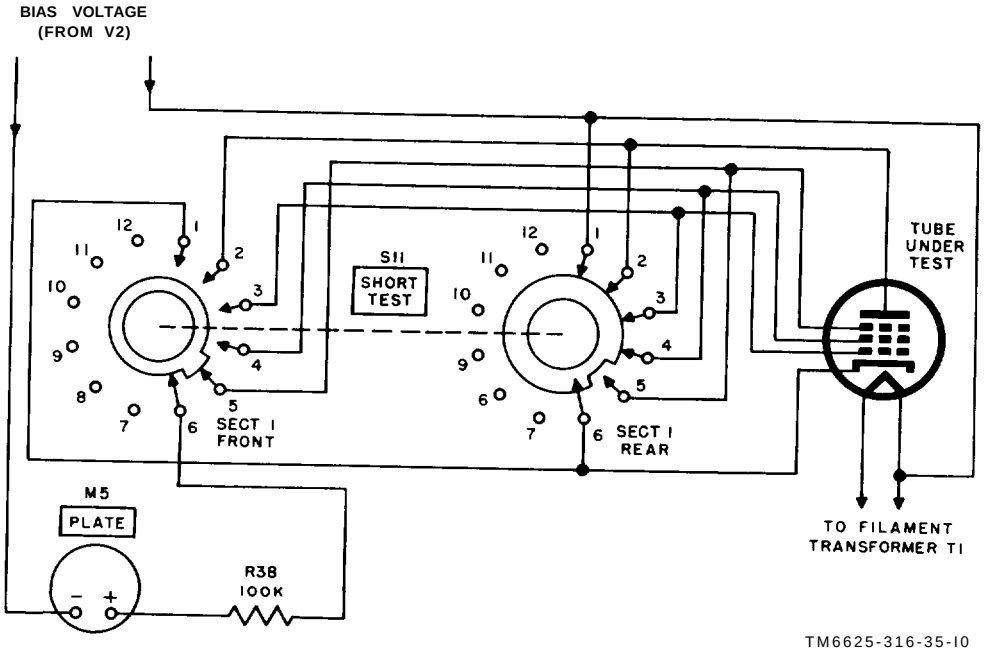


Figure 10. Leakage test circuit of Test Set, Electron Tube TV-2(*)/U, simplified schematic diagram.

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.

h. Localization. The tube tester can be used to check pilot lamps, diode tubes, amplifier tubes for transconductance (G,,,), 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–682A/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.

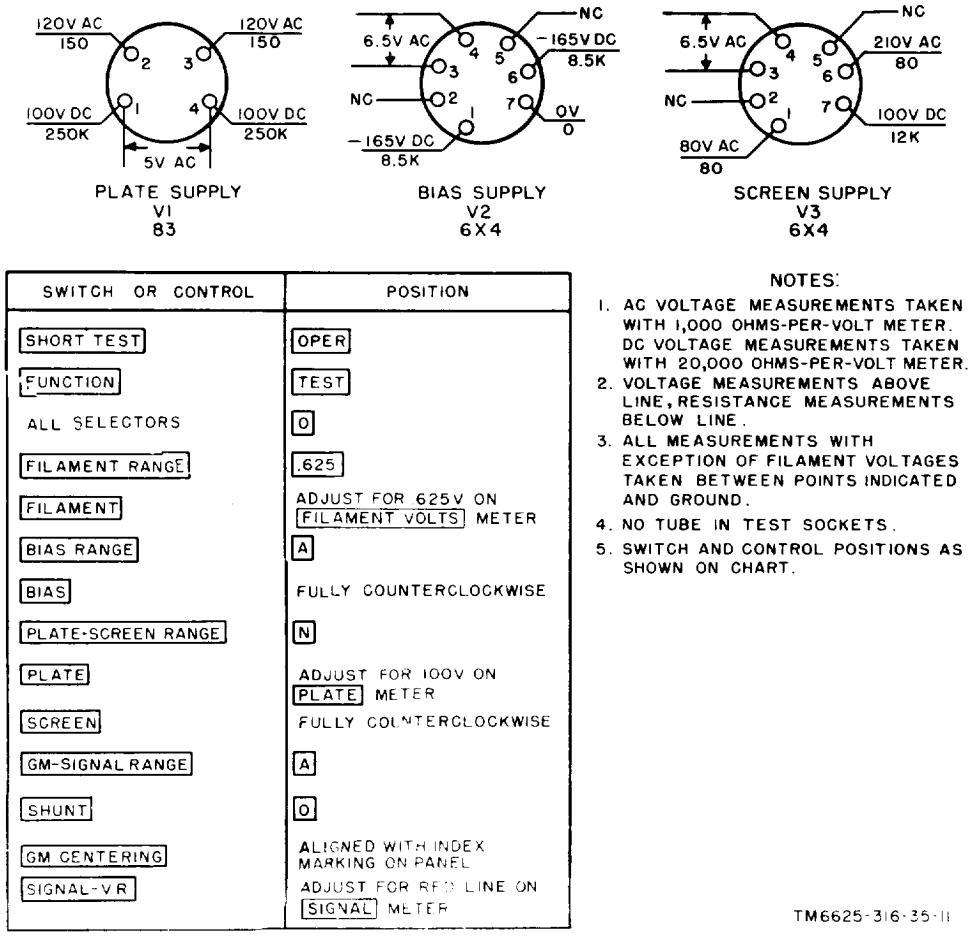


Figure 11. Tube socket voltage and resistance diagram.

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

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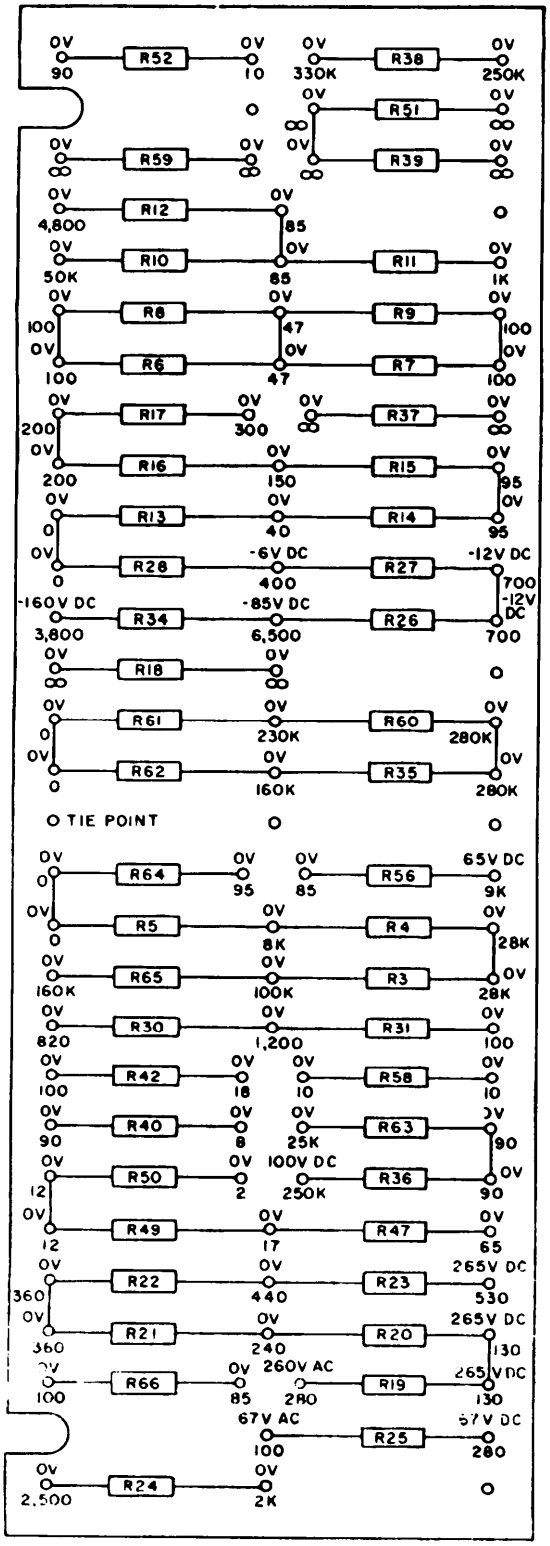


NOTES:

1. VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHMS-PER-VOLT METER
2. VOLTAGE MASUREMENTS 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	0
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 100V ON PLATE METER
SCREEN	FULLY COUNTER-CLOCKWSE
GM-SIGNAL RANGE	A
SHUNT	0
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL
SIGNAL-VR	ADJUST FOR REDLINE ON SIGNAL METER

TM6625-316-35-13

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 multi meter. 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 the referenced 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
	PILOT lamp 11 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 11 defective	Check lamp 11 and replace if necessary.
		Power cord defective	Check power cord and connector and replace if necessary.
	PILOT lamp 11 lights but FILAMENT VOLTS meter M1 does not indicate.	FILAMENT VOLTS meter Ml 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 11 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.

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 12 does not light in any position of SHORT TEST switch S11.	FIL CONT. SHORT lamp 12 defective.	Replace lamp 12 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 trans. conductance (G,,,) 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 PI switch S16 depressed and a tube known to be good being tested, FIL. CONT. SHORT lamp 12 does not light.	FIL. CONT. SHORT lamp 12 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 (ohm.)
1-2	2.3
3-4	17.4
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 3

FOURTH ECHELON REPAIRS

19. Parts Replacement Techniques

Caution: **Be careful to avoid damage to delicate mechanisms, circuit parts, and wiring when the chassis of the tube tester is removed from the case. Only qualified maintenance personnel, equipped with the proper tools, should attempt repair and replacement of parts.**

Most maintenance and repair can be performed on Test Set, Electron Tube TV-2(*)/U by removing the chassis from the case (TM 11–6625–316–12). However, for checking parts that are located on the front (fig. 14) of the chassis or parts that are mounted through the chassis where terminals on both sides must be available, the chassis must be lowered (par. 20). Some parts that are located beneath the chassis or near the resistor mounting board cannot be replaced unless the chassis is repositioned and the resistor mounting board is removed from the chassis.

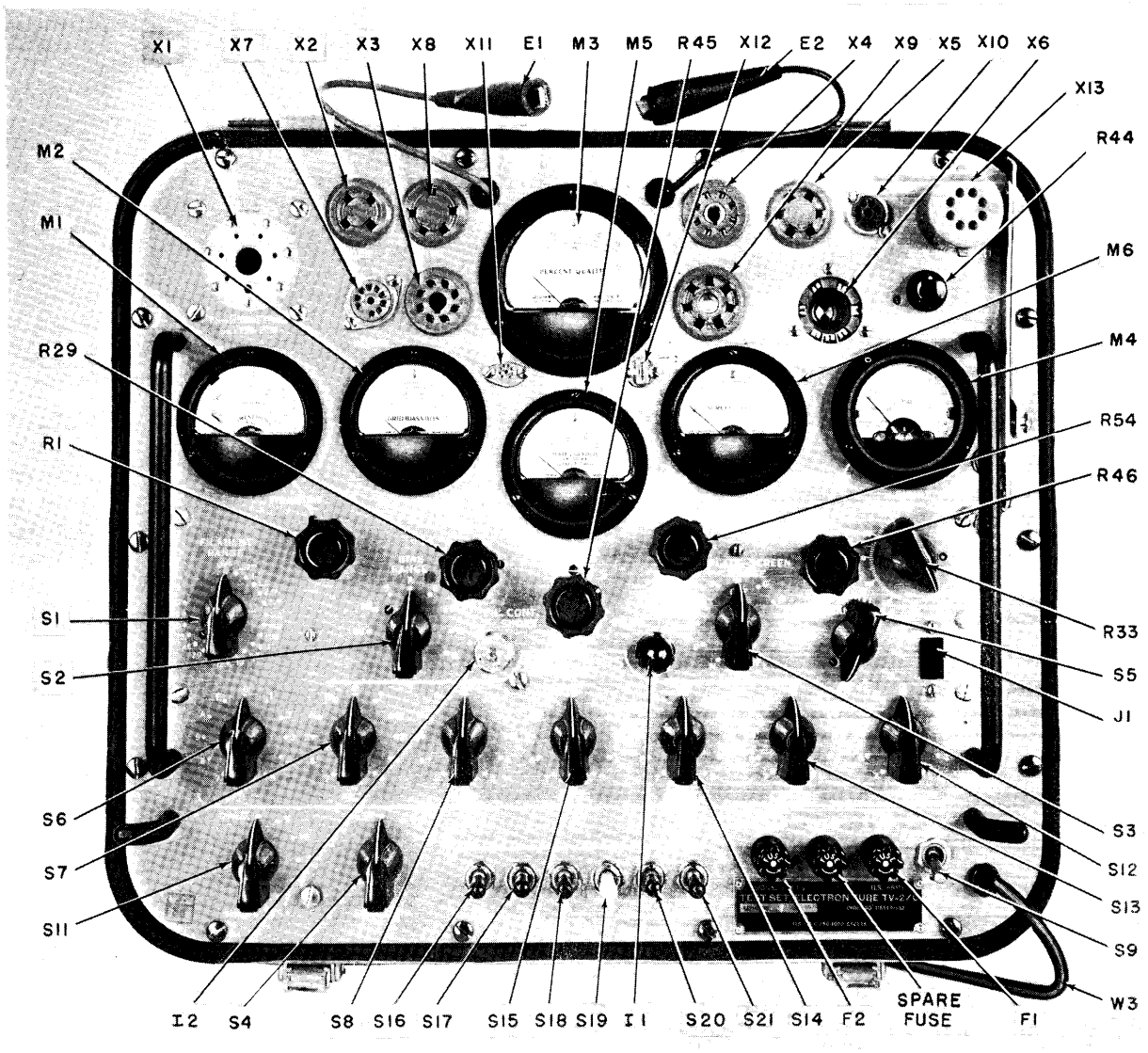


Figure 14. Panel of Test Set, Electron Tube TV-2(*)/U, location of parts.

20. Lowering Chassis

(figs. 15-19)

If the part to be checked or replaced is located on the front of the tube tester chassis or mounted through the chassis, lower the chassis so that the part can be reached without removing the chassis from its mounting brackets; proceed as follows :

a. Place the panel of the tube tester face downward (fig. 15). Remove the chassis mounting bolts on the bottom of each mounting bracket just behind the cutouts on the resistor mounting board (fig. 16).

b. Raise the tube tester to a vertical position so that it rests on the bottom edge of the panel and the chassis supports. Remove the mounting bolts nearer the top of the chassis on both chassis mounting brackets (figs. 17 and 19).

Note. On the TV–2A/U only, remove the flathead bolt on the rear of the chassis (fig. 18).

c. Loosen the bolts in the slotted mounting bolt channels on each mounting bracket (figs. 17 and 19).

d. Slide the chassis up in the slotted channels, swing it away from the panel, and lower it until the front of the chassis is at right angles to the panel (fig. 19). The chassis will remain in this position.

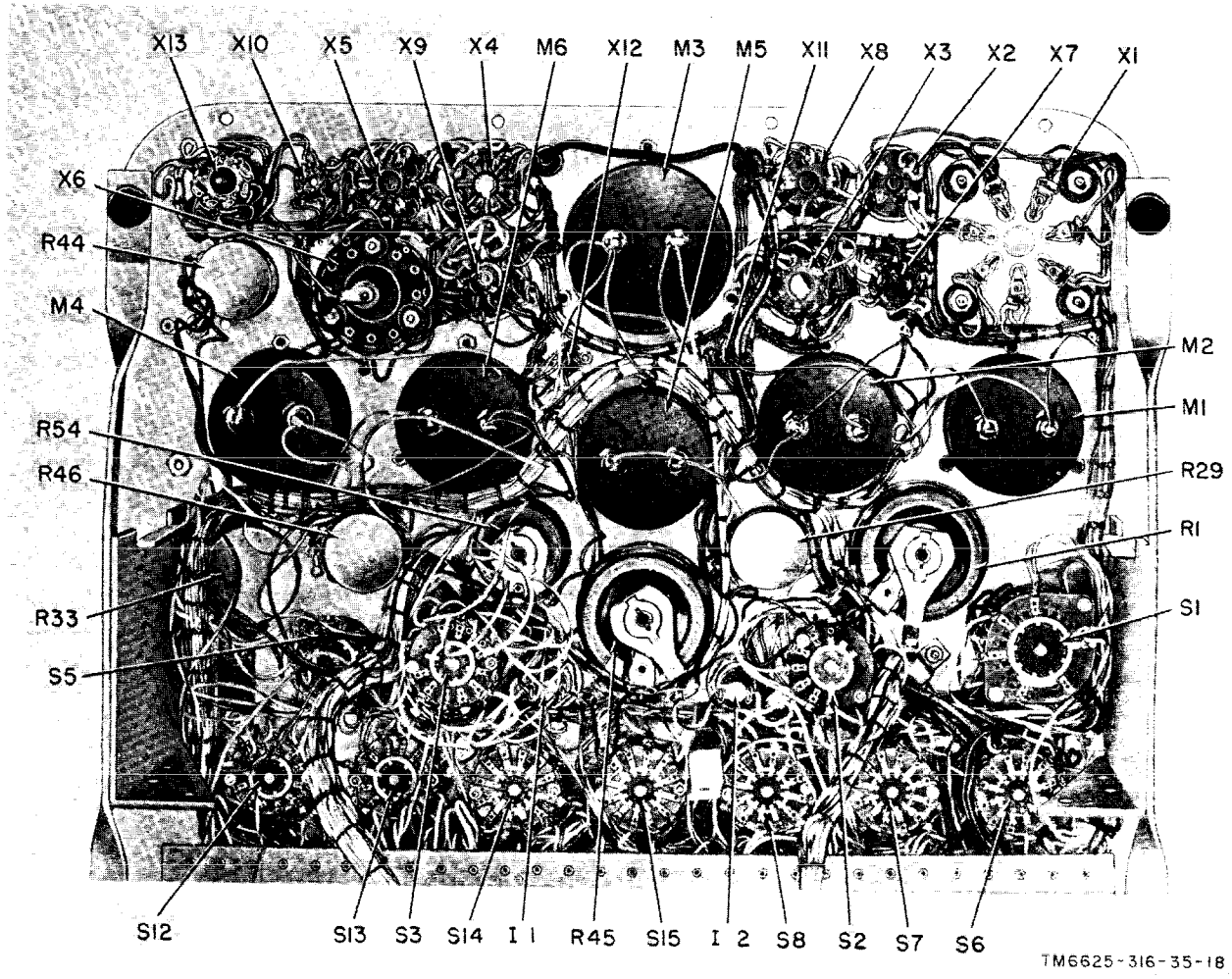
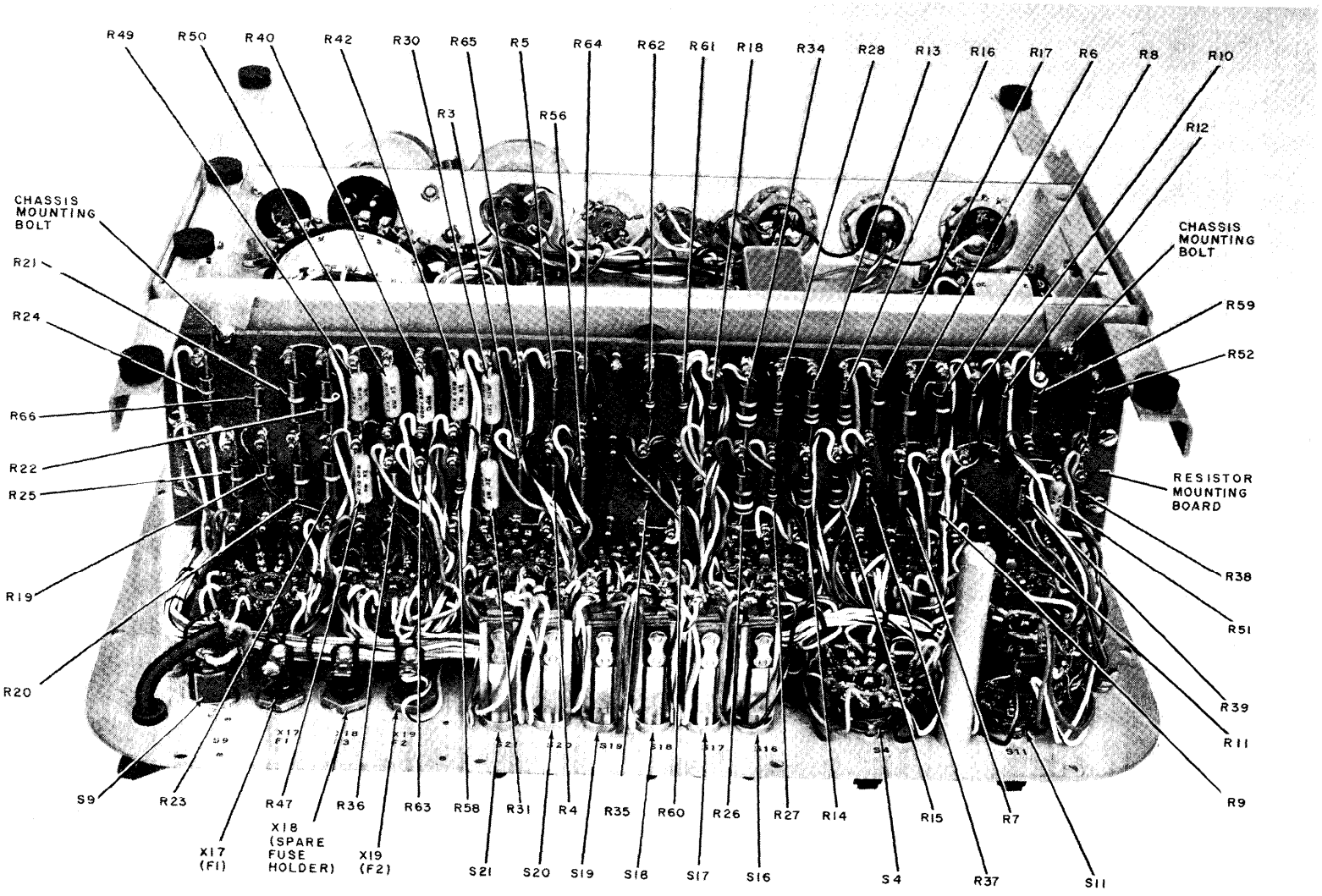


Figure 15. Rear of panel of Test Set, Electron Tube TV-2(*)/U, location of parts.



NOTE:
ON THE TV-2A/U, RESISTORS R40 AND R42 ARE MOUNTED ON THE REAR OF THE CHASSIS.

TM6625-316-35-17

Figure 16. Bottom of chassis and resistor mounting board of Test Set, Electron Tube TV–2(*)/U, location of parts.

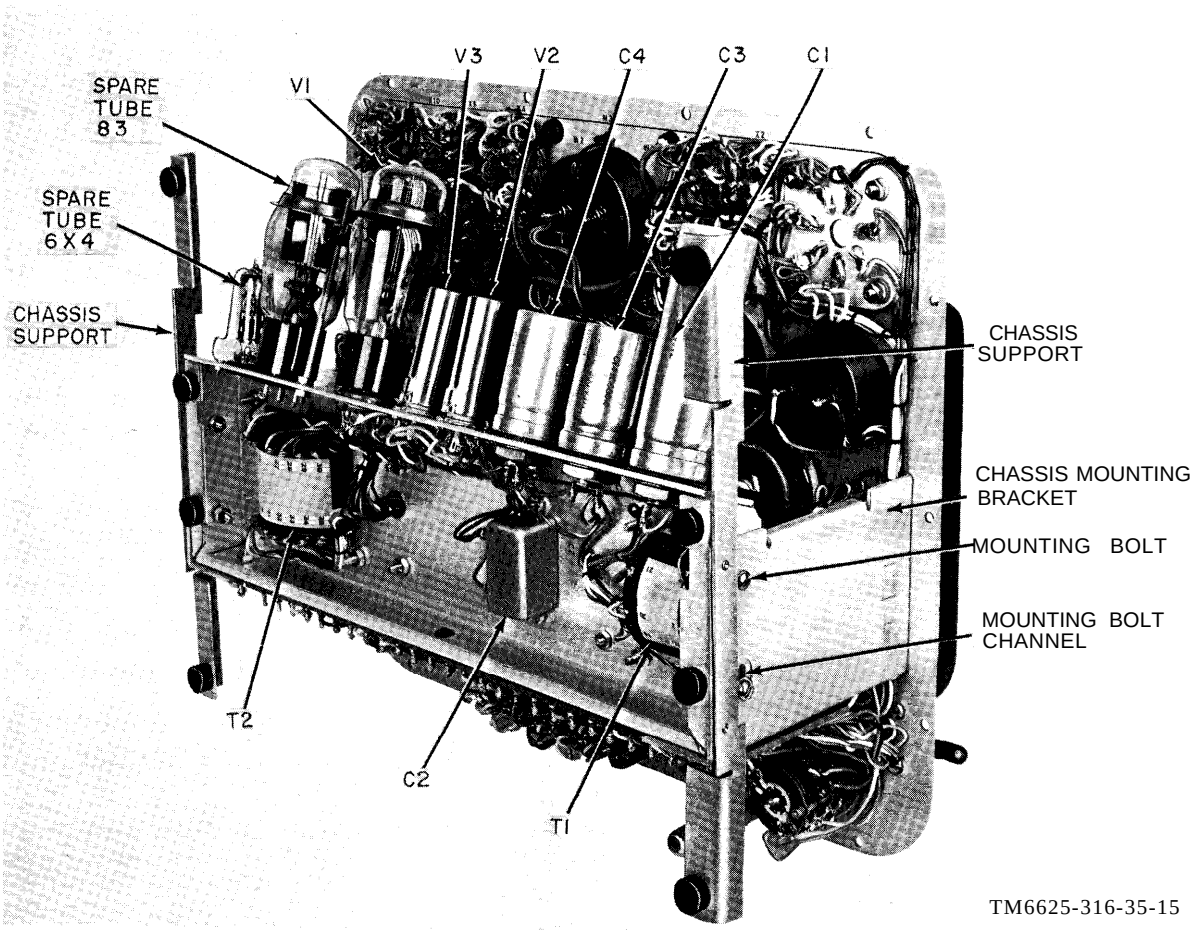


Figure 17. Rear of chassis of Test Set, Electron Tube TV-2/U and TV-2B/U, and TV-2C/U, location of parts.

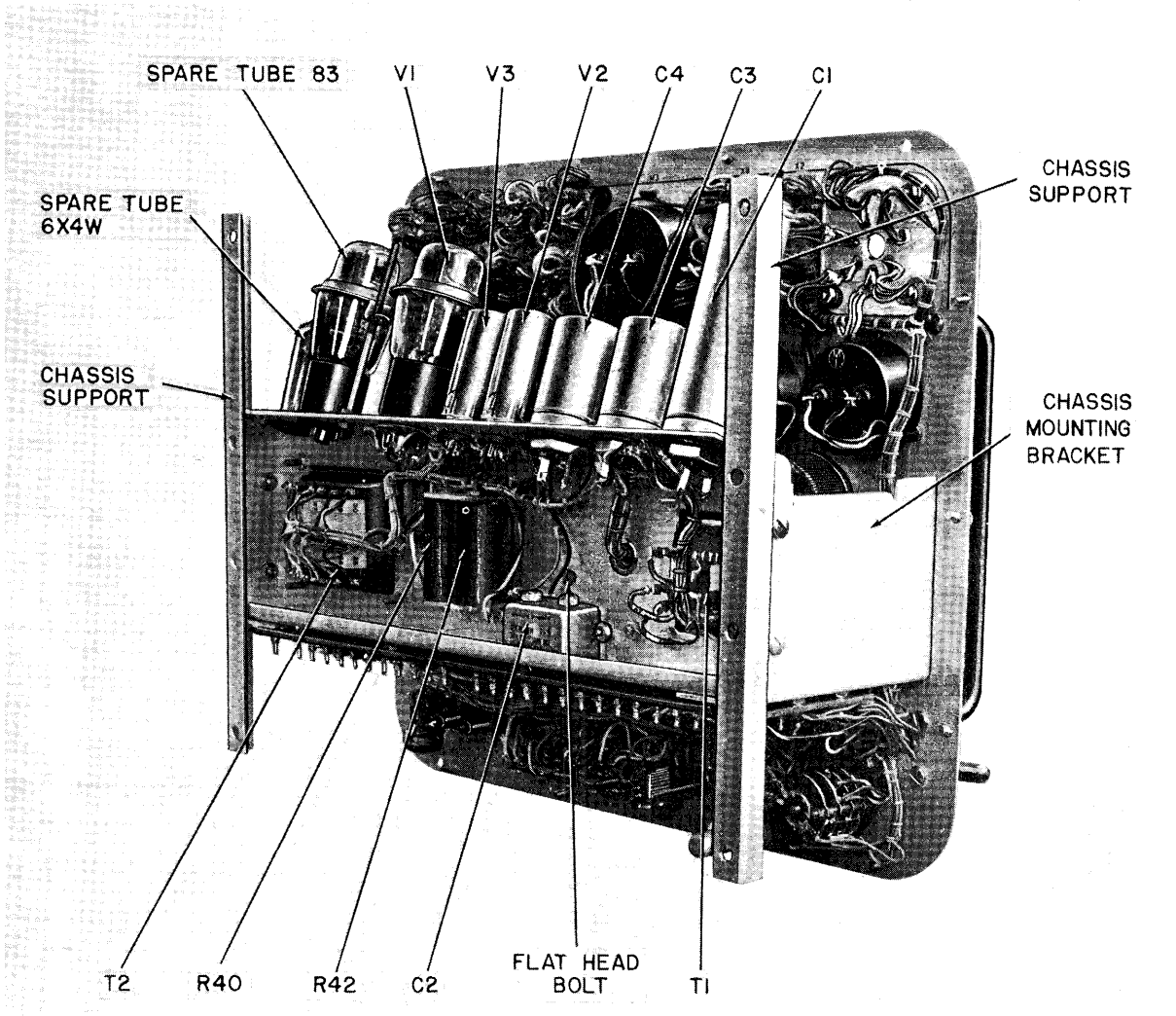


Figure 18. Rear of chassis of Test Set, Electron Tube TV-2A/U, location of parts.

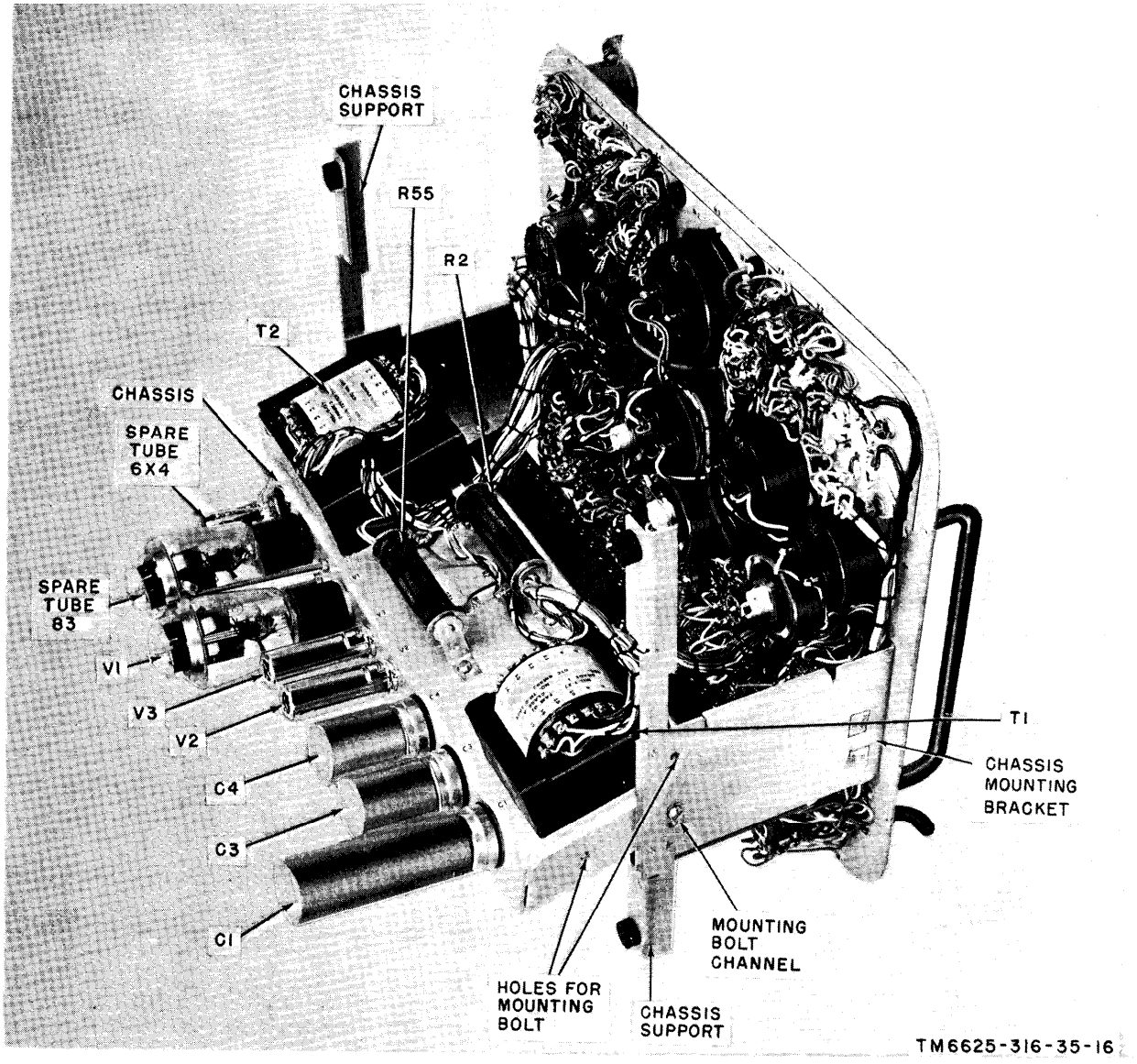


Figure 19. Front of chassis of Test Set, Electron Tube TV-2(*)/U, location of parts.

21. Removal and Replacement of Transformers

a. Removal.

(1) Remove the chassis from the case and lower the chassis (par. 20). Transformers T1 and T2 are mounted through the chassis (figs. 17, 18, and 19).

(2) Disconnect and tag the wiring to the terminals of the defective transformer on both the front and rear of the chassis.

(3) Remove the bolts, the nuts, and the lockwashers that mount the transformer on the chassis. Pull the defective transformer away from the front of the chassis.

b. Replacement.

(1) Mount the transformer through the front of the chassis.

(2) Replace the bolts, the nuts, and the lockwashers that hold the transformer on the chassis.

(3) Connect the transformer wiring to the appropriate terminals on both the front and rear of the chassis as indicated on the tag.

22. Removal and Replacement of Resistor Mounting Board

Caution: **To disconnect wire leads, remove the resistor mounting board or chassis completely; be sure to tag all disconnected leads so that they can be reconnected to the proper terminals when the tube tester is reassembled.**

a. Removal.

(1) Lower the chassis (par. 20).

(2) Remove the four screws that mount the resistor mounting board on the chassis mounting brackets.

(3) Move the resistor mounting board away from the chassis mounting brackets.

(4) Move the resistor mounting board forward or backward, as required, as far as the wiring will permit.

b. Replacement.

(1) Move the resistor mounting board forward or backward, as required, to line up the four holes with those on the chassis mounting bracket.

(2) Replace the four screws.

23. Removal, Mounting, and Replacement of Tube Data Roll Chart

(fig. 20)

Caution: **The roller gears are made of nylon and should never be lubricated.**

When a new tube test data roll chart is to be installed in the tube tester, follow the instructions in *a* through *c* below.

a. Removal.

(1) The tube test data roll chart housing is bolted to two mounting brackets inside the cover of the tube tester (fig. 1, TM 11-6625-31 6–12). Remove the tube test data roll chart housing by removing the two bolts, the nuts, and the lockwashers that mount the housing to these brackets.

(2) Remove the three screws that mount the roller guide plate to the housing. Pull the roller guide plate from the housing. *Do not* loosen the three screws that mount the tube test data roll chart guide plate to the gear end of the housing.

(3) Remove the two rollers by sliding them away from the gear end of the housing.

(4) Remove the old tube test data roll chart and the tape that mounts the tube test data roll chart to the rollers. To remove any adhesive from the old mounting tape that may be adhering to the rollers, clean the rollers with a cloth dampened with Cleaning Compound (Federal stock No. 7930-395-9542) .

warning: Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.

b. Mounting.

(1) Unroll 1 foot of the new tube test data roll chart. With the rollers positioned as shown in figure 20, place the top of the tube test data roll chart, with the printed side upward, parallel to the guideline marked on the upper roller.

(2) Use two small tabs of pressure-sensitive tape, approximately one-half inch long, to anchor the top of the tube test data roll chart along the guideline.

(3) Apply pressure-sensitive tape to the entire length of the roller, with half

the width of the tape on the tube test data roll chart and the other half on the roller.

(4) Roll the tube test data roll chart, with the printed side upward, onto the upper roller to within approximately 1 foot of the end of the tube test data roll chart. Be careful to keep the tube test data roll chart square with the edges of the upper roller. Keep the paper taut by hooking a rubberband over the pin on the gear end of the roller and stretching it over the pin on the other end of the roller.

(5) Fasten the end of the tube test data roll chart to the lower roller with pressure-sensitive tape. Apply the tape as described in (2) and (3) above. Roll the remaining length of the tube test data roll chart onto the upper roller.

c. *Replacement.*

(1) Place the tube test data roll chart housing on end, with the gear (closed) end on the bottom.

(2) Hold the tube test data roll chart taut on both rollers. Insert the gear ends of the rollers through the tube test data roll chart guide plate and into the holes in the roller pivot plate. Move the knurled knob on the front of the housing, if necessary, to engage the gears and guide the pins into their pivots.

(3) Replace the roller guide plate; at the same time, insert the pins on the right-hand end of the rollers through the holes in the roller guide plate.

(4) Replace the three roller guide plate mounting bolts, nuts, and lockwashers. Tighten the bolts with the fingers. There should be a clearance of approximately 0.06 inch (three thicknesses of old tube test data roll chart paper) between the faces of the rollers and the roller guide plate.

(5) Check the knurled knob on the front of the tube test data roll chart housing for ease of operation by turning the tube test data roll chart once through its entire length. If the tube test data roll chart binds and the knurled knob is difficult to turn, or if the knurled knob turns so freely that the tube test data roll chart becomes slack, readjust for proper clearance between the faces of the rollers and the roller guide plate by loosening the bolts and again adjusting for a clearance of 0.06 inch ((4) above). The bolt holes through the roller guide plate end of the tube test data roll chart housing are slightly elongated to permit adjustment. When operation of the knurled knob is satisfactory, tighten the screws securely.

(6) Remount and tighten the tube test data roll chart housing on the mounting brackets inside the cover of the tube tester.

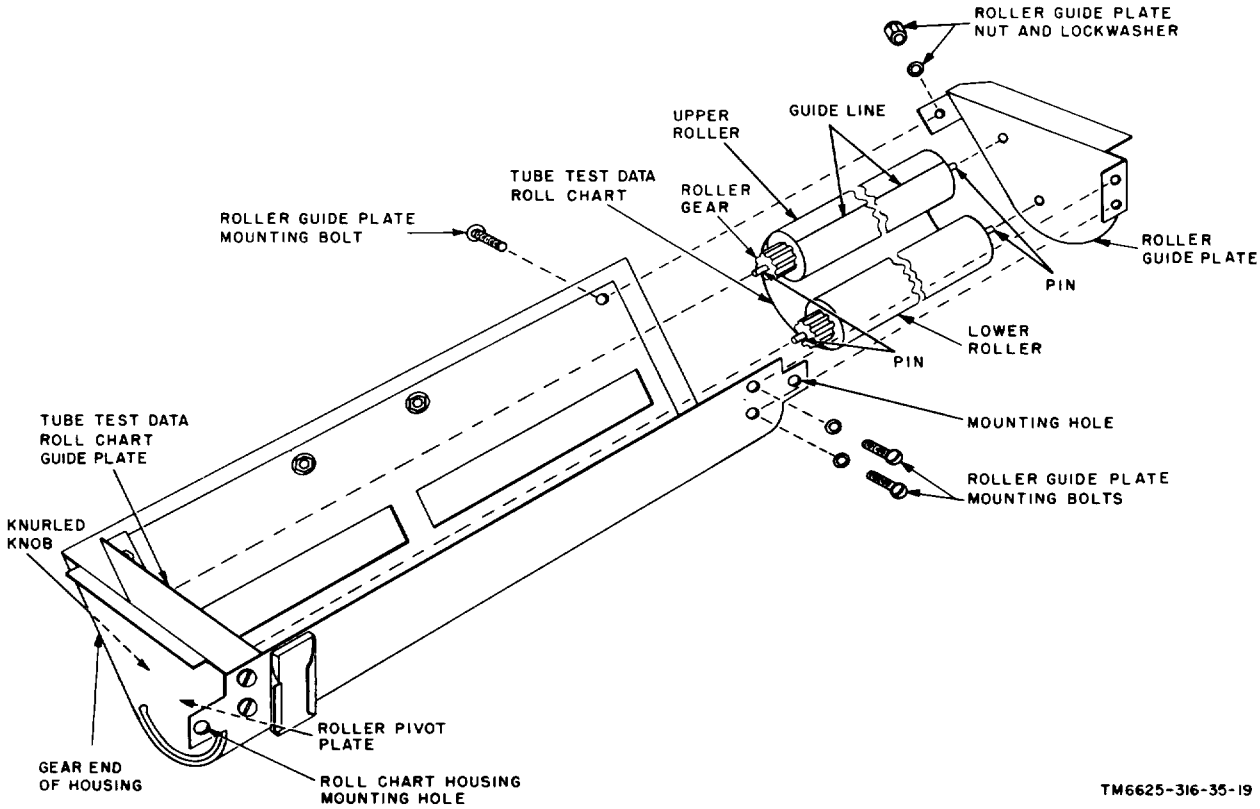


Figure 20. Tube test data roll chart housing assembly.

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.

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

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 Multi meter 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.

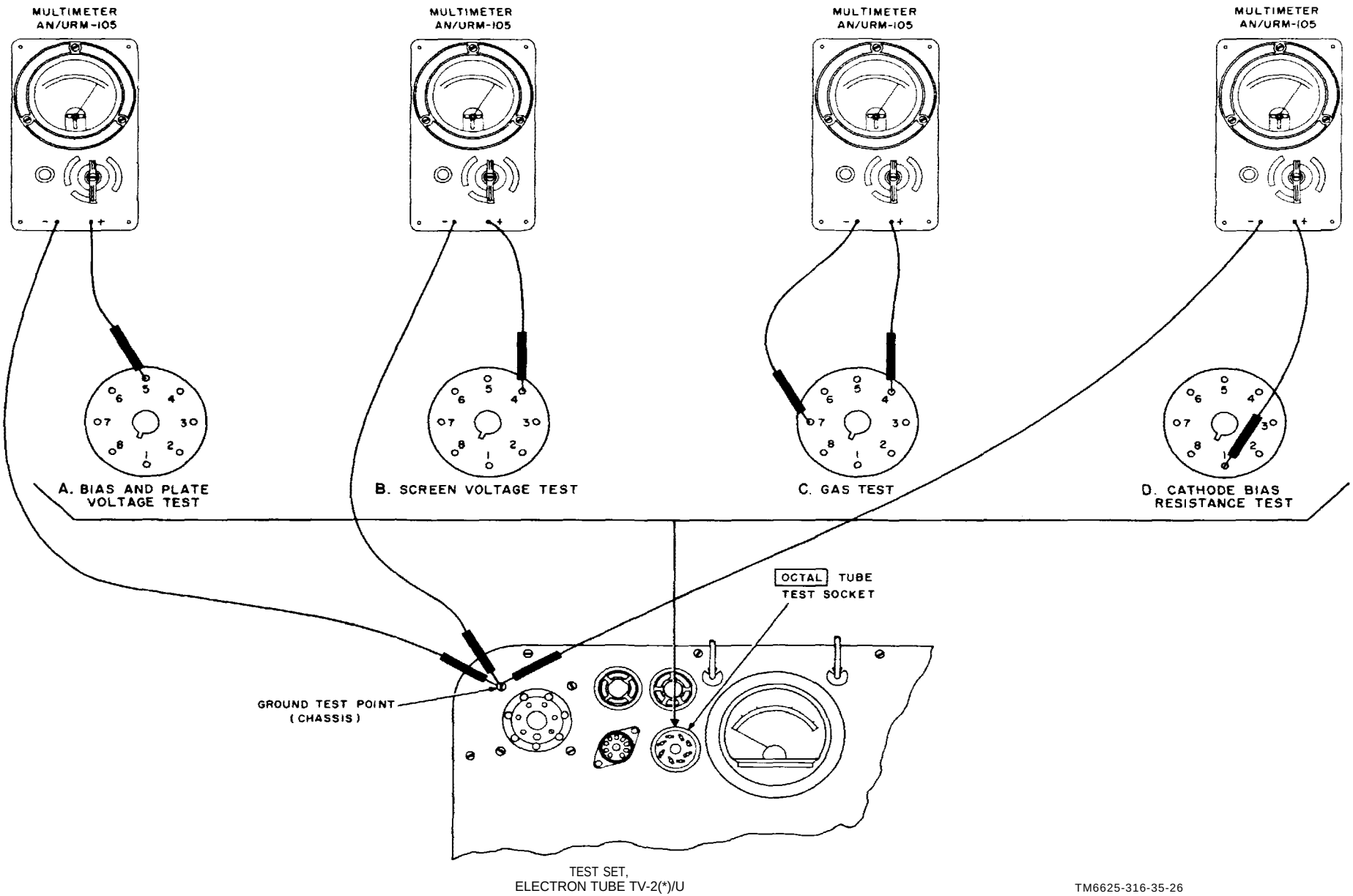


Figure 21. Voltage, gas and resistance tests.

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
O	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.

i. 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.

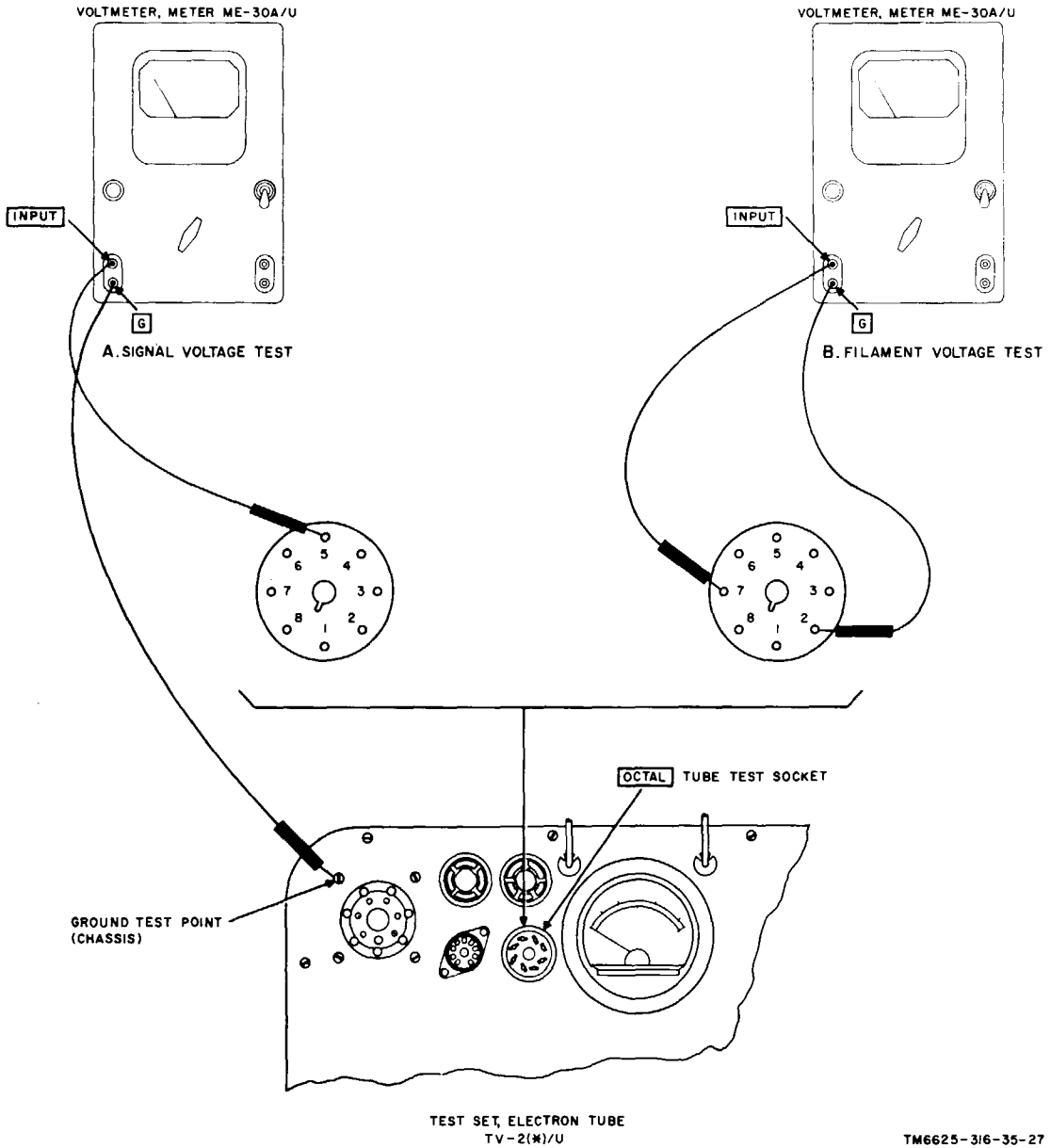


Figure 22. Signal and filament voltage tests.

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 IL4 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.

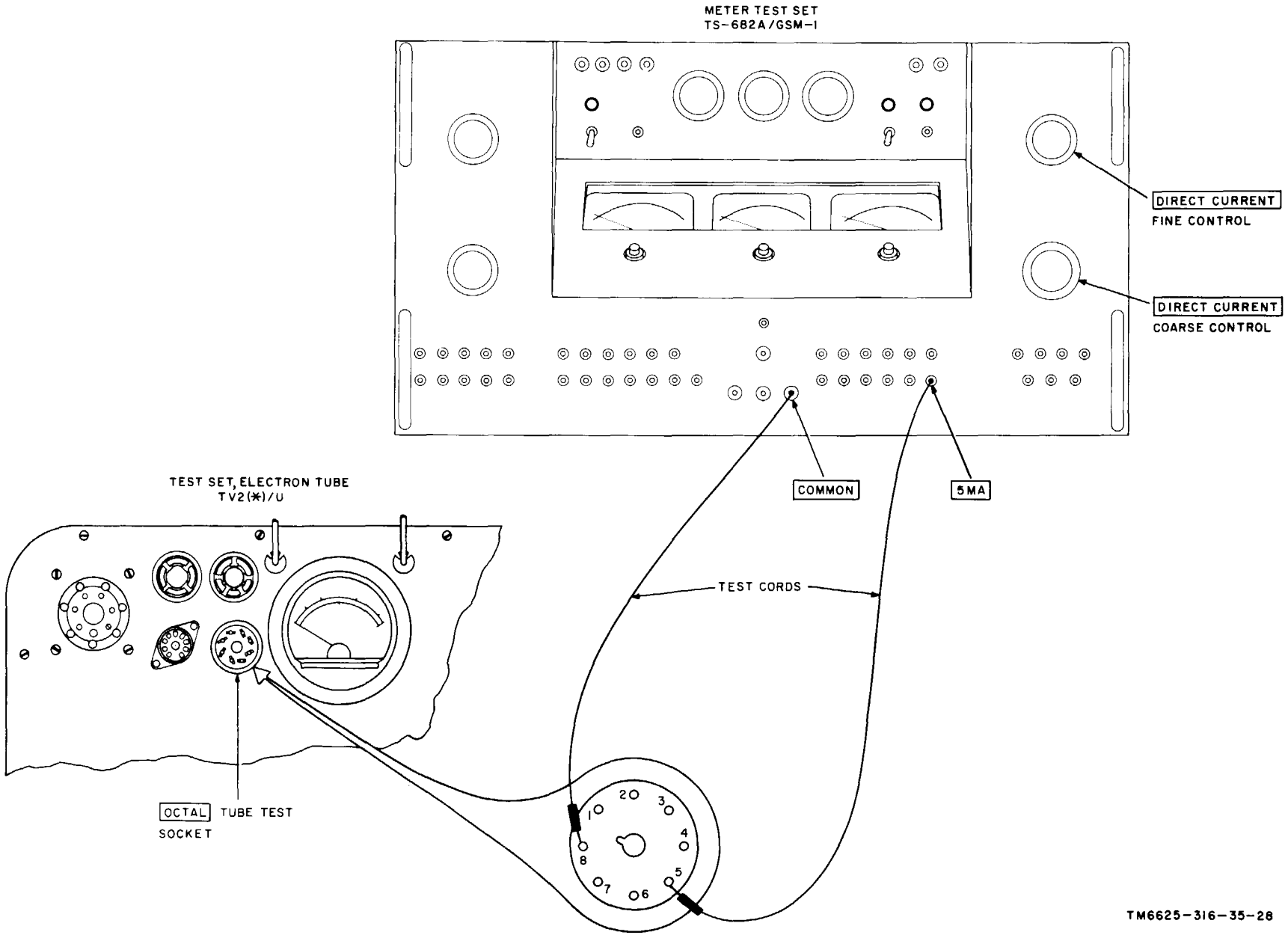


Figure 23. Shunt control test.

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 conduct. ante 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 micrornhos
12AU7	3,100 micromhos
36	900 micromhos
41	2,200 micromhos
45	2,100 micromhos
955	2,200 micromhos
5840	5,00O 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)

APPENDIX

REFERENCES

Following is a list of references applicable and available to the field and depot maintenance repairman of Test Set, Electron Tube TV–2(*)/U:

DA Pam 310–4	Military Publications: Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
MWO 11-6625-316-45/1	Modification of Test Sets, Electron Tube TV–2/U and TV–2A/U to Improve Rectifier and Diode Test Circuits.
MWO 11–6625–316–45/2	Modification of Electron Tube Test Sets TV–2/U and TV–2A/U to Improve the Short Test Circuit.
NAVSHIPS 91734	Electron Tube Test Set AN/USM–31.
TA 11-17	Signal Field Maintenance Shops.
TA 11-100 (11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TM 11-2535B	Meter Test Set TS-682A/GSM-1.
TM 11-6625-203-12	Operation and Organizational Maintenance: Multimeter AN/URM–105, Including Multimeter ME–77/U.
TM 11–6625–203–35	Field and Depot Maintenance: Multimeter AN/URM–105 Including Multimeter ME–77/U.
TM 11–6625-316-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME–30A/U and Voltmeters, Electronic ME-30B/U and ME–30C/U.
TM 11-6625-316-35P	Operator's and Organizational Maintenance Manual, Test Sets, Electron Tube TV-2/U, TV–2A/U, and TV-2B/U.
TM 11–6625-320-12	Field and Depot Maintenance Repair Parts and Special Tools List: Electron Tube Test Sets TV-2/U, TV–2A/U, and TV-2B/U.

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(2 copies each except as indicated)
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11-6
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11-15
11–16
11-38
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11-55
11-56
11–57
11–58
11–96
11–97
11-98
11-117
11-155
11-157
11-158
11–237
11-500 (AA-AE, RA-RT) (4)
11-555
11-557
11-587
11-592
11-597
29-56

NG: State AG (3) ; units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

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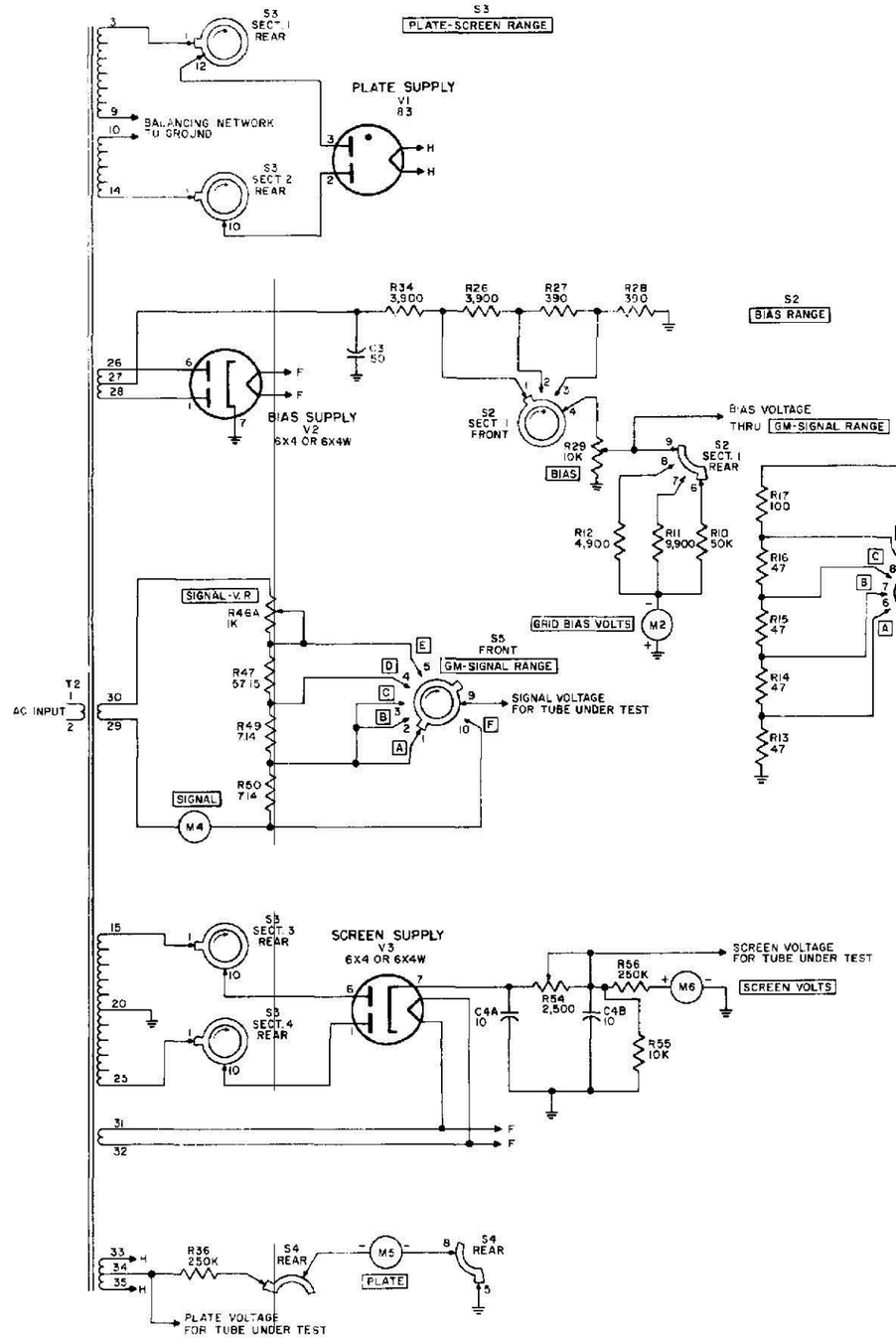


Figure 4. Simplified power supply circuit.

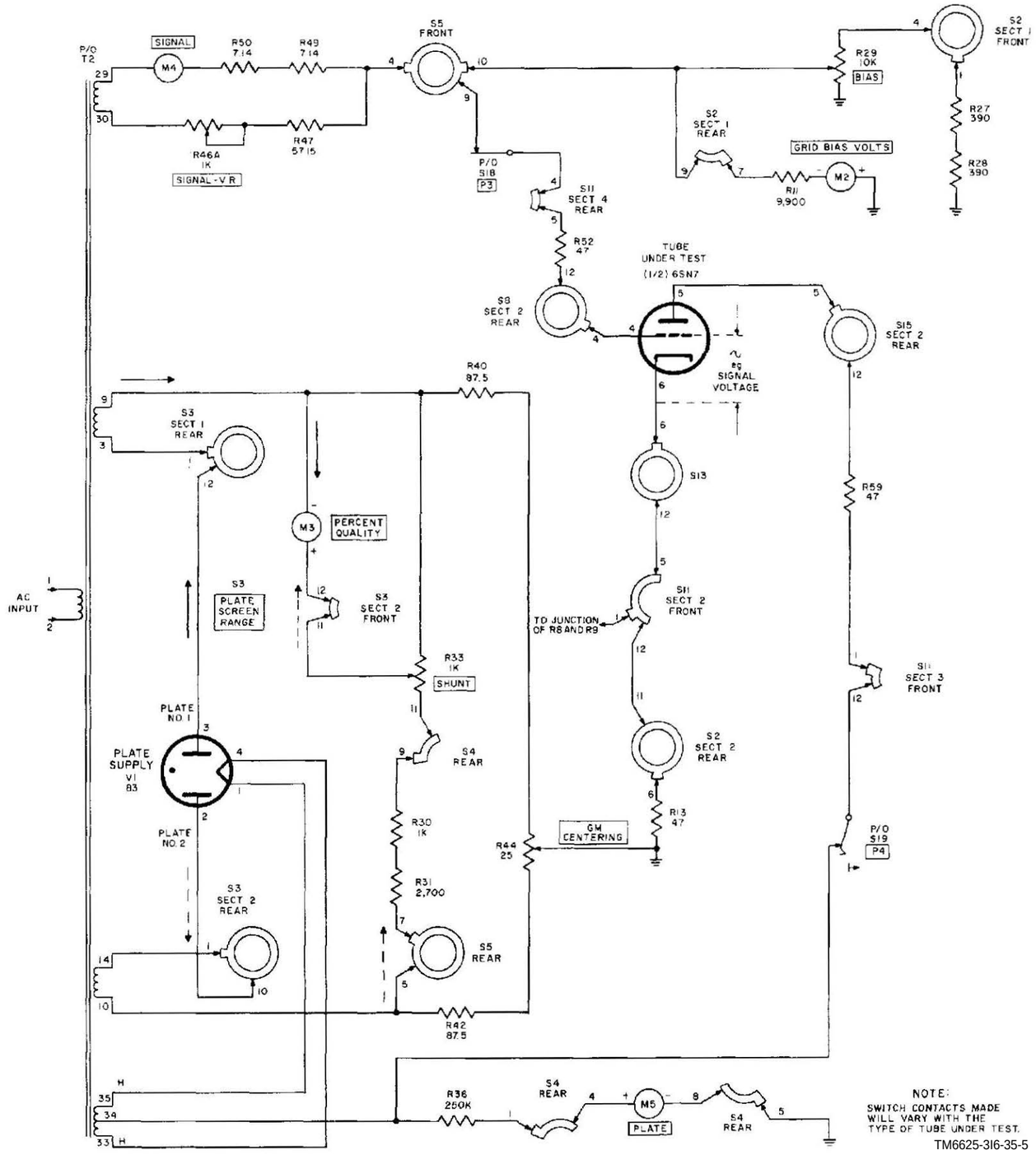
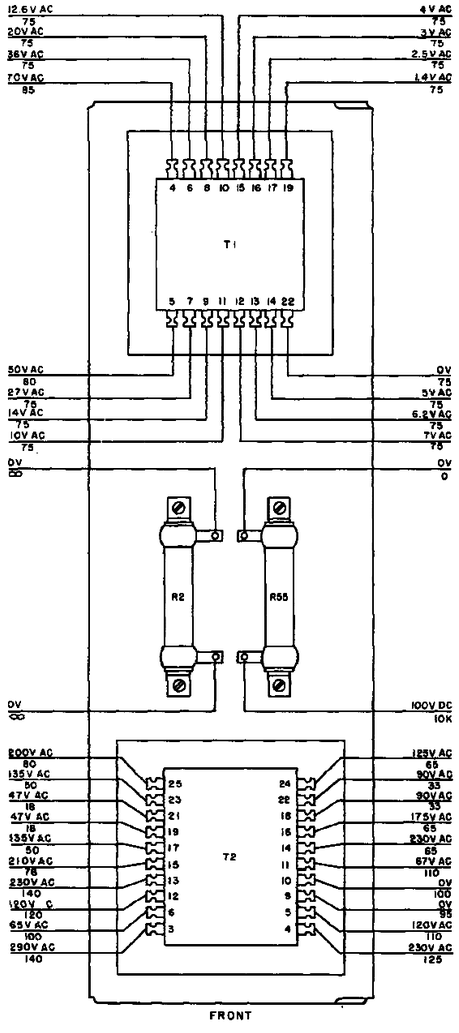
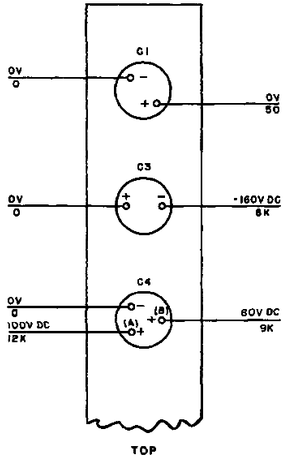
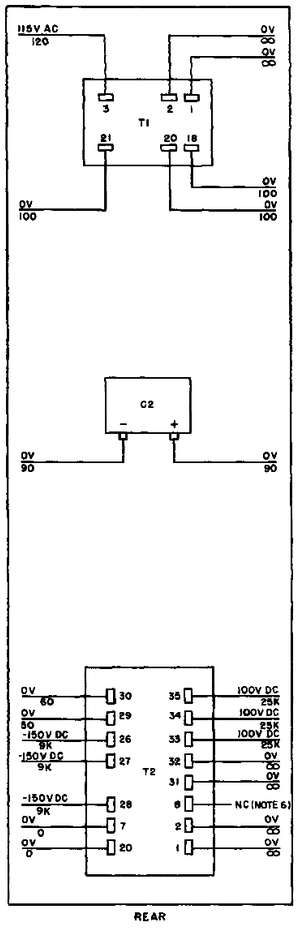


Figure 5. Transconductance measurement circuit of Test Set, Electron Tube TV-2(*)/U.







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	0
GM CENTERING	ALIGNED WITH INDEX MARKING ON PANEL.
SIGNAL-V.R.	ADJUST FOR RED LINE ON SIGNAL METER

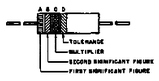
6. ON TV-2C/U ONLY, TERMINAL 8 OF T2 IS USED. REFER TO SCHEMATIC DIAGRAM.

TM6625-316-35-12

Figure 12. Chassis voltage and resistance diagram.

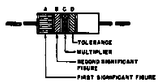
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A—Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



BAND A—Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	TOLERANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

BAND

A	B	C	D*
ORANGE	WHITE	RED	SILVER
3	9	X100	± 10%

NOMINAL RESISTANCE 3,900 Ohms

RESISTANCE TOLERANCE ± 10 percent

BAND

A	B	C	D*
ORANGE	BLUE	GOLD	GOLD
3	6	X0.1	± 5%

3.6 Ohms

± 5 percent

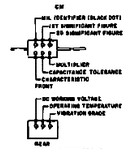
STD-RE

*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

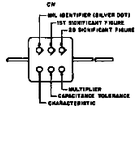
Figure 24. MIL-STD resistor color code markings.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

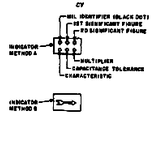
GROUP I Capacitors, Fixed, Various-Dielectric, Styles CM, CN, CY, and CB



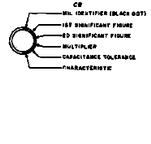
MICA-DIELECTRIC



PAPER-DIELECTRIC

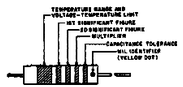


GLASS-DIELECTRIC, GLASS CASE

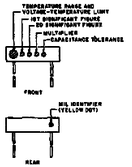


MICA, BUTTON TYPE

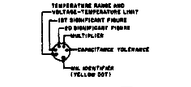
GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD

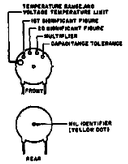


RADIAL LEAD



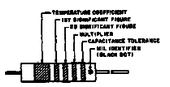
FEED-THROUGH

STAND-OFF

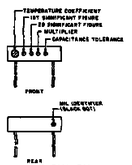


DISK-TYPE

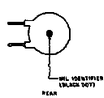
GROUP III Capacitors, Fixed, Ceramic-Dielectric (Temperature Compensating) Style CC

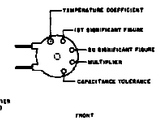


AXIAL LEAD



RADIAL LEAD





DISK-TYPE

Figure 25. MIL-STD capacitor color code markings.

COLOR CODE TABLES

TABLE I — For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE CM	CAPACITANCE TOLERANCE CN	CAPACITANCE TOLERANCE CY	CAPACITANCE TOLERANCE CB	CHARACTERISTIC[2] CM	CHARACTERISTIC[2] CN	CHARACTERISTIC[2] CY	CHARACTERISTIC[2] CB	DC WORKING VOLTAGE CM	OPERATING TEMP. RANGE CM	VIBRATION GRADE CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%	A					−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		E			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–3,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GRAY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CM				± 10%	± 10%	± 10%	± 10%							

TABLE II — For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE — TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CX	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III — For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE Capacitances over 10uuf	CAPACITANCE TOLERANCE Capacitances 10uuf or less	MIL ID
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL-C-5, MIL-C-91, MIL-C-11272, and MIL-C-10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL-C-11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD-CC

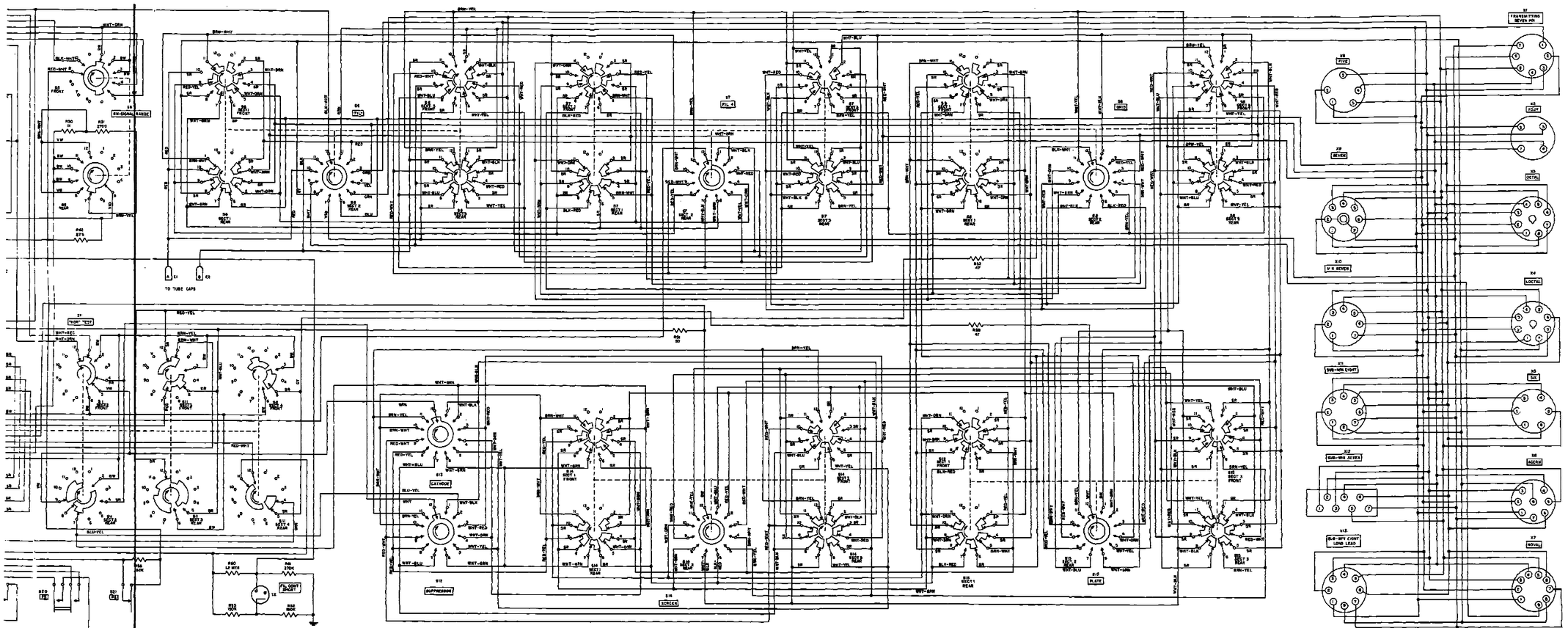


Figure 26. Test Set, Electron Tube TV-2(*)/U, schematic diagram.

TM6625-316-35-22

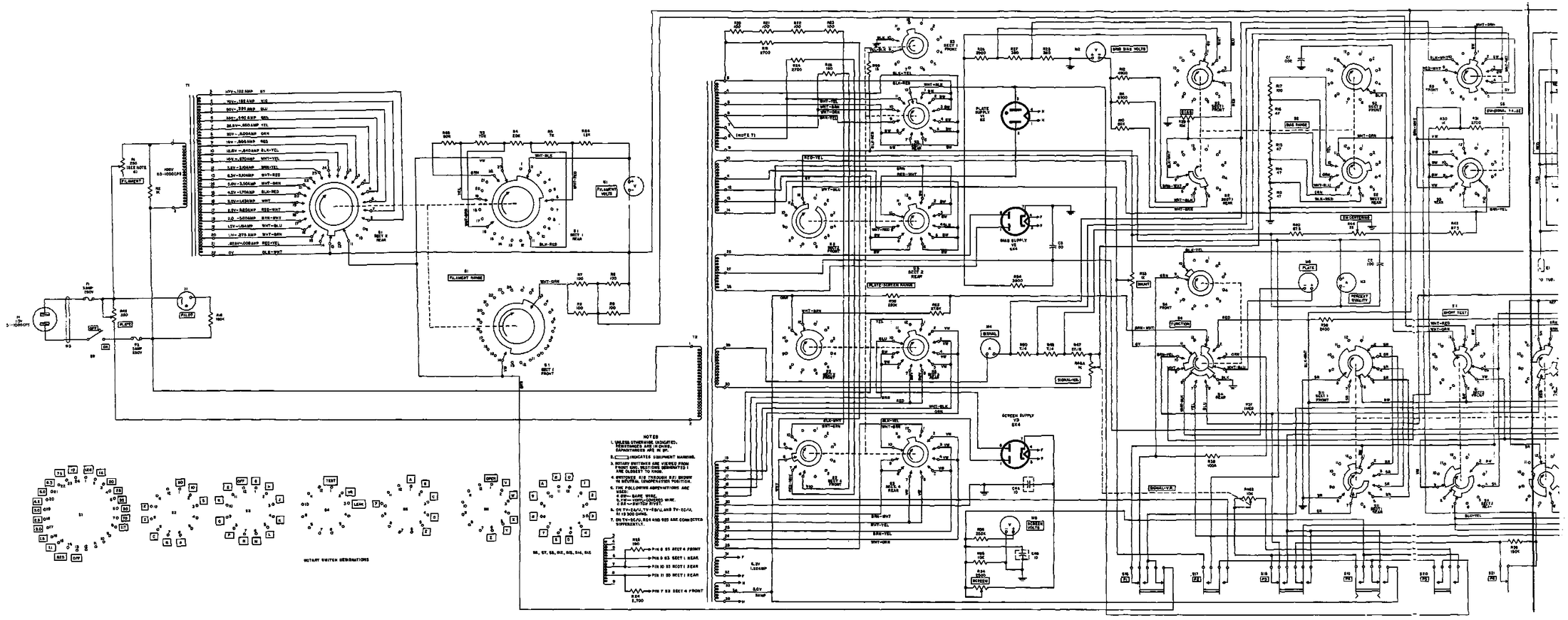


Figure 26. Test Set, Electron Tube TV-2(*)/U, schematic diagram.

NOTES:
1. THE FOLLOWING EXPLANATION SUPPLEMENTS THE WIRE LEAD COLOR-CODING APPEARING ON LEAD LINE.
   A. FIRST NUMBER INDICATES COLOR OF WIRE LEAD, AS FOLLOWS:

1···BRN	6···BLU
2···RED	7···VIO
3···ORN	8···GY
4···YEL	9···WHT
5···GRN	0···BLK

   (FIRST DIGIT INDICATES BASIC COLOR OF WIRE; SECOND DIGIT INDICATES COLOR OF TRACER.)
   B. SECOND NUMBER INDICATES STATION NUMBER.
   C. THIRD NUMBER INDICATES REFERENCE SYMBOL.
   D. FOURTH NUMBER DESIGNATES SWITCH SECTION.
      F DESIGNATES FRONT.
      R DESIGNATES REAR.
      IF LETTER APPEARS WITHOUT NUMBER, THE SWITCH IS A ONE-SECTION SWITCH.
   E. NUMBER IN PARENTHESES INDICATES TERMINAL NUMBER OR DESIGNATION:
      EXAMPLES:
      24(RED-YEL)-44(STA NO)-S5(REF SYMBOL) -2R(SECT 2,REAR) (12) (TERM. NO.); 7(VIO) -7(STA NO.)-C4A(REF SYMBOL) (+)(TERM.DESIGNATION).
2. THE FOLLOWING ADDITIONAL ABBREVIATIONS ARE USED:
   A. BW·····BARE WIRE.
   B. VW·····VINYL-COVERED WIRE.
   C. SR·····SWITCH RIVET.
3. ALL WIRE LEADS TERMINATING AT A GANGED ROTARY SWITCH, STATIONS 43 THROUGH 55 AND STATIONS 65 AND 86, GIVE SECTION AND TERMINAL NUMBERS AT POINT OF ORIGIN. REFER TO COLOR-CODED PORTION OF SCHEMATIC DIAGRAM FOR SWITCH TERMINATION. TO TRACE A WIRE LEAD FROM ANY SWITCH SECTION, REFER TO SCHEMATIC DIAGRAM.
4. GANGED SWITCH SECTIONS DESIGNATED 1 ARE CLOSEST TO KNOB END OF SWITCH.
5. ON TV-2(V), R24 AND R25 ARE CONNECTED DIFFERENTLY, REFER TO SCHEMATIC DIAGRAM.

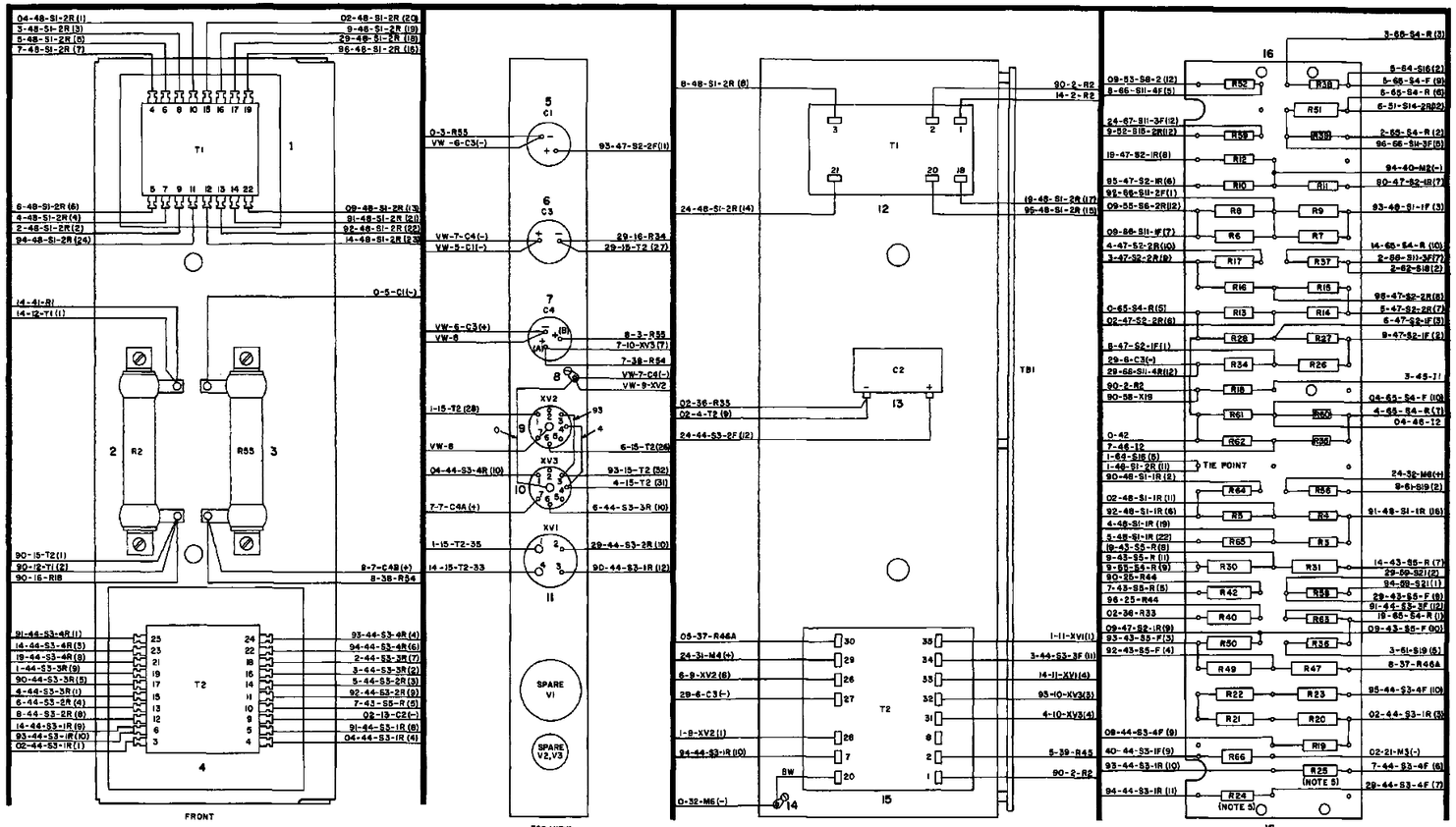
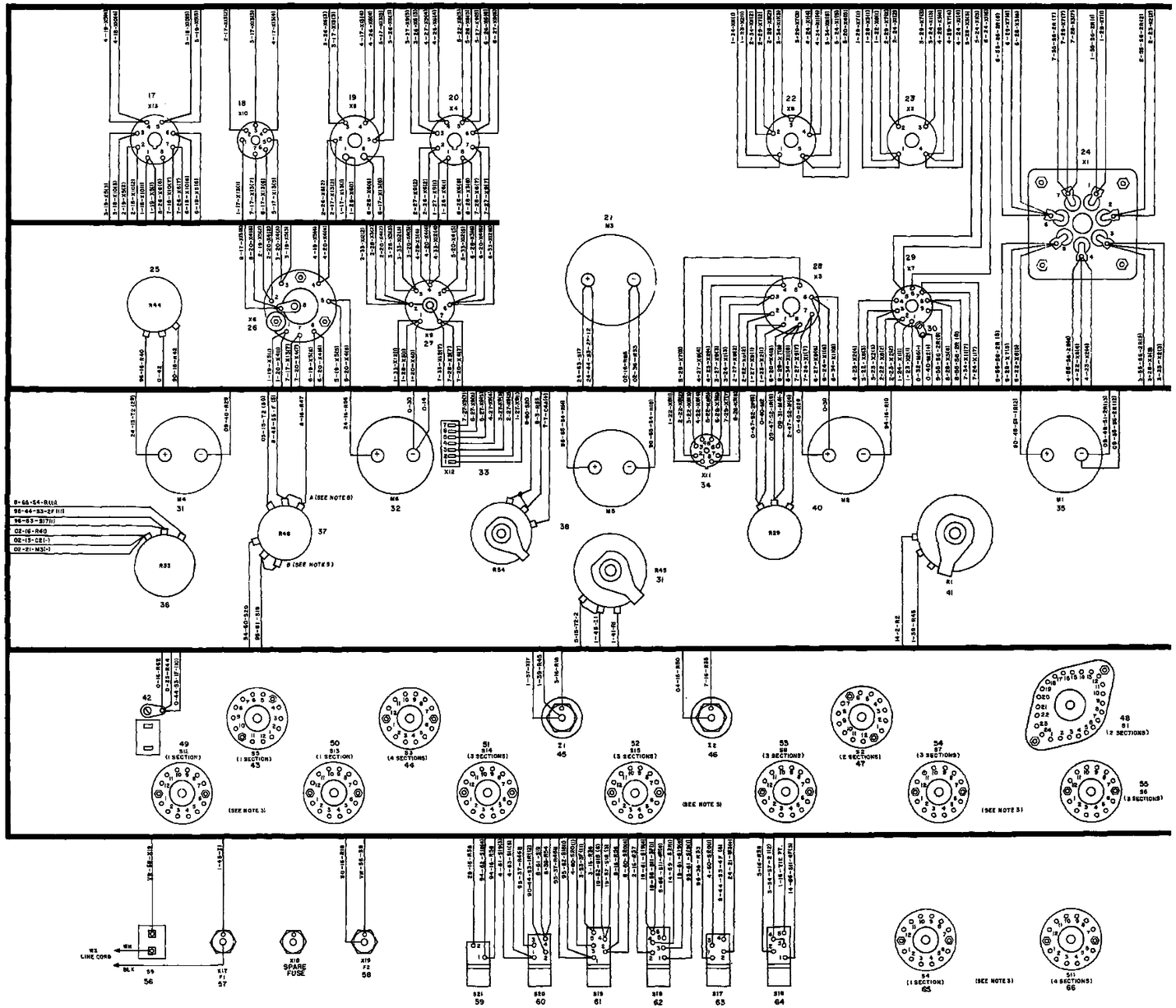


Figure 27. Test Set, Electron Tube TV-2(*)/U, chassis and resistor mounting board, wiring diagram.

TM6625-316-35-23



NOTES:

1. THE FOLLOWING EXPLANATION SUPPLEMENTS THE WIRE LEAD COLOR-CODING APPEARING ON LEAD LINE:
   A. FIRST NUMBER INDICATES COLOR OF WIRE LEAD, AS FOLLOWS:

1. BRN	6. BLU
2. RED	7. VIO
3. ORN	8. GY
4. YEL	9. WHT
5. GRN	0. BLK

   (FIRST DIGIT INDICATES BASIC COLOR OF WIRE; SECOND DIGIT INDICATES COLOR OF TRACER.)

   B. SECOND NUMBER INDICATES STATION NUMBER.

   C. THIRD NUMBER INDICATES REFERENCE SYMBOL.

   D. FOURTH NUMBER DESIGNATES SWITCH SECTION. F DESIGNATES FRONT, R DESIGNATES REAR. IF LETTER APPEARS WITHOUT NUMBER, THE SWITCH IS A ONE-SECTION SWITCH.

   E. NUMBER IN PARENTHESES INDICATES TERMINAL NUMBER OR DESIGNATION.

   EXAMPLES:

   241(RED-YEL)-44 (STA NO.)-53 (REF SYMBOL)-2R (SECT 2, REAR) (12) (TERM. NO.).

   7 (VIO)-7 (STA NO.)-D4A (REF SYMBOL) (A) (TERM. DESIGNATION).

2. THE FOLLOWING ADDITIONAL ABBREVIATIONS ARE USED:

   A. BW - BARE WIRE.

   B. VW - VINYL-COVERED WIRE.

   C. SR - SWITCH RIVET.

3. ALL WIRE LEADS TERMINATING AT A GANGED ROTARY SWITCH, STATIONS 49 THROUGH 56 AND STATIONS 65 AND 66, GIVE SECTION AND TERMINAL NUMBERS AT POINT OF ORIGIN. REFER TO COLOR-CODED PORTION OF SCHEMATIC DIAGRAM FOR SWITCH TERMINATION TO TRACE A WIRE LEAD FROM ANY SWITCH SECTION, REFER TO SCHEMATIC DIAGRAM.

4. GANGED SWITCH SECTIONS DESIGNATED 1 ARE CLOSEST TO KNOB END OF SWITCH.

5. RESISTOR R488 IS SECTION NEARER KNOB END.

TM6625-316-35-24

Figure 28. Electron Tube TV-2(*)/U control and instrument panel, wiring diagram.

PIN: 017102