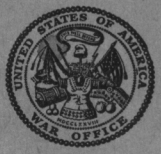
DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

TM 11-5083

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TO 16-35TV7-6

ELECTRON TUBE TEST SET TV-7/U





DEPARTMENTS OF THE ARMY AND THE AIR FORCE
SEPTEMBER 1953

TECHNICAL MANUAL
No. 11-5083
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WASHINGTON 25, D. C., *29 September 1953*

ELECTRON TUBE TEST SET TV-7/U

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains information on the operation, organizational maintenance, theory of operation, and field maintenance of the Electron Tube Test Set TV–7/U.

b. This manual applies only to Electron Tube Test Set TV–7/U. Appendix I contains a list of references, including supply catalogs, technical manuals, and other publications applicable to the equipment. Appendix II contains an identification table of parts.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), Navy Shipping Guide, Article 1850–4, and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

d. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Electron Tube Test Set TV–7/U (figs. 1, 2) is a portable tube tester of the dynamic mutual conductance type. The TV–7/U is used to test

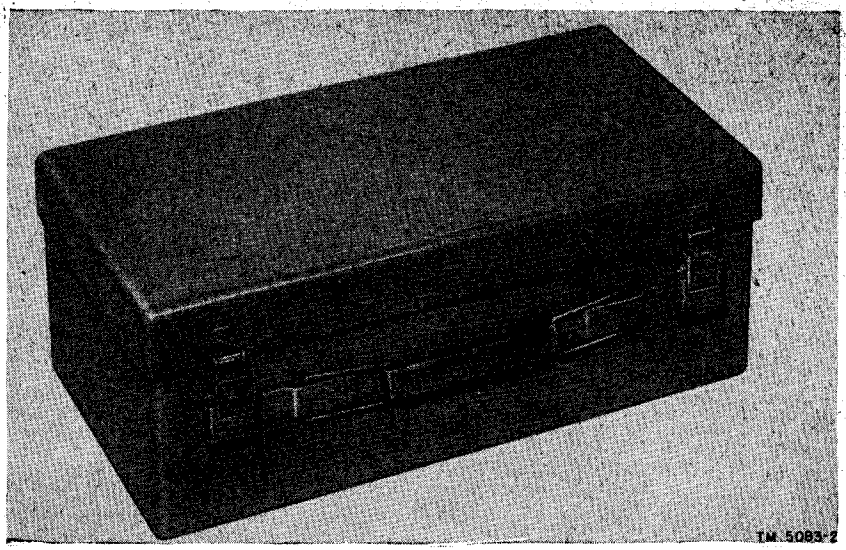


Figure 1. Electron Tube Test Set TV–7/U, with cover closed.

and measure the performance capabilities and to determine the rejection limits for electron tubes used in receivers, in low power transmitters, and in many other electronic equipments.

4. Technical Characteristics

a. Tests that can be made on Electron Tube Test Set TV–7/U are as follows:

Dynamic mutual conductance test (for amplifier tubes).
Emission test (for rectifier tubes).
Shorts test.
Gas test (amplifier tubes).
Noise test.
Continuity test (ballast tubes).
Pilot lamp test.

b. The following technical data apply to Electron Tube Test Set TV–7/U:

Meter range	0 to 120 arbitrary units.
Tubes	2 (1 type 83, 1 type 5Y3GT).
Power consumption	45 watts at 115 volts, 50 cycles.
Power supply:	
Voltage	115 volts ±10 percent, single phase.
Frequency	50 to 1,000 cps.

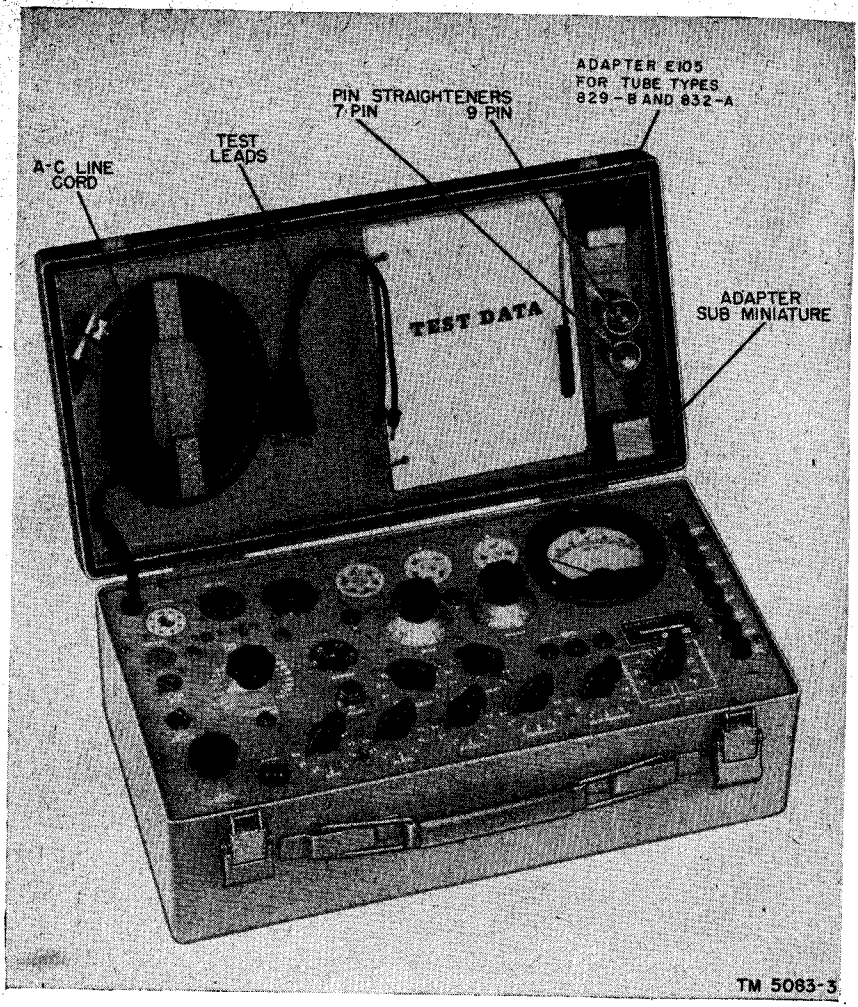


Figure 2. Electron Tube Test Set TV–7/U, with cover open.

5. Packaging Data

(fig. 3)

When packaged for shipment, Electron Tube Test Set TV–7/U is placed in a corrugated fiberboard box. The box is 11⅛ inches high, 20⅝ inches wide, and 13⅜ inches deep. It has a volume of 1.22 cubic feet.

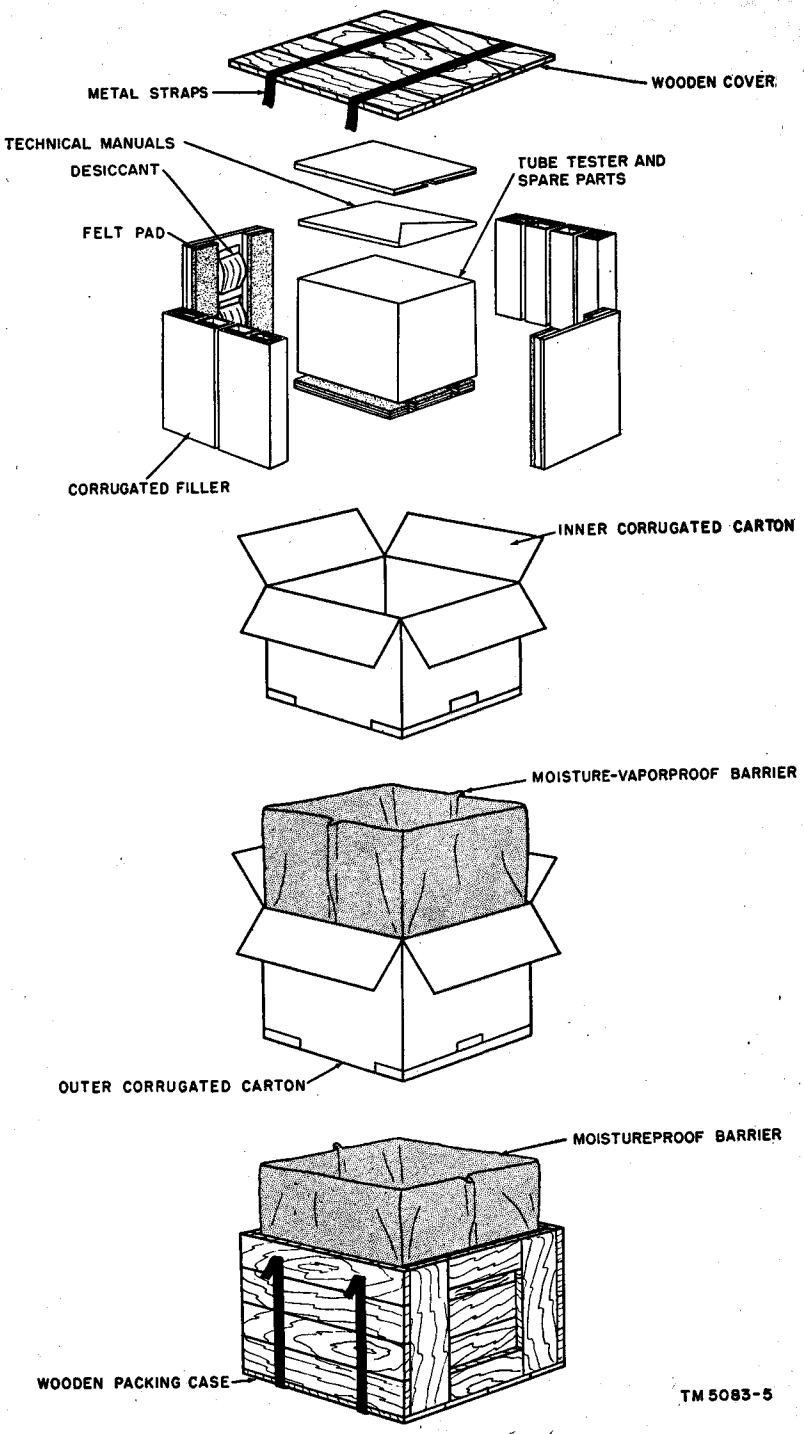


Figure 3. Electron Tube Test Set TV-7/U, packaged for shipment.

6. Table of Major Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)
Test set including tubes and lamps	1	6 1/16	8 3/8	15 5/8	.46	18
Adapter: 829–B and 832–A tubes	1		2 dia.	1 7/16		
Adapter: 2C39 tube.						
Adapter: subminiature	1					
Test leads	2			15		
Spare parts (par. 8)	1 set					

Note. This list is for general information only. See appropriate supply publication for information pertaining to requisitions of spare parts.

7. Description

a. The test set is self-contained in an aluminum carrying case. The case is provided with a carrying handle and the cover is secured by two pull-down catches. Brackets on the inside of the case cover are used to secure and store in place the test leads, power cable, pin straighteners for 7- and 9-pin miniature tubes, and adapters (par. 19). Ring binders inside the case cover hold the tube test data book. The cover is hinged by slip hinges and can be removed from the case.

b. An indicating meter and all controls, knobs, push buttons, sockets, and indicating lamps are located on the panel. The necessary data for setting and operating the controls to test the various tube types are contained in the tube test data book (*a* above). The power cable is permanently secured at one end in the upper left-hand corner of the panel and terminates in Plug U–120/U at the other end. Sockets to receive tubes to be tested are provided across the top and in the upper left-hand corner of the panel. The indicating meter, located in the upper right-hand corner, is calibrated in arbitrary units from 0 to 120, and is used to indicate the condition of the tubes under test. Eight molded phenolic test push buttons (par. 13*h*) are arranged in a vertical row on the right-hand side of the panel; the selector switches (par. 13*d*) are arranged in the lower center portion. The selector switches select the test socket terminals to which the internal test voltages are applied. The FUNCTION SWITCH has two positions: a RANGE and a SHORTS position. In the SHORTS position, the switch is used to determine the existence of interelectrode shorts; in the RANGE position it controls the sensitivity of the meter circuit and the magnitude of the signal voltage. Other controls and indicators provided on the panel are a POWER ON-OFF toggle switch and a PILOT indicator lamp; a FUSE

lamp which serves as an overload indicator; a BIAS and a SHUNT control (each provided with a dial on which are engraved markings from 0 to 100 in steps of 10); a FILAMENT VOLTAGE switch with pointer knob which provides 18 positions for selecting filament voltages from .6 to 117 volts ac, a BLST. position (for testing ballast tubes), and an OFF position; a LINE ADJUST rheostat in the lower left-hand corner of the panel which controls input voltage to the transformer; a black tip jack labeled G and a red tip jack labeled P to accommodate the grid and plate test leads; and two black tip jacks for NOISE test lead connections.

8. Spare Parts

A group of spare parts, supplied with each test set, is packed in the shipping container with the equipment. Spares are provided for all normally expendable items, such as lamps and tubes. The following is a list of spares:

Quantity	Name	Ref symbol
2	Neon glow lamp, type NE–45	E101
2	Pilot lamp, type 47	E102
3	Fuse lamp, type 81	E103
1	Tube, type 83	V101
1	Tube, type 5Y3GT	V102

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. INSTALLATION OF EQUIPMENT

9. Unpacking, Uncrating, and Checking New Equipment

a. General. Equipment may be shipped in oversea packing cases, in domestic packing cases and, in some circumstances, in its own carrying case. When new equipment is received, select a location convenient to the permanent or semipermanent installation of the equipment where it can be unpacked without exposure to the elements. Be careful when unpacking or handling the equipment. The test set is a precision instrument and mishandling may make it inaccurate or inoperative.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is damaged easily. If it becomes damaged or exposed, a complete overhaul may be required or the equipment may be rendered useless.

b. Step-by-step Instructions for Unpacking and Checking. Be careful when unpacking the equipment. Avoid thrusting tools into the interior of the container.

(1) Cut the gummed tape along the top seam and along the top ends of the fiberboard of the shipping container.

(2) Open the top flaps and remove the top fiberboard pad and cell cushion.

(3) Remove the box of spare parts which is packed between the outer container and the protective cell surroundng the equipment.

(4) Remove the corrugated cells from around the sides; carefully remove the equipment from the shipping container and remove the protective wrapping.

(5) Check the contents against the master packing slip.

Note. Save the original packing cases and containers from both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

c. Inspection of Equipment After Unpacking.

(1) Place the equipment on the workbench, near its final location.

(2) Inspect for external damage which may have occurred during shipment.

(3) Release the two catches and open the cover of the combination case.
(4) Determine if all leads, adapters, and others parts are included (par. 6 and fig. 2).
(5) Check all controls for ease of rotation.
(6) The test set is shipped with the tubes installed. Check to see whether the tubes are seated firmly in their sockets only if the test set proves to be inoperative. To inspect the tubes, remove the equipment from its case. Refer to paragraph 45*d* for instructions.

10. Installation of Equipment

The test set is shipped with the tubes in place. Place the test set on a flat bench or firm base close to an a-c outlet supplying a voltage of 115 volts ±10 percent, at a frequency of 50 to 1,000 cps (cycles per second). Do not use any other power source.

11. Connections

a. A 6-foot line cord with a connector plug is provided to connect the test set to the a-c power outlet. Do not plug the test set into the line socket before the proper instructions are read and before the steps covering the starting procedure (par. 21) are performed.

b. Make connections to the top caps of certain types of tubes with the two test leads. Insert the tip plugs attached to these leads into jacks G and P.

12. Service Upon Receipt of Used or Reconditioned Equipment

a. To unpack and check the test set, follow the instructions in paragraph 9.

b. Check used or reconditioned equipment for tags or other information which pertains to changes in the wiring of the equipment. If any changes in wiring have been made note the change on the schematic diagrams in this publication.

c. Check all controls for ease of operation.

d. Follow the instructions covering installation and connection given in paragraphs 10 and 11.

Section II. CONTROLS AND INSTRUMENTS

13. Controls and Their Uses

Refer to figure 5 to locate the various controls on the panel of Electron Tube Test Set TV–7/U. The functions of these controls are as follows:

a. POWER ON-OFF switch S111 controls the power input to the TV–7/U.

b. The LINE ADJUST rheostat (R126) adjusts the input voltage to the power transformer in such a manner that proper test voltages are supplied to the elements of the tube under test.

c. FILAMENT VOLTAGE switch S108 provides an 18-step selection of filament or heater voltages from .6 volt through 117 volts ac, a position marked BLST. to permit the testing of ballast tubes and an OFF position.

d. Selector switches (FILAMENT S107, FILAMENT S106, GRID S105, PLATE S104, SCREEN S103, CATHODE S102, and SUPPRESSOR S101) connect proper internal circuits to apply correct test voltages to the various pins of the tube under test.

e. BIAS control R129 adjusts to the proper value the bias voltage that is applied to the tube under test.

f. SHUNT control, dual potentiometer R127, adjusts the sensitivity of the meter circuit to the level required to test the rectifier and other diode-type tubes.

g. FUNCTION SWITCH S109 selects the proper meter range for the tube under test as indicated by the test data book. When this switch is set in the A position, SHUNT potentiometer R127 is connected into the circuit and must be set as indicated in the test data book. This position of the switch is used when rectifiers or other diode-type tubes are tested. The five RANGES of the FUNCTION SWITCH are identified by the letters A, B, C, D, and E. The settings for proper meter sensitivity are shown in the test data book. In positions B, C, D, and E, fixed shunt resistors are connected across the meter as required. SHORTS positions 1 through 5 of the FUNCTION SWITCH connect the various elements of the tube under test to the shorts test circuit which contains neon indicator lamp E101.

h. Eight push-button switches (S110–1 through S110–8) are located at the right-hand edge of the panel and are designated as follows: 1—LINE ADJ., 2—DIODE, 3—MUT. COND., 4—GAS 1, 5—GAS 2, 6—OZ4, 7—RECT, and 8—METER REV.

(1) The 1—LINE ADJ. test button is depressed when line voltage is adjusted.

(2) The 2—DIODE switch permits the testing of low-power diodes such as 6H6.

(3) The 3—MUT. COND. switch is used to test amplifier tubes only. The 3—MUT. COND. switch should never be used when rectifier tubes are tested.

(4) The 4—GAS 1 and 5—GAS 2 switches are used for gas test.

(5) The 6—OZ4 switch is used to test cold cathode rectifiers, such as the OZ4.

(6) The 7—RECT switch is used to test rectifiers such as the 5Y3, 6X4, 83 etc.

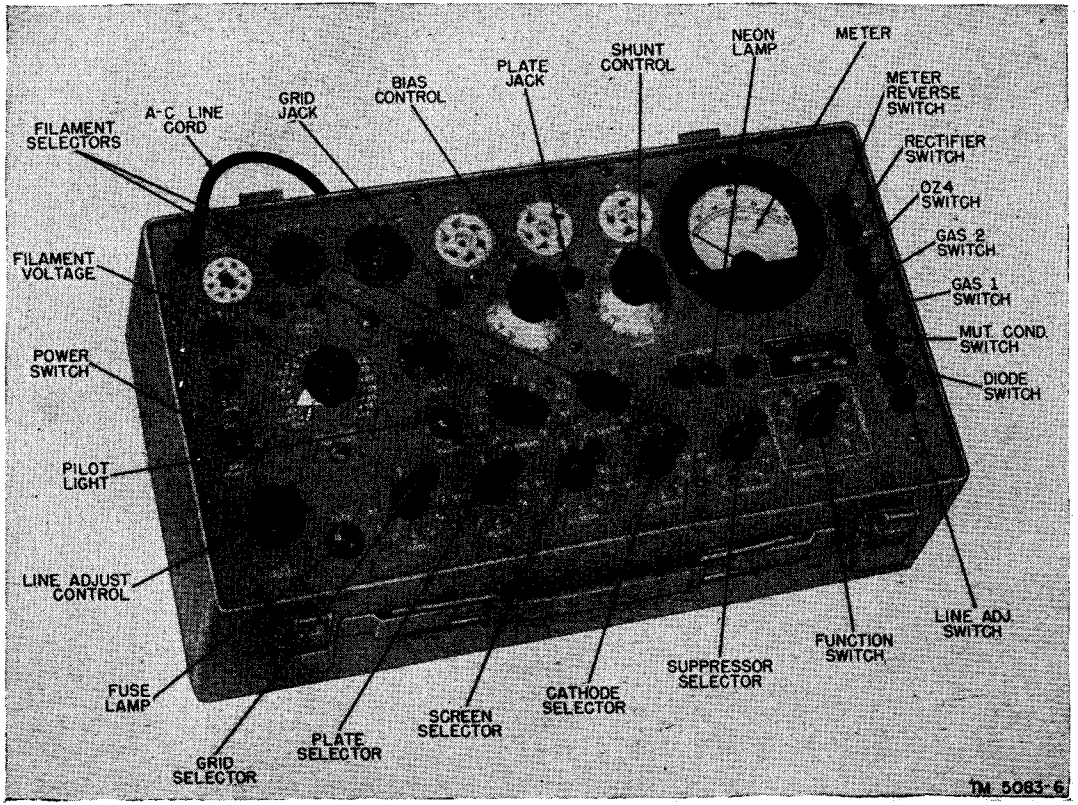


Figure 4. Electron Tube Test Set TV-7/U, front panel.

(7) The 8—METER REV. switch is used to reverse the polarity of voltage applied to the meter when certain types of tubes (117N7) are tested. Use information found in the tube test data book.

14. Meter

Meter M101 indicates the tube condition in arbitrary numerical units from 0 to 120. The tube test data book, mounted inside the cover of the equipment, lists the minimum numerical value of meter reading for satisfactory performance. Tubes reading below this value are not considered suitable for use in military equipment. A LINE TEST mark at midscale is used to establish the correct input voltage to the power transformer for efficient operation of the equipment.

15. Indicator Lamps

a. PILOT indicator I103 contains miniature lamp E102 which glows when the POWER switch is in the ON position.

b. Neon lamp E101 serves to indicate and to locate shorted tube elements.

c. FUSE lamp E103 serves both as a protective fuse and an overload indicator. This lamp will flash brightly when an overload is placed on the test set or the tube under test. Turn off the equipment immediately. When an overload occurs, the FUSE lamp will burn out, and replacement will be necessary.

16. Test Sockets

(fig. 4)

The test sockets are grouped along the top edge and in the upper left-hand section of the panel as follows:

a. Located from left to right along the top edge are test sockets for LOKTAL and OCTAL tubes, a combination large and small radius socket to accommodate standard 7-pin tubes and pilot lamps and sockets for 6-, 5-, and 4-pin standard base tubes.

b. Along the left-hand edge of the panel are located test sockets for NOVAL 9-pin tubes and 7-pin miniature tubes.

c. Two sockets for subminiature-type tubes labeled SUB MIN. are located below the OCTAL socket. One of these sockets is for the round and the other for the flat-type subminiature tubes.

d. The ACORN socket, designed to accommodate all tubes of this type now in use, is located directly above the PILOT indicator.

17. Panel Connections

a. Two tip jacks, one black and one red, marked G and P, provide connections for the grid and plate test leads that are necessary to test tubes with top grid and/or top plate connections.

b. Two black tip jacks provide NOISE test connections.
c. All jacks accommodate $^{3}/_{32}$-inch diameter tip plugs.

18. Test Leads

Two test leads are provided to make connections from the G and P panel jacks to the top caps of tubes as required. These leads are terminated on one end in a $^{3}/_{32}$-inch diameter tip plug and on the other end in a battery-type clip with an insulating cover. When the leads are not in use, stow them inside the top of the case.

19. Adapters

Three tube socket adapters are supplied: one (E105) to permit the testing of type 829–B and 832–A tubes in the OCTAL socket of the

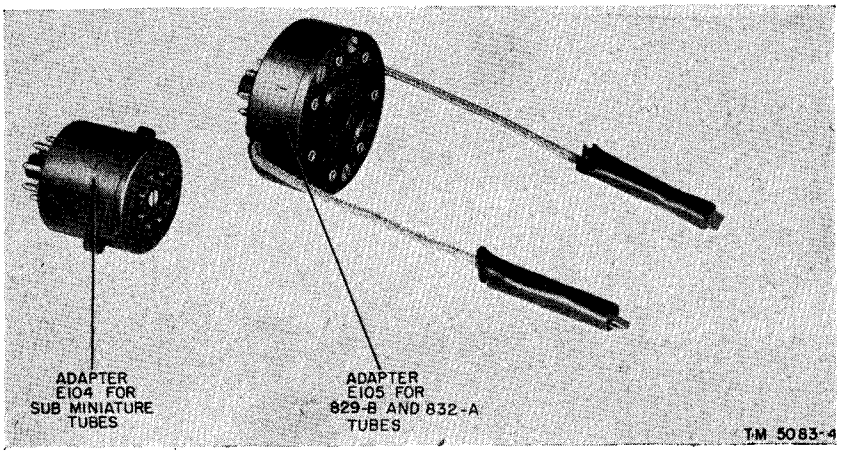


Figure 5. Adapters E104 and E105.

test set, another (E104) to provide a convenient means for testing subminiature tubes with leads instead of pins in the standard OCTAL test socket, and the third, to test ZC39 type tubes. Secure the adapters, when not in use, to the inside of the top of the case.

20. Tube Test Data

A test data book is mounted on the inside of the top of the case. Information necessary to set the controls for the various tube types is tabulated in nine columns in the test data book. Read the headings from left to right as follows:

a. Tube Types. All type numbers which the TV–7/U is designed to test are listed numerically in this column. Tubes having type letters only instead of numbers, such as XXB, are listed at the end of the numerical listings.

b. Fil. Correct filament or heater voltages for the listed tube types are shown in this column. The FILAMENT VOLTAGE switch must be set before a tube is inserted in any of the test sockets.

c. Selectors. The correct setings for the two FILAMENT selector switches and the GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR selector switches are listed in this column. The settings are shown in the same order in which the switches appear on the panel, listing first the two FILAMENT selectors and then continuing from left to right with the other five selectors.

d. Bias. This column lists the proper settings for the BIAS dial. The bias voltage applied to the tube under test is controlled with the BIAS potentiometer.

e. Shunt. This column lists the settings for the dial of the *SHUNT* resistors which control the sensitivity of the meter circuit. Setting of this dial is required only when the FUNCTION SWITCH is in the RANGE A SHUNT position.

f. Range. The proper settings for the FUNCTION SWITCH are listed in this column. The letters A, B, C, D, and E correspond with the RANGES markings for the FUNCTION SWITCH.

g. Press. Under this heading are listed the correct test push buttons that are used for the various tube types and their individual sections in the case of multipurpose tubes.

h. Min. Value. The minimum, numerical values of meter indication for the various tubes and individual sections of multipurpose tubes are shown in this column. Any tube showing a meter reading less than the value indicated in this column should be discarded.

i. Notations. Special information pertaining to patricular tube types is listed under this heading.

Section III. OPERATION UNDER USUAL CONDITIONS

21. Starting Procedure

Before using Electron Tube Test Set TV–7/U, read all the operating instructions contained in this manual carefully. Observe all cautions. Be sure to comply with the procedures outlined below before attempting to test tubes with Electron Tube Test Set TV–7/U.

a. Open the latches and raise the cover of the test set.

b. Check the voltage and the frequency of the power source that is used with Electron Tube Test Set TV–7/U. The voltage must be 115 volts ac ±10 percent and the frequency between 50 and 1,000 cycles per second. Never connect the TV–7/U to a d-c (direct-current) power source. If the voltage and frequency are correct, unwind the line cord from the bracket that is mounted in the top of

the case, and insert the plug in the outlet receptacle of the power source.

c. Set the POWER switch to the ON position. When the red PILOT indicator lights, the power transformer is energized.

d. Press push button 1—LINE ADJ. Rotate the LINE ADJUST control knob until the meter pointer rests over the LINE TEST mark. When this adjustment is accomplished, the tester receives the proper voltage from the power source, and the correct output voltages are delivered from the secondary windings of the transformer.

e. Set the left-hand FILAMENT selector at A, the right-hand FILAMENT selector at P, and the GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR selectors at 0, 0, 0, 2, and 2, respectively. Rotate the FUNCTION SWITCH through the five SHORTS positions. The neon lamp will glow in positions 2 and 3 of the FUNCTION SWITCH to indicate that the short test circuit is functioning.

f. If results obtained from the procedures in *c*, *d*, and *e* above are satisfactory, the test set is ready for operation.

g. Turn the POWER switch to the OFF position; study paragraph 22 thoroughly before attempting to test tubes.

22. Operational Procedure

The operational steps outlined below are applicable to single section tubes and multipurpose tubes (tubes having more than one set of elements housed in the same envelope). For multipurpose types, however, test each section or group of elements individually. Test data for the multipurpose types are listed by sections, and the sections are joined by a bracket in their listing in the test data book.

Caution: Do not insert a tube into a test socket until all controls have been set in accordance with the instructions below.

a. Selectors. The seven switches that are located in the lower center of the panel and marked FILAMENT (left), FILAMENT (right), GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR select the test socket connections to apply correct test voltages to the elements of the tube under test. For the purpose of clarity and simplification these seven controls will, in some instances, be referred to collectively as the selectors in this manual. When referred to collectively they are considered in the same order as shown above.

b. Setting Controls.

(1) Locate the type number of the tube to be tested in the test data book which is mounted in the cover of the case.

(2) Turn the FILAMENT VOLTAGE switch to the voltage shown in the column of the test data book headed *Fil.*

(3) Set the selectors. The setting of these seven controls compares to the setting of the dial of a telephone. In the test data book, the dial numbers are listed below the column headed *Selectors*. These numbers consist of two letters and five figures. Turn the knobs of the seven selectors until the letters and numbers indicated by the pointer knobs are the same, if read from left to right, as those indicated in the test data book.

Example: The test data book indicates JR6–2375 under *Selectors*. Starting at the left, turn the knob of the FILAMENT (left) selector to the letter J. Turn the FILAMENT (right) selector knob to the letter R. Turn the GRID selector knob to number 6, the PLATE selector to No. 2, the SCREEN selector to No. 3, the CATHODE selector to No. 7, and the SUPPRESSOR selector to No. 5. The sequence of letters and numbers thus selected then is identical to that listed in the test data book (JR6–2375). The selectors are interconnected electrically so that two different voltages cannot be applied to the same tube pin at the same time. Therefore accidental shorts are avoided.

(4) Set the BIAS dial to the point indicated in the *Bias* column of the test data book.

(5) Set the SHUNT dial to the position indicated in the *Shunt* column of the test data book. If no setting is indicated, disregard this operation, and proceed with the adjustments below.

(6) Set the FUNCTION SWITCH to the No. 1 position.

(7) Insert the tube to be tested in the proper test socket and, if the instructions listed in the *Notations* column require it, make connections from the panel connectors G or P to the tube caps with the test leads.

(8) Throw the POWER toggle switch to the ON position. The PILOT indicator will light.

Note. For tubes of the heater cathode type, sufficient time for the cathode to reach operating temperature must be allowed before the tests can begin.

(9) Press the push button 1—LINE ADJ. The pointer of the meter will move up the scale and to the right.

(10) Hold down push button 1—LINE ADJ. Turn the knob of the LINE ADJUST control until the meter pointer rests exactly on the LINE TEST mark located at the center of the meter scale. Standard voltages are thus established for the tube test circuits.

c. Shorts Test.

(1) Turn the **FUNCTION SWITCH** from No. 1 position through to position 5; meanwhile tap the tube lightly with a finger or an eraser end of a pencil, and watch the neon short indicator lamp on each switch position. Tubes with shorted elements will cause the lamp to glow.

(2) A short is indicated by a steady glow on both plates of the neon lamp. A momentary glow when the switch is turned from one position to another should be disregarded because this flashing is caused by the charging of a capacitor in the short test circuit. Intermittent flashing resulting from tapping the tube indicates existence of loose elements which can cause noisy or erratic operation.

(3) Tubes having more than one section, such as the 6J6, must be tested for shorts on each section.

(4) A shorted tube is discarded without further test.

Note. Some tubes will show a shorted condition on certain positions of the switch even though they are good tubes. Check the *Notation* column for remarks. SHORTS on 1 and 2 would mean that a short indication on positions 1 and 2 is normal.

(5) In the following chart, the mark X shown under any SHORTS switch position indicates what element might be in a shorted condition if the neon lamp glows in that position of the SHORTS switch.

Note. A list of tubes not to be tapped during the shorts test is contained in the test data book.

Kind of short	Switch position				
	1	2	3	4	5
Screen to suppressor	X	X	X	X	X
Grid to cathode	X	X	X		X
Filament to plate	X	X		X	X
Filament to grid	X	X			X
Filament to screen	X		X	X	X
Plate to suppressor	X			X	X
Grid to suppressor	X				X
Grid to screen		X	X	X	
Plate to screen		X	X		
Filament to suppressor		X			
Filament to cathode			X		
Grid to plate				X	

Note. Multisection tubes must be tested for shorts by individual sections. Data in the shorts test chart above apply to the elements of the sections of these tubes.

(6) If the tube passes the shorts test, proceed as stated below.

d. Selection of Range.

(1) Turn the FUNCTION SWITCH from the SHORTS side to one of the five RANGES indicated in the test data book under the column headed RANGE.

(2) This operation automatically adjusts the sensitivity of the meter circuit to the proper level for the tube being tested.

e. Operating Push Buttons.

Caution: When rectifier tubes are tested, do not press push button 3—MUT. COND.

(1) Press the test push button that is indicated in the PRESS column of the test data book. The push buttons are identified on the panel as follows:

1—LINE ADJ. (line adjust test button)
2—DIODE (diode test button)
3—MUT. COND. (mutual conductance test button)
4—GAS-1 (first gas test button)
5—GAS-2 (second gas test button)
6—OZ4 (test button for cold cathode rectifiers such as type OZ4)
7—RECT (standard rectifier test button)
8—METER REV. (meter reversing button)

(2) Refer to the column headed *Notations* for special information pertaining to specific tube types.

Note. When voltage regulator tubes, thyratrons, tuning eye tubes, and other special types are tested, the choice of the push button varies with the tube that is tested. Refer always to the data book to insure the use of the correct push button.

(3) When the proper test button is depressed, the meter indicates the condition of the tube.

f. Meter Reading.

(1) The meter scale is calibrated in divisions from 0 to 120.

(2) When the proper test button is depressed, the meter gives the condition of the tube under test as a numerical value.

(3) Compare the numerical value of the meter reading with the minimum acceptable value listed in the test data book under the heading *Min. Value.*

(4) If the numerical value of the meter reading is less than the listed minimum value, the tube is not suitable for use in military equipment and must be replaced.

(5) To convert the numerical value of the meter reading to mutual conductance in micromhos use the following table:

Meter reading	Corresponding value in micromhos			
	Range B	Range C	Range D	Range E
0	0	0	0	0
10	250	500	1250	2500
20	500	1000	2500	5000
30	750	1500	3750	7500
40	1000	2000	5000	10000
50	1250	2500	6250	12500
60	1500	3000	7500	15000
70	1750	3500	8750	17500
80	2000	4000	10000	20000
90	2250	4500	11250	22500
100	2500	5000	12500	25000
110	2750	5500	13750	27500
120	3000	6000	15000	30000

g. Gas Test. Push button 4—GAS 1 and push button 5—GAS 2 are used to test the gas content of amplifier tubes.

(1) Turn the FUNCTION SWITCH to the position indicated under the *Range* column in the test data book.

(2) Push button 4—GAS 1 and hold it down while the BIAS dial is adjusted until the pointer of the meter indicates 10 on the scale.

(3) Hold down push button 4—GAS 1 and press 5—GAS 2.

(4) If the tube contains gas, the pointer of the meter will move up the scale. If the pointer movement is not more than one division of the scale, the gas content is satisfactory.

Note. The meter reading of some tubes, such as the type 45, cannot be brought down to 10 by turning the BIAS dial. In such cases, turn the BIAS dial to 100. Test for gas and note whether the pointer moves more than one division up the scale when push button 4—GAS 1 is held down and push button 5—GAS 2 is pressed. Allow tubes of the heater type to warm up before testing for gas.

h. Noise Test. The shorts test circuit is used also when noise tests of electron tubes are made. The noise test jacks, J103 and J104, are connected to the antenna and ground posts, respectively, of a radio receiver. Tap the tube under test with the finger while the FUNCTION SWITCH is turned from position 1 through position 5. Intermittent disturbances which are too brief to register on the neon lamp, will be reproduced as static by the loudspeaker of the receiver.

i. Pilot Lamp Test. The receptacle located in the center of the large 7-pin socket is used to check pilot lamps. Set the filament selector

switches on HR. Set the filament voltage switch to the proper voltage for the lamp being tested. Insert the lamp in the receptacle and press the center contact firmly against the button; then tilt the lamp until the metal shell makes contact with the rim of the receptacle.

j. Special Tube Types.

(1) To test voltage regulator tubes, apply a voltage high enough to ionize the gas and to cause the voltage regulator tube to conduct. Refer to the tube test data book for the proper use of the test buttons and for settings of the controls.

(2) To test thyratons, set the controls as indicated by the test data book. Press the proper push button and adjust the BIAS control dial until the tube strikes; this is indicated by a glow between the elements and a sharp rise of the meter point. The limits of the bias voltage between which the tubes will strike are shown in the test data book. After the tube strikes, the condition of the tube is read on the meter.

(3) To test the tuning eye tubes, apply suitable standard test voltages to the control elements and note the effects on the tuning eye. Refer to the test data book for proper choice of test buttons and control settings.

k. Testing Subminiature Tubes.

(1) Subminiature tubes of the round type with short wire leads or pins are tested in the TV–7/U with special socket X110. This circular socket has eight numbered contacts (fig. 6).

(*a*) There are several basing arrangements used for these tubes as illustrated by figure 7. Examine the tube; identify the basing (fig. 7) and check the *Notations* column in the tube test data book. Proceed as directed in (*b*) below. On subminiature tube types with long leads, use adapter E104 as directed in *l* (2) below.)

(*b*) The numbered leads or pins of the tubes are inserted in the corresponding contacts of socket X110. If the leads are long enough, grasp each lead about one-eighth inch from its end with the tips of a pair of long-nosed pliers, and insert the leads in the proper socket contacts.

(2) Subminiature tubes of the flat or inline-contact type with pins or leads are tested in flat socket X109 (fig. 6). The tube pins or leads must be inserted so that the dot on the base of the tube is directly in line with the small molded dot on the socket.

(3) Subminiature type tubes are identified in the test data book by a star beside the type number. The applicable basing for the various round types is indicated under the column headed *Notations*. The basing designation letter refers to the diagrams shown in figure 7.

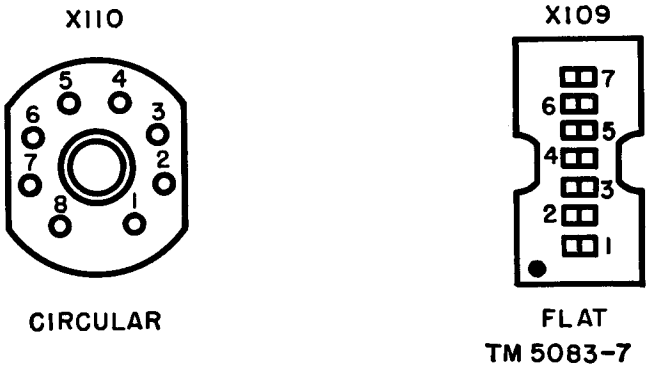


Figure 6. Top view of sockets X109 (flat) and X110 (circular).

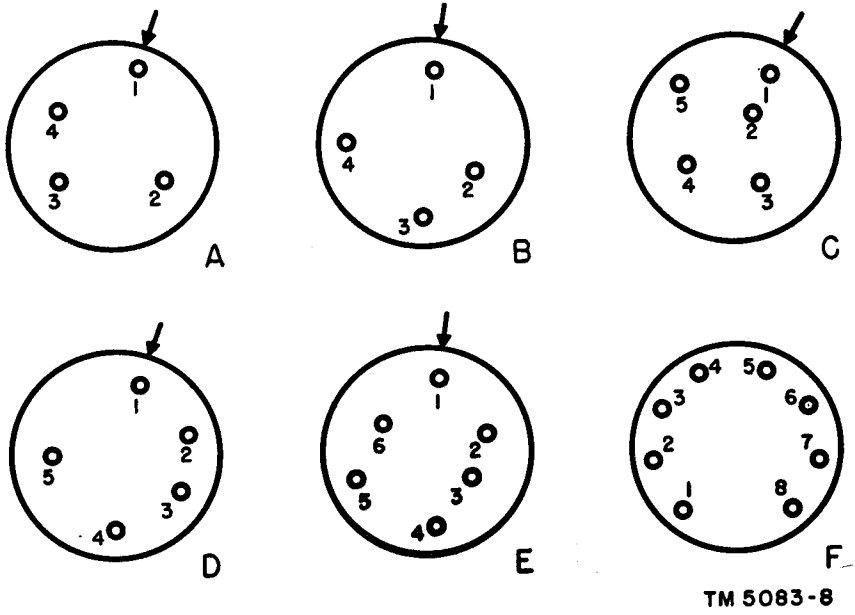


Figure 7. Basing diagrams for subminiature tubes (Letters A, B, C, D, E and F identify basing for use with test data book.)

l. Adapters.

(1) Because of their special base design tube types 829–B and 832–A cannot be tested directly in Electron Tube Test Set TV–7/U. Specially provided adapter E105 consists of a special socket for these tubes and is mounted on an octal base which permits testing these tubes in the standard OCTAL socket of the test set.

(2) Adapter E104 permits the testing, in the OCTAL socket, of subminiature tubes with long leads instead of pins. This

adapter has a spring locking action which grips the leads after insertion. Before the leads are inserted, be sure the lock is released and is in the open position. The test procedures are outlined in paragraph 22*k*. The only difference in testing is that if the leads are long enough, they are inserted in adapter E104 instead of into the subminiature socket.

(3) Also furnished is a special adapter for testing the 2C39 type tube in the OCTAL socket of the test set.

m. Special Notes.

(1) Power line voltage varies in different localities and under changing conditions of field operation. A survey has indicated that the average voltage for the Continental United States is about 117 volts; this does not mean that every locality maintains a constant voltage at that level.

(2) A used tube may test good, but will not work in a particular type equipment; but when a new tube is substituted, the equipment will operate correctly. In this case, check the line voltage that is applied to the equipment. The used tube that would not perform may not have received its specified filament voltage because of a drop in line voltage. The new tube performed because of its initial reserve capacity. The used tube would have performed if it had received its specified filament voltage.

(3) Tube failure frequently occurs in a-c or d-c equipment where the heaters or filaments of several tubes are connected in series. Sometimes, even though the power line voltage is normal, a series tube with abnormally high filament resistance will rob its companion tube of its normal filament voltage. The robbed tube apparently fails; but when tested under specified conditions, the tube will test good.

(4) When 7-pin and 9-pin miniature tubes are tested, inspect the base for bent pins before inserting the tube into the test socket. If any of the pins are bent, insert the tube into the proper pin straightener, either 7- or 9-pin as required, and press the tube firmly in place. The hardened steel die in the pin straightener will straighten and aline the pins so that the tube may be inserted into the test socket without damage.

n. Precautions.

(1) Do not connect the TV–7/U into a d-c power supply line. Be sure that the power line supplies 115 volts a-c at a frequency between 50 and 1,000 cycles.

(2) Do not insert a tube into any of the test sockets without first properly adjusting the controls.
(3) Do not attempt to test tubes without first checking for shorted elements.
(4) Do not press the push button 3—MUT. COND. when testing rectifier tubes.
(5) Do not fail to turn off the equipment, and return all leads and adapters to their proper places after use.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

23. General

Electron Tube Test Set TV-7/U is designed for normal operation through a temperature range from −40° F. to +125° F. The operation of the equipment may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs instructions are given for minimizing the effects of these unusual operating conditions.

24. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather may affect the efficient operation of the equipment.

a. Handle the equipment carefully.

b. Keep the equipment in a warm and dry spot. If the equipment is not located in a heated inclosure, construct an insulated box for the tester. Since a stand-by heater is not provided, keep the power switch of the tester turned on. Remember not to overload the power unit to which the equipment is connected.

c. In order to reach peak efficiency, mercury vapor rectifier tube, type 83, requires more time to warm up than other electron tubes. This is particularly true for operation at excessively low temperatures. Allow the test set to warm up for 10 to 15 minutes. The length of warm up time depends on the temperature of the surrounding air. This will prevent damage due to voltage surge through a cold tube.

d. When equipment that has been exposed to cold is brought into a warm room, moisture will form on it and continue to do so until room temperature is reached. This condition also arises when equipment warms up during the day after exposure during a cold night. Dry the equipment thoroughly when room temperature is reached.

e. Keep the watertight cover of the test set closed at all times when the equipment is not in operation. This will prevent accumulation of moisture within the equipment due to sweating.

25. Operation in Tropical Climates

When operated in tropical climates, electronic test equipment can be set up in tents, huts or, when necessary, in underground dugouts. When the equipment is installed below ground, when it is set up in swampy areas, or when it is set up in the tropics, moisture conditions are more acute. Ventilation usually is very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment is lower than the temperature of the ambient air. To minimize this condition keep the watertight cover of Electron Tube Test Set TV–7/U closed except when the tube tester is in use.

26. Operation in Desert Climates

Conditions similar to those in tropical climates often prevail in desert areas. The main problem in such areas, however, is the large amount of sand and fine dust which may enter the equipment. Take every precaution to keep the building in which the equipment is operated as dustproof as possible. Keep the watertight cover of Electron Tube Test Set TV–7/U closed except when the equipment is in use. Be careful to keep the equipment as clean and free from dust and grit as possible. Make frequent preventive maintenance checks as outlined in chapter 3.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

27. Tools and Equipment

No special tools or equipment are supplied or issued for Electron Tube Test Set TV–7/U. None are required for organizational maintenance. Only the usual tools, such as screwdrivers and pliers, generally available to maintenance personnel, are required. They are supplied in Tool Equipment TE–41.

28. Definition of Preventive Maintenance

Preventive maintenance is work performed on the equipment when the equipment is not in use to keep it in good working order so that break-downs and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair. Its aim is to prevent certain troubles from occurring. See AR 750–5.

29. General Preventive Maintenance Techniques

a. Use number 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth. Do not use cleaning solvent (SD) for electrical contacts.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

c. If available, use dry compressed air at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful however, not to cause any mechanical damage to the equipment from the air blast.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

30. Use of Preventive Maintenance Forms

(figs. 8 and 9)

a. The information in paragraphs 29, 31, 32, 33, and 34 is presented as a guide to the individual making an inspection of equipment in accordance with instructions on DA AGO Forms 11–238 and 11–239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Specific preventive maintenance procedures applicable to the TV–7/U are outlined in paragraph 32 and should be referred to before completing forms DA AGO 11–238 and 11–239.

31. Performing Preventive Maintenance

The electrical components of Electron Tube Test Set TV–7/U require routine preventive maintenance to keep the instrument operating at peak efficiency. Hit-and-miss methods are not satisfactory. For this reason, only authorized preventive maintenance should be practiced, and the instructions given here must be used by personnel assigned to such duties.

Caution: Do not tighten screws, nuts, and bolts beyond the pressure for which they are designed. Overtightening will result in bent, broken, and damaged parts and stripped threads.

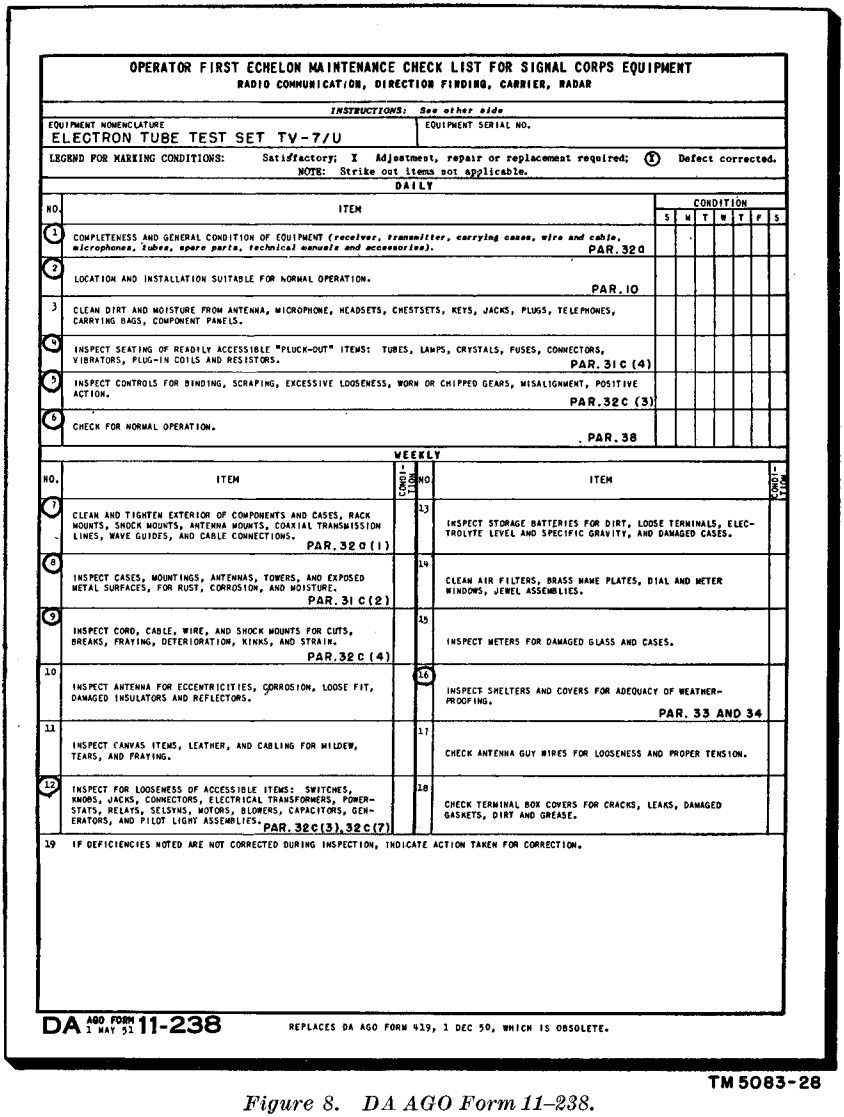
a. Perform all work when the instrument is disconnected from the power line.

b. Check to see if any component is overheating. If a component, other than a tube, becomes so hot that it cannot be touched, its temperature is too high and the cause must be established.

c. Visual inspection is the most important operation in preventive maintenance because it gives the first indication that repairs or adjustments are required. A careful observer will not overlook minor signs of trouble since valuable time and effort can be saved if such trouble is corrected before a major break-down occurs. A maintenance man must be thoroughly familiar with the normal operations of the instrument. It will enable him to recognize signs of a defective instrument.

(1) Carefully examine all parts of the equipment; note the state of cleanliness and the placement of wires. Signs of overheating are indicated by discoloration of the affected part. Note the general condition of resistors, capacitors, switches, and wiring.

(2) Look for loose or broken connections, loose mountings or



OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: ELECTRON TUBE TEST SET TV-7/U
EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: Satisfactory; X Adjustment, repair or replacement required; ⊘ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 32a							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 10							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS.							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 31c (4)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 32c (3)							
6	CHECK FOR NORMAL OPERATION. PAR. 38							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 32c (1)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 31c (2)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 32c (4)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR. 33 AND 34	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 32c(3), 32c(7)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA AGO FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 5083-28

Figure 8. DA AGO Form 11–238.

broken parts, and cut, frayed, or peeling insulation of wires.

(3) Examine all recesses for accumulation of dust or dirt, especially between connecting terminals. Keep parts, connections, and terminals free of dirt and corrosion. In tropical and high humidity locations, look for fungus growth and mildew.

(4) See that all tubes are seated properly in their sockets. Check the tightness of all mounting screws and nuts. After a loose connection is tightened, varnish should be applied with a small brush to moistureproof and fungiproof it.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: ELECTRON TUBE TEST SET TV-7/U

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	COND.
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 32 a	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 10	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS.	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 46, 47, 48	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION.	
6	CHECK FOR NORMAL OPERATION. PAR. 38	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 32 a (1)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 31 c (2)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 32 c (4)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 32 c (3), 32 c (7)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR. 33 AND 34	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS; INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES.	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION.	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 32 c (3)	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
37	MOISTURE AND FUNGIPROOF. PAR. 33 c	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA AGO FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—84283-1

TM 5083-29

Figure 9. DA AGO Form 11-239.

32. Preventive Maintenance Checklist

The following preventive maintenance operations are performed by organizational personnel at the intervals indicated, unless these intervals are reduced by the local commander. The checklist is a summary of the preventive maintenance operations to be performed on Electron Tube Test Set TV–7/U. For best performance of the instrument, follow the procedure outlined in the checklist as frequently as it is required. Preventive maintenance is applied in accordance with the techniques explained in paragraphs 29 and 31. Do not use gasoline as a cleaning fluid; do not smoke near inflammable liquids.

a. Daily.

(1) Clean the external surfaces of the case.
(2) Clean the front panel.
(3) Check the operation of the PILOT light.
(4) Check for proper line voltage adjustment (par. 21*d*).

b. Monthly.

Caution: Disconnect the equipment from the power source before performing the following operations. Upon completion, reconnect power and check for satisfactory operation.

(1) Remove the tube tester from its case and clean the interior of the case.
(2) Clean all components accessible without removal.
(3) Clean dust, sand, etc., from inaccessible places with an air hose or blower to prevent mechanical damage to switch contacts, etc.
(4) Visually inspect all parts for mechanical damage, charring of resistors, broken or loose connections, and frayed or broken insulation.
(5) Operate the equipment and check for overheating of the transformer or resistors.
(6) Inspect tube sockets, especially test sockets, for worn or broken contacts.

c. Semiannually.

(1) Check the 83 and 5Y3GT rectifier tubes and replace them if necessary.
(2) Check terminals of electrolytic capacitor C103 for corrosion.
(3) Check rotary and push button switches for dirt, corrosion, loose contacts, and unsatisfactory mechanical action.
(4) Check wires, cords, and cables for cracked, cut, and frayed insulation.
(5) Check terminal boards for dirt and loose connections.
(6) Check all visible terminals and connections for loose connections or corrosion.

(7) Check controls R126, R127, and R129 for unsatisfactory electrical and mechanical operation.
(8) Check moistureproofing and fungiproofing coatings for breaks. Retouch them with a brush if necessary.
(9) Check finish for scratches and bare spots. Retouch if it is necessary.

Section II. WEATHERPROOFING AND PAINTING

33. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent failure in areas subject to extremely high temperatures, low humidity, and excessive sand or dust are explained fully in TB SIG 75.

e. Protection Against Moisture. Electron Tube Test Set TV–7/U is housed in a watertight combination case. Keep the cover tightly closed when the equipment is not in use. This is the best possible precaution against moisture or foreign matter entering the equipment.

34. Rustproofing and Painting

a. Whenever the finish on the case and cover has been scarred or damaged badly, touch up the bared surface to prevent rust and corrosion. Clean the scarred surface down to the bare metal. Use No. 000 sandpaper to obtain a bright smooth finish. For severe rust, use solvent, dry cleaning (SD), to soften the rust and then use sandpaper to remove the rust.

Caution: Do not use steel wool or emery cloth instead of sandpaper. Minute particles of conducting material may enter the equipment and cause shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove dirt and corrosion from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent

(SD) to soften the corrosion; then use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

35. General

The troubleshooting and the repair work that can be performed at the organization maintenance level (operators and repairmen) is limited necessarily in scope by the tools, test equipment, replaceable parts used, and by the existing tactical situation. Accordingly, troubleshooting is based on the performance of the equipment, the use of the senses, continuity checks, and tube testing in determining such troubles as burned-out tubes and damaged test leads.

a. The following tools and test equipment are required for effective troubleshooting.

Tools and test equipment	Sig C stock No.
Multimeter TS–297/U (TM 11–5500)	3F4325–297
Electron-Tube Test Set TV–7/U	3F3952–3
Tool Equipment TE–41	6R38041

b. The paragraphs which follow in this section help to determine which circuits are at fault, and to localize the fault to an item such as a tube or fuse lamp.

36. Visual Inspection

a. Failure of the TV–7/U may be caused by one or more of the following faults:

(1) Incorrect voltage from power supply.
(2) Worn, broken, or disconnected line plug.
(3) Burned-out FUSE lamp (E103).
(4) Defective PILOT lamp (E102).
(5) Defective neon lamp (E101).
(6) Defective tube (V101 or V102).
(7) Defective tube leads.

b. When failure is encountered and when the cause is not immediately apparent, check as many of the above items as is practicable before a detailed examination of the component parts of the equipment is started. Obtain detailed information from the operator of the equipment regarding the performance of the equipment at the time trouble occurred.

c. Visually inspect the equipment for mechanical damage which might have caused failure.

37. Troubleshooting With the Use of Equipment Performance Checklist

a. General. The equipment performance checklist (par. 38) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerance of correct operation, and corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings and the conditions under which the item is checked. For other items the information given represents an action that must be taken to check the normal indications of the equipment given in the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible signs that the operator must perceive when he checks the items. If the indications are not normal, the operator must apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can take without returning the equipment for repairs. If the set is completely inoperative or if the recommended corrective measures do not yield results, troubleshooting is necessary.

38. Equipment Performance Checklist

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	Line cord	Insert line cord plug into socket of a-c source.		
2	POWER-ON-OFF	Set to ON position	PILOT lamp lights	Check for defective line cord or plug, defective FUSE lamp, defective lamp in PILOT indicator.
3	Meter		Pointer stays on zero	Check for defective type 83 tube.
4	Line test	Press push button 1—LINE ADJ. Rotate LINE ADJUST control.	Meter pointer should adjust to LINE TEST mark at midscale.	Check for low line voltage at power source.
5	Neon lamp	Set selectors at AP 0–0022. Rotate FUNCTION SWITCH through positions 1, 2, 3, 4, and 5.	The neon lamp should glow on positions 2 and 3.	Lamp must be seated tightly in its socket. Replace lamp.
6	Plate voltage	Set the selectors at HS 5–3460. Connect a multimeter or voltmeter at the OCTAL test socket between contacts 3 and 6. Press push button 3—MUT. CON.	Test meter should indicate a plate voltage of approximately 150 volts dc.	Test or replace type 83 tube V101. Refer to paragraphs 58 and 60.
7	Screen voltage	Set selectors at HS 5–3460. Connect a multimeter or voltmeter at the OCTAL test socket between contacts 4 and 6. Press push button 3—MUT. COND.	Test meter should indicate a screen voltage of approximately 130 volts dc.	Test or replace type 5Y3GT tube V102. Refer to paragraphs 58 and 60.

8	Bias voltage	Set selectors at HS 5–3460. Connect a multimeter or voltmeter between contacts 5 and 6 of the OCTAL test socket. Set BIAS dial at 100.	Test meter should indicate a bias voltage of 40 volts dc.	Refer to paragraphs 58 and 60.
9	Signal voltage	Set selectors at HS 5–3460. Connect a multimeter or voltmeter between contacts 5 and 6 of the OCTAL test socket. Set BIAS dial at 0. Set FUNCTION SWITCH at B, C, D, and E in rotation.	Test meter should indicate 5 volts ac at B and C, 1 volt ac at D, and ½ volt ac at E.	Refer to paragraph 58.

CHAPTER 4

THEORY

39. Basic Tube Tester Requirements

a. Electron tubes supplied to the Armed Forces are in nearly all cases procured under either JAN specifications or other military specifications, which impose rigid controls on the processes of manufacturing, handling, and transportation to insure delivery of the highest possible quality tubes to the Services. It is necessary, however, to provide some means of determining the condition of new replacement tubes and also the condition of tubes which have been in service for some time. Electron Tube Test Set TV–7/U employs the dynamic mutual conductance test method. The mutual conductance of the tube under test is indicated on the meter scale in terms of arbitrary units from 0 to 120.

Note. The terms, mutual conductance and transconductance, are used interchangeably. Either term may be defined as the ratio of a small change in plate current to the corresponding change in control grid voltage which produces it. Values of mutual conductance are expressed in micromhos. The symbol G_m is used to represent mutual conductance or transconductance in various mathematical representations of tube characteristics and their relationship.

b. In addition to the mutual conductance test, it is essential that the test set provide adequate means of testing for shorted elements and excessive gas content. In the case of tubes of the diode type, a straight emission test must be used. Some means of adjusting the voltage input to the test set must be provided to maintain the proper test potentials at all elements under varying conditions of voltage.

40. Basic Theory of Mutual Conductance Test

a. Examine first the simple full-wave rectifier circuit shown in figure 10. The two power transformer secondary windings have their inner ends connected to a d-c milliammeter. A center-tapped resistor R_M is shunted across the milliammeter. The load, resistance R_L, is connected between the center tap of the transformer and the rectifier filament as in any other full-wave rectifier circuit. When rectifier plate 2 is positive, electron flow is through the upper half of R_M, and the meter tends to deflect in one direction. When plate 1 is positive, electron flow is through the lower half of R_M, and the meter tends to

deflect in the opposite direction. With the load resistance fixed and equal forces acting on the meter in both cases, the pointer of the meter indicates zero. It cannot follow the variations at the rate of the power line frequency because of the inertia of the movement.

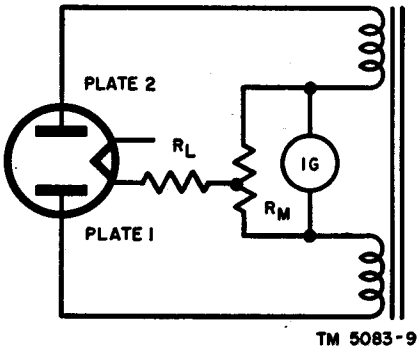


Figure 10. Rectifier diagram.

b. If the tube to be tested is substituted for the fixed load resistance and a fixed bias E is applied to the tube (fig. 11), the meter will still read zero because the tube under steady-state conditions acts like a fixed resistance.

c. If, in addition to the d-c bias, an a-c potential is applied to the grid of the tube under test, the circuit becomes equivalent to the one

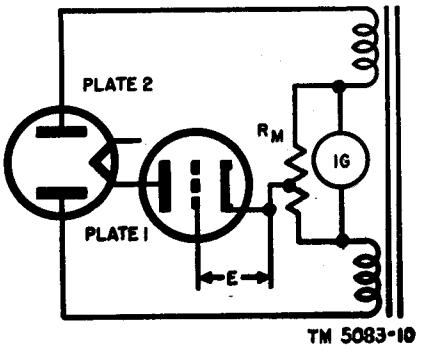


Figure 11. Basic mutual conductance circuit.

that is employed for quality and mutual conductance tests in Electron Tube Test Set TV–7/U. When the a-c potential swings the grid positive, the plate current of the tube is increased, the plate-cathode resistance is lowered, more current flows through R_M, and the deflecting force on the pointer of the meter is greater than before the a-c potential was applied. When the grid swings negative on the other half-cycle, the resistance of the tube under test is increased and the deflecting force on the pointer of the meter is smaller. With unbal-

anced currents on adjacent half-cycles and consequent unequal forces applied to the pointer of the meter, the deflection of the meter becomes proportional to the difference in currents. Since this difference is created by the difference of a-c potential applied to the grid, the meter indicates the plate-current changes produced by the applied grid voltage change; or in other words, the deflection of the meter gives a measure of the mutual conductance of the tube under test.

41. Block Diagram

The block diagram (fig. 12) illustrates the several major circuit sections of the equipment and their relation to each other. Voltage from a 115-volt a-c power source is reduced and standarized by the operation of the line adjust circuit. For line voltage adjustments depress push button 1—LINE ADJ. Voltage is applied to the meter circuit through metallic rectifier CR101. When the meter pointer comes to rest on the mark of the scale labeled LINE TEST, the voltages for the test circuits are standardized. The power supply circuit consists essentially of transformer T101 and rectifier tubes V101 and V102. It provides d-c voltages for the tubes under test and also a-c signal voltages for the mutual conductance tests. Voltage is applied to the filament or heater of the tube under test through switch S108 and through the selector switches. The push button switch assembly S110 provides a selection of various combinations of plate, screen, bias, and signal voltages that are required for the testing of the different types of tubes. Proper selection of these voltages is made through the setting of the selector switches before the voltages are applied to the tube under test. The selector switches determine the test socket terminals to which the various test voltages are applied. The FUNCTION SWITCH serves a dual purpose: when shorts tests are made, the settings of the FUNCTION SWITCH permit the application of an a-c voltage to the different elements of the tube under test. When the FUNCTION SWITCH is set to the RANGE position, the sensitivity of the meter and the magnitude of the signal voltage are controlled. The tube data book gives the correct setting for the proper range for the tube under test. Meter M101 indicates the condition of the tube under test.

42. Circuit Analysis

a. Power Supply Circuit (fig. 13).

(1) The primary of power transformer T101 is supplied from a voltage source of 115 volts plus or minus 10 percent and a frequency of 50 to 1,000 cps through the POWER ON-OFF switch (S111), the LINE ADJUST control (R126), and the FUSE lamp (E103). The LINE ADJUST control, operated

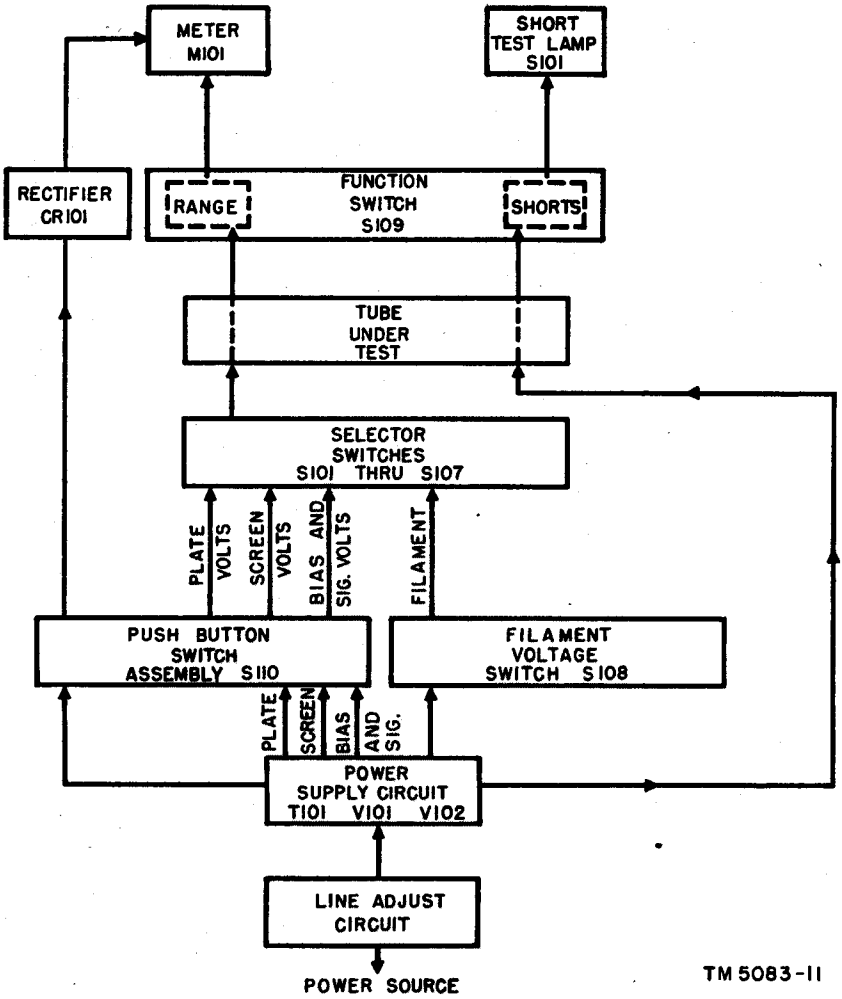


Figure 12. Electron Tube Test Set TV-7/U, block diagram.

in conjunction with the line test circuit, regulates the voltage across the primary of T101 at 93 volts.

(2) Secondary No. 7 of power transformer T101 consists of a multitapped winding designed to supply the various filament or heater voltages for the tubes under test. Voltages shown on figure 14 are measured under load. No-load voltages will be somewhat higher. For example, no-load voltage measured from point 19 to point 37 will be approximately 121 volts with 93 volts on the primary. Secondary No. 7 also supplies voltage for rectifier emission tests.

(3) Secondaries No. 1 and No. 2 supply approximately 154 volts ac to the plates of the type 83 tube (V101) which supplies

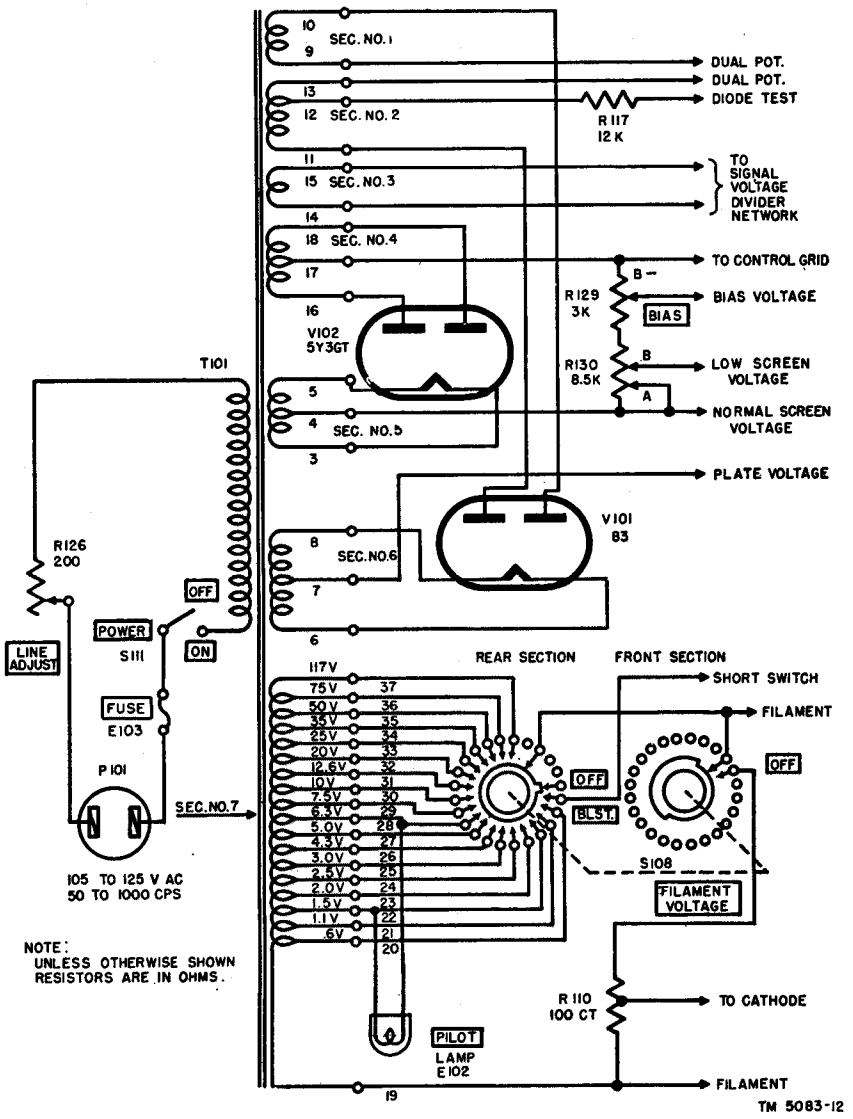


Figure 13. Simplified power supply circuit.

plate voltage to the tube under test. Secondary No. 2 is tapped at 18 volts to supply voltage for diode emission tests.

(4) Secondary No. 6, a center-tapped 5-volt winding, supplies filament voltage for type 83 rectifier tube V101.

(5) Secondary No. 3 supplies the signal voltage for mutual conductance tests, 5 volts ac. A voltage divider network across this winding also provides signal voltages of 1 volt and .5 volt.

(6) Secondary No. 4, 330 volts center tapped, supplies the plates of the screen voltage rectifier (V102), a type 5Y3GT tube. A voltage divider system consisting of the BIAS control R129 and adjustable resistor R130 across the output of this rectifier provides bias voltage for mutual conductance tests and screen voltages for the tubes to be tested.

(7) Secondary No. 5, 5 volts center tapped, supplies the filament of type 5Y3GT tube V102.

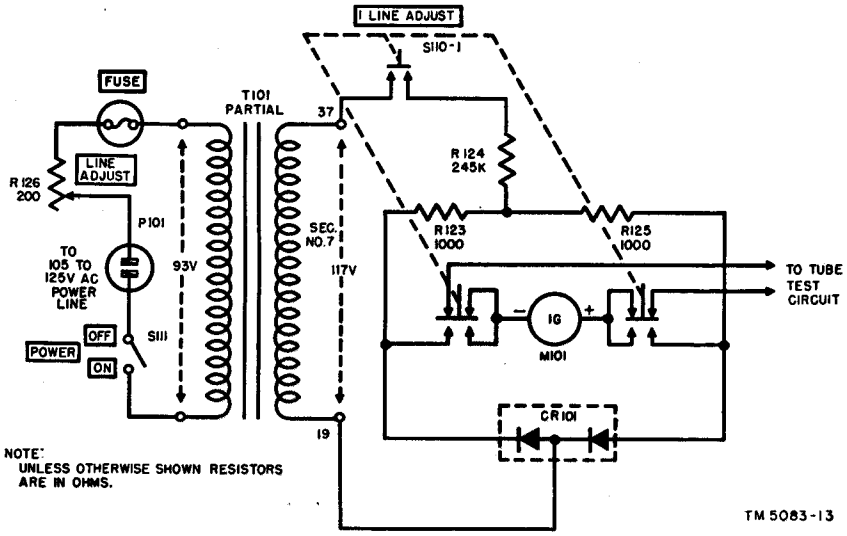


Figure 14. Simplified line voltage test circuit.

b. Line Voltage Test Circuit (fig. 14).

(1) Press the 1—LINE ADJ. push button to connect the meter to the rectifier bridge system which is made up of copper oxide rectifier CR101 and resistors R123 and R125. The a-c voltage obtained from points 19 and 37 of the power transformer is applied to the bridge network through resistor R124.

(2) Resistor R124 is of such value that 121 volts rms (root mean square) obtained from terminal 19 to terminal 37 of the power transformer cause meter M101 to read at LINE TEST.

(3) The power transformer is so designed that if 93 volts a-c rms are applied to the primary winding, 121 volts a-c rms are induced across the total secondary No. 7 winding or across points 19 and 37.

(4) Keep the 1—LINE ADJ. push button pressed down and turn the LINE ADJUST control (R126) until the pointer of the meter is exactly over the LINE TEST mark, and a standard

voltage of 93 volts rms will be established across the primary winding of the transformer.

c. Shorts Test Circuit (fig. 15).

(1) Secondary No. 2 of T101 applies an a-c potential of approximately 154 volts rms to voltage divider resistors R108 and R107. A voltage of approximately 93 volts rms is developed across R107. This voltage is applied to the elements of the tube under test through capacitor C102 and neon short test lamp E101 which is shunted by resistor R109.

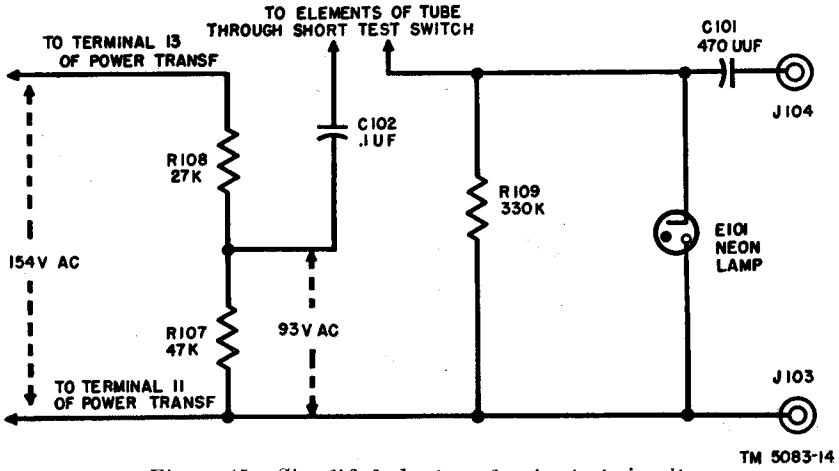


Figure 15. Simplified shorts and noise test circuit.

(2) The selectors are set correctly for the particular tube. When FUNCTION SWITCH S109 is turned from position 1 through position 5, the various elements of the tube under test are connected between neon lamp E101 and capacitor C102. Any shorted portion between the elements will complete the circuit through capacitor C102 to neon lamp E102 and will cause the neon lamp E101 to glow.

d. Noise Test Circuit. The shorts test circuit (fig. 15) also may be used for making a noise test of electron tubes. Connect the NOISE test jacks J103 and J104 to the antenna and ground posts of a radio receiver. Turn FUNCTION SWITCH S109 from position 1 through position 5; tap the tube under test with a finger or with the eraser end of a pencil. Intermittent disturbances between the electrodes that are too brief to register on the neon lamp establish a momentary short, permit the alternating voltage from the power supply to be applied to the neon lamp, and cause a brief oscillation. This oscillation is reproduced by the loudspeaker or headphones as an audible signal similar to static.

e. Rectifier Test Circuit (fig. 16). Rectifier tubes and diode detector tubes can be tested only for emission. The test circuit is quite simple: Press push button 7—RECT; an a-c potential of 35 volts is applied between the cathode and plate of the tube under test through resistor R106 and meter M101 and is rectified by the tube under test. This test is used for power rectifiers such as the 5Y3 or 83 types. The rectifying action of the tube under test will cause a pulsating current to flow through the meter. The current indicated by the meter is proportional to the electron emission of the tube. The deflection of

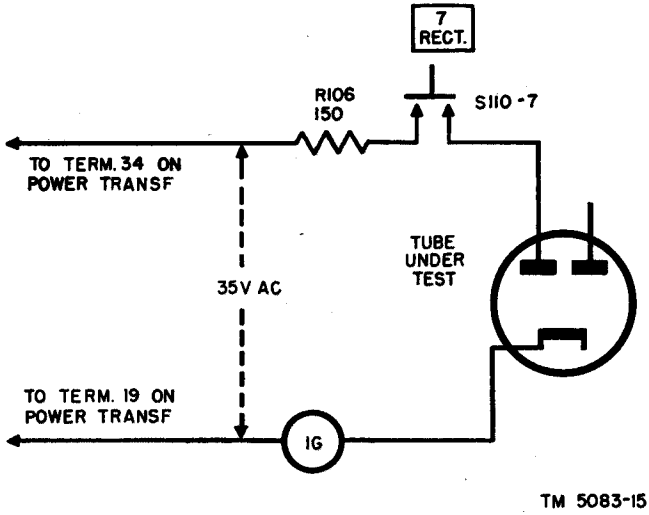


Figure 16. Simplified rectifier test circuit.

the meter is a measure of the efficiency of electron emission of the tube. The tube test data book lists the minimum meter readings for the various tube types. If the deflection of the meter is below this value, tubes should be rejected. Press push button 6—OZ4; a circuit similar to figure 16 is set up, but a higher voltage is applied (330 volts ac) to test rectifiers of the cold cathode type such as the OZ4. Press push button 2—DIODE; a circuit similar to figure 16 is set up. Only a lower voltage (20 volts ac) is used to protect the delicate cathodes of diode detector type tubes such as the 6H6.

f. Mutual Conductance Test Circuit (fig. 17). The mutual conductance (G_m) of an amplifier-type vacuum tube, also called the grid plate transconductance, is an expression which represents the efficiency of performance of a tube. It is defined as the change in plate current (ΔI_p) divided by the change in grid voltage (ΔE_g). The relation generally is written $G_m = \frac{\Delta I_p}{\Delta E_g}$ Transconductance is expressed in mi-

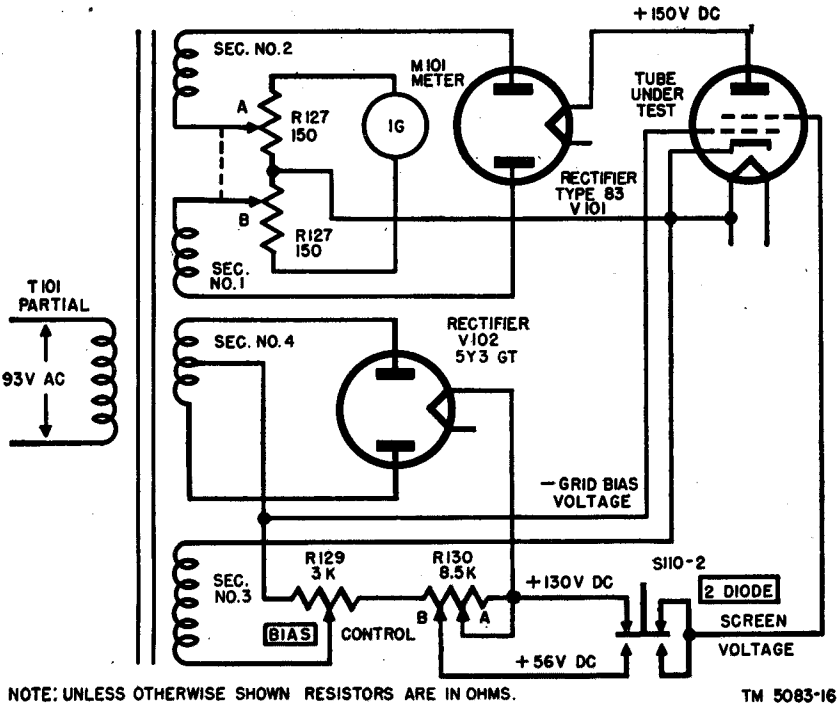


Figure 17. Simplified mutual conductance test circuit.

cromho units. Its value gives a performance indication because it shows the effectiveness of a tube to convert a small change in grid voltage (grid signal) to a large change in plate current. For the measurement of the mutual conductance value directly, the proper d-c grid voltage for the tube under test is supplied by a full-wave rectifier circuit using a 5Y3GT tube (V102). Adjust the negative bias voltage with BIAS control R129 to the correct value for the particular tube under test which is shown in the tube test data book. An a-c signal voltage from secondary winding No. 3 of the power transformer (T101) to act in series with the d-c grid bias is required for this type of test. This voltage alternately swings the grid to either side of the d-c bias value, thereby producing the variable grid voltage (ΔE_g) required for the dynamic test. The plate voltage for the tube under test is supplied by another full-wave rectifier circuit, which uses the type 83 tube (V101). The return lead contains the meter circuit which serves to measure the plate-current change (ΔI_p). The mutual conductance test circuit is actuated by push button 3–MUT. COND. The normal screen voltage of 130 volts is excessive for testing certain tubes such as type 1R5. In such cases it is necessary to press and hold down push button 2—DIODE before red push button 3—MUT. COND. is pressed. Push button 2—DIODE op-

erates switch S110–2 and reduces the screen voltage to approximately 56 volts as illustrated by figure 17.

g. Gas Test Circuit (fig. 18).

(1) Press 4—GAS 1 push button. A definite value of plate voltage and grid bias voltage is applied to the tube under test and causes a definite value of plate current to flow. This current is indicated on the meter (M101).

(2) Press 5—GAS 2 push button. A 180,000-ohm resistor (R128) is inserted in the grid circuit. If grid current flows from the bias voltage source through the grid circuit to the cathode, due to gas in the tube, the current will develop a voltage drop across resistor R128. This voltage drop reduces the negative bias on the grid and causes a corresponding increase in the plate current which is measured by the meter (M101).

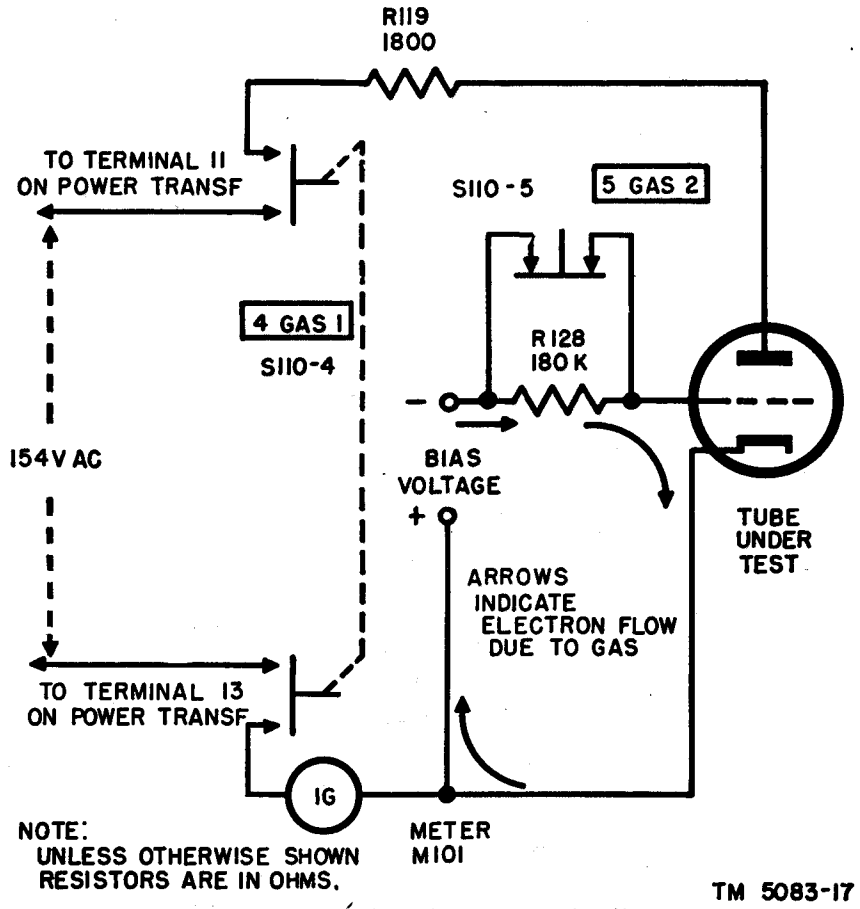


Figure 18. Simplified gas test circuit.

(3) If the tube contains gas, the pointer of the meter moves up scale. The increase in meter reading must not exceed one scale division.

43. Special Switching Circuits

a. Selector Switches.

(1) The selector switches, FILAMENT (S107 and S106), GRID (S105), PLATE (S104), SCREEN (S103), CATHODE (S102) and SUPPRESSOR (S101) are constructed and interconnected so that the possibility of applying more than one voltage to any tube pin at the same time or of creating a shorted condition by accidental disturbance of the switches is eliminated. The basic principle of this interlocking circuit is illustrated in figure 19.

(2) Conductors from socket contacts 1 through 9 enter the switching circuit from the left and progress toward the right through the FILAMENT, GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR selectors. To simplify the illustration only portions of the first four selectors have been shown.

(*a*) The first FILAMENT selector is set to apply voltage to pin No. 1. This switch setting automatically breaks the conductor from pin No. 1 at point A, and makes it impossible for any other voltage to reach pin No. 1 regardless of where the succeeding selectors are set.

(*b*) Set the second FILAMENT selector, and apply voltage to pin No. 2; the conductor is broken from this pin at point B, and no other voltage can reach pin No. 2.

(*c*) When the GRID selector is set to deliver grid voltage to pin No. 3, the conductor is broken from this pin at point C and the application of any other voltage to pin No. 3 is prevented.

(*d*) Setting the PLATE selector to deliver plate voltage to pin No. 4 breaks the conductor from pin No. 4 at D.

(*e*) If the first four selectors are set in this manner, filament voltage is applied across pins No. 1 and No. 2, grid voltage to pin No. 3, and plate voltage to pin No. 4, but application of any other voltage to these pins is impossible.

b. Shorts Test Switch. The operation of the SHORTS portion of FUNCTION SWITCH S109 is illustrated by figure 20. It shows the shorts test section in the number 1 position. In this position, the cathode filament, and suppressor of the tube under test are in contact with segment A; and the screen, plate, and grid are in contact with segment B. Any shorted condition between an element on segment

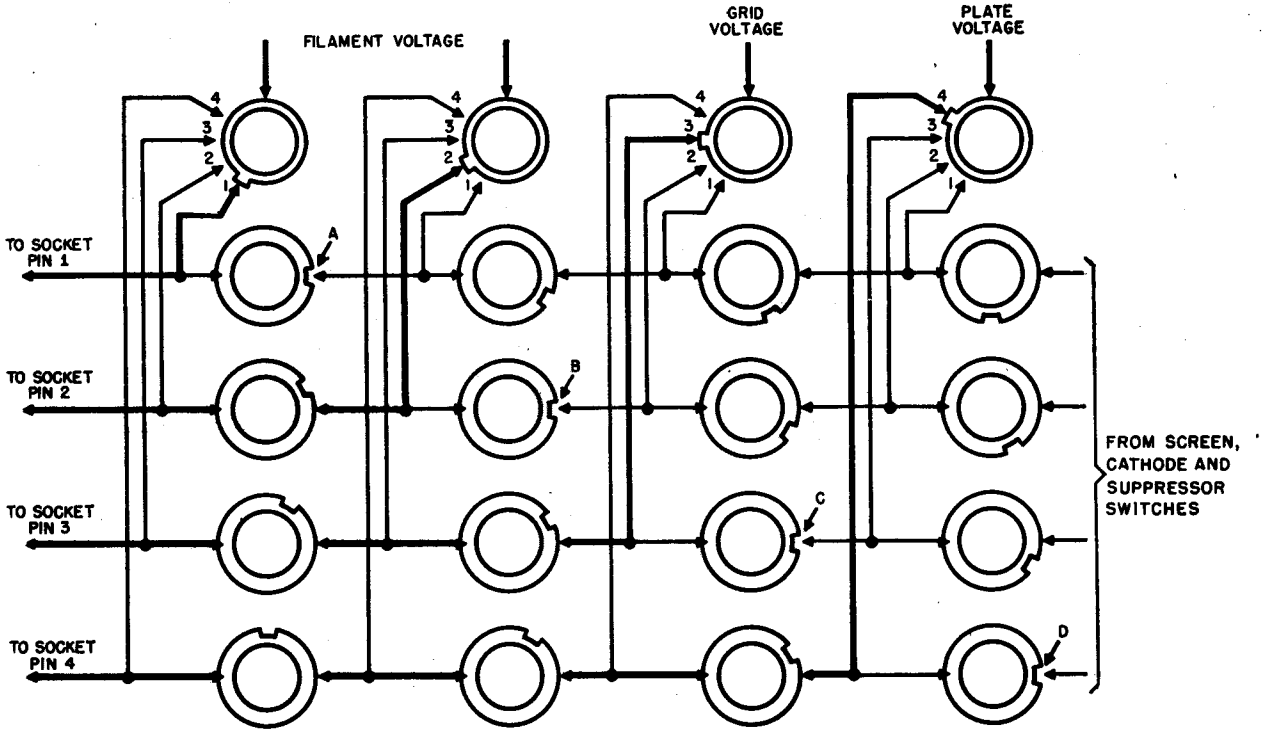


Figure 19. Simplified selector switch diagram.

A and elements on segment B completes the circuit between points X and Y and neon lamp E101 will glow. Rotation of the switch from position 2 through position 5 changes the grouping of the elements on the two segments. Different types of shorts will cause the neon lamp to glow on different positions of the switch; that is, a screen-to-suppressor short will cause the lamp to glow in all five positions while a grid-to-plate short will cause a glow only on position No. 4. Refer to the shorts test chart to identify the various types of shorts.

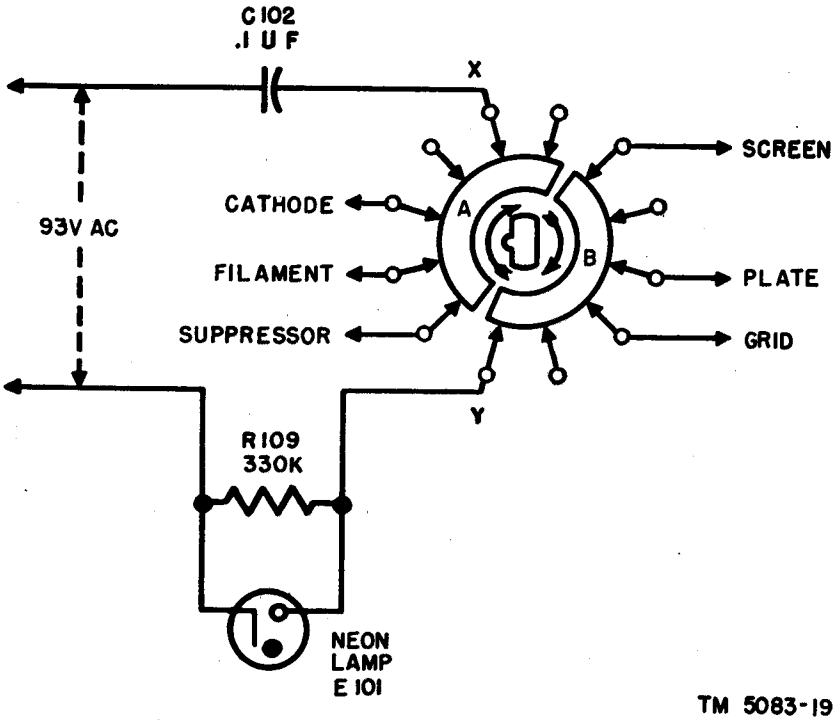


Figure 20. Simplified shorts test switch diagram.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field depot maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. PREREPAIR PROCEDURES

44. Tools, Materials, and Test Equipment

Tools, materials, and test equipment needed for performing the prerepair procedures in this section are listed below.

Item	*Sig C stock No.*
Tool Equipment TE–113	6R38113
Lint-free cloth	6Z1989
Sandpaper No. 0000	6Z7500–0000
Solvent, Dry-Cleaning (SD)	6G1914
Carbon tetrachloride	6G184
Small brush (TL–72)	6Z1372
Solder, rosin core	6N7531
Alcohol (for removing excess rosin)	6G16.1
Multimeter TS–352/U	3F4325–352

45. Removal of Pluck-Out Parts

a. To remove FUSE lamp E103 from the front of the panel press downward on the bulb and rotate it in a counterclockwise direction in such a manner that the prongs of the bayonet base will disengage from the socket.

b. Neon glow lamp E101, accessible from the front of the panel, is of the screw base type; for removal, rotate it counterclockwise.

c. Remove pilot lamp E102 as follows: First unscrew the red jewel cover of the PILOT indicator (I 103). Press down on the lamp and rotate counterclockwise in such a manner that the prongs of the bayonet base will disengage from the socket.

d. To remove the rectifier tubes, proceed as follows:

(1) Raise the cover of the test set. To remove it from the case, slide the cover to the left until the separable hinges are disengaged. Remove the 12 mounting screws which secure the test set to the case. While holding the tester in the case, turn the equipment over carefully and place it face down on a workbench or another clean flat surface. Carefully lift the case away from the tester.

(2) Press the locking lug of the tube clamp which secures the 83 rectifier to disengage the clamp from the threaded support post. Lift the clamp clear of the post.

(3) The tube clamp which holds the 5Y3GT tube is released in the same manner as above.

(4) To remove the tubes, pull them directly away from the socket. Do not rock or jiggle the tube in its socket if it can be extracted by a direct pull. Rock it gently if it does not release easily. Jiggling of a tube in its socket during removal spreads the contacts, may result in poor socket connections, and may cause faulty operation.

46. Cleaning, Inspecting, and Testing Tubes

a. Cleaning. Clean the tubes with a cloth moistened with solvent (SD); clean the prongs with crocus cloth.

b. Inspecting. Inspect tubes for cracks in the glass or damage to the base, and for bent and broken prongs.

c. Testing. Test the tubes for emission and short circuits; use a tube tester or substitute tubes that are known to be good. Note any change in the operation of the equipment.

47. Inspecting, Cleaning, and Testing Fuse Lamps

a. Inspecting. Inspect the FUSE lamp for cracks in the glass or damage to the base.

b. Cleaning. Clean the FUSE lamp with a cloth moistened with solvent (SD); clean the base and center contacts with crocus cloth.

c. Testing. Check FUSE lamp for continuity.

48. Inspecting, Cleaning, and Testing Pilot Lamp

Inspect PILOT lamp for cracked glass or loose or damaged base. Clean lamp and base with a cloth moistened in solvent (SD), clean base and center contacts with crocus cloth. Check lamp for continuity.

49. Inspecting, Cleaning, and Testing Neon Lamp

a. Inspect the lamp for cracked glass or loose or damaged base.

b. Clean the lamp and base with a cloth moistened with solvent (SD); if necessary clean the base and center contact with crocus cloth.

c. Test the neon lamp using the procedure outline in paragraph 21*e*.

50. Cleaning and Inspecting Test Set

a. Cleaning. Thorough cleaning of the equipment will insure optimum performance and will prevent corrosion, rust, dust, and fungus growth which damages parts or causes a low resistance leakage path within the electrical circuits. Before repairs are started, the interior of the test set and case is cleaned thoroughly. Remove loose dust and dirt with a small brush or an air blower. Remove dirt or other foreign matter which adheres to the panel and parts with a brush or cloth moistened with solvent (SD).

b. Inspecting. After the test set has been cleaned thoroughly and carefully, make a visual inspection of parts and wiring for rust, corrosion, loose connections, frayed or damaged insulation, loose screws, and burned and charred resistors. Carefully inspect tube sockets for broken and worn contacts, rotary and push button switches for loose or bent contacts and broken insulation, and terminal board for loose or broken lugs. Inspect and tighten all dial and pointer knobs.

51. Reassembling Test Set

a. Replace the 5Y3GT tube in its socket. Slip the clamp for the 5Y3GT over the threaded support post and press the clamp firmly against the top of the tube.

b. Replace the type 83 tube in its socket. Slip the large tube clamp over the support post and press the clamp firmly over the end of the tube. The dome of the type 83 tube will protrude through the opening of the clamp.

c. Carefully lower the tube tester into the case, and replace the 12 mounting screws around the edge of the panel. Carefully tighten the screws in rotation a little at a time around the panel to prevent binding.

d. Replace the FUSE lamp, neon lamp, and PILOT lamp in their respective sockets.

e. Screw the red jewel of the PILOT indicator back in place over the lamp.

f. Check the equipment for operation.

Section II. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

52. Troubleshooting Procedures

The first step in servicing test equipment is to sectionalize the fault. Sectionalization means tracing the fault to the *major circuit* responsible for the abnormal operation of the tester. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults such as burned-out resistors, a shorted transformer, loose connections, and mechanical damage often can be located by sight, smell, and touch. The majority of faults, however, will be localized through *voltage* and *resistance* checks.

a. Circuit Sectionalization. Circuit sectionalization may be accomplished by applying the procedures discussed in paragraphs 37 and 54.

b. Component Localization. The tests listed below aid in isolating the source of trouble. Follow the procedure in the given order. Remember that servicing procedure must not cause any further damage to the equipment. First, trouble must be localized to a single circuit. Then the trouble is isolated within that circuit by appropriate voltage and resistance measurements. The service procedure can be summarized as follows:

(1) *Visual inspection.* The repairman frequently may discover the trouble or determine the portion of the circuit in which trouble exists through visual inspection. Often additional trouble to the test set is avoided through inspection because damage might occur through improper servicing methods and future failures might be forestalled.

(2) *Operational test.* The operational test is important because it frequently indicates the general location of the trouble. In many instances the information gained will determine the exact nature of the fault. To utilize this information fully, interpret all symptoms in relation to one another.

(3) *Troubleshooting chart.* The trouble symptoms listed in this chart (par. 53) will aid greatly in localizing trouble.

(4) *Intermittents.* Remember that faulty operation may be the result of intermittent conditions. This type of trouble often can be made to appear by tapping or jarring the equipment.

53. Troubleshooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the illustrations listed in *a* below for troubleshooting data.

a. Illustrations.

Fig. No.	Title
22	Voltage calibration check diagram.
23	Internal view of Electron Tube Test Set TV–7/U (front left oblique).
24	Internal view of Electron Tube Test Set TV–7/U (front right oblique).
25	Internal view of Electron Tube Test Set TV–7/U (rear left oblique).
26	Internal view of Electron Tube Test Set TV–7/U (rear right oblique).
27	Internal view of Electron Tube Test Set TV–7/U (direct rear view).
28	Transformer diagram.
29	Schematic wiring diagram of Electron Tube Test Set TV–7/U.

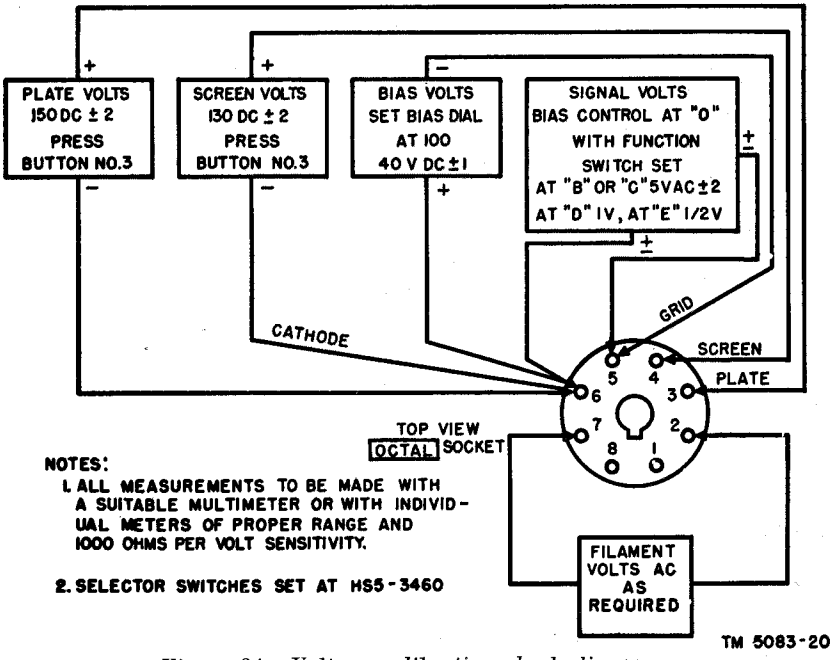


Figure 21. Voltage calibration check diagram.

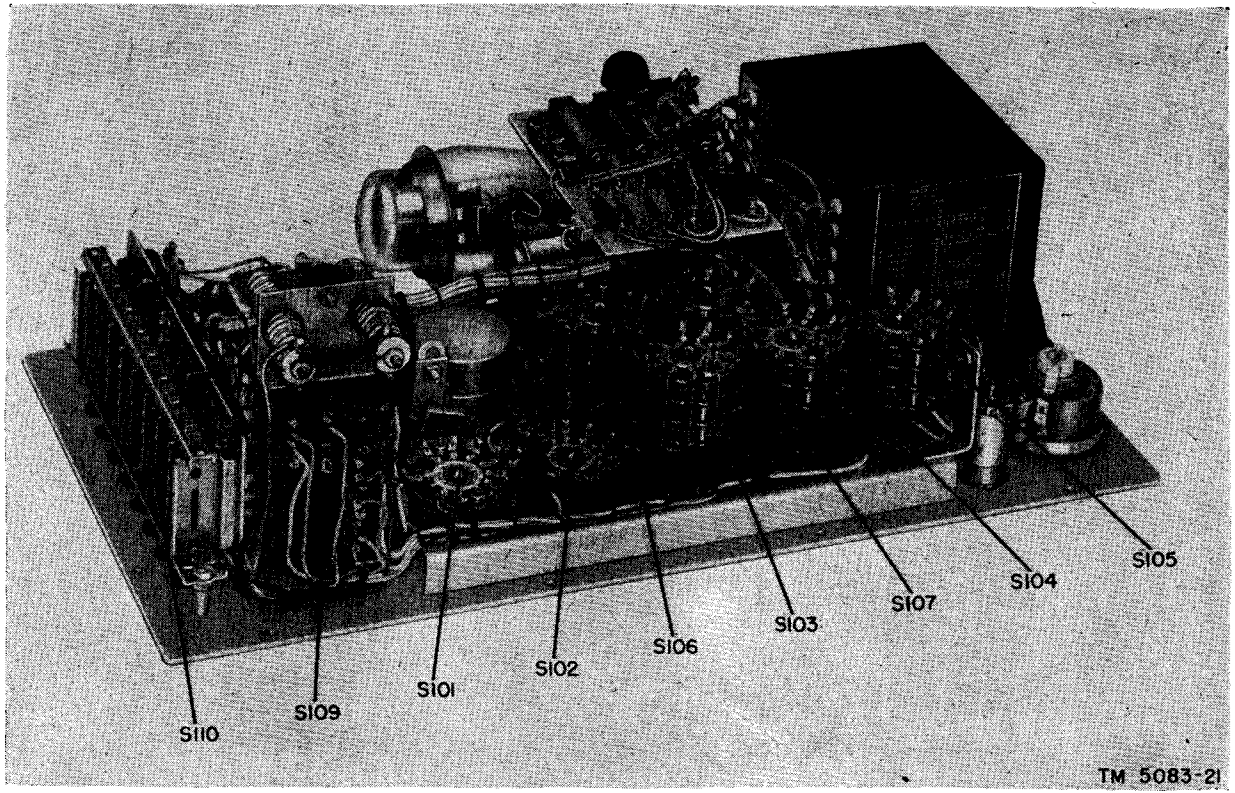


Figure 22. Internal view of Electron Tube Test Set TV-7/U, front left oblique.

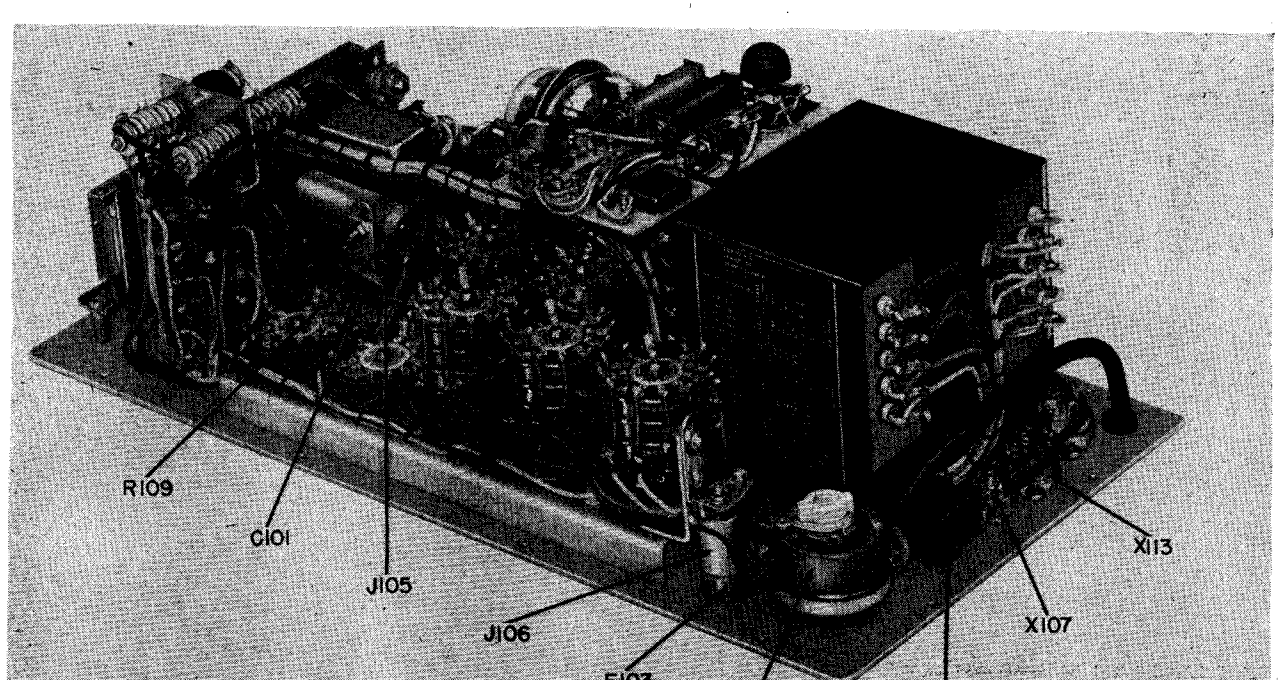


Figure 23. Internal view of Electron Tube Test Set TV-7/U, front right oblique.

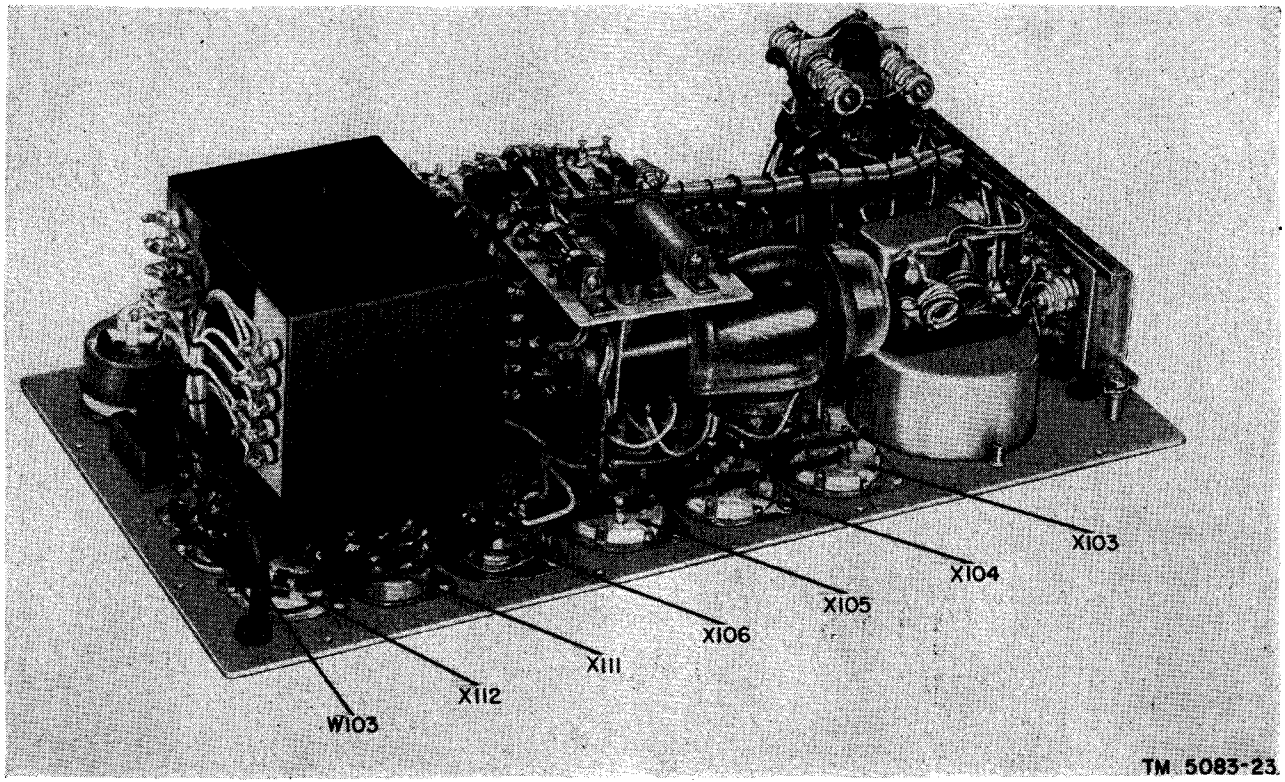


Figure 24. Internal view of Electron Tube Test Set TV–7/U, rear right oblique.

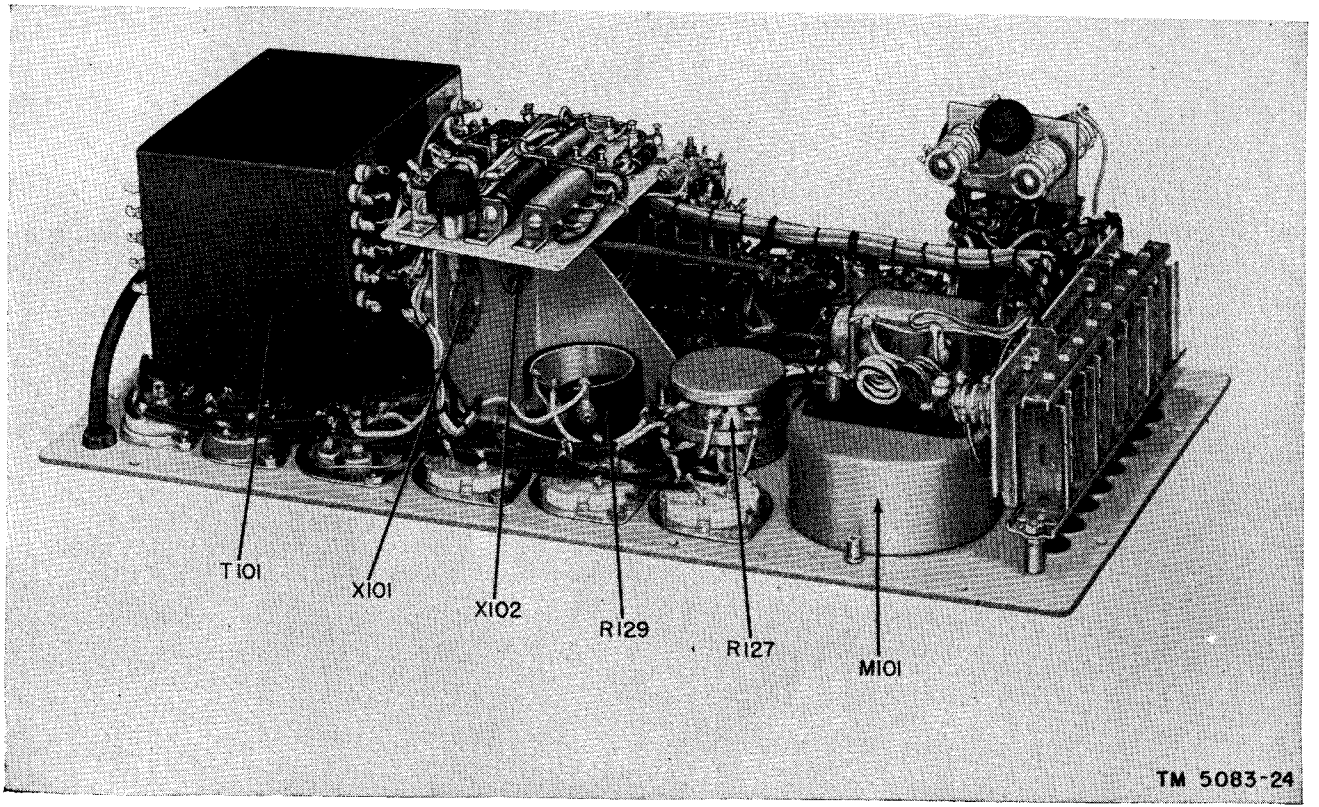


Figure 25. Internal view of Electron Tube Test Set TV-7/U, rear right oblique.

b. Cross-Reference List of Parts.

Symbol designation	Name of part	Location or figure
C101	Capacitor	24.
C102	Capacitor	27.
C103	Capacitor	27.
C104	Capacitor	27.
CR101	Rectifier	27.
E101	Neon lamp	6.
E102	PILOT light	6.
E103	FUSE lamp	6, 24.
E104	Adapter, SUB MIN	3, 4.
E105	Adapter (829–B and 832–A types)	3, 4.
E106	Terminal board	27.
H109	Clamp, electron tube	27.
H110	Clamp, electron tube	27.
I 103	PILOT indicator	27.
J101	Plate jack	6.
J102	Grid jack	6.
J105	Lampholder	24.
J106	Lampholder	24.
M101	Meter	6, 26.
R101	Resistor, fixed, composition	27.
R102	Resistor, fixed, composition	Mounted on SCREEN switch.
R103	Resistor, fixed, composition	Mounted on PLATE switch.
R104	Resistor, fixed, composition	Mounted on GRID switch.
R106	Resistor, fixed, WW	27.
R107	Resistor, fixed, composition	Mounted on FUNCTION switch.
R108	Resistor, fixed, composition	Mounted on FUNCTION switch.
R109	Resistor, fixed, composition	24.
R110	Resistor, fixed, WW	27.
R111	Resistor, fixed, WW	27.
R112	Resistor, fixed, WW	27.
R113	Resistor, fixed, WW	27.
R114	Resistor, fixed, WW	27.
R115	Resistor, fixed, WW	27.
R117	Resistor, fixed, composition	27.
R118	Resistor, fixed, WW	27.
R119	Resistor, fixed, WW	27.
R120	Resistor, fixed, WW	27.
R121	Resistor, fixed, WW	27.
R122	Resistor, fixed, WW	27.
R123	Resistor, fixed, composition	27.
R124	Resistor, fixed, composition	27.
R125	Resistor, fixed, composition	27.
R126	Resistor, variable, WW	24.
R127	Resistor, variable, WW	26.

Symbol designation	Name of part	Location or figure
R128	Resistor, fixed, composition	Mounted on PUSH BUTTON switch.
R129	Resistor, variable, WW, BIAS control	26.
R130	Resistor, adjustable, WW	27.
S101	SUPPRESSOR, selector	6, 23.
S102	CATHODE, selector	6, 23.
S103	SCREEN, selector	6, 23.
S104	PLATE, selector	6, 23.
S105	GRID, selector	6, 23.
S106	FILAMENT, selector	6, 23.
S107	FILAMENT, selector	6, 23.
S108	FILAMENT VOLTAGE switch	6.
S109	FUNCTION switch	6, 23.
S110	Push-button switch	24.
S111	POWER switch	6, 24.
T101	Transformer	26.
V101	Electron tube, type 83	27.
V102	Electron tube, type 5Y3GT	27.
W103	Cable assembly, power	3, 25.
X101	Socket, electron tube	26.
X102	Socket, electron tube	26.
X103	Socket, electron tube	25.
X104	Socket, electron tube	25.
X105	Socket, electron tube	25.
X106	Socket, electron tube	25.
X107	Socket, electron tube	24.
X108	Socket, electron tube	27.
X109	Socket, electron tube	Mounted below OCTAL test socket (fig. 5).
X110	Socket, electron tube	Same as X109.
X111	Socket, electron tube	25.
X112	Socket, electron tube	25.
X113	Socket, electron tube	24.

54. Test Equipment Required

The test equipment required for troubleshooting Electron Tube Test Set TV–7/U is listed below. The technical manual associated with the test equipment is listed also.

Test equipment	Publication
Electron Tube Test Set TV–7/U or equal. (The older model I–177 series tube tester may be used.)	TM 11–2627
Multimeter TS–352/U or equal. (The sensitivity of the multimeter must be no less than 1,000 ohms per volt.)	TM 11–5527
Meter Test Set TS–682/GSM–1	TM 11–2535A

55. Troubleshooting Chart

The following chart is supplied as an aid to locating trouble in the test set. This chart lists the symptoms which the repairman observes while making a few simple tests. The chart also indicates how to localize trouble in the test set. For detailed information on voltage calibration checks and procedure, see paragraphs 58 and 60.

Symptom	Probable trouble	Correction
1. POWER switch ON position. PILOT lamp does not light.	Defective cord	Replace cord.
	Burned-out FUSE lamp	Replace FUSE lamp.
	Burned-out PILOT lamp	Replace PILOT lamp.
	Defective POWER switch or transformer.	Check and replace if necessary.
2. Meter pointer deflects	Defective type 83 tube in tester.	Replace tube.
3. Cannot bring meter to test	Low line voltage	Check power source.
	Defective meter	Check and replace meter if necessary.
	Defective rectifier CR101	Replace rectifier CR101.
	Defective transformer	Check and replace if necessary.
4. Plate voltage zero	V101 defective	Replace V101.
	Open secondary 2, 6, or 7 of T101.	Replace T101.
Plate voltage low	V101 defective	Replace V101.
	C101 shorted	Replace C102.
	Open secondary 1 or 2 of T101.	Replace T101.
Plate voltage high	Resistor R124 defective	Replace R124.
	Rectifier CR101 defective	Replace CR101.
5. Screen voltage zero	V102 defective	Replace V102.
	R129 open at (−) end	Replace R129.
	Open secondary 3, 4, 5 of T101.	Replace T101.
Screen voltage low	V102 weak	Replace V102.
	Open secondary 3 or 4 of T101.	Replace T101.
Screen voltage high	R129 open at (+) end	Replace R129.
	R130 open	Replace R130.
6. Bias voltage zero	R129 open at (+) end	Replace R129.
	R130 open	Replace R130.
	V102 defective	Replace V102.
	Open secondary 3, 4, 5 of T101.	Replace T101.
Bias voltage low	V102 weak	Replace V102.
	Open secondary 3 or 4 of T101.	Replace T101.
Bias voltage high	R129 open at (−) end	Replace R129.

Symptom	Probable trouble	Correction
7. Signal voltage zero	R120, R121, or R122 defective.	Replace defective resistor.
	Open secondary 3 of T101.	Replace T101.
Signal voltage low	R120, R121, or R122 defective.	Replace defective resistor.
Signal voltage high	R120, R121, or R122 defective.	Replace defective resistor.

56. General Precautions

Carelessness in making repairs or in replacing parts often creates new faults. Note the following points.

a. Before unsoldering a part, note the position of the leads. If a part, such as a transformer, has a number of connections tag each of the leads.

b. Be careful not to damage other leads by pushing or pulling them out of the way.

c. Do not allow drops of solder to fall into the equipment, since they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is very important to make properly soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

e. Do not disturb the adjustable contacts on resistor R130 unless readjustment is indicated as a result of voltage calibration checks (par. 58).

57. Operational Test

a. Operate the test set as directed by the equipment performance checklist in paragraph 38. This checklist is important because it will in most cases indicate the presence and general location of the trouble.

b. Using tubes which are known to be satisfactory, test several different types in the equipment being serviced and note the results. This procedure often will localize the trouble to one particular test circuit.

c. The voltage calibration test diagram (fig. 21) provides a rapid means of determining if proper voltages are supplied to the test sockets. The use of this diagram in conjunction with the equipment performance checklist and the troubleshooting chart generally will provide all the information necessary to locate trouble in the test set.

58. Voltage Calibration Check

(fig. 21)

Electron Tube Test Set TV–7/U may be checked for proper voltages and for correct calibration of the SHUNT and BIAS control dials as follows: Set the selectors at HS 5–3460 and set the FUNCTION SWITCH to RANGE. Press the LINE ADJ. push button and rotate the LINE ADJ. control until the meter pointer is set at the LINE TEST mark. Use Multimeter TS–352/U with a sensitivity of 1,000 ohms per volt. Make the tests outlined below.

a. Plate Voltage Check (150 volts dc).

(1) Connect the postive (+) terminal of the multimeter to contact No. 3 of the OCTAL test socket and the negative (−) terminal to contact No. 6 of the same socket.

(2) Press red push button No. 3. The voltmeter should read 150 volts dc plus or minus 2 volts.

b. Screen Voltage Check (130 volts dc).

(1) Connect the positive (+) terminal of the voltmeter to contact No. 4 of the OCTAL test socket and the negative (−) terminal to contact No. 6. Set the BIAS control to zero.

(2) Press red button No. 3. The voltmeter should read 130 volts dc plus or minus 2 volts.

c. Bias Voltage Check.

(1) Set the BIAS dial (I 101) of the bias control (R129) at 100.

(2) Connect the positive (+) terminal of the voltmeter to contact No. 6 of the OCTAL test socket and the negative (−) terminal to the No. 5 contact.

(3) The voltmeter should read 40 volts dc plus or minus 1 volt.

d. Signal Voltage Check (.5, 1, and 5 volts ac).

(1) Set the BIAS dial (I 101) of the bias control (R129) at zero.

(2) Connect the terminals of the a-c voltmeter to contacts 5 and 6 of the OCTAL test socket.

(3) With the FUNCTION SWITCH set at B or C, the meter should read 5 volts ac plus or minus .2 volt.

(4) With the FUNCTION SWITCH set at D, the meter should read approximately 1 volt ac.

(5) With the FUNCTION SWITCH set at E, the meter should read approximately .5 volt.

e. Filament Voltage Check (.6 to 117 volts ac.)

(1) Set the FILAMENT VOLTAGE switch to the desired voltage.

(2) Connect the terminals of an a-c voltmeter or a multimeter of suitable range between contacts 2 and 7 of the OCTAL socket.

(3) The meter should read within the limits indicated in the filament voltage table for the various nominal settings of the FILAMENT VOLTAGE switch.

f. Filament Voltage Table.

Filament voltage setting	Minimum	Maximum
.6	.65	.72
1.1	1.06	1.16
1.5	1.28	1.42
2.0	1.9	2.1
2.5	2.58	2.85
3.0	3.25	3.6
4.3	4.3	4.75
5.0	5.15	5.68
6.3	6.2	6.8
7.5	7.32	8.1
10.0	9.8	10.8
12.6	12.3	13.5
20.0	19.0	21.0
25.0	25.3	28.0
35.0	35.2	39.0
50.0	51.5	57.0
75.0	74.0	82.0
117.0	116.0	128.0

g. Bias and Shunt Dial Adjustment. The BIAS dial and the SHUNT dial should indicate zero when they are in full counterclockwise positions. If they do not, loosen the setscrews and reset the dials on the shaft.

59. Suggestions for Locating Trouble

If proper voltages are not present in the test set, the following suggestions are offered to locate and to correct the trouble. If all voltages are found to be either high or low, it is possible that the trouble is in the line test circuit. Check resistor R124 for correct value. An excessively high or low resistance of resistor R124 results in improper adjustment of the line voltage and causes high or low test voltages at the points covered in paragraph 58. A faulty rectifier CR101 causes an erroneous meter reading and subsequent high secondary voltages in transformer T101.

a. Incorrect Plate Voltage.

(1) High plate voltage results from the application of incorrect voltage to the primary of T101.

(2) Probable causes of incorrect voltages in the test set are listed in paragraph 55.

b. Copper Oxide Rectifier. Failure of a meter rectifier of the type used in the TV–7/U seldom occurs in normal use. A defective rectifier will cause a considerable drop in sensitivity, and thereby introduce error in the meter line-test indication.

60. Calibration Procedure

a. If tapped resistor R130 (fig. 26) is replaced, re-establish proper voltage distribution as follows:

(1) Set all controls as outlined in paragraph 58, and turn the equipment on.
(2) Connect the positive (red) lead of the d-c voltmeter to pin 6 and the negative (black) lead to pin 5 of the OCTAL socket XIII.
(3) Set the BIAS control to 100.
(4) Loosen and adjust clamp A (fig. 26) of R130 until the voltmeter reads 40 volts plus or minus 1 percent on the 50-volt range.
(5) Set the BIAS control to zero (0).
(6) Connect the positive voltmeter lead to pin 4 and the negative lead to pin 6 of the OCTAL socket.
(7) Depress and hold the 2—DIODE and the 3—MUT. COND. buttons. Loosen and adjust clamp B (fig. 27) of R130 until the voltmeter reads 56 plus or minus 1.5 percent on the 150-volt scale.
(8) Tighten the clamp screws and recheck the voltages.

b. If dual potentiometer (SHUNT control) R127 (fig. 25) is replaced, proceed with the voltage calibration as follows:

(1) Set the FUNCTION SWITCH at A.
(2) Adjust the line voltage with the LINE ADJUST control knob until the meter pointer indicates LINE TEST (par. 21).
(3) Set the SHUNT control at 73.
(4) Connect a 10K resistor between contacts 3 and 6 of the OCTAL socket.
(5) Depress and hold the 3—MUT. COND. button.
(6) Turn the movable cap that covers the casing of the dual potentiometer until the TV–7/U meter shows zero deflection. One of the two windings of the dual potentiometer is mounted in the cap.
(7) Maintain the position of the cap by soldering it to the casing.
(8) Recheck the voltmeter indication.

c. Calibrate the meter line-adjust circuit as follows:

(1) Follow the procedure outlined in paragraph 58*a* and *b*.
(2) Depress the 1—LINE ADJ. button.

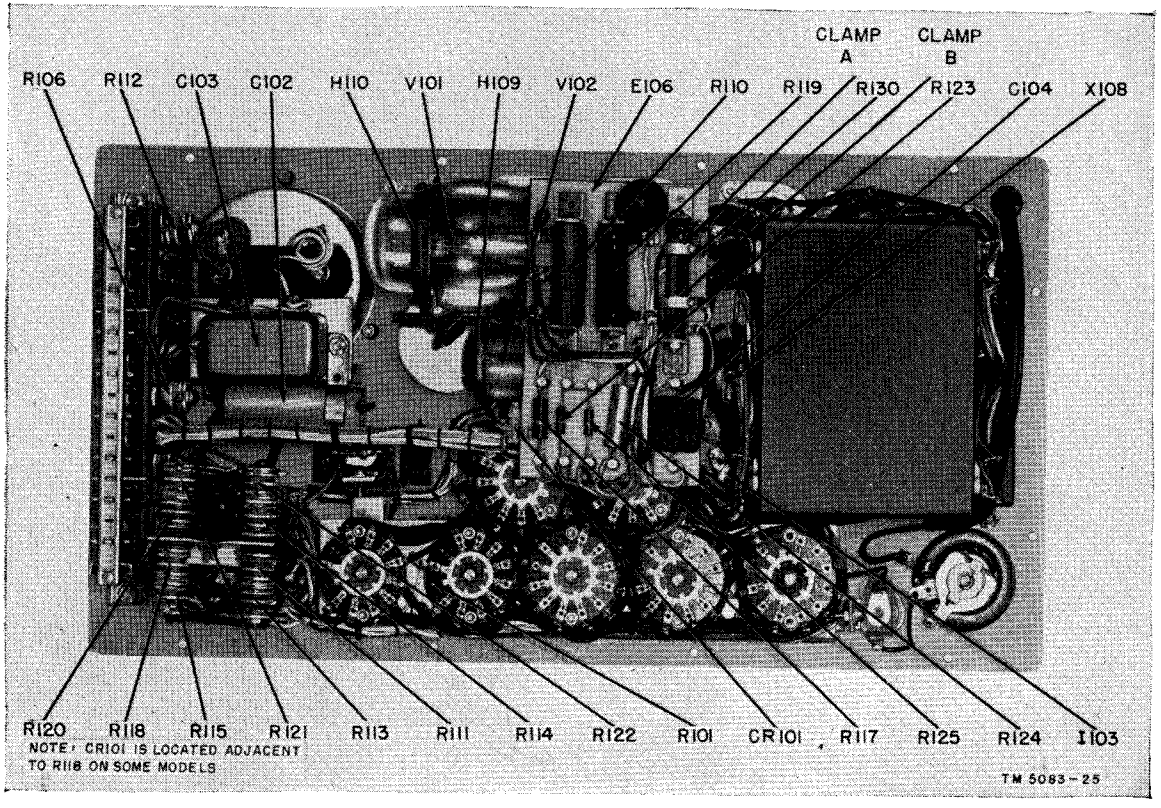


Figure 26. Electron Tube Test Set TV-7/U, direct rear view.

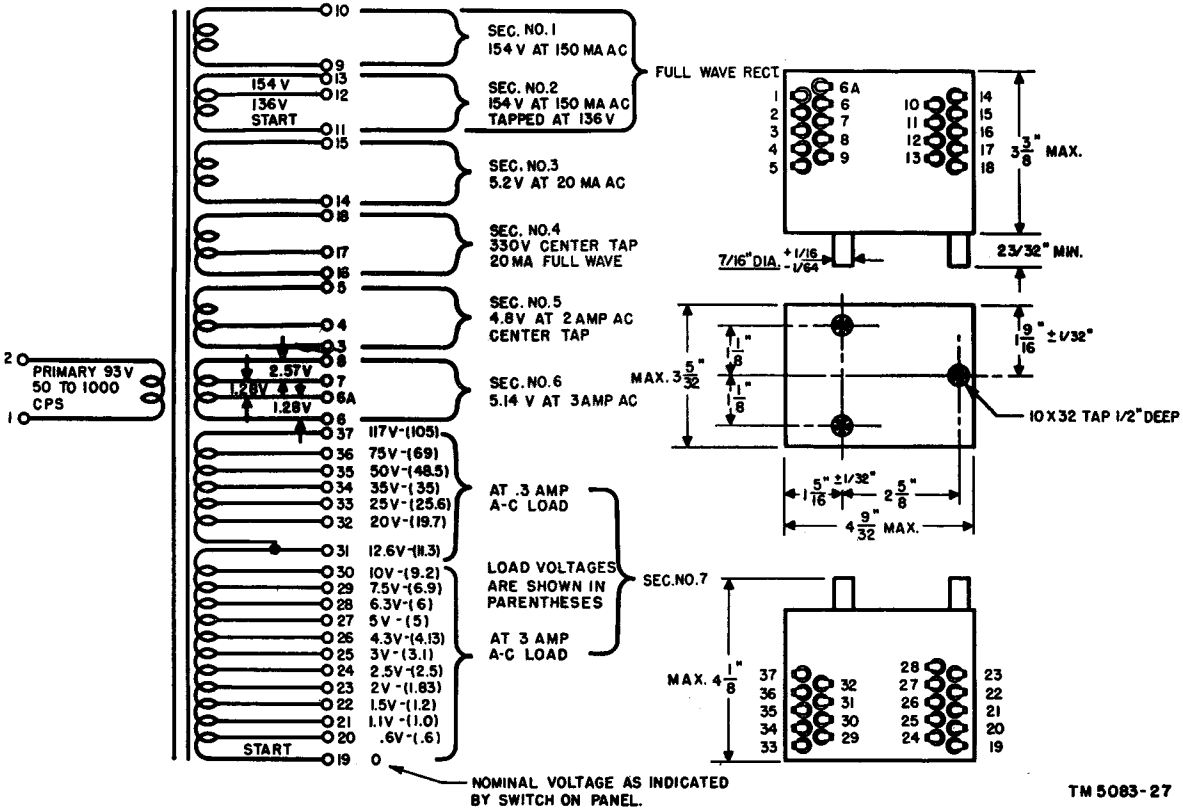


Figure 27. Transformer diagram.

(3) If the TV–7/U meter indicates from 56 to 59, connect a 2- to 15-megohn fixed resistor across resistor R124. Use the resistor value that will return the TV–7/U meter pointer to LINE TEST position.

(4) If the meter indicates approximately 63 or 64, connect a 40K to 50K fixed resistor across the rectifier CR101. Use the resistor value that will return the TV–7/U meter pointer to LINE TEST position.

(5) If the meter indicates more than plus or minus 6 divisions from the LINE TEST position (60), replace rectifier CR101 with a new one.

(6) If rectifier CR101 is replaced, repeat the calibration procedure outlined in (1) through (5) above.

Note. To insure increased accuracy of the calibration procedure, make frequent checks of Multimeter TS–352/U with Meter Test Set TS–682/GSM–1 at the following d-c voltmeter settings: 40, 56, 130, and 150. Note the deflection of the pointer of Multimeter TS–352/U for these settings. Be sure to use the voltmeter calibration charts for increased accuracy. Meter Test Set TS–682/GSM–1 is part of Meter Test Equipment AN/GMS–1B and is covered in TM 11–2535A.

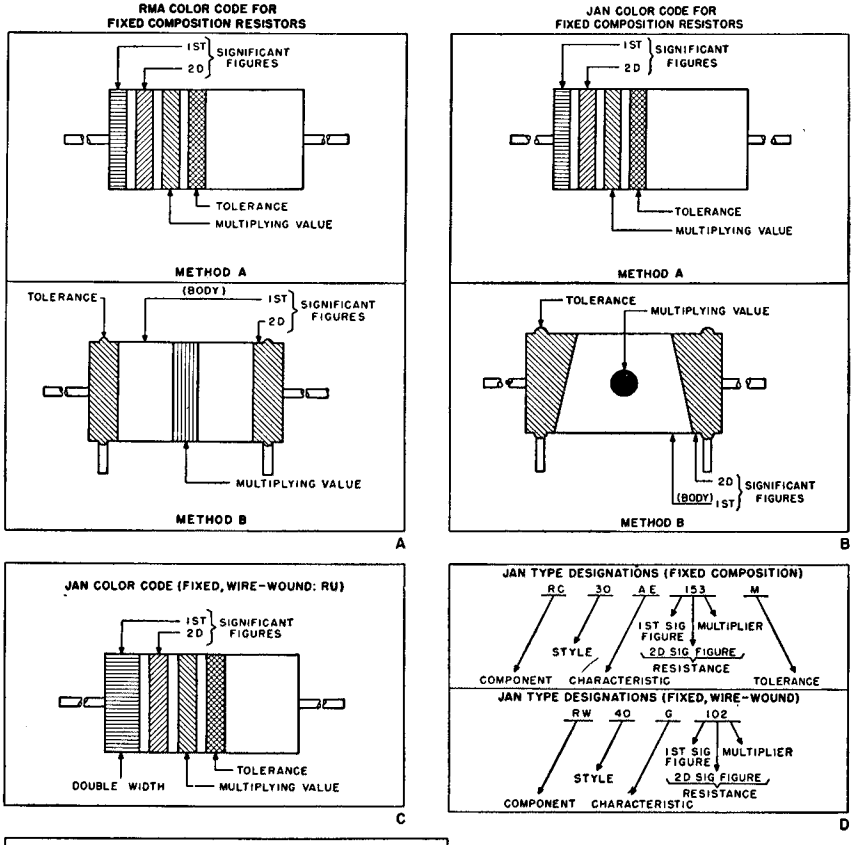
61. Final Testing

a. Check the line voltage adjustment (par. 21).

b. Make voltage calibration checks (par. 58).

c. If a second TV–7/U is available, make a comparison check. Test several known good tubes in the tube tester under repair; then test the same tubes in the second tube tester. Compare the results. If the pointers of both equipment meters indicate the same or nearly the same, the repaired tube tester may be returned to service.

RESISTOR COLOR AND LETTER CODE



STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	—	—
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	—
YELLOW	4	10,000	± 4	—
GREEN	5	100,000	± 5	—
BLUE	6	1,000,000	± 6	—
VIOLET	7	10,000,000	± 7	—
GRAY	8	100,000,000	± 8	—
WHITE	9	1,000,000,000	± 9	—
GOLD	—	0.1	± 5	J
SILVER	—	0.01	± 10	K
NO COLOR	—	—	± 20	M

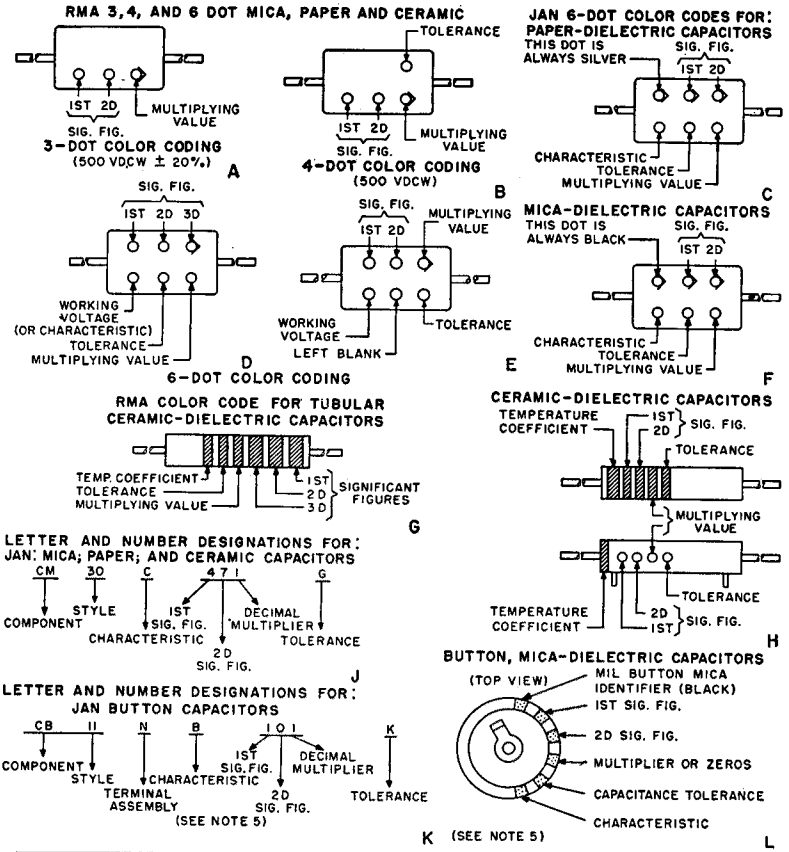
NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY-NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

TM RC

Figure 29. Resistor color codes.

CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CN		JAN CERAMIC-CC					
									CAP. TOL. FOR MORE THAN 10 UUF			CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	.A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-

*. THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%

NOTES

JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON: *CC* CERAMIC: *CM* MICA MOULDED: *CN* PAPER MOULDED

TM CC

Figure 30. Capacitor color codes.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

62. Removal from Service

a. Disconnect the test set from the power supply.

b. Place the adapters under the clamps provided. Wind the power cord around the brackets set in the cover. Slip the test leads under the coiled line cord which will hold them in place.

c. Fasten the cover tightly in place.

63. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 8 and figure 4, and follow the instructions in reverse order.

b. Whenever possible, place a dehydrating agent such as silica gel inside the equipment. Protect the equipment with a waterproof paper barrier, seal the seams of the paper barrier with a waterproof sealing compound or tape. Pack the protected equipment in a padded fiberboard box.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

64. General

The demolition procedures outlined in paragraphs 65 and 66 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

65. Methods of Destruction

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Use axes, handaxes, and machetes.

c. Burn. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. Explode. Use firearms, grenades, and TNT.

e. Other. Use anything immediately available for destruction of this equipment.

f. Disposal. Bury in slit trenches, fox holes and other holes. Throw in streams. Scatter.

66. Destruction of Components

a. Smash meter, tubes, resistors, switches, and capacitors.

b. Cut cords and wiring.

c. Burn cords, resistors, capacitors, coils, wiring, office records, and technical manuals.

d. Bend the case, cover and panel.

e. Bury or *scatter* the destroyed parts.

f. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, see SR 310–20–3, SR 310–20–4, SR 310–20–5, and Department of the Army Supply Manual SIG 1, for Signal Corps Supply Manuals.

1. Army Regulations

AR 380–5	Safeguarding Security Information.
AR 750–5	Maintenance Responsibilities and Shop Operation.

2. Supply Publications

SB 11–6	Dry Battery Supply Data.
SR 725–405–5	Preparation and Submission of Requisitions for Signal Corps Supplies.

3. Auxiliary Equipment and Test Equipment

TM 11–300	Frequency Meter Sets SCR–211–A, B, C, D, E, F, J, K, L, M, N, O, P, Q, R, T, AA, AC, AE, AF, AG, AH, AJ, AK, AL, and AN
TM 11–2627	Tube Tester I–177 and I–177–A.
TM 11–4700	Electrical Indicating and Measuring Instruments Repair Instructions.
TM 11–5527	Multimeter TS–352/U.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.
TM 9–2851	Painting Instructions for Field Use.

5. Camouflage, Decontamination, and Demolition

FM 5–20	Camouflage, Basic Principles.
FM 5–25	Explosives and Demolitions.
TM 3–220	Decontamination.

6. Other Publications

FM 24–18	Field Radio Techniques.
FM 72–20	Jungle Warfare.
SR 310–20–3	Index of Training Publications.
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SR 310–20–5	Index of Administrative Publications.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247 (R1)).
SR 745–45–5 Navy Shipping Guide Article 1850–4 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), S and A–70–6 (Navy), and AF–MC–U2 (Air Force)).
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TB SIG 223	Field Expedients for Wire and Radio.
TM 11–430	Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11–455	Radio Fundamentals.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11–681	Electrical Fundamentals (Alternating Current).
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.
TM 11–5500	Multimeter TS–297/U.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The following is an identification table of parts for Electron Tube Test Set TV–7/U (Sig C stock No. 3F3952–3). The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O & E, T/A, SIG 7–8–10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Manual applicable to the equipment covered in this technical manual is SIG 7–AV–7/U. For an index of available supply manuals in the Signal portion of the Department of the Army Supply Manual, see SIG 1.

Identification Table of Parts

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E104	ADAPTER, tube socket	To provide means of testing subminiature tubes in octal sockets.	2Z307–161
E105	ADAPTER, tube socket: phenolic body; 7/8" lg, 2" dia, over-all length including cont 1 7/16".	Provides means of testing special base tubes in standard test socket.	2Z307–153
H101, H102, H103, H104, H105, H106, H107.	BUTTON, push: phenolic, black; 15/32" length x 7/16" dia push-on type to fit .052" x 3/16" flat shaft, with spring.	H101: Operating button for S110 section 1 H102: Operating button for S110 section 2 H103: Operating button for S110 section 4 H104: Operating button for S110 section 5 H105: Operating button for S110 section 6 H106: Operating button for S110 section 7 H107: Operating button for S110 section 8	2Z1480.18
H108	BUTTON, push: phenolic, red; 15/32" long x 7/16" dia push-on type to fit .052" x 3/16" flat shaft with spring.	Operating button for S110 section 3	2Z1480.48
W104	CABLE, power: electrical, 7 ft lg excluding terminations.	Line cord part of W103	1B3018–2.28
C103	CAPACITOR, fixed: electrolytic; 100 μf; 15 vdcw.	Filter capacitor across meter	3DB100–45
C101	CAPACITOR, fixed: mica dielectric; 470 μμf ±10%; 500 vdcw.	Isolating capacitor noise test; prevents shorting when making noise test.	3K2047121
C104	CAPACITOR, fixed: mica dielectric; 2700 μμf ±10%; 500 vdcw.	Neutralizing capacitor, prevents oscillation in tube under test.	3K3027221
C102	CAPACITOR, fixed: paper dielectric; 100,000 μμf ±10%; 600 vdcw.	Isolating capacitor short test; blocks flow of direct current.	3DA100–730
H109	CLAMP, electron tube: 2 1/32" lg x 1 7/16" wd, 23/32" h.	Locks 5Y3GT rectifier in socket	2Z1619–79

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H110	CLAMP, electron tube: 2 9/16" lg x 2 1/8" w x 3/4" h.	Locks type 83 rectifier in socket	2Z7780–109
O110	CLIP, electrical	Termination for grid and plate connector leads W101 and W102.	3Z1089
	CLIP, insulator	Test clip cover for grid and plate leads W101 and W102.	3Z1722–1
P101	CONNECTOR, Plug U–120/U	Termination of line cord part of W103	2Z7250–120
	CONNECTOR, plug	Termination for grid and plate connector leads W101 and W102.	2Z7111–23
J102, J103, J104	CONNECTOR, receptacle	J102: Panel connection for grid test lead J103, J104: Panel connections for NOISE test.	2Z5573.9
J101	CONNECTOR, receptacle	Panel connection for plate test lead	2Z3062–16
I 101, I 102	DIAL CONTROL: knob type, 1" h, 1 13/16" overall.	I 101: Adjustment dial of bias voltage control I 102: Adjustment dial for shunt control.	2Z3723–427
V101	ELECTRON TUBE: duo diode; type 83	Rectifier plate voltage supply	2J83
V102	ELECTRON TUBE: duo diode, type 5Y3GT/G.	Rectifier screen voltage and bias supply	2J5Y3GT
O101 through O110	KNOB: phenolic; black; round, 1/4" dia, 17/32" d shaft hole.	O101: Control knob for FUNCTION SWITCH. O102: Control knob for left FILAMENT selector switch. O103: Control knob for right FILAMENT selector switch. O104: Control knob for GRID selector switch O105: Control knob for PLATE selector switch. O106: Control knob for SCREEN selector switch.	2Z5822–13.1

		O107: Control knob for CATHODE selector switch. O108: Control knob for SUPPRESSOR selector switch. O109: Control knob for FUNCTION selector switch. O110: Control knob for RANGE selector switch.	
O112	KNOB: plastic; black; round, ¼″ dia, 7/16″ d shaft hole.	Control knob for FILAMENT VOLTAGE switch.	2Z5822–370
O111	KNOB: phenolic; black; round, ¼″ dia, 7/16″ d shaft hole.	Control knob for LINE ADJUST rheostat	2Z5822–94
E101	LAMP, glow: 105 to 125 v; candelabra screw base, clear.	Short test indicator	2Z5889–13
E102	LAMP, incandescent: 6 to 8 v, 6 cp, 1.14 amp; single cont candelabra bayonet base.	Fuse and overload indicator in primary circuit of transformer T101.	6Z6806.14
E103	LAMP, incadescent: 6 to 8 v; .15 amp; miniature bayonet base, single cont.	Pilot lamp	2Z5952
J105	LAMPHOLDER: 125 v, 75 w; 1¾″ lg x 1″ wd x 5/8″ h.	Socket for neon short indicator lamp E101	2Z5956.16
J106	LAMPHOLDER: 115 v, 10 w; 2″ lg x 11/16″ wd x 5/8″ h.	Socket for fuse lamp E103	6Z8332
W101, W102	LEAD, test	W101: Connects top caps of tubes to plate jack. W102: Connects top caps of tubes to grid jack.	
I103	LIGHT, indicator: ½″ dia, red, frosted jewel; miniature bayonet base socket.	On-off indicator and socket for E102	2Z5991–3
M101	METER, electron tube tester	Indicates condition of tube under test	3F3299–9.6
CR101	RECTIFIER, metallic: copper oxide; input data, 4.5 v ac, single ph; output data, 3 v dc, 5 ma max.	Meter rectifier to permit checking of line voltage.	3H4956–77

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R130	RESISTOR, adjustable: wire wound; 8500 ohms ±10%; 10 w 2 sliding contacts.	Part of ohmmeter voltage divider	3Z6585–10
R101	RESISTOR, fixed: composition; 1 megohm ±10%; ½ w.	Grid resistor for converter tubes	3RC20BF105K
R102, R103, R104	RESISTOR, fixed: compositions; 47 ohms ±10%; ½ w.	Neutralizing resistor, oscillation suppressor	3RC20BF470K
R107	RESISTOR, fixed: composition; 47,000 ohms ±5%; ½ w.	Limiting resistor short test	3RC20BF473J
R108	RESISTOR, fixed: composition; 27,000 ohms ±5%; ½ w.	Limiting resistor short test	3RC20BF273J
R109	RESISTOR, fixed: composition; 330,000 ohms ±10%; ½ w.	Shunt for neon lamp	3RC20BF334K
R116	RESISTOR, fixed: composition; 15,000 ohms ±5%; 1 w.	Limiting resistor tube test, plate circuit	3RC30BF153J
R117	RESISTOR, fixed: composition; 1200 ohms ±10%; 1 w.	Limiting resistor diode test circuit	3RC30BF122K
R124	RESISTOR, fixed: composition; 245,000 ohms ±1%; 1 w.	Voltage dropping resistor for line test circuit	3Z67245K–1
R128	RESISTOR, fixed: composition; 180,000 ohms ±10%; ½ w.	Series grid resistor gas test circuit	3RC20BF184K
R106	RESISTOR, fixed: wire wound; 150 ohms ±1%; ½ w.	Load resistor rectifier test	3Z6015–131
R110	RESISTOR, fixed: wire wound; 100 ohms ±5%; 10 w.	Provides center tap from filament type tubes. Prevents injection of filament voltage into grid signal voltage.	3RW18326
R111, R118	RESISTOR, fixed: wire wound; 109 ohms ±1%; ½ w.	Part of shunt network for control of meter sensitivity.	3Z6010J9
R112	RESISTOR, fixed: wire wound; 27 ohms ±1%; ½ w.	Meter shunt rectifier circuit	3Z6002G7–14

R113, R115	RESISTOR, fixed: wire wound; 41 ohms ±1%; ½ w.	Part of shunt network for control of meter sensitivity.	3Z6004A1–3
R114	RESISTOR, fixed: wire wound; 280 ohms ±1%; ½ w.	Meter shunt for range C	3Z6028–12
R119	RESISTOR, fixed: wire wound; 1800 ohms ±5%; 10 w.	Limiting resistor OZ4 test circuit	3RW25819
R120	RESISTOR, fixed: wire wound; 800 ohms ±1%; ½ w.	Part of voltage divider for signal volts	3Z6080–72
R121	RESISTOR, fixed: wire wound; 111 ohms ±1%; ½ w.	Part of voltage divider for signal volts	3Z6011A1–5
R122	RESISTOR, fixed: wire wound; 89 ohms ±1%; ½ w.	Part of voltage divider for signal volts	3Z6008J9.2
R126	RESISTOR, variable: 200 ohms ±10%; 25 w.	Line adjust rheostat	3RP6007
R127, R127A, R127B	RESISTOR, variable: 2 sections, 150 ohms each section ±5%; 4 w.	R127: Shunt potentiometer controls meter sensitivity for rectifier and diode tests. R127A and R127B: Parts of R127.	3Z7150–9
R129	RESISTOR, variable: 3000 ohms ±10%; 1 w.	Bias potentiometer, controls bias voltage	3Z7330–23
R123, R125	RESISTOR, fixed: composition; 1000 ohms ±5%; ½ w.	Part of voltage divider	3RC20BF102J
X101	SOCKET, electron tube: standard 4 pin	Socket for type 83 rectifier tube, V101	2Z8674.159
X103	SOCKET, electron tube	Test socket for 4 pin tubes	2Z8757.3
X102	SOCKET, electron tube: 8 contacts	Socket for type 5Y3GT rectifier tube, V102	2Z8670.33
X104	SOCKET, electron tube: 5 contacts	Test socket for 5 pin tubes	2Z8711
X105	SOCKET, electron tube: 6 contacts	Test socket for 6 pin tubes	2Z8676.36
X106	SOCKET, electron tube: 7 contacts	Test socket for large and small radius 7 pin tubes and miniature base pilot lamps.	2Z8677.228
X108	SOCKET, electron tube: 7 contacts	Test socket for acorn tubes	2Z8677.139
X109	SOCKET, electron tube: 7 contacts	Test socket for subminiature tubes with inline contacts for leads.	2Z8677.174

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
X110	SOCKET, electron tube: 8 contacts	Test socket for subminiature tubes with round base.	2Z8678.331
X111	SOCKET, electron tube: 8 contacts	Test socket for octal tubes	2Z8678.337
X112	SOCKET, electron tube: 8 contacts	Test socket for loktal tubes	2Z8678.294
X113	SOCKET, electron tube: 9 contacts	Test socket for noval tubes	2Z8679.25
X107	SOCKET, electron tube: 7 contacts; miniature 7 pin.	Test socket for miniature tubes	2Z8677.229
S110	SWITCH, push: 8 sections, 18 pole 46 cont, 14 throws; 6 7/32" lg x 1 5/16" wd x 1 57/64 h.	Selects proper test voltage for various tube types.	3Z9824–6
S101, S102	SWITCH, rotary: 1 pole, 10 throws; 3/4" lg x 1 1/2" wide x 1 5/16" h.	S101: Connects suppressor voltage to selected socket contacts. S102: Connects cathode voltage to selected socket contact.	3Z9825–62.717
S103 through S107	SWITCH, rotary: 10 poles, 10 throws; 2 1/8" lg x 1 1/4" wide x 1 5/16" h.	S103: Connects screen voltage to selected socket contact. S104: Connects plate voltage to selected socket contact. S105: Connects grid voltage to selected socket contact. S106, S107: Connects one side of filament voltage to selected socket contact.	3Z9825–62.712
S108	SWITCH, rotary: 2 poles, 20 throws; 1 3/16" lg x 1 15/16" wide x 2 5/16" high.	Selects proper filament voltage for tube under test.	3Z9825–62.716
S109	SWITCH, rotary: 19 poles, 10 throws; 3" lg x 1 5/8" wide x 1 7/8" high.	Short test and micromho switch	3Z9825–62.713
S111	SWITCH, toggle: 6 amp, 125 volt; 1 9/32" lg x 23/32" wide x 23/32" deep.	Power ON-OFF switch	3Z9863–17A
E106	TERMINAL BOARD	Insulated mounting for various resistors and capacitors.	3Z770–10.107
T101	TRANSFORMER, power: step-up and step-down.	Supplies a-c voltages to filament and rectifier circuits.	2Z9621B–23

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[AG 413.6 (16 Sep 53)]

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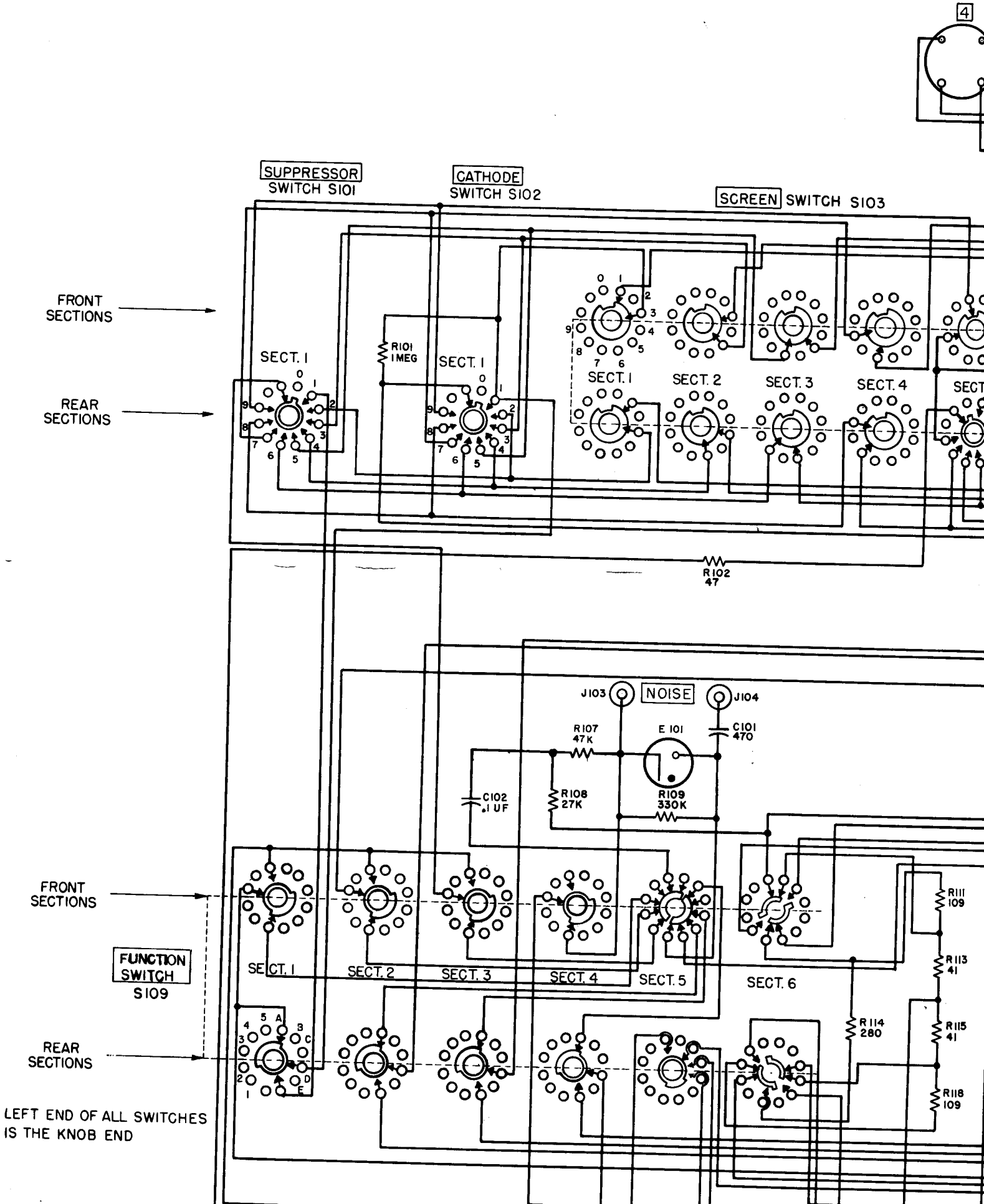
Tech Svc (1); Tech Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (2); Log Comd (5); A (5) CHQ (2); FT (2); Sch (5) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); POE (2), OSD (2); Lab 11 (5); Mil Dist (3); Field Maint Shops 11 (3); Two (2) copies to each of the following T/O & E's: 11–107; 11–127A; 11–128; 11–500A, CA, CB, CC, CD; 11–587; 11–592; 11–597.

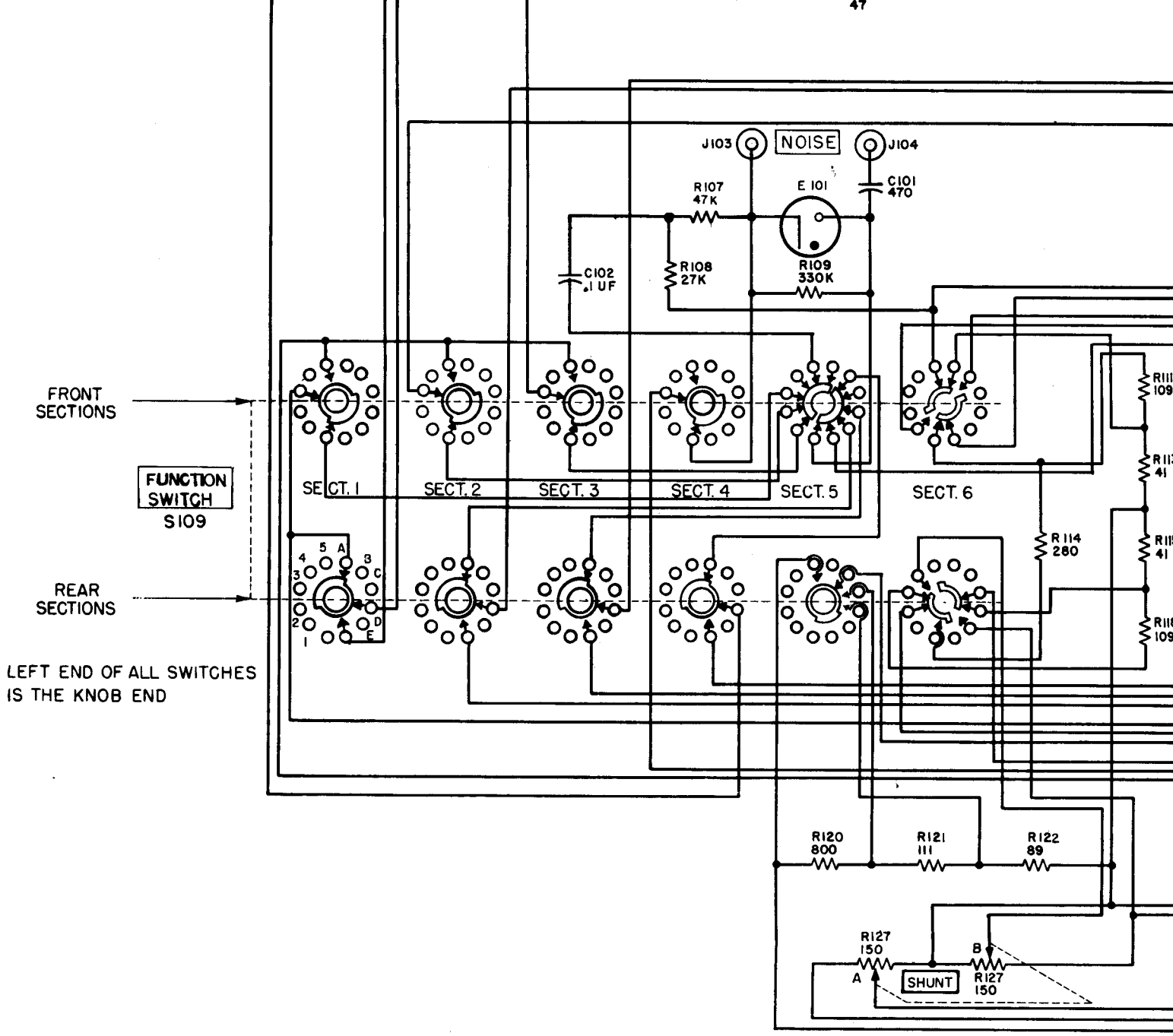
NG: Same as Active Army except one copy to each unit.

Army Reserve: Same as Active Army except one copy to each unit.

For explanation of distribution formula, see SR 310–90–1.

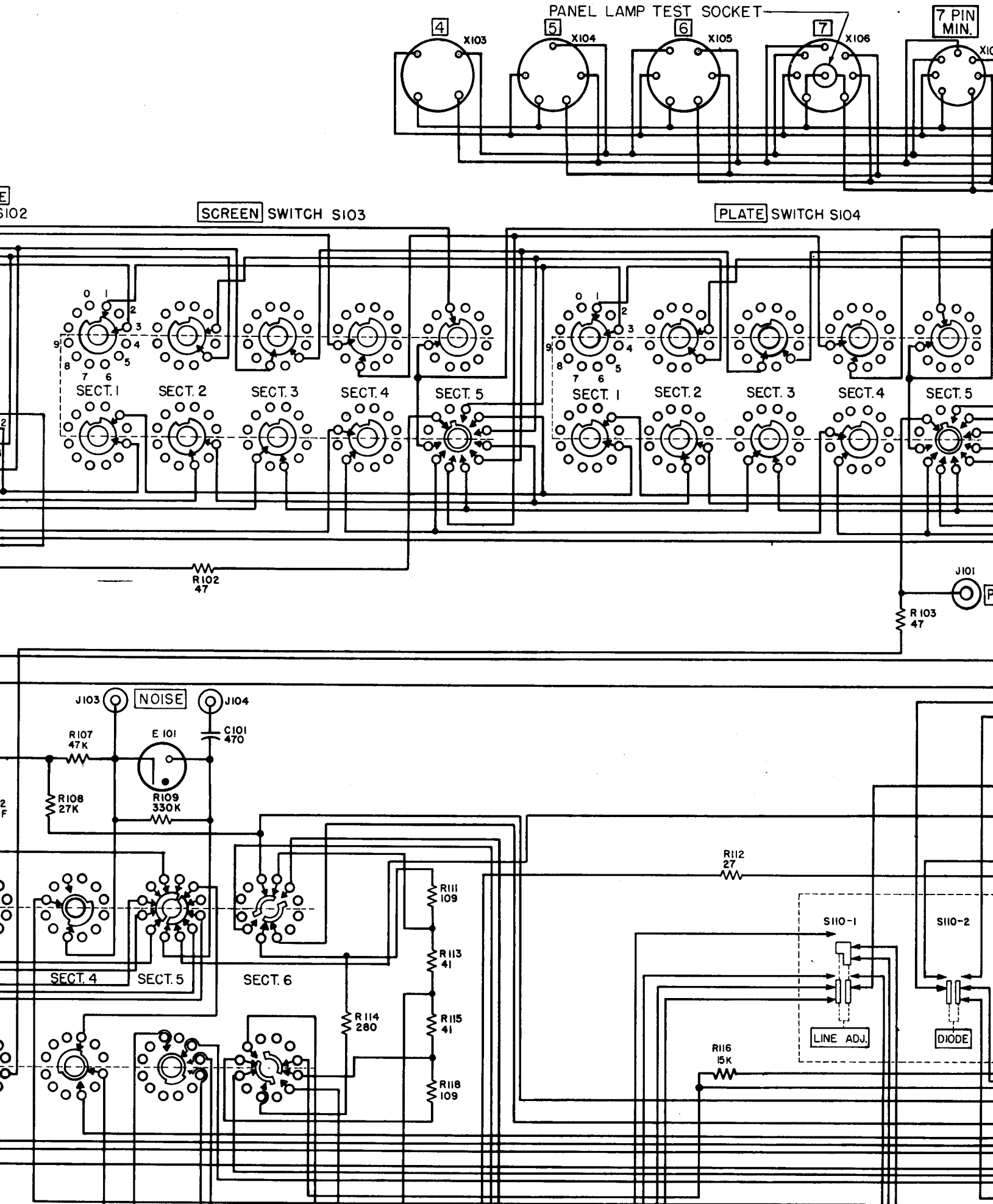
U. S. GOVERNMENT PRINTING OFFICE: 1953

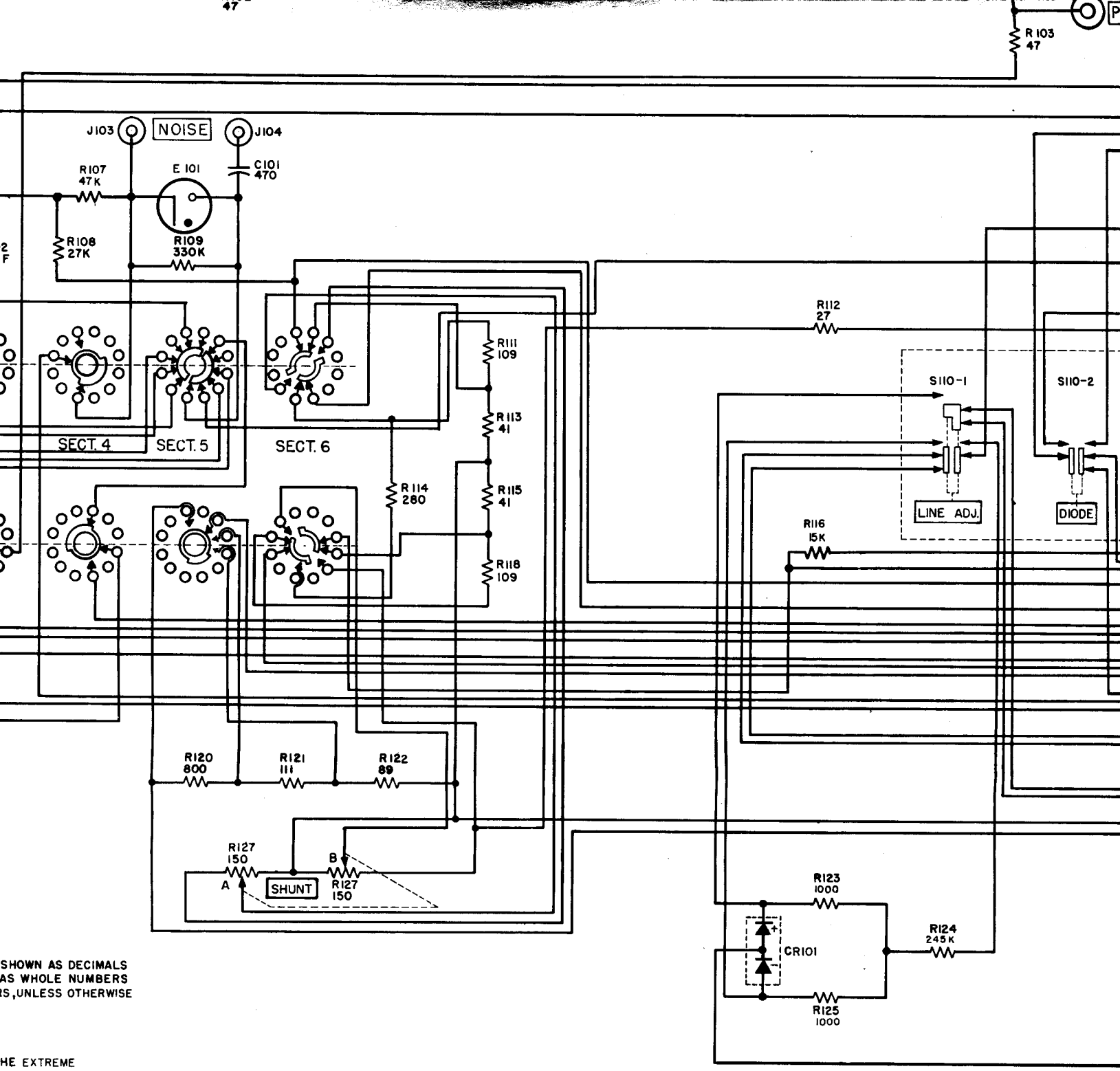

4
SUPPRESSOR
SWITCH S101
CATHODE
SWITCH S102
SCREEN SWITCH S103
FRONT
SECTIONS
REAR
SECTIONS
SECT. 1
R101
1 MEG
SECT. 1
SECT. 1
SECT. 2
SECT. 3
SECT. 4
R102
47
J103
NOISE
J104
R107
47K
E 101
C101
470
C102
.1 UF
R108
27K
R109
330K
FRONT
SECTIONS
FUNCTION
SWITCH
S109
REAR
SECTIONS
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
SECT. 6
R111
109
R113
41
R114
280
R115
41
R118
109
LEFT END OF ALL SWITCHES
IS THE KNOB END



NOTES:

1. UNLESS OTHERWISE INDICATED ALL CAPACITIES SHOWN AS DECIMALS ARE IN MICROFARADS (U F) AND THOSE SHOWN AS WHOLE NUMBERS ARE IN MICRO-MICROFARADS (U U F). RESISTORS, UNLESS OTHERWISE INDICATED, ARE IN OHMS.
2. ALL SOCKETS VIEWED FROM BOTTOM.
3. ALL ROTARY SWITCH SECTIONS ARE SHOWN IN THE EXTREME COUNTER CLOCKWISE POSITION VIEWED FROM THE FRONT OR KNOB END OF SWITCH. FRONT SECTION IS CLOSEST TO KNOB END.

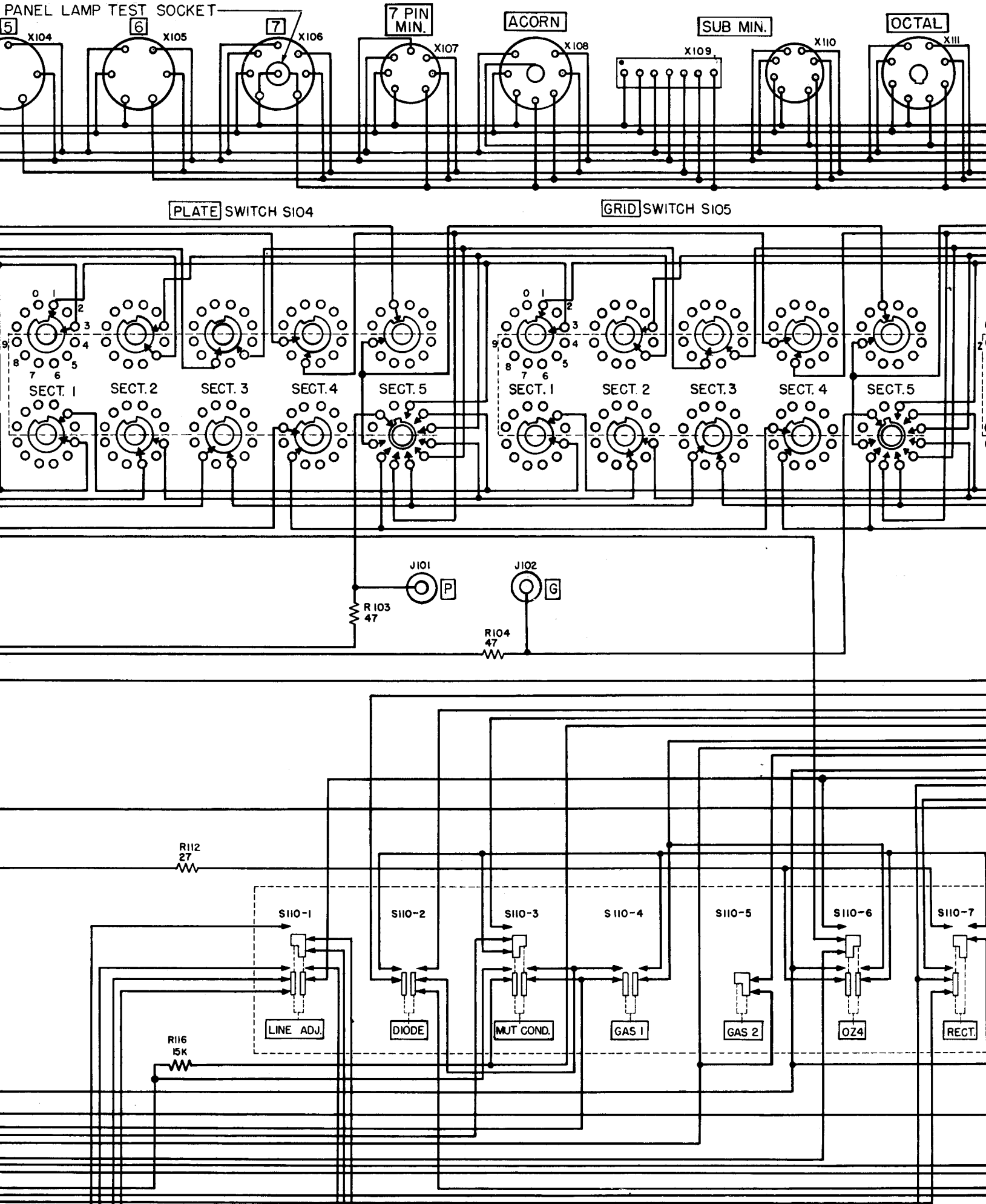

PANEL LAMP TEST SOCKET
4
X103
5
X104
6
X105
7
X106
7 PIN MIN.
SCREEN SWITCH S103
PLATE SWITCH S104
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
R102 47
J101
R103 47
J103
NOISE
J104
R107 47K
E 101
C101 470
R108 27K
R109 330K
R111 109
R112 27
R113 41
R114 280
R115 41
R116 15K
R118 109
SECT. 4
SECT. 5
SECT. 6
S110-1
S110-2
LINE ADJ.
DIODE



SHOWN AS DECIMALS
AS WHOLE NUMBERS
RS, UNLESS OTHERWISE

HE EXTREME
HE FRONT OR KNOB
NOB END.

Figure 28.—Elec


PANEL LAMP TEST SOCKET
5
X104
6
X105
7
X106
7 PIN MIN.
X107
ACORN
X108
X109
SUB MIN.
X110
OCTAL
X111
PLATE SWITCH S104
GRID SWITCH S105
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
J101
P
J102
G
R 103
47
R104
47
R112
27
S110-1
S110-2
S110-3
S110-4
S110-5
S110-6
S110-7
LINE ADJ.
DIODE
MUT COND.
GAS 1
GAS 2
OZ4
RECT.
R116
15K

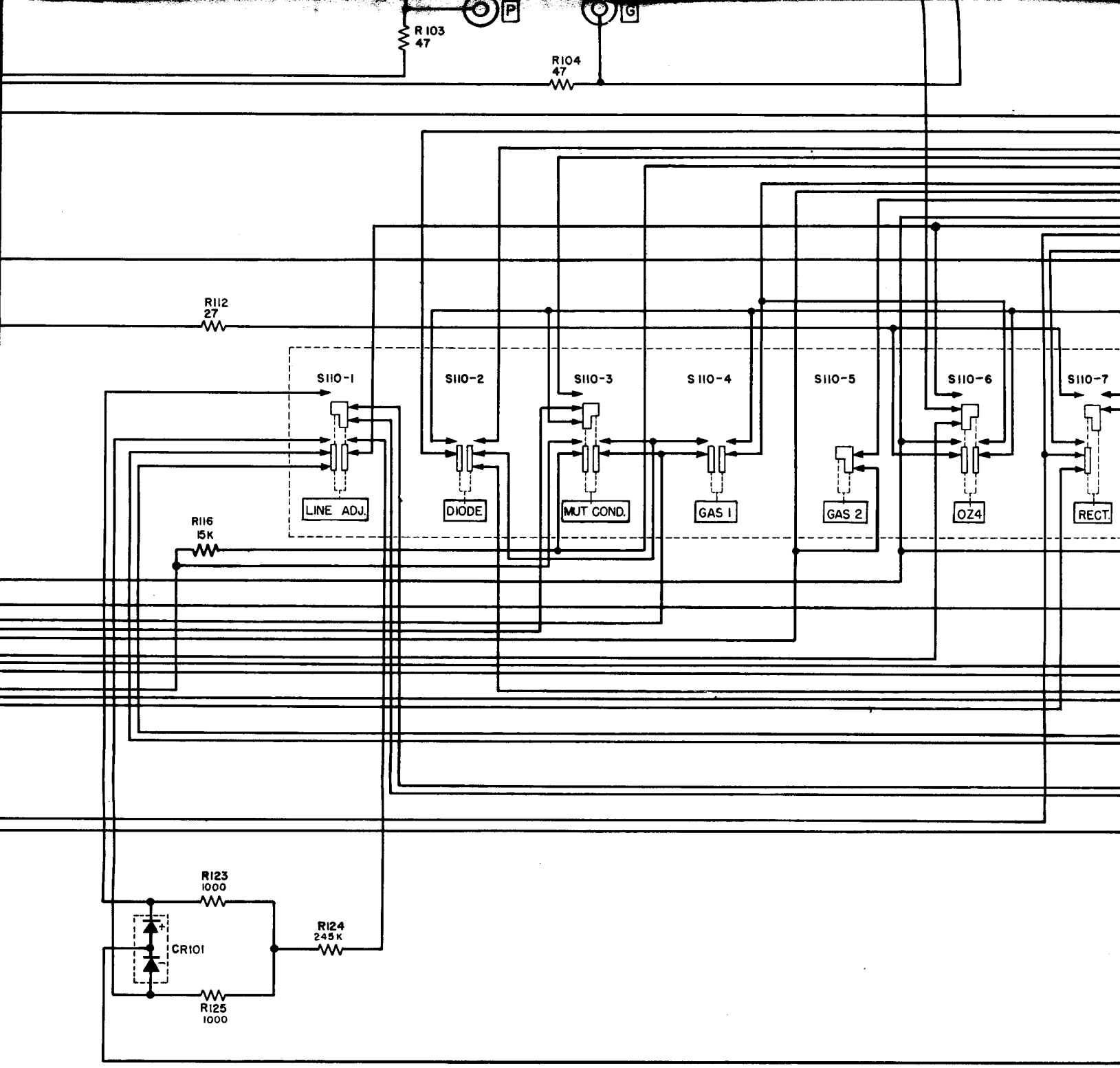
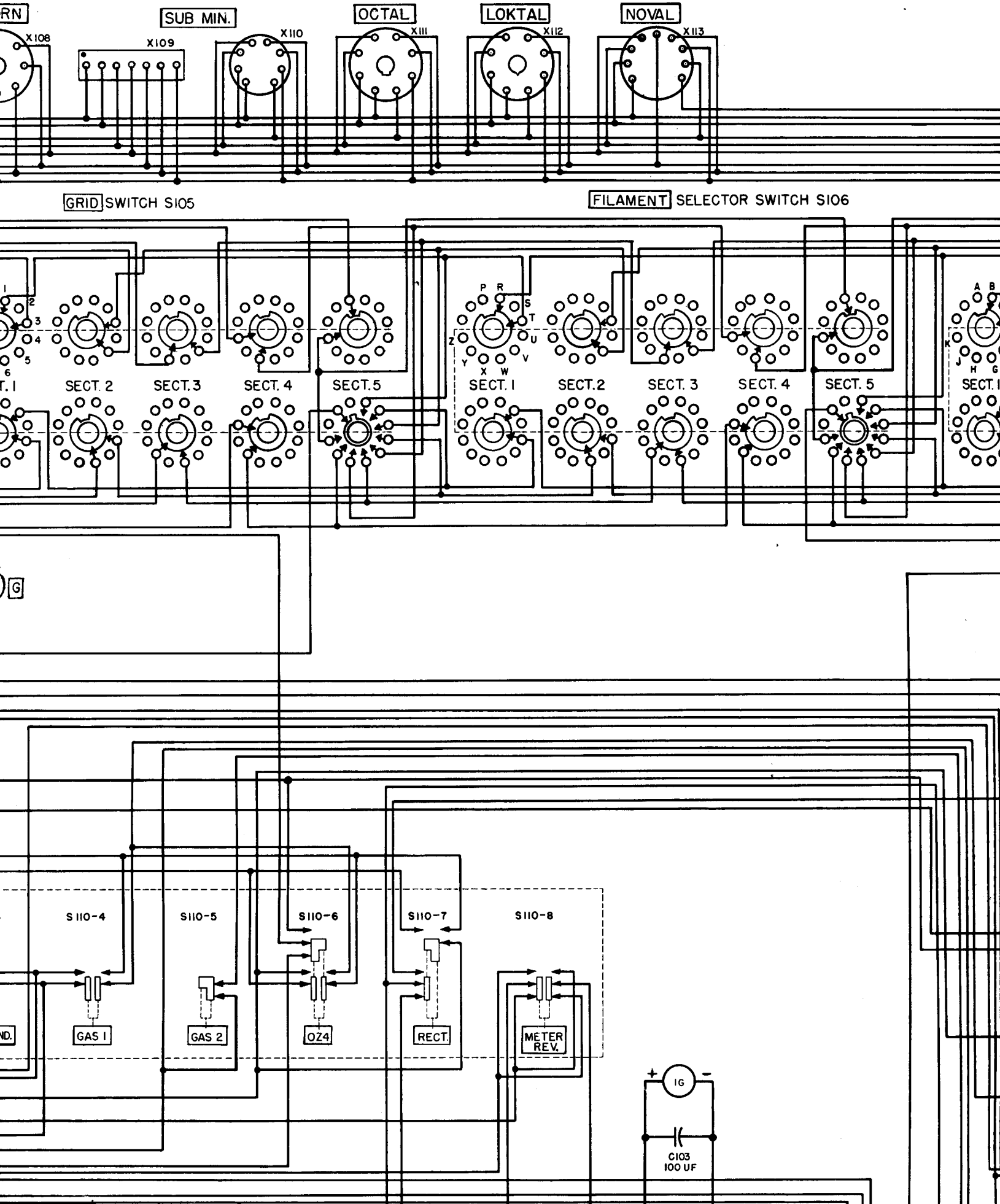
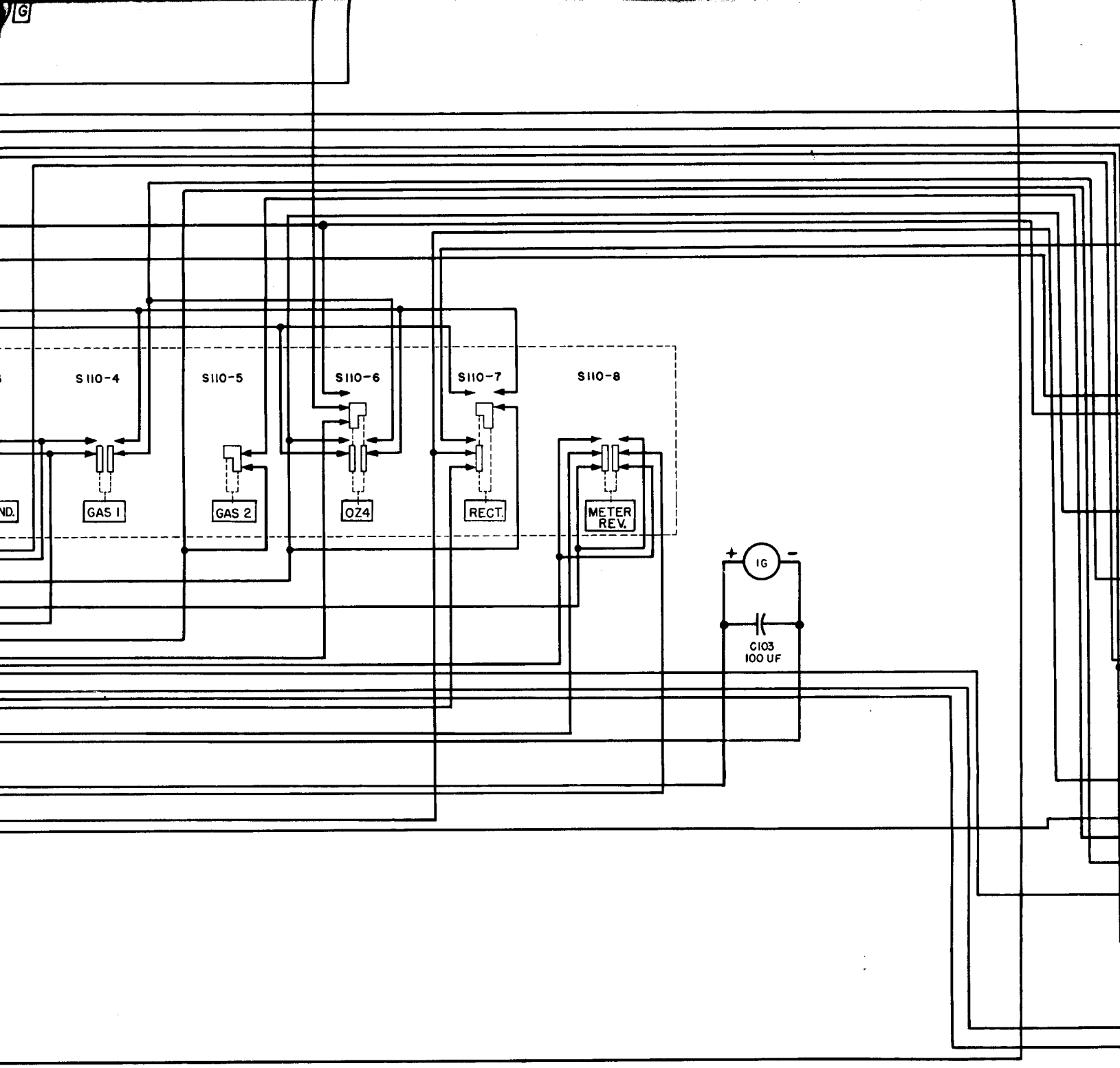
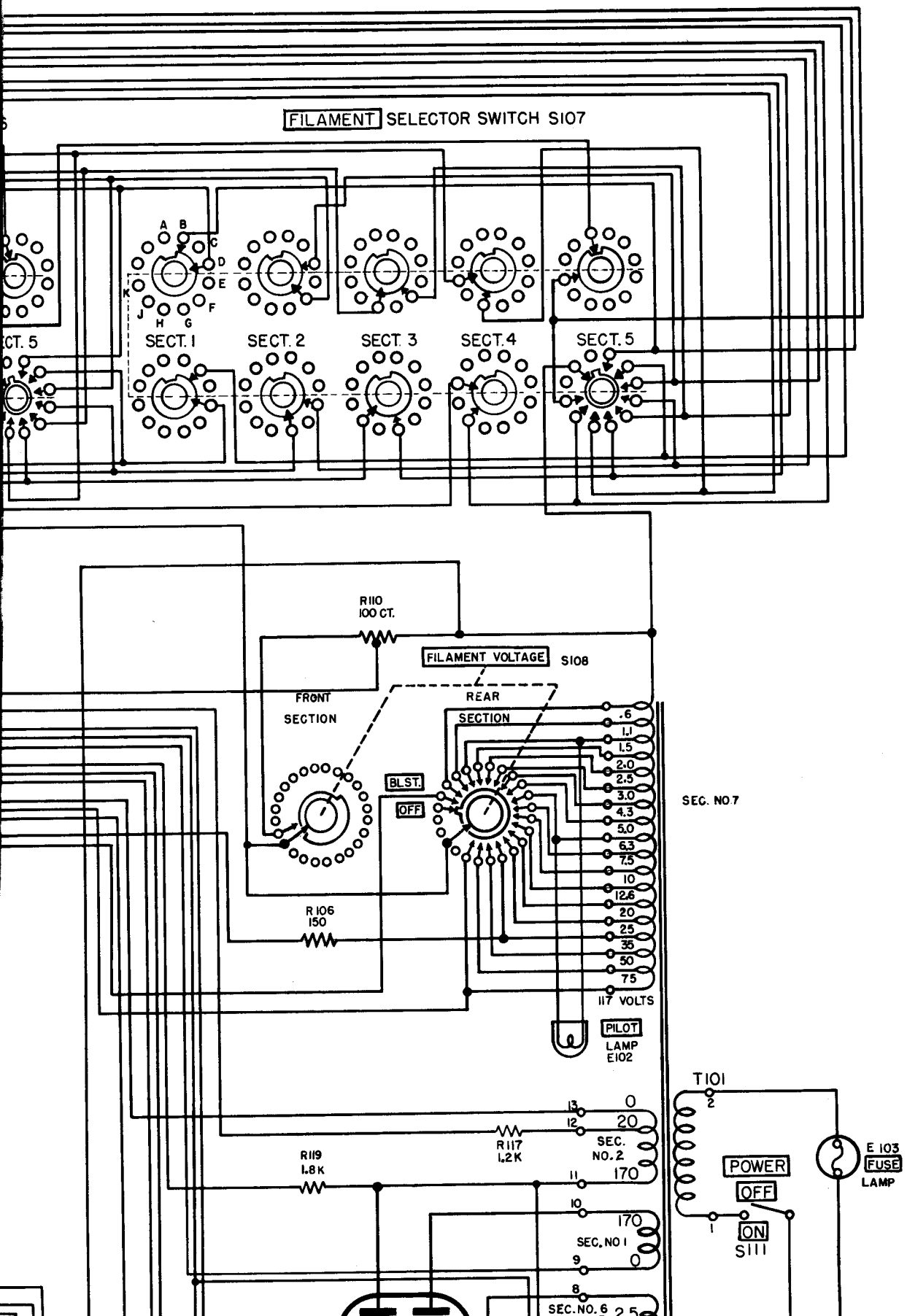


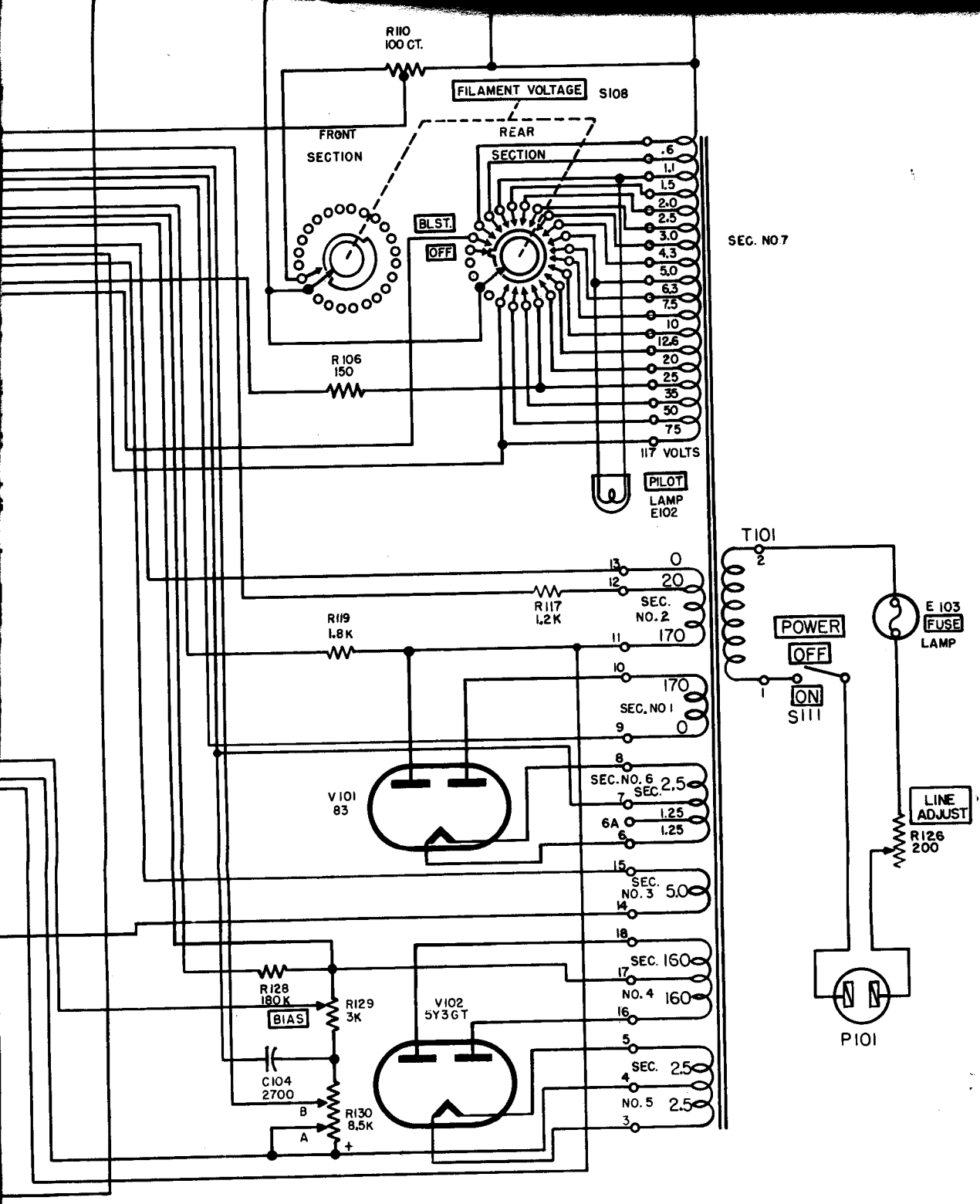
Figure 28.—Electron Tube Test Set TV-7/U, schematic diagram.


RN
X108
SUB MIN.
X109
X110
OCTAL
X111
LOKTAL
X112
NOVAL
X113
GRID SWITCH S105
FILAMENT SELECTOR SWITCH S106
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
SECT. 1
G
S110-4
S110-5
S110-6
S110-7
S110-8
GAS 1
GAS 2
OZ4
RECT.
METER REV.
IG
C103
100 UF



t Set TV-7/U, schematic diagram.


FILAMENT SELECTOR SWITCH S107
A B C D E F G H J K
SECT. 1
SECT. 2
SECT. 3
SECT. 4
SECT. 5
R110
100 CT.
FILAMENT VOLTAGE S108
FRONT SECTION
REAR SECTION
BLST.
OFF
.6
1.1
1.5
2.0
2.5
3.0
4.3
5.0
6.3
7.5
10
12.6
20
25
35
50
75
117 VOLTS
SEC. NO.7
R106
150
PILOT LAMP E102
T101
R117
1.2K
R119
1.8K
SEC. NO.2
0
20
170
SEC. NO.1
170
0
SEC. NO.6
2.5
POWER OFF
ON
S111
E103 FUSE LAMP


R110
100 CT.
FILAMENT VOLTAGE
S108
FRONT
SECTION
REAR
SECTION
BLST.
OFF
.6
1.1
1.5
2.0
2.5
3.0
4.3
5.0
6.3
7.5
10
12.6
20
25
35
50
75
117 VOLTS
SEC. NO 7
R106
150
PILOT
LAMP
E102
T101
2
0
13
20
12
SEC.
NO. 2
170
11
R117
1.2K
R119
1.8K
170
10
SEC. NO 1
0
9
8
SEC. NO. 6
2.5
7
SEC.
1.25
6A
1.25
6
V101
83
15
SEC.
NO. 3
5.0
14
18
SEC. 160
17
NO. 4
160
16
5
SEC.
2.5
4
NO. 5
2.5
3
R128
180K
BIAS
R129
3K
V102
5Y3GT
C104
2700
B
A
R130
8.5K
+
POWER
OFF
ON
S111
1
E 103
FUSE
LAMP
LINE
ADJUST
R126
200
P101

TM 5083-26