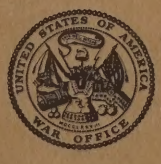
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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

INSTRUCTION BOOK FOR ELECTRONIC MULTIMETER ME6-C/U



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INSTRUCTION BOOK FOR ELECTRONIC MULTIMETER ME-6C/U

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SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of Bureau of Ships Manual or superseding instructions on the subject of Radio-Safety precautions to be observed.

1. While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed.

KEEP AWAY FROM LIVE CIRCUITS:

2. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties *always* remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

3. Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

4. Do not depend upon door switches or interlocks for protection, but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door or safety switch be removed, short circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

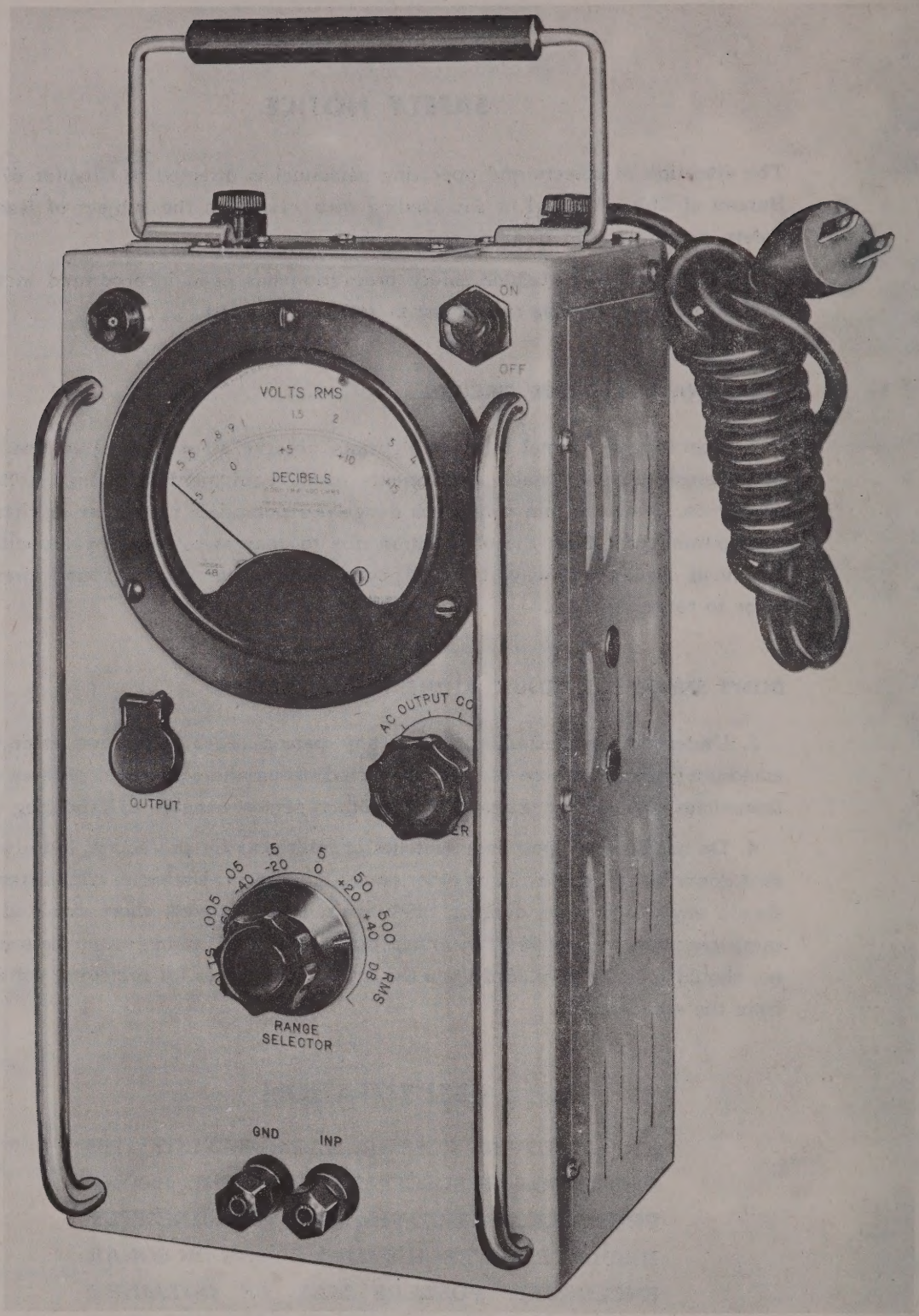


Figure 1-1. Electronic Multimeter ME-6C/U, Equipment Supplied

SECTION 1
GENERAL DESCRIPTION

1. INTRODUCTION.

a. The purpose of this instruction book is to present information required for the operation and maintenance of Electronic Multimeter ME-6C/U, which is a portable test instrument having a wide range of applications in the laboratory and repair depots of service installations.

b. Procedures to be followed in testing and adjusting the equipment are thoroughly detailed in later sections.

2. PURPOSE OF THE EQUIPMENT.

a. The Electronic Multimeter ME-6C/U is a highly sensitive instrument for accurately measuring a-c voltages by the vacuum-tube voltmeter principle. The Multimeter covers the voltage range from 500 microvolts r-m-s to 500 volts r-m-s, within the frequency limits from 15 cycles to 250 kilocycles per second. The meter scale has two calibrations: the upper scale showing a-c voltage from 0.5 to 5, (with slight extensions below and above this range for overlap), and the lower scale indicating decibels, over the range from —5 to +17 based on 0 db. = 0.001 watt in 600 ohms.

b. An auxiliary purpose of the Multimeter is to serve as a flat high-gain wideband amplifier. Its frequency response approximates that of the voltmeter, from a nominal 15 cycles to 250 Kc. Maximum voltage gain of about 1600 can be achieved. Essentially distortionless waveshape is obtainable up to at least 8 volts a-c output.

3. GENERAL PHYSICAL CHARACTERISTICS.

a. The Electronic Multimeter ME-6C/U is supplied complete with its own metal cabinet, power supply, a-c amplifier, rectifiers, indicating meter, and power cable. All operating controls, signal input terminal posts, signal output jack, and the pilot lamp are located on the front panel. The power fuse is replaceable from the top surface of the instrument panel, and adjustment controls are available from the side of the metal housing. The chassis is held in its metal cabinet by means of six standard slotted head machine screws. A metal handle is provided at the top of the housing for portability of the equipment.

b. All front panel controls, terminals, and the output jack are clearly marked as to function or value in black characters. All components of the Multimeter are mounted on the rear of the aluminum front panel. Both the front panel and its metal housing are finished in flat grey enamel, with the sides of the housing louvered to provide for equipment ventilation. The overall dimensions of the equipment, including the embossed feet at the base of the cabinet, are 11-13/16 inches long, 5-3/4 inches wide, and 5-13/16 inches high.

4. GENERAL ELECTRICAL CHARACTERISTICS.

a. The Electronic Multimeter ME-6C/U consists essentially of a multi-stage amplifier terminated by two germanium crystal diodes, connected in a bridge circuit, and a panel-mounted meter to indicate the rectified current. The meter is especially designed with shaped pole pieces so that the indications are proportional to the logarithm of the rectified current over a range of 10 to 1. The rectified current is accurately proportional to the input voltage over the working range of the instrument.

b. A unique feature of the Electronic Multimeter is the stability of gain in the amplifier system, a feature which is achieved by feeding back amplified voltage to part of the input circuit. This action renders meter readings that are substantially independent of variations in line voltage, tube aging, and circuit component replacement.

c. Electronic Multimeter ME-6C/U may be used as a flat high-gain amplifier by inserting a mating telephone plug into OUTPUT jack J-101 and rotating the a-c output control clockwise from its METER position. OUTPUT CONTROL switch S-103 disconnects the output of the last cathode follower V-108 from the crystal diodes and the indicating meter M-101. Fine adjustment of the a-c output signal is provided by means of the arbitrarily calibrated OUTPUT CONTROL, located directly below and to the right of the indicating meter.

d. The equipment operates from 117 volts ±10%, 50 to 400 cycles, single phase a-c. A full-wave high-voltage rectifier circuit supplies approximately +350 volt d-c. An electronic voltage-regulator consisting of a beam pentode, a pentode amplifier, and a diode voltage-reference tube, supplies voltage regulation for reliable operation of the amplifiers and cathode followers within the equipment. The heaters of three tubes in the amplifying circuit, where hum problem is greatest, are supplied with d-c power derived from a metallic rectifier. The heaters of all other tubes in the equipment operate at approximate 150 volts d-c above ground, as a means of reducing the heater-to-cathode potential of these stages to a safe operating value.

TABLE 1-1. EQUIPMENT SUPPLIED

Quantity per Equipment	Name of Unit	Nomenclature	Overall Dimensions			Volume	Weight
			Height	Width	Depth		
1	Electronic Multimeter	ME-6C/U	5-13/16	5-3/4	11-11/16	0.23	9-1/2
2	Instruction Books	NAVSHIPS 91797	11	8-1/2	3/16	....	2/3

Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.

5. EQUIPMENT SUPPLIED.

The complete Electronic Multimeter equipment supplied by the manufacturer is listed above in table 1-1, and is illustrated in figure 1-1. A complete table of replaceable parts appears in Section 7 of this instruction book.

6. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

The additional equipment required for trouble-shooting and measuring d-c and a-c voltages (except signal voltages), but which is not supplied by the equipment manufacturer, consists of an accurately calibrated 20,000 ohms-per-volt, or better, d-c voltmeter and an a-c voltmeter of 1000 ohms-per-volt. Each voltmeter should be capable of indicating 500, 100, 50, and 10 volts, full-scale, with an accuracy of $\pm 2\%$ or better, at its point of reading. Adjustment of the +B voltage, available by means of potentiometer R-124, is described in Section 3 of this instruction book. Special equipment required in re-calibrating the instrument is listed in Paragraph 4 of Section 3.

7. SHIPPING DATA.

Table 1-2 gives the essential shipping data concerning the equipment, including weights and dimensions of crated equipment.

8. ELECTRON TUBE, FUSE, AND INDICATOR LAMP COMPLEMENT.

Below are listed in numerical order the types and ratings of the entire complement of electron tubes, fuses, and indicator lamps used in the Multimeter. For tube socket location and internal pin connections, see Section 6 of this instruction book.

TABLE 1-2. SHIPPING DATA

Shipping Box No.	Contents	Overall Dimensions			Volume	Weight
		Height	Width	Depth		
1 of 1	Electronic Multimeter ME-6C/U	11-5 8	12-1 2	20	1.8	30

Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.

TABLE 1-3. EQUIPMENT ELECTRON TUBE, FUSE, AND INDICATOR LAMP COMPLEMENT

Tube Type	Application	Quantity
	Electron Tubes	
5654/6AK5W	Miniature pentode amplifier	4
6005/6AQ5W	Miniature beam power amplifier	1
6J6W	Miniature twin triode amplifier	2
6X4W	Miniature double diode rectifier	1
5651	Miniature voltage-reference tube	1
	Indicator Lamp	
47	Incandescent, miniature bayonet base	1
		Total 10
	Fuse	
Type	Rating	Quantity
3AG or AGC	1 ampere	2 incl. spare.

9. QUICK REFERENCE DATA.

a. Nomenclature ..... Electronic Multimeter ME-6C/U

b. Contract number and date ..... NObsr-57577, dated 30 June 1952

c. Contractor ..... Specialty Engineering Div. of the Specialty Assembling & Pkg. Co. Inc. Brooklyn, New York

d. Cognizant Naval Inspector ..... Inspector of Naval Material, USN New York, N.Y.

e. Number of packages involved per complete shipment of equipment 1

f. Total cubical contents
Crated ..... 1.8 cubic ft.
Uncrated ..... 0.23 cubic ft.

g. Total weight
Crated ..... 30 lbs.
Uncrated ..... 9-½ lbs.

h. Power supply requirements ..... 117 volts ± 10%, 50 to 400 cycles, single phase a-c.

i. Power consumption of equipment ..... Approximately 31 watts at a power factor of approximately unity.

j. A-c voltage measurement range ..... 500 Microvolts to 500 volts r-m-s., (or −65 to +57 VU).

k. Frequency pass band 15 cycles to 250 Kc ± 3%.

l. Voltage meter scale range ..... .5 to 5, with 3 scale markings above and below this range, providing for overlap.

m. Decibel meter scale range ..... −5 to +17 db.

n. Decibel conversion basis ..... .001 watt reference level in 600 ohm line.

o. Meter ranges ..... (1) 500 microvolts to 5 millivolt.
(2) 5 millivolt to 50 millivolt.
(3) 50 millivolt to 500 millivolt.
(4) 0.5 to 5 volts.
(5) 5 volts to 50 volts.
(6) 50 volts to 500 volts.

p. Input impedance ..... 2 megohms in shunt with 25 micromicrofarads.

q. Instrument accuracy.. ± 3% from 15 cycles to 250 Kc. per second.

r. Stability ..... ± 1% over line variation from 105 to 125 volts a-c.

s. Amplifier switching ... Obtained by rotating a-c output control clockwise from off position.

t. Output control ..... Variable resistor in cathode circuit of final cathode follower stage; panel markings arbitrarily calibrated.

u. Amplifier undistorted output ..... Up to 8 volts a-c, supplied from an internal impedance not greater than 2000 ohms.

v. Maximum input voltage ..... Not to exceed 500 volts r-m-s. or 707 volts peak.

w. Amplifier gain ..... 1600.

x. Bandwidth of internal amplifier ..... 15 cps to 250 Kc ± 3%.

TABLE 1-4. Basic Similarities in Model 6/U Series Equipment

Model	Operating Voltage	Mechanical Design	Remarks
6/U			Matched Pair
6A/U	115 V. 50-400 ~		CR-181A and 181B Used
6B/U	115 V. 50-400 ~	Same as 6A/U	Shielded Meter Used
6C/U	117 V. 50-400 ~	Mechanical elements, in general, not interchangeable with previous models	Electrical elements, in general, are interchangeable except power transformer, T-101; metallic rectifier, CR-101; and meter, M-101

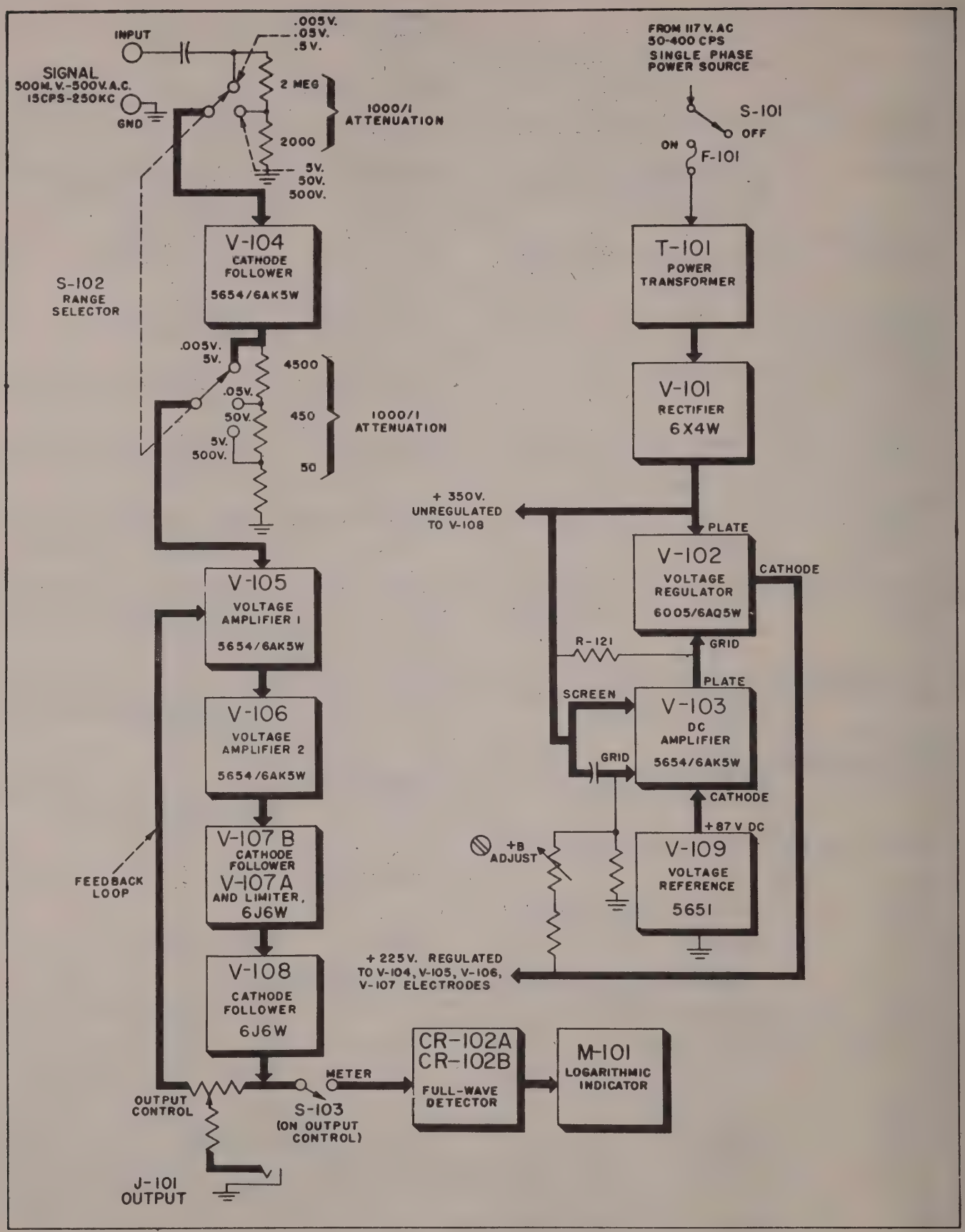


Figure 2-1. Electronic Multimeter ME-6C/U, Functional Block Diagram

SECTION 2
THEORY OF OPERATION

1. SUMMARY.

(See figure 2-1.)

a. Electronic Multimeter ME-6C/U consists essentially of a multi-stage amplifier (V-104 through V-108) having a six-position input attenuator, controlled by RANGE selector S-102, terminated by a bridge-type rectifier circuit, and the specially designed meter M-101. A four stage power supply circuit is incorporated in the equipment. Meter indications that are proportional to the logarithm of the rectified current, over the range 10 to 1, are obtained by means of the micro-ammeter's specially shaped pole pieces. Stabilization of gain in the amplifier circuit is obtained by feeding back to the cathode of the first voltage amplifier V-105 a portion of the amplified energy available across AC OUTPUT control R-143, located in the cathode circuit of V-108.

b. The equipment is easily changed from operating as an a-c voltmeter, over the range of 15 cycles-per-second to 250-kilocycles, to operating as a high-gain amplifier. Rotating the OUTPUT control in a clockwise direction from its meter position, disconnects the meter rectifying circuit from the output of the amplifier, and permits the signal under measurement to appear at OUTPUT jack J-101, located to the bottom left of the meter scale. As an amplifier, the Multimeter's frequency response is the same as that of the voltmeter, with a maximum voltage gain of approximately 1600.

c. The equipment contains the power supply circuits necessary to convert the primary power of 117 volts ±10%, 50 to 400 cycles per second, single phase, to the required heater, screen and plate voltages. A series-tube voltage regulator circuit is used to provide a substantially constant d-c voltage to those circuits within the equipment whose operation is critical with respect to supply voltage variations. A metallic rectifier is employed to supply d-c heater voltage to the first three stages of the amplifier circuit in order to eliminate hum interference. The instrument is isolated from the 50 to 400 cycles power source by the electrostatically shielded transformer T-101. An external ground lead may be connected to GND. terminal E-102, if desired.

2. POWER SUPPLY CIRCUIT.

(See figure 2-2.)

a. INTRODUCTION—The Electronic Multimeter ME-6C/U produces a regulated output of 225 volts d-c, which is supplied to the high-potential electrodes of all amplifiers, except to cathode follower V-108. (The common plates of V-108 receive unregulated potential of 350 volts d-c directly from the filter of the rectifier stage.) This regulated output voltage is independent of changes in a-c input voltage and load over a wide range. The following components are included in the voltage-regulating system:

(1) Power transformer T-101 and its associated rectifier V-101,

(2) Series-voltage regulator V-102,

(3) Direct-coupled amplifier V-103,

(4) Voltage-reference stage V-109.

b. POWER TRANSFORMER T-101.—Power transformer T-101 is of the filament and plate type, capable of receiving 117 volts a-c, 50 to 400 cycles per second, single phase, at its input terminals. Three output windings are provided, as follows:

(1) A high-voltage center-tapped secondary with terminals 3 and 5 connected to the plates, pins 6 and 1, of full-wave rectifier V-101 type 6X4W. Rating of this winding is 28 ma. d-c, at 290 volts r-m-s each side of the winding to ground.

(2) A center-tapped filament secondary, rated at 6.3 volts a-c across terminals 6 and 8, at 2.275 amperes, for supplying heater power to the following five stages in the equipment: V-101, V-102, V-103, V-107, and V-108. The center tap is connected to an approximate 150-volt B+ voltage, in order to reduce the heater-to-cathode potential of the tubes to a safe operating value.

(3) An additional center-tapped low-voltage secondary, producing 8.6 volts a-c across terminals 9 and 10, at 0.525 ma. d-c, for supplying metallic rectifier CR-101 with input power. The metallic rectifier is connected as a full wave bridge and delivers 6.3 volts d-c, after filtering action by the 1500-microfarad capacitor C-102, to the heaters of cathode-follower V-104, and voltage amplifiers V-105 and V-106. Introduction of hum into the grid circuits of the first three stages in the amplifier is thereby prevented.

c. VOLTAGE REFERENCE STAGE V-109.—The voltage reference tube V-109 holds the cathode of the direct-coupled amplifier V-103 at a constant positive potential (about 87 volts d-c) with respect to ground. The plate, pins 1 and 5, of the voltage-reference tube is also connected to the regulated voltage output at the cathode of the series voltage-regulator V-102 through voltage-dropping resistor

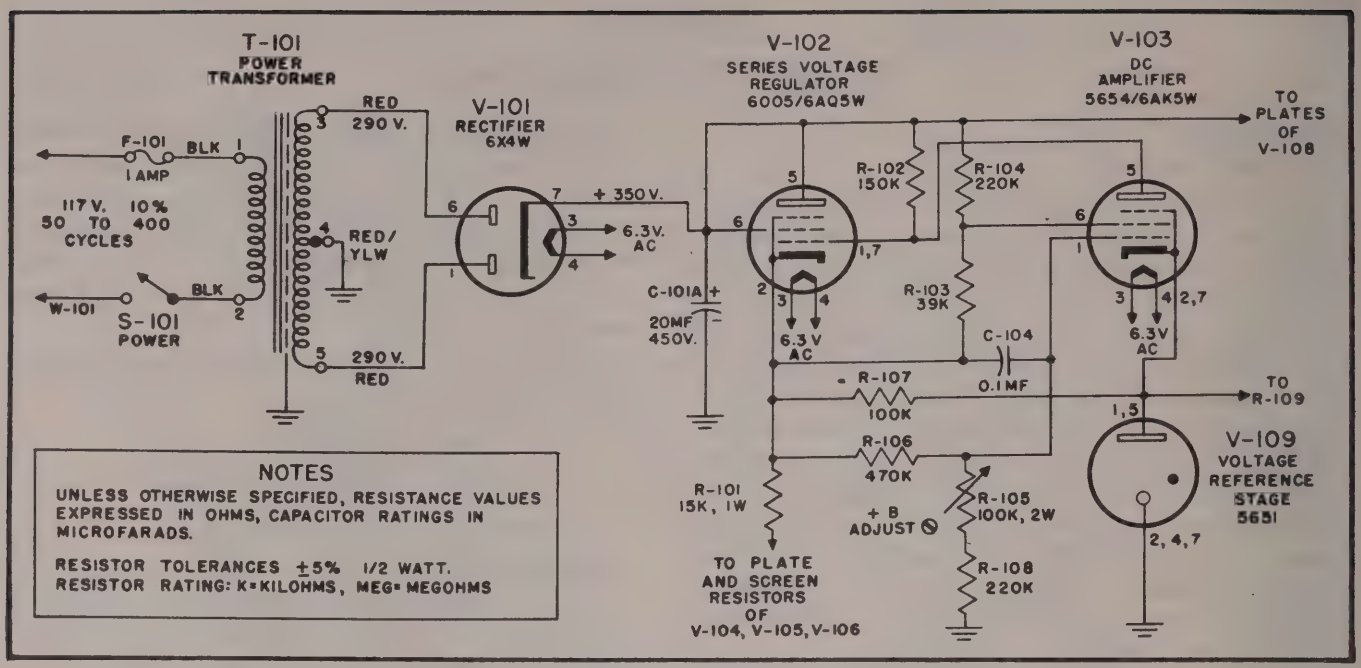


Figure 2-2. Power Supply Circuit, Sectionalized Schematic Diagram

R-107. Immediately after POWER switch S-101 is thrown to its ON position, and B-plus voltage is developed, the striking or ionizing potential of the voltage-reference tube is reached, and the tube fires.

d. D-C AMPLIFIER V-103.—A 5654/6AK5W sharp cutoff pentode is used as a d-c amplifier. Its control grid pin 1, is d-c coupled through voltage-divider resistor R-106 to the cathode of the series voltage regulator stage V-102. Any variation in the output voltage of V-102, appears also on the grid of V-103. In order to minimize the effect of sudden fluctuations in the unregulated +B supply voltage, resistor R-103, which is part of the voltage divider network supplying +B potential to the screen grid of V-103, is returned to the cathode of V-102. Coupling capacitor C-104 allows sudden fluctuations to reach the grid of V-103 thus enabling the series voltage regulator tube V-102 to counteract variations both in the regulated and unregulated +B supply. Any variation in potential at the output of rectifier V-101, due to line disturbances or other causes, is applied through R-104, R-103, and C-104 to V-103 grid, and changes its bias potential. A rise in grid potential increases the plate current of this stage, and consequently causes a greater voltage drop across plate load resistor R-102.

e. SERIES-VOLTAGE REGULATOR V-102.—A triode-connected beam-power pentode 6005/6AQ5W serves as the series voltage-regulator. Its plate pin 5 and screen grid pin 6 are tied in parallel to the unregulated B+ line, while its grid bias resistor R-102 also functions as the plate load for d-c amplifier V-103. The cathode of V-102 is returned to ground through the voltage-divider network R-106 through R-108. Subparagraph *d.*, above, pointed out that a rise in input voltage or an increase in a-c line potential causes a smaller grid bias at d-c amplifier V-103, since its cathode is maintained at a constant potential by the voltage-reference tube. With a greater voltage drop across the dual-purpose resistor R-102, caused by the larger current flowing through d-c amplifier V-103, the plate resistance of voltage-regulator V-102 is increased. Therefore, more of the available voltage appears across the higher plate resistance of V-102, and the load voltage is held constant. On the other hand, a negative voltage variation on the grid of d-c amplifier V-103 decreases the plate resistance of voltage-regulator V-102. Less of the available voltage is then developed across the plate resistance of the regulator tube, cancelling any negative variations in voltage output and holding the load voltage constant. The 100,000-ohm variable resistor R-105 establishes the operating potential of V-103 control grid, and serves as a convenient method of adjusting the regulated B+ potential.

3. SPECIAL FEATURES OF THE EQUIPMENT.

a. GENERAL.—The Model ME-6C/U is a logarithmic type a-c vacuum tube voltmeter, having the following special characteristics:

(1) A single meter scale accommodates all ranges, from 500 microvolts to 500 volts, root-mean-square,

with a maximum error of ±3% at any part of the scale.

(2) A special d-c meter of the "shaded pole" type is used in which the pointer deflection is proportional to the logarithm of meter current. The scale is therefore calibrated logarithmically from 0.5 to 5.0 volts, with the zero indication suppressed. This arrangement permits range switching in six decade steps as shown below:

(*a*) From .0005 to .005 volt,
(*b*) From .005 to .05 volt,
(*c*) From .05 to 0.5 volt,
(*d*) From 0.5 to 5 volts,
(*e*) From 5 to 50 volts,
(*f*) From 50 to 500 volts.

b. UNIFORM PERCENTAGE OF ACCURACY. —Electronic Multimeter ME-6C/U employs a voltage scale over which a uniform percentage of accuracy is maintained over the entire scale arc. Reference to figure 2-3, illustrating a log scale, shows that the scale used in the present equipment does not have equal spacing between each calibration mark. This non-linearity has the advantage of spreading out the lower end of the scale. Readings can, therefore, be obtained with more accuracy than is possible with a linear scale, for the following reason:

(1) Referring to figure 2-3, let us suppose first that a 0.5 volt signal is being measured and that this voltage changes by 100% or by 0.5 volt. Note the deflection which this change gives on the logarithmic meter scale. Now suppose that a 1.5 volt signal is being measured and that this voltage changes by 100% or by 1.5 volts. Note that a change in voltage from 1.5 to 3 volts gives approximately the same change in pointer deflection as a change from 0.5 to 1 volt. In each case the change in input voltage is 100%, and this 100% variation produces about the same change in deflection.

(2) By way of comparison, note that on the linear meter scale illustrated in figure 2-4, the change from 0.5 volt to 1 volt gives only one-third of the change in deflection which is obtained for the same 100% change from 1.5 to 3 volts. Thus the accuracy of reading is considerably smaller at low values on a linear scale.

c. LINEAR DECIBEL SCALE.—The lower arc of the meter scale used in the present equipment is calibrated in terms of decibels, within the range from −5 to +17 db, (1 milliwatt reference level in a 600-ohm line). Since a decibel represents a fixed percentage change in level, the log scale calibrated in db is relatively linear. Equal percentage changes occupy about the same length of arc throughout the entire length of the scale.

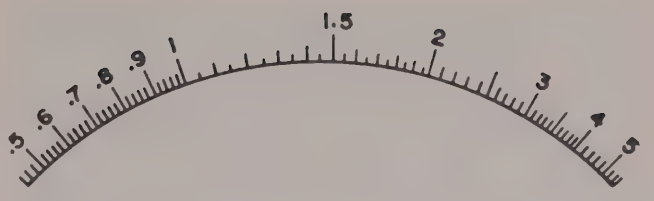


Figure 2-3. A Representative Logarithmic Meter Scale

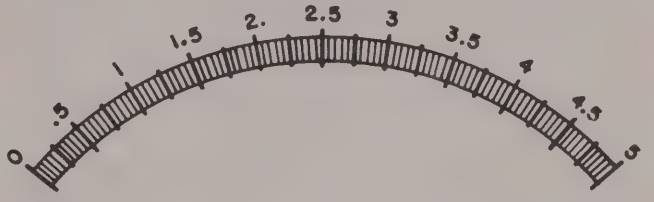


Figure 2-4. A Representative Linear Meter Scale

4. THE AMPLIFYING AND LIMITING CIRCUIT. *(See figure 6-4.)*

a. GENERAL.—The high sensitivity of Electronic Multimeter ME-6C/U is obtained by employing a full-wave diode rectifier, consisting of two germanium crystal diodes CR-102A and CR-102B, in the output of a five stage wide-band amplifier and limiter circuit. In order to keep within the linear range of the amplifier circuit, a compensated attenuator is connected in the grid circuits of cathode follower V-104 and first voltage amplifier V-105. The degree of attenuation is determined by the setting of the double-deck rotary RANGE selector S-102. (See sub-paragraph *b.* below, for detailed description of the attenuator action). The main portion of the amplifier consists of stages V-104 through V-108. Feedback voltage is coupled from the output of the final stage, cathode follower V-108, to the cathode of the first voltage amplifier V-105, for the purpose of maintaining a high order of linearity and stability. The function of each stage is summarized briefly as follows:

(1) V-104—cathode follower, (5654/6AK5W),
(2) V-105—first voltage amplifier, (5654/6AK5W),
(3) V-106—second voltage amplifier (5654/6AK5W),
(4) V-107—A section: amplifier and limiter (6J6W),
B section: cathode follower,
(5) V-108—cathode follower (6J6W).

b. ATTENUATOR ACTION.—The a-c signal under measurement, within the frequency range of 15 cycles to 250 kilocycles per second, is applied at INPUT and GND. terminals E-101 and E-102. The input impedance of the Multimeter, 2 megohms in shunt with about 25 micro-microfarads, is sufficiently high that its loading effect upon circuits being measured is at a minimum. The input blocking capacitor C-105,

in conjunction with the trimmer capacitor C-107 and C-106, allows a total of 1000 volts a-c signal superimposed on a d-c potential to be applied to the input of the instrument without causing damage. Reference to schematic circuit diagram, figure 6-4, shows that the A section of RANGE selector S-102 consists essentially of two positions. When small input voltages (over the range from 500 microvolts to .5 volt) are under measurement, RANGE selector may be set to its .005 V. .05 V. or .5 V. position. Consequently, the input signal appears across the combined series impedance of the 2-megohm and 2-kilohm precision resistors R-117 and R-118, and no attentuation is introduced at this point The input signal may be attenuated, depending on the position of the RANGE selector, in the B section of S-102. The signal, appearing across the load of cathode follower V-104, is slightly reduced in amplitude due to cathode follower action, and is coupled through capacitor C-109 to the B section of the attenuator network. The one-half per-cent tolerance precision resistors R-124, R-125, and R-126 comprise this section. When the RANGE selector is at its .005 V. position, no attenuation is presented since the signal appears across the three resistors in series. Rotating the selector knob to its .05 position causes the movable arm of S-102 to contact the junction of R-124 and R-125, and an attenuation factor of 10 is achieved. When the selector knob is rotated to its .5V. position, the movable arm of S-102 then contacts the junction of R-125 and R-126, and an attenuation factor of 100 is applied to input signals over the range .05 to .5 volts. Since the B section of S-102 accommodates signals up to .5 volts only, additional attenuation for greater amplitude signals is provided by the A section of the switch, consisting of the resistor network R-117 and R-118. Rotating the RANGE knob to its 5V., 50V., or 500 V., position causes the 2-megohm resistor R-117 and the 2 kilohm resistor R-118 to act as a voltage divider, with the arm of S-102 contacting the small portion of the signal appearing across R-118. A resultant attenuation factor of 1000 to 1 is achieved by this voltage-divider arrangement. The entire attenuator network is so arranged that the first three steps of attenuation appear at the grid circuit of first voltage amplifier V-105, and the next three steps are obtained by causing the movable arm of S-102A to contact the junction of R-117 and R-118. A total attenuation factor of 100,000 to 1 is obtainable, for full-scale readings, or 1 million to 1 for minimum (500 microvolts) to maximum (500 volts) readings.

c. BIAS CIRCUITS.—The following circuit arrangements are used in applying bias to the various stages of the amplifying and limiting circuits:

(1) The first cathode follower V-104 is self biased by its cathode resistor R-122, while its grid leak resistor R-120 is returned to an appropriate point in the cathode load circuit.

(2) The bias of the first and second voltage amplifiers V-105 and V-106 is supplied by bias cell E-103, and is applied to the grid of V-105 through R-128 and to the grid of V-106 through R-132.

(3) Grid potential for cathode follower V-107B and limiter V-107A is derived from a voltage divider consisting of R-139 and R-140, connected between the 225-volt regulated B-plus potential and ground. At the junction of R-139 and R-140, a potential of about 60 volts d-c exists. This potential is applied directly to the grid pin 6 of V-107A and through grid leak resistor R-136 to the grid pin 5 of V-107B. Since the cathode of this stage operates with about 65 volts d-c above ground, due to plate current flow through its cathode load R-137, an effective bias potential of about 5 volts is present between each grid and the common cathode.

(4) The plate of V-107A is directly coupled to the grid pins 5 and 6 of output cathode follower V-108, and a grid potential of about 180 volts d-c is present at these electrodes. Current flowing through this tube causes a potential of about 185 volts d-c to appear across the d-c cathode load resistors R-141 and R-142. A resultant bias potential of about 5 volts exists at this stage.

5. A-C SIGNAL PATH.

a. Reference to either the functional block diagram, figure 2-1, or the schematic circuit diagram, figure 6-4, will aid in tracing an a-c signal, applied at INPUT and GND. terminal E-101 and E-102, through the various stages to the OUTPUT or meter circuit.

b. If a source of sinusoidal a-c voltage, about 2000 cycles per second in frequency and .005 volts in amplitude, is connected to the input circuit, and RANGE selector S-102 is set in its extreme counterclockwise .005 V. position, the full signal appears at the grid pin 1 of cathode follower V-104. Parasitic suppressor R-119 serves to eliminate spurious oscillations. The total gain of V-104 is about 0.9. Therefore, the output signal of this stage, coupled from its load circuit through C-109 and from the movable arm of RANGE selector S-102B through capacitor C-111, is about .0045 volt in amplitude when it appears at the grid pin 1 of voltage amplifier V-105.

c. The normal amplification of the 5654/6AK5W employed as the first voltage amplifier is about 100. As will be explained in a later section, however, this stage receives a feedback voltage in its cathode circuit that cuts down its amplification to a factor of about 2 or 2.5. Let us assume that the feedback is of such a value that V-104 operates at this time with an ampli-

fication factor of 2.2. The a-c signal in its plate output circuit has therefore reached a level of about .01 volt.

d. Second voltage amplifier V-106 has an amplification factor of about 100. As the output signal from V-105 is coupled through C-112 to its grid pin 1 at a level of about .01 volt, its plate output signal is now increased to about 1 volt, and is capacitively coupled through C-114 to the following stage.

e. The B section of the dual triode V-107 operates as a cathode follower, while the A section functions as an amplifier or limiter. Operation as a limiter protects the indicating meter M-101 from damage that could otherwise be caused by applying a larger signal voltage to the input of the instrument than is proper for a particular setting of RANGE SELECTOR S-102. Limiter action is described in detail as follows:

(1) The d-c component of both sections of V-107 flows through common cathode resistor R-137, thereby causing the cathode to assume a d-c potential of 61 volts positive with respect to chassis ground.

(2) Since V-107B operates as a cathode follower, the signal voltage appears across cathode load resistor R-137. The potential of the cathode will, therefore, rise and fall in accordance with the instantaneous signal voltage. The grid of V-107A is supplied with a fixed d-c potential of 58 volts positive with respect to ground by voltage divider R-139 and R-140. Reference to the schematic circuit diagram shows that capacitor C-115 by-passes V-107A grid to ground so that no a-c signal voltage appears at this grid. The grid is therefore held 3 volts negative with respect to its cathode.

(3) If the signal voltage appearing at the cathode of V-107 does not exceed the 3-volt bias voltage of V-107A, this section of the circuit amplifies the signal and yields a gain of approximately ten. Since the plate pin 1 of V-107 is directly connected to the grids pins 5 and 6 of the output cathode follower, a signal level of about 10 volts appears at the grids of V-108.

(4) However, if the signal voltage across cathode resistor R-137 exceeds the bias voltage, the instantaneous voltage drop across plate load resistor R-138 is so large that plate current cutoff is achieved during the negative alternation of the applied a-c signal. During the positive alternation, no conduction occurs because the cathode potential moves farther away from V-107A grid potential, thereby developing excessive bias voltage.

(5) Values of the circuit components in this stage have been chosen so that the current flowing through the indicating meter is held to two and one-half times the full-scale current. The meter movement is so constructed that it will not be damaged by a current flow exceeding eight times its full-scale current rating.

f. A 6J6W twin-triode, connected in parallel, is employed as a conventional cathode follower in the output stage, resulting in some loss of signal level. An output signal of 8 volts is available at the cathode load of this stage. When the OUTPUT CONTROL is in its extreme counter-clockwise METER position, switch contact S-103 is closed and the signal is applied through R-145 to the germanium crystal diodes CR-102A and CR-102B. After rectification by the full-wave diodes, meter movement M-101 is supplied with d-c current, and indicates a full scale deflection. On the other hand, no a-c signal is supplied to the meter rectifying circuit when the OUTPUT CONTROL is rotated clockwise from its METER setting, since this action causes the switch contact S-103 to open. The full a-c output may then be available across potentiometer R-143, and its amplitude is determined by the setting of the OUTPUT CONTROL knob. Connecting a single circuit telephone plug into OUTPUT jack J-101 permits further use of the signal as a source for driving an oscilloscope, an additional amplifier, if desired, or for other laboratory or field uses.

6. THE METER RECTIFIER CIRCUIT.

a. DESCRIPTION.—The meter rectifier circuit serves the purpose of changing the a-c signal current to d-c current in order to actuate the indicating meter M-101. The operation of the circuit is as follows:

(1) The 1N35 germanium crystal diodes CR-102A and CR-102B are connected to form a full-wave rectifying system, with CR-102A conducting during the positive part of a cycle and CR-102B conducting during the negative alternation of the same cycle. The current flowing through these diodes develops a potential across the 2000-ohm resistors R-110 and R-114.

(2) During the positive part of the cycle, the junction of CR-102A and R-110 assumes a positive potential with respect to the junction of CR-102B and R-114. (The diode CR-102B does not conduct during the positive part of the cycle.) During the negative part of the cycle, CR-102B conducts while the diode CR-102A does not. The junction of CR-102B and R-114 therefore becomes more negative with respect to the junction of CR-102A and R-110. Reference to the schematic circuit diagram shows that the indicating meter M-101 is connected through its positive terminal to the junction of CR-102A, R-110, and, by means of the SENSITIVITY adjust control R-112, the negative terminal is connected to the junction of CR-102B, R-114. D-c current flows from the high-potential junction, through the meter movement and the SENSITIVITY control, to the low-potential junction, causing a deflection of the meter pointer.

(3) Circuit constants are chosen so that the meter pointer deflects to the 5 calibration mark at the top end of the scale when .005 V., .05 V., 0.5 V., 5 V., 50 V., or 500 V. r-m-s is applied to the INPUT and GND. terminals of the instrument, and RANGE SELECTOR S-102 is set at its appropriate position.

b. ADJUSTMENTS AVAILABLE.—Slight variations encountered in meter sensitivity and in the gain of the amplifier circuit may be compensated for by adjusting the SENSITIVITY control R-112. This control allows for an adjustment of ±12%. The indicating meter is of the suppressed type, designed to have approximately 7% mechanical suppression. Since an accurate 10% suppression of full-scale current is required for proper tracking, additional suppression is incorporated in the instrument by the positive d-c potential which is supplied from the voltage reference stage V-109, through ZERO SUPPRESSION control R-116, to the negative junction of CR-102B and R-114. By adjusting the ZERO SUPPRESSION control, it is possible to change the pointer deflection at the .5 calibration mark at the low end of the scale by approximately ±12%. By means of both the SENSITIVITY and the ZERO SUPPRESSION controls, the meter pointer can be accurately positioned at the 5 and .5 calibration marks, thereby assuring accurate tracking. If, after long use of the instrument, it is not possible to position the meter pointer at these calibration marks, this is an indication that the vacuum tubes in the equipment should be checked for proper operating characteristics, as explained in Section 5 of this instruction book.

SECTION 3
INSTALLATION AND ADJUSTMENT

1. GENERAL.

Electronic Multimeter ME-6C/U is designed to function as a self-contained, portable test equipment, and can be used wherever an a-c power source of 117 volts ±10%, 50 to 400 cycles-per-second, single phase, is available. No special precautions need be taken in placing the instrument near equipment under measurement. If desired, a ground lead may be connected from the GND. terminal post E-102, to a good ground connection.

2. UNPACKING AND INSPECTING THE EQUIPMENT.

(See figure 3-1.)

a. The equipment has been calibrated and adjusted, as well as tested, before shipment, and careful handling will help prevent changes in calibration or adjustment due to mechanical shock. Carefully unpack and examine the equipment for any apparent damage. Check the equipment received against the accompanying packing slips and the list of equipment supplied, table 1-1, Section 1 of this instruction book.

b. Make sure that all dust and packing material is removed, and check the power plug, the INPUT terminal posts, and the OUTPUT jack to make certain that no contacts are bent or broken. Any damage noted may be taken as indication that the equipment has been subject to severe shock during shipment, and the damage should be reported to the appropriate authority, after which the damage should be repaired and a complete functional check of the equipment should be made in accordance with the procedures outlined in Section 4.

c. Inspect the equipment front panel controls to see that the two control knobs are tight on their shafts, that the OUTPUT CONTROL knob action is smooth and continuous, and that switch action is firm and positive. Remove the six screws which hold the front panel to the instrument housing, and pull the panel out. Inspect all tubes to see that they are seated properly in their sockets, and that tube shields are properly placed over only tubes V-104, V-105, V-106, and V-109. Replace the front panel over the instrument housing and replace the six screws holding the panel securely in place.

Note

It should be noticed that the equipment manufacturer has supplied tube shields for four tubes only, as listed immediately above.

It is recommended that no additional tube shields be used. The 6X4W rectifier V-101, the 6005/6AQ5W series voltage-regulator V-102, the 5654/6AK5W d-c amplifier V-103, and the 6J6W stages V-107 and V-108 should have NO shields.

3. CALIBRATION CHECK.

a. No initial adjustment of the equipment is required before performing the calibration check. However, the Multimeter may be checked for accuracy of calibration by comparing its readings to an a-c voltmeter of the iron-vane type or a dynamometer type meter, the calibration of which is known to be more accurate than ±1% at its point of reading. Meter Test Set TS-690/U would be most suitable for this purpose. For this calibration check, apply an a-c test signal, within the limits of .005 to 500 volts, and within the frequency range of both the Multimeter and the accurately calibrated comparison equipment, to the INPUT terminals of both equipments connected in parallel. Be sure to rotate RANGE SELECTOR S-102 to the proper position to accommodate the test signal. Also, make certain that the OUTPUT CONTROL is in its extreme counter-clockwise METER position. The meter indications of both instruments should agree. If discrepancies in excess of ±5% are obtained, Electronic Multimeter ME-6C/U requires recalibration.

b. Follow the procedure outlined in Section 6, if the accuracy of calibration of the equipment is in question.

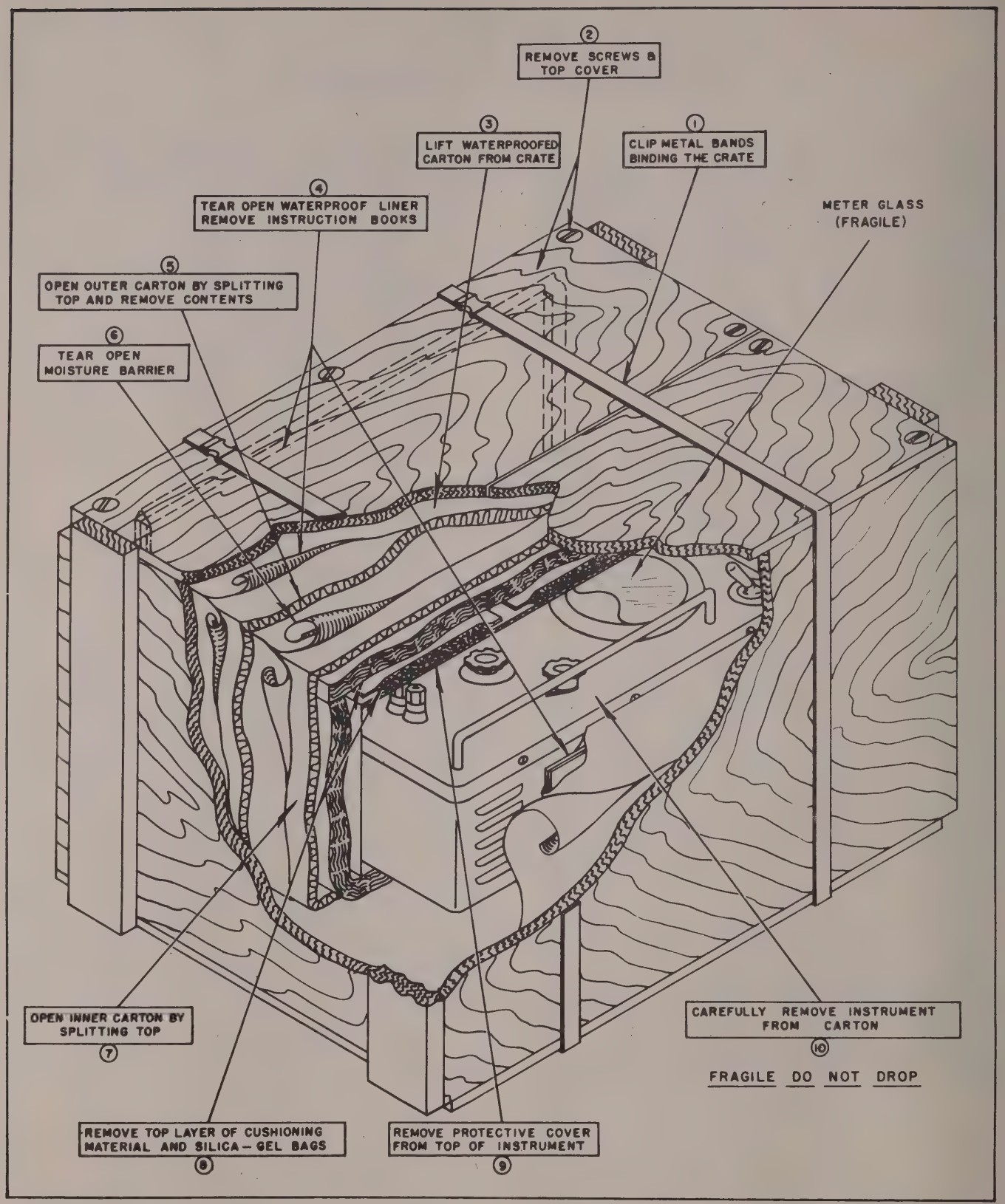


Figure 3-1. Electronic Multimeter ME-6C/U, Unpacking Procedure

SECTION 4
OPERATION

1. GENERAL.

Electronic Multimeter ME-6C/U is designed to measure sine-wave voltages over the range from 500 microvolts to 500 volts, r-m-s. Its frequency response extends from 15 cycles per second to 250 kilocycles. Its power source requirement is 117 volts ±10%, single phase, 50 to 400 cps. The meter voltage scale is logarithmic over a range of 10 to 1, covering from .5 volt to 5 volts, with slight extensions below and above this limit for overlap. The entire voltage range of the instrument is obtained by the use of a precision attenuator, controlled by the RANGE SELECTOR. Six positions, indicating the full-scale meter value, are available for the attenuator. The instrument may also be operated as a flat high-gain amplifier, with the output signal available at the OUTPUT jack, located to the lower left of the meter window. Rotating the OUTPUT CONTROL knob, located to the lower right of the meter window, in a clockwise direction from its METER position, disconnects the meter and its rectifying circuit from the instrument. A fine adjustment of the a-c amplified signal is provided by means of the arbitrarily calibrated OUTPUT CONTROL.

2. OPERATING CONTROLS.

(See figure 1-1.)

a. An understanding of the functions of all operating controls is necessary for intelligent operation of the equipment. The proper sequence of controls, and their functions, are as follows:

(1) POWER ON—OFF SWITCH S-101.—This switch controls the application of primary power to the equipment. After the switch is placed ON, the green pilot I-101, located in the upper left corner of the front panel, lights.

(2) INPUT AND GND. TERMINALS E-101 AND E-102.—These terminal posts receive the signal from equipment under test. The input signal must be within the frequency range of 15 cps to 250 Kc., and within the amplitude range of 500 microvolts to 500 volts, r-m-s. The magnitude of a-c input signal superimposed on a d-c potential should not exceed about 1000 volts. Failure to observe this precaution may cause breakdown of the instrument's input circuit.

(3) OUTPUT CONTROL R-143 AND METER SWITCH S-103.—This common switch and potentiometer serves two functions. In its extreme counterclockwise METER position, the signal at OUTPUT jack J-101 is completely attenuated, and the meter, with its associated detectors, is in the circuit. Electronic Multimeter operates as an a-c voltmeter *only* when METER switch S-103 is closed. On the other hand, rotating the OUTPUT CONTROL clockwise from its METER setting, as indicated by an audible switch click, disconnects the meter from the instrument, and permits operation of the instrument as a high-gain amplifier, with flat response. Panel markings for R-143 are arbitrary. The signal available at OUTPUT jack J-101, is at its maximum amplitude when OUTPUT CONTROL R-143 is fully clockwise.

(4) RANGE SELECTOR S-102.—This six-position double-deck rotary switch determines the attenuation applied to input signals. The switch circuitry is arranged so that no attenuation is presented to signals when the switch is at its .005 V. setting. The tabulation below shows other attenuations:

Setting of Range Selector S-102	Attenuation Factor (Full-scale)
.05 V.	10-to-1
.5 V.	100-to-1
5. V.	1000-to-1
50. V.	10,000-to-1
500. V.	100,000-to-1

Note

In applying a signal to the Multimeter, the RANGE SELECTOR should be rotated to that position which yields a pointer deflection between the .5 and 5 VOLTS scale markings. No damage to the instrument will result if the pointer deflection is off-scale. It is recommended however, that care should be taken to avoid leaving the instrument with the pointer in the off-scale region for long periods of time.

(5) OUTPUT JACK J-101.—This is a telephone jack connector, designed to receive a single-circuit standard telephone plug, with grounded sleeve. The a-c amplified signal is available at this connector, *only* when OUTPUT CONTROL R-143 is at any setting other than METER position. A maximum signal of 8 volts a-c potential is available at this jack if RANGE SELECTOR S-102 is set so that the meter deflection is full-scale with the OUTPUT CONTROL in its METER position.

SECTION 5

PREVENTIVE MAINTENANCE

1. BASIC CONSIDERATIONS.

a. Electronic Multimeter ME-6C/U is a test equipment designed for use in making tests and adjustments upon operational equipments, and for amplifying signals of small amplitude to levels up to 8 volts a-c. If these tests and uses are to be made with reasonable accuracy, it is essential that the Multimeter be maintained in proper operating condition, and that its calibration remain completely reliable. Periodic performance checks, together with measurements of the voltages existing at tube socket terminals, will serve to ensure continued reliable performance of the equipment.

b. The best maintenance is preventive in nature, with possible defects corrected before they have a chance to develop. This involves regular checks and tests of the equipment, with a record kept of all performance data and voltage measurements. Month-to-month variations in the performance of the equipment should be small. Any marked deviation should be regarded as a sign of trouble and should be promptly investigated.

c. All observational and mechanical checks should be completed before electrical tests are undertaken. After any repairs and replacements have been made, the equipment should be thoroughly re-checked, visually, mechanically, and electrically, and proven to be in satisfactory operating condition. Preventive maintenance test schedules are listed in table 5-1, while trouble shooting procedures are outlined in Section 6.

2. MAINTENANCE TEST SCHEDULES.

(See table 5-1.)

The procedures listed by performance interval in table 5-1 are recommended to assure satisfactory operation of the equipment. These tests and inspections will show up potential failures in most instances, since aging of components produces the greatest number of equipment failures. This is especially true of electron tubes and germanium diodes, because of their design and construction. The performance checks described in Paragraph 4 of Section 3 of this instruction book are also recommended.

TABLE 5-1. MAINTENANCE TEST SCHEDULES

Period	Check	Performance
Weekly	General, Visual and Mechanical	Pilot lamp should light when cable W-101 is connected to proper power source (117 volts a-c, 50—400 cps), and POWER switch is placed ON. Switch action of RANGE SELECTOR, POWER switch, and METER—OUTPUT CONTROL should be firm and positive; clockwise rotation of OUTPUT CONTROL should be smooth and continuous; both control knobs should be tight on shafts. There should be no evidence of cable insulation failure on the power cord, or of corrosion or dirt in or around contacts of cable connector.
Monthly	General, Visual and Mechanical	The chassis should be removed from its housing and a visual inspection made to see that all tubes are firm in their sockets and that tube shields are properly located over V-104, V-105, V-106, and V-109 only. With power applied to the equipment, the heaters of all tubes should light, and the voltage-reference stage V-109 should glow. All components should be secure and rigidly mounted, with no evidence of loose hardware.

TABLE 5-1. MAINTENANCE TEST SCHEDULES — Contd.

Period	Check	Performance
		DANGER With operating power applied, potentials of 350 volts d-c and 580 volts a-c are present in the chassis. USE EXTREME CARE IN HANDLING THE INSTRUMENT OUTSIDE OF ITS HOUSING.
	Electrical	Turn equipment on and allow a ten-minute warm-up period. Perform the calibration check, as outlined in Paragraph 3 of Section 3. Check the B+ regulated voltage. First turn power OFF. Clip the test leads of a d-c voltmeter having a sensitivity of 20,000 ohms per volt or greater and an accuracy of ±2% or better between cathode pin 2 of socket XV-102 and chassis ground. Use voltmeter scale of 250 volts or higher. Turn power ON, and allow a 5-minute warm-up period. Voltmeter indication should be 225 volts. If this reading is not obtained, use a screwdriver to rotate the shaft of the B+ ADJUST control R-105, located on the side of the bottom sub-panel, until a 225-volt indication is obtained. (See figure 5-1.) After turning power OFF, remove voltmeter test lead clips.
Quarter-annually	General and Electrical	Voltage measurements should be taken at the contacts of all tube sockets, and the measurements compared with the representative values shown in this instruction book. Marked variations from these values may be taken as an indication of potential trouble, even though the equipment may appear to be operating within performance limits. All tubes should be removed from the equipment and checked on an approved type tube checker, preferably of the transconductance type, to see that they are in satisfactory condition. Make the performance checks as specified in Paragraph 4, Section 3.

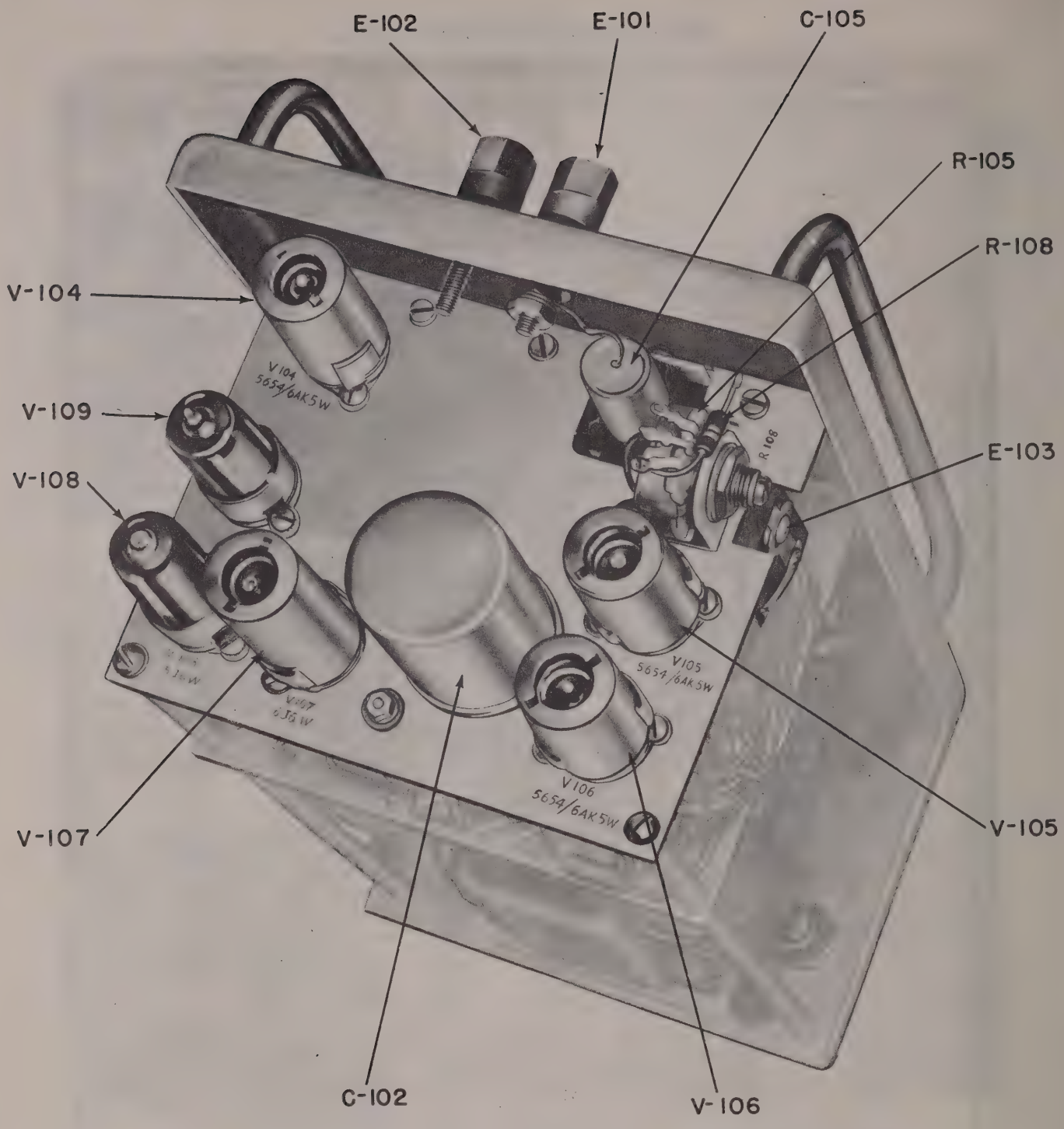


Figure 5-1. Electronic Multimeter ME-6C/U, Top View of Lower Amplifier Chassis

Note

The attention of maintenance personnel is invited to the requirements of Chapter 67 of the "Bureau of Ships Manual" of the latest revision.

3. FUSE LOCATION AND SYMPTOM OF FUSE FAILURE.

One fuse is used to protect the equipment from excessive line voltage surges and from effects of internal faults or short-circuits. The fuse is rated at 1-ampere, 250-volt, and is located in the fuseholder adjacent to the handle on the top surface of the instrument panel. Since the fuse is located electrically in the primary winding of the power transformer, a fuse failure is immediately indicated by no light at pilot lamp I-101, no meter indications at any position of the RANGE SELECTOR, and no a-c signal at the OUTPUT jack.

WARNING

Never replace a fuse with a new one of higher rating unless the continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

4. TUBE REPLACEMENT DATA.

(See figures 5-1 thru 5-3.)

a. When replacing a tube, note the positions of the Multimeter's front panel and adjustment controls before making any changes. If, after replacing the tube, resetting the controls does not correct the abnormal condition, restore the controls to their original settings and replace the original tube, unless a tube test made with an approved tube checker shows the tube to be defective.

b. The miniature tubes V-104, V-105, V-106, and V-109 are covered by standard bayonet-mounting miniature tube shields to prevent possible hum pick-up or oscillation. This type of shield may be removed by depressing the shield and giving it a fraction of a turn counter-clockwise. The shield may then be pulled upward away from the tube. When removing or inserting any of the miniature tubes, do not use excessive pressure, and exert pressure only along the tube and socket axis to avoid breaking the glass-to-metal seals at the tube base-pins. Tube shields must be replaced after checking or replacing any tubes so equipped.

c. Typical operating characteristics of the tubes used in this equipment are given in table 5-2. When the transconductance of a given tube, as revealed by a tube checker, falls below the minimum value shown in the table, replacement of the tube is necessary.

TABLE 5-2. RATED TUBE CHARACTERISTICS

Tube Type	Heater Voltage (V)	Heater Current (MA)	Plate Voltage (V)	Grid Bias (V)	Screen Voltage (V)	Plate Current (MA)	Screen Current (MA)	Transconductance (Micromhos)	
								Nominal	Minimum
5654/6AK5W	6.3	175	200[1]	—2	155[1]	7.5	2.4	5000	2900
6005/6AQ5W	6.3	450	275[1]	—12.5	275[1]	45	3.8	4100	3000
6J6W[2]	6.3	450	330[1]	....	....	9	....	5650	4000
6X4W	6.3	600	1375[1]	....	....	70	....	....	....
5651[3]	....	....	115[4]	....	....	2.5	....	....	....

[1] Absolute maximum ratings.

[2] Amplification factor, 38 MU, nominal value.

[3] Regulation 3 volts DC, 5 ma current at ionization voltage.

[4] Starting voltage, operating voltage is 87 volts d-c.

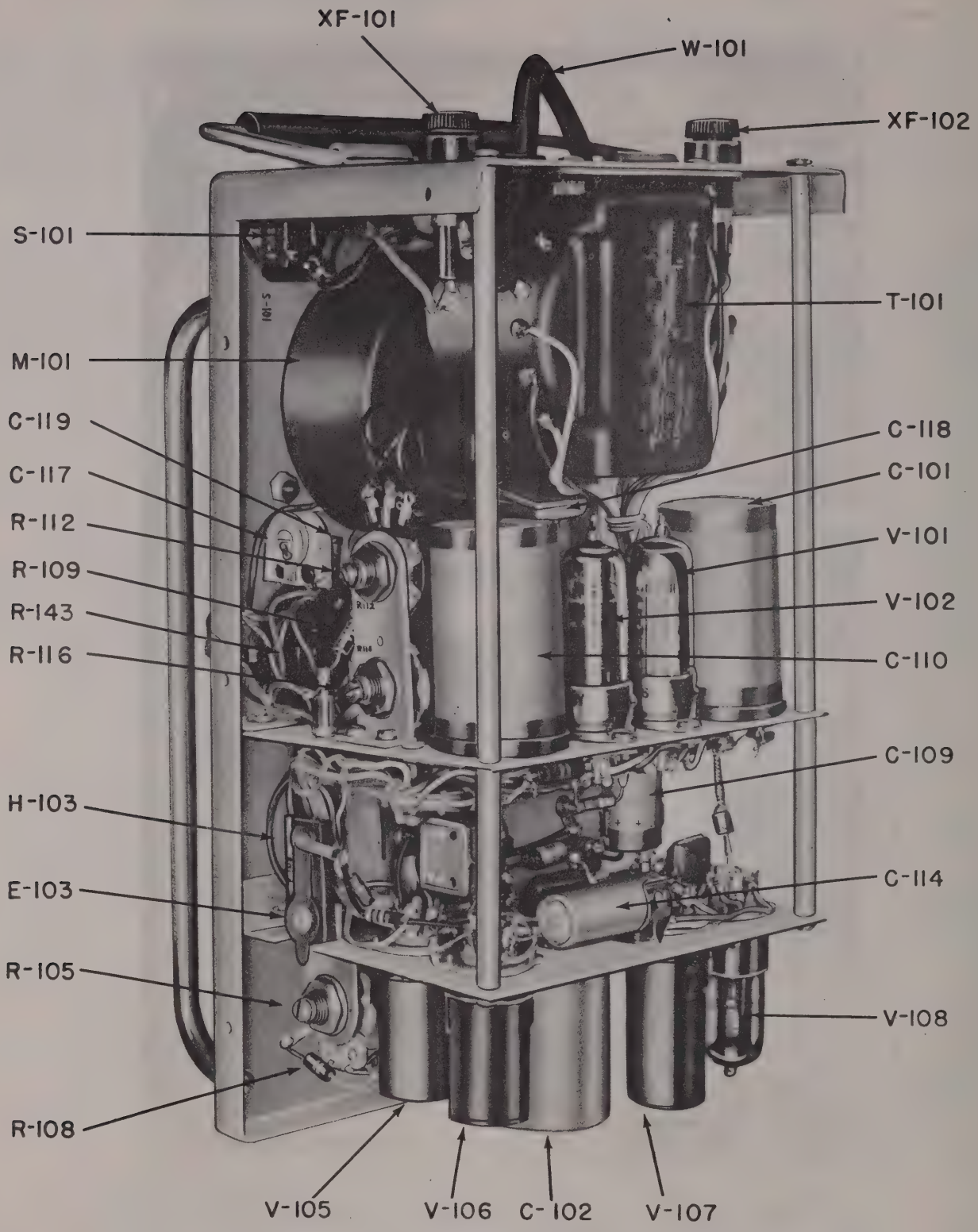


Figure 5-2. Electronic Multimeter ME-6C/U, Right Side of Chassis

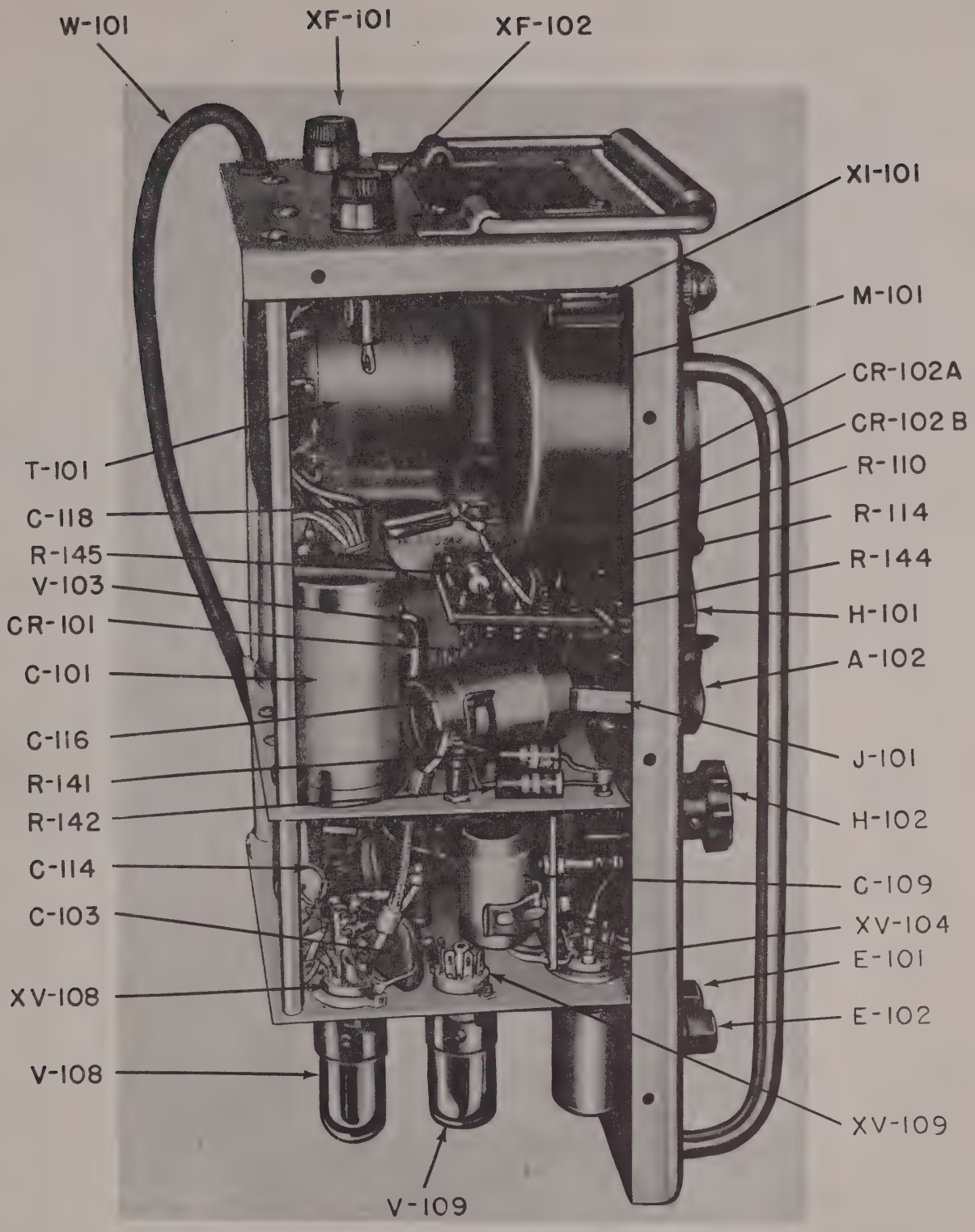


Figure 5-3. Electronic Multimeter ME-6C/U, Left Side of Chassis

SECTION 6

CORRECTIVE MAINTENANCE

1. MAINTENANCE PROCEDURES.

Before any attempt is made to service Electronic Multimeter ME-6C/U, maintenance personnel should be thoroughly familiar with the operating procedures and with the detailed theory of operation of the equipment circuitry, covered in Sections 4 and 2, respectively, of this instruction book. Reference to the functional block diagram of figure 2-1, and to the equipment schematic diagram of figure 6-4, will be found of assistance in gaining an understanding of the overall performance of the equipment.

2. PERFORMANCE CHECK

a. GENERAL.—Electronic Multimeter may be initially checked for accuracy of operation by performing the calibration check described in Paragraph 3-3.

b. CHECKING WITH AN ACCURATE VOLTAGE-CALIBRATED SIGNAL GENERATOR.—To check the accuracy of each position of the RANGE SELECTOR, auxiliary equipment is required. If available, use an accurate voltage-calibrated source of sine-wave output, within the frequency range of 60 to 1000 cps, and capable of producing output amplitudes of .005 volt, .05 volt, 0.5 volt, 5 volts, 50 volts, and 500 volts r-m-s, with an accuracy of ±1%. The output impedance of this signal source should be low, not exceeding 500 ohms. Meter Test Set TS-690/U is recommended for this purpose. Proceed as follows:

(1) Insert power cable W-101 into a power source delivering 117 volts a-c, within the frequency limits of 50 to 400 cps. Place the POWER switch ON, and allow a 10-minute warm-up period for Electronic Multimeter ME-6C/U.

(2) Rotate the OUTPUT CONTROL to its extreme counter-clockwise METER position. Connect the output leads of the signal generator to the INPUT and GND. terminals of the Electronic Multimeter.

(3) Set the RANGE SELECTOR to its 500 V. position, and apply a 500-volt ±1% signal from the signal generator. The Multimeter should indicate a precise full-scale 500 V. deflection.

(4) With the RANGE SELECTOR still at its 500 V. position, apply a 50-volt ±1% signal from the signal generator. This signal should produce a 50-volt indication, at the low end of the Multimeter scale.

(5) Rotate the RANGE SELECTOR counter-clockwise to its 50 V. position, and apply the same 50-volt ±1% signal from the signal generator that was used in step (4), above. The Electronic Multimeter should indicate a precise full-scale 50 V. deflection.

(6) With the RANGE SELECTOR still at its 50 V. position, apply a 5-volt ±1% signal from the signal generator. This signal should produce a 5 volt indication, at the low end of the Multimeter scale.

(7) Rotate the RANGE SELECTOR counter-clockwise to its 5 V. position, and apply the same 5-volt ±1% signal from the signal generator that was used in step (6), above. The Electronic Multimeter should indicate a precise full-scale 5 V. deflection.

(8) With the RANGE SELECTOR still at its 5 V. position, apply a 0.5-volt ±1% signal from the signal generator. This signal should produce a 0.5-volt indication, at the low end of the Multimeter scale.

(9) Rotate the RANGE SELECTOR an additional step counter-clockwise to its .5 V. position, and apply the same 0.5-volt ±1% signal from the signal generator that was used in step (8) above. The Electronic Multimeter should indicate a precise full-scale 0.5 volt deflection.

Note

If steps (8) and (9) do not produce the meter indications of 0.5 volt at the low end and the top end of the meter scale, this is an indication that R-117, located in the high-impedance section of RANGE SELECTOR S-102A, has changed in value. In order to assure tracking, this resistor must be replaced with a resistor of the same type and ±1% accuracy, as specified in the Parts List in this instruction book.

(10) With the RANGE SELECTOR still at its 0.5 V. position, apply a .05-volt ±½% signal from the signal generator. This signal should produce a .05-volt indication, at the low end of the Multimeter scale.

(11) Rotate the RANGE SELECTER counter-clockwise to its .05 V. position, and apply the same .05-volt ±½% signal from the signal generator that was used in step (10), above. The Electronic Multimeter should indicate a precise full-scale .05 volt deflection.

Note

If steps (10) and (11) do not produce the meter indications of .05 volt at the low end and the top end of the meter scale, this is an indication that the instrument is inaccu-

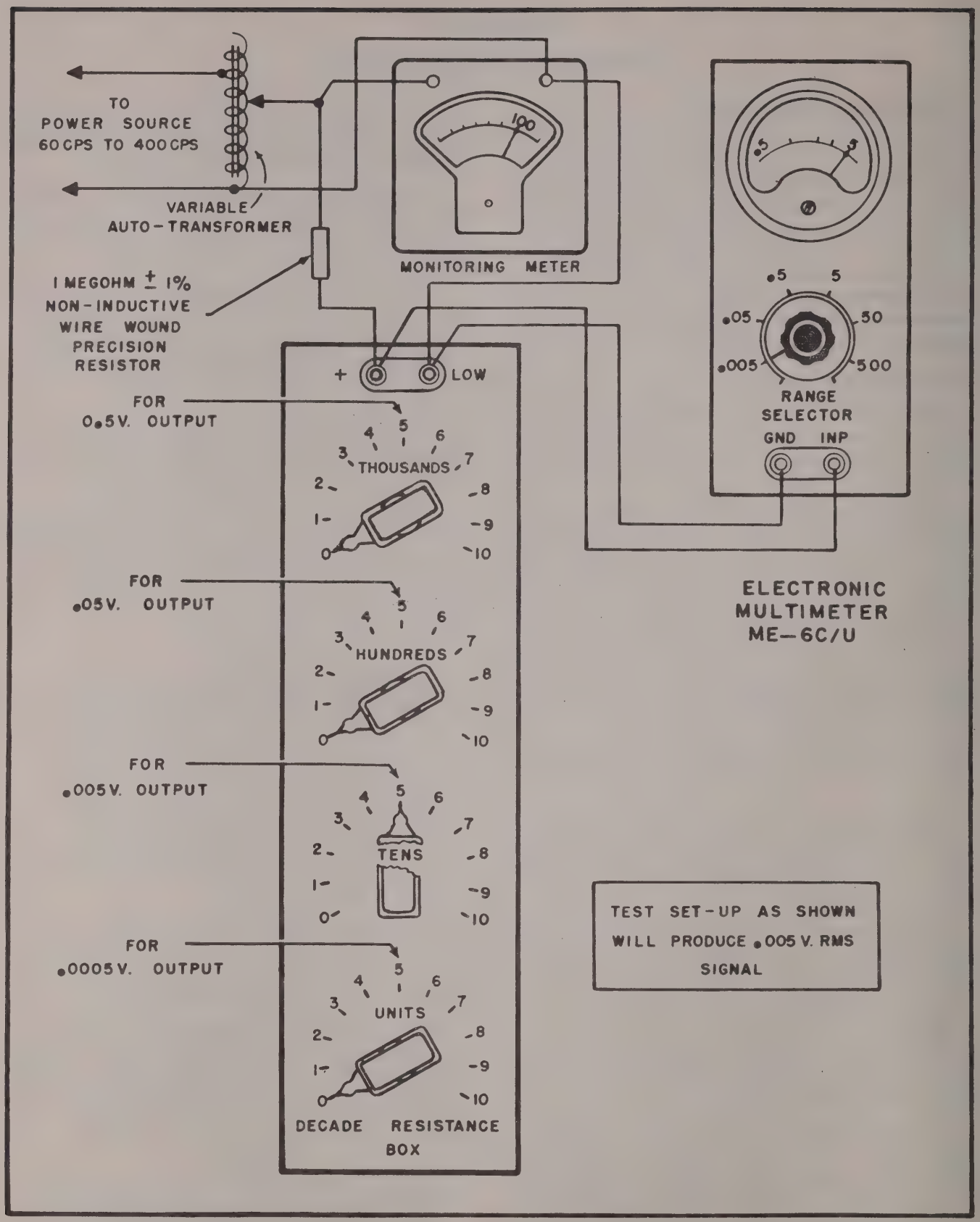


Figure 6-2. Test Set-up for Checking .005 V., .05 V., and 0.5 V. Positions of Range Selector

rately calibrated. The procedure for recalibrating the instrument, by accurately setting SENSITIVITY control R-112 and ZERO SUPPRESSION control R-116 is explained in Paragraph 3 above. (Figure 5-2 shows location of these adjustments.)

(12) With the RANGE SELECTOR still at its .05 V. position apply a .005-volt ±1% signal from the signal generator. This signal should produce a .005-volt indication, at the low end of the Multimeter scale.

(13) Rotate the RANGE SELECTOR to its extreme counter-clockwise .005 V. position, and apply the same .005-volt ±1% signal from the signal generator that was used in step (12), above. The Electronic Multimeter should indicate a precise full-scale .005 volt deflection.

(14) If the signal source is capable of producing an output of .0005 volt, ±1%, keep the RANGE SELECTOR at its extreme counter-clockwise position, and apply the .0005-volt signal from the generator. This signal should produce a .0005 volt indication, at the low end of the Multimeter scale.

(15) The above procedure provides an accurate and thorough performance check of the Electronic Multimeter ME-6C/U for the frequency range from 15 cps to approximately 100 kilocycles per second. Discrepancies in excess of ±5% in the performance described above suggests the need for adjustment of the SENSITIVITY control R-112 and ZERO SUPPRESSION CONTROL R-116. The procedure for adjusting SENSITIVITY and ZERO SUPPRESSION is as follows:

(16) Place the POWER switch S-101 in its ON position, and allow at least ten minutes for the instrument to reach thermal equilibrium.

(17) Apply a test signal of .05 volt a-c, within the frequency range of the equipment (preferably 60 to 1000 c.p.s.) to INPUT and GND. terminals E-101 and E-102.

(18) Rotate RANGE SELECTOR S-102 to the .05 V. (R-M-S) full scale position, and set OUTPUT CONTROL to its extreme counter-clockwise METER POSITION.

(19) The meter pointer should indicate a full-scale value of .05 volt. If this indication is not obtained use a screwdriver to adjust SENSITIVITY control R-112, until full-scale indication is obtained. This adjustment is available through that hole in the side of the meter housing which is closest to the handle at the top of the equipment. (See figure 5-2.)

(20) Rotate the RANGE SELECTOR clockwise to the .5 V. position. The meter pointer should now indicate .05 volt, at the low end of the scale. If this indication is not obtained, use a screwdriver to adjust ZERO SUPPRESSION control R-116, until the indication is .05 volt at the low end of the scale. This adjustment is available through that hole in the side of the meter housing which is located at the greater distance from the handle end of the equipment. (See figure 5-2.)

(21) Since the adjustments outlined in steps (19) and (20) above are inter-dependent to some degree, the procedure should be repeated until accurate full-scale indication for the .05 V. position, and accurate low-end-of-scale indication for the .5 V. position of RANGE SELECTOR S-102 is obtained.

(22) The procedure for adjusting the trimmer capacitors, C-107 and C-117, to provide uniformity of response up to 250 Kc is described in paragraph 6-5 below.

c. CHECKING WITH A 117-VOLT POWER SOURCE AND AUXILIARY EQUIPMENT.—If an accurate voltage-calibrated signal generator, within the frequency and amplitude characteristics listed in sub-paragraph *b.* (above) is *not* available, the performance check may be obtained by using the 117-volt sine-wave power source, in association with the following equipment:

(1) An a-c voltmeter, capable of indicating 500 volts, 100 volts, and 5 volts, r-m-s, with an accuracy of ±½% or better at the above reference voltages. (Individual a-c voltmeters, providing the same voltage indications with the same degree of accuracy at the 500, 100 and 5-volt marks, may be substituted.)

(2) A variable auto-transformer, capable of receiving 117-volts a-c from the power source at its input terminals.

(3) A step-up transformer with a 117-volt primary winding, and a nominal 500-volt secondary winding.

(4) A step-down transformer with a 117-volt primary winding, and a nominal 5-volt secondary winding.

(5) A non-inductive decade resistance box with a maximum range of 11,110 ohms, having an accuracy of ¼% or better. The decade resistance box should contain four decades, consisting of THOUSANDS, HUNDREDS, TENS, and UNITS. With the equipment set up as shown in Figure 3-2 voltages from 0.1 to 1 volt may be obtained on the THOUSANDS decade, depending on its setting, while all other decades are at the zero settings. Voltages from .01 to 0.1-volt may be obtained on the HUNDREDS decade, from .001 to .01-volt on the TENS decade, and from .0001 to .001-volt on the UNITS decade, while all other decades except the one in use are at the zero settings.

(6) A 1-megohm ±1% precision wire-wound non-inductive resistor.

d. PROCEDURE FOR CHECKING WITH

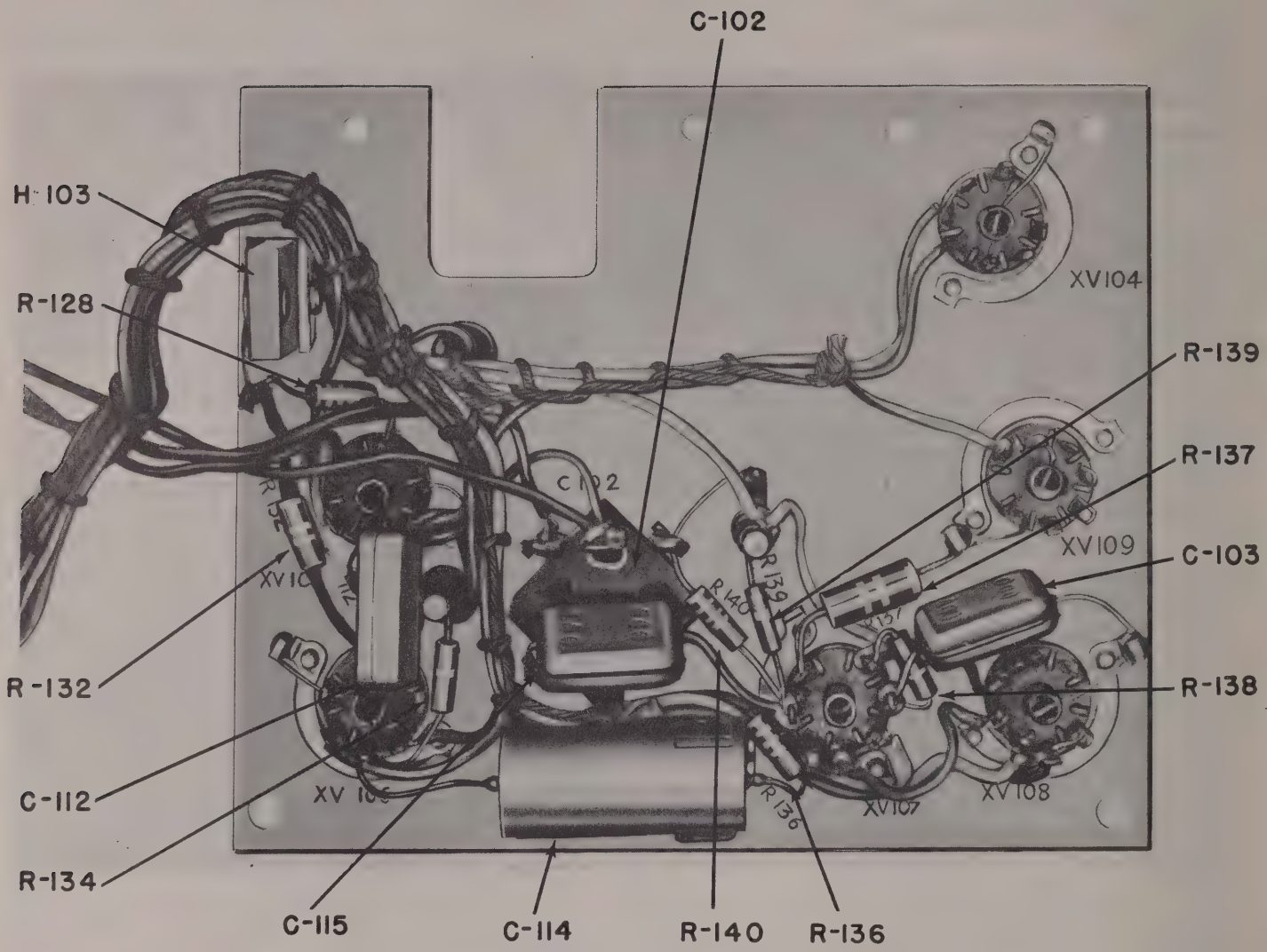


Figure 6-3. Electronic Multimeter ME-6C/U, Socket Terminal Side of Lower Amplifier-Chassis

POWER SOURCE AND AUXILIARY EQUIPMENT.—To check the performance of Electronic Multimeter ME-6C/U with the 117-volt power source and the auxiliary equipment listed immediately above, proceed as follows:

(1) Insert power cable W-101 into a power source delivering 117 volts a-c, within the frequency limits of 50 to 400 cps. Place the POWER switch ON, and allow a ten-minute warm-up period for the Electronic Multimeter.

(2) Rotate the OUTPUT CONTROL to its extreme counter-clockwise METER position.

(3) Connect the input of the auto-transformer to the power source. Connect the output of the auto-transformer to the step-up transformer. Then connect the output of the step-up transformer to the INPUT and GND. terminals of the Multimeter. Monitor the output of the transformer with the auxiliary a-c voltmeter capable of indicating 500 volts with an accuracy of ½%. Vary the control on the auto-transformer until the a-c voltmeter indicates a precise output of 500 volts ±½%.

CAUTION

Be sure to disconnect the auto-transformer from the power source BEFORE moving any signal leads. Turn the power ON *only after* all lead connections on the transformers, the auxiliary a-c voltmeter, and the Electronic Multimeter have been made and tightened on the respective terminal posts. Use extreme care to avoid touching the INPUT and GND. terminal posts on the ME-6C/U instrument. Failure to observe this precaution may result in shock.

(4) Set the RANGE SELECTOR to its 500 V. position. With the 500 volt r-m-s signal obtained from the power source through the variable auto-transformer and the step-up transformer applied to the Multimeter, the ME-6C/U meter should indicate a precise 500 volt full-scale deflection.

(5) Keep the RANGE SELECTOR at its 500 V. position. Apply a 50-volt r-m-s signal, obtained from the power source and the variable auto-transformer only, to the Multimeter. Monitor this voltage by the auxiliary a-c voltmeter capable of indicating 50 volts with an accuracy of ±½%. This signal should produce a 50-volt indication on the Multimeter, at the low end of the scale.

(6) Rotate the RANGE SELECTOR counter-clockwise to its 50 V. position and apply the same 50 volt ±½% signal that was used in step (5) above, with the same monitoring set-up. The Electronic Multimeter should indicate a precise full-scale 50 V. deflection.

(7) Keep the RANGE SELECTOR at its 50 V. position. Apply a 5 volt r-m-s signal, obtained from the power source through the variable auto-transformer and step-down transformer, to the Multimeter. Monitor this voltage by the auxiliary a-c voltmeter capable of indicating 5 volts with an accuracy of ±½%. This signal should produce a 5-volt indication on the Multimeter, at the low end of the scale.

(8) Rotate the RANGE SELECTOR counter-clockwise to its 5 V. position, and apply the same 5-volt ±½% signal that was used in step (7), above, with the same monitoring set-up. The Electronic Multimeter should indicate a precise full-scale 5-volt deflection.

(9) In order to check the Multimeter at its 0.5 V., .05 V., .005 V., and .0005 V. ranges, the decade resistance circuit, as shown in the accompanying illustration, figure 3-2, must be used. Disconnect the step-down transformer from the test set-up. Connect the output of the auto-transformer to the input of the decade resistance box through a 1-megohm precision wire-wound non-inductive resistor. Monitor the output of the auto-transformer with the aid of an a-c voltmeter capable of indicating 100 volts with an accuracy of ±½%. Vary the auto-transformer control until the monitoring meter shows an output of 100 volts ±½%. Then proceed as follows:

(a) Keep the RANGE SELECTOR on the Multimeter at its 5 V. position. Set the THOUSANDS decade on the decade resistance box to 5. (Set all other decades to zero.) With the output of the resistance box connected to the Multimeter terminals, this signal should produce a 0.5-volt indication on the ME-6C/U meter, at the low end of the scale.

(b) Rotate the RANGE SELECTOR counter-clockwise to its .5 V. position, and apply the same 0.5-volt ±½% signal that was used in step *(a)*, above. The Electronic Multimeter should indicate a precise full-scale 0.5-volt deflection.

(c) Keep the RANGE SELECTOR at its .5 V. position. Set the HUNDREDS decade on the decade resistance box to 5. (Set all other decades to zero.) With the output of the resistance box connected to the Multimeter terminals, this signal should produce a .05-volt indication on the ME-6C/U meter, at the low end of the scale.

(d) Rotate the RANGE SELECTOR counter-clockwise to its .05 V. position, and apply the same .05-volt ±½% signal that was used in step *(c)*, above. The Electronic Multimeter should indicate a precise full-scale .05-volt deflection.

(e) Keep the RANGE SELECTOR at its .05 V. position. Set the TENS decade on the decade resistance

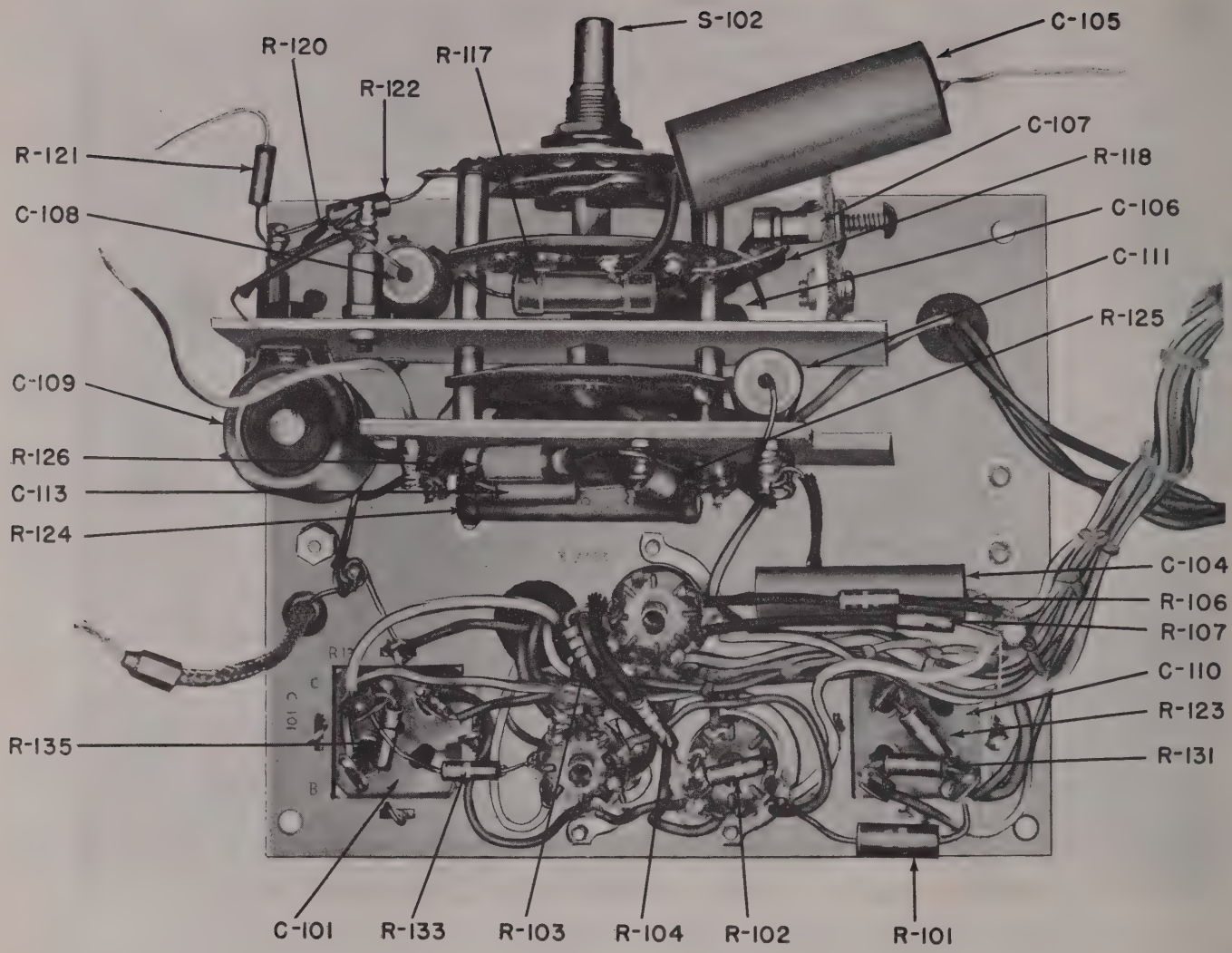


Figure 6-4. Electronic Multimeter ME-6C/U, Socket Terminal Side of Upper Power Supply Chassis, Showing Range Selector

box to 5. (Set all other decades to zero.) With the output of the resistance box connected to the Multimeter terminals, this signal should produce a .005 volt indication on the ME-6C/U meter, at the low end of the scale.

(f) Rotate the RANGE SELECTOR to its extreme counter-clockwise .005 V. position, and apply the same .005 volt ±½% signal that was used in step *(e)*, above. The Electronic Multimeter should indicate a precise full-scale .005-volt deflection.

(g) Keep the RANGE SELECTOR at its .005 V. position. Set the UNITS decade on the decade resistance box to 5. (Set all other decades to zero.) With the output of the resistance box connected to the Multimeter terminals, this signal should produce a .0005-volt indication on the ME-6C/U meter, at the low end of the scale.

(10) The above procedure is an accurate and thorough performance check of Electronic Multimeter ME-6c/o. Discrepancies in excess of ± 5% in the performance described above suggests the need for adjustment of the SENSITIVITY control R-112 and ZERO SUPPRESSION control R-116. The procedure to be followed for adjusting the SENSITIVITY and ZERO SUPPRESSION controls is described in paragraphs, 2b(16) to 2b(21), inclusive, of this section.

3. SIGNAL TRACING.

a. The a-c input signal applied to terminals E-101 and E-102 may be traced throughout the amplifier either by using an oscilloscope, such as Oscilloscope OS-8/U series, utilizing the sawtooth sweep generator incorporated in the scope, or by using an a-c electron tube voltmeter, such as a duplicate Electronic Multimeter ME-6C/U. If a tracking error is observed and it cannot be corrected by the SENSITIVITY and ZERO SUPPRESSION controls, refer to paragraph 6-6 for instructions.

b. If an oscilloscope is used, be sure to inter-connect the ground terminal of the scope to GND. terminal E-102 on the Multimeter. Solder a 50,000-ohm, ½ watt resistor, to the scope test lead in order to minimize the effect of hand capacitance. The signal can be traced at the circuit points indicated below. Sine waveforms should be observed throughout when sine-wave input is used. If waveshapes other than sinusoidal are observed, this is an indication of faulty operation due to tube failure. Judgment must be used in properly interpreting the waveforms, since the Multimeter incorporates a feedback amplifier. Clipping of either the positive or negative alternation of a cycle (or both alternations) will be observed when the input of the amplifier is overdriven. Check that RANGE SELECTOR S-102 is at the proper setting to accommodate the amplitude of the input signal.

c. PROCEDURE.—The overall gain of the amplifier and limiter circuit may be checked as follows:

(1) Apply 5 volts to input terminals. Then 5 millivolts is present at the grid pin 1 of cathode follower V-104, when RANGE SELECTOR is in the 5 V. position. Cathode follower operation causes a loss of about 10%, so that a signal of .0045 volt should be present at the high potential end of the bi-filar wound resistor R-124.

(2) This .0045 volt signal is coupled through C-111 to the grid pin 1 of first voltage amplifier V-105. No attempt should be made, however, to measure this potential across the high-impedance grid leak resistor R-128. The gain of V-105 is about 2 to 2.5. (Ordinarily the gain of a 6AK5 amplifier is about 100, but is reduced in this circuit to approximately 2, because feedback factor of about 50 is introduced into the cathode circuit of this stage.) A signal output of .01 volt should be present at the plate pin 5 of V-105.

(3) The second voltage amplifier V-106 has a gain of about 100. The output signal of this stage may be measured at the grid pin 5 of cathode follower V-107B, and should be 1.0 volt.

(4) The gain of amplifier-limiter V-107A is approximately 10. A signal voltage of 10 volts should be present either at the plate pin 1 of V-107A, or at grids pins 5 and 6 of cathode follower V-108.

(5) The output cathode follower V-108 introduces a loss of about 20%. The signal level, as measured from the cathode pin 7 of V-108 to ground, should be 8 volts.

(6) When the OUTPUT CONTROL is set to its extreme counter-clockwise METER position, an 8-volt a-c signal may be obtained from the negative end of coupling capacitor C-116 to ground. The signal is reduced in level at the input to the diodes CR-102A and CR-102B to 2 volts. Since the diodes operate as full-wave rectifiers, a signal level of about 1.85 volts may be measured across the ungrounded terminals of bridge rectifier resistors R-110 and R-114.

4. MEASURING FEEDBACK FACTOR.

a. If a measurement of the feedback factor is desired, proceed as follows:

(1) Rotate RANGE SELECTOR S-102 to its 5 V. position, and apply operating power to the equipment with the chassis outside of its housing.

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment outside of its housing.

(2) Obtain a signal source capable of delivering an a-c signal of about 2000 to 2500 cycles per second, of such an amplitude as to produce an indication of 0.1 volt across V-108 cathode resistors R-141 and R-142 to ground. Measure this potential with another Electronic Multimeter ME-6C/U, the calibration of which is known to be accurate. In making the measurement, be sure that the leads from the signal source, and the leads connecting to V-108 cathode are separated far enough to avoid mutual coupling to prevent oscillation. (See figure 6-2.)

(3) Solder a short length of wire across the terminals of the precision 2.6-ohm resistor R-130, at the exact point of grounding of R-130. Short-circuiting this resistor removes the feedback voltage from the amplifier circuit, and full gain of the amplifier will be obtained. The voltage present across V-108 cathode resistors R-141 and R-142 to ground will now be about 50 to 60 times greater than 0.1 volt. For a feedback factor of 50, for example, the potential across the parallel resistors R-141 and R-142 will be 5 volts.

b. This feedback factor of 50 to 60 will drop in value during the life of a set of tubes to a value of zero, over a considerable length of time. Zero feedback indicates that one or more tubes should be replaced. The frequency response, as well as the stability, of the instrument will not meet performance requirements if the tube(s) is not replaced. The feedback factor should not be permitted to drop below a figure of approximately 8.

c. It is always well to check on the feedback factor with the aid of an oscilloscope. Connect the scope probe to the cathode pin 7 of V-108. The signal should be sinusoidal in shape, with no evidence of clipping. If the display on the scope shows a clipped waveform, at either the positive or negative alternation, this is an indication that the input signal is too great in amplitude, and should be reduced at the signal source until the scope display is sinusoidal, with some hash on the base line, without changing the RANGE SELECTOR setting.

d. SUMMARY.—The ratio of voltages measured at cathode pin 7 of V-108, when performing the above procedure, is the feedback factor of the instrument.

5. TRIMMER CAPACITORS.

a. Two trimmer capacitors are used in the amplifying circuit of the instrument. Variable capacitor C-117, located in the feedback loop from the cathode of V-108 is used to compensate the frequency response near its upper frequency limit of 250 Kc. It has been correctly set at the factory and no further adjustment should be necessary. Input trimmer C-107, located in parallel with the input attenuator resistor R-117, is part of the network that compensates for the reactive components of the input circuit. No adjustment of the trimmers should be required under normal circumstances. If R-117 is replaced at any time, or if other components in the amplifier are replaced, or rewired, it may be necessary to readjust the trimmers to obtain proper performance at the upper frequency limit of 250 Kc. The following procedure should be used in that event:

(1) Obtain a stable sine-wave generator capable of delivering 5 volts over the frequency range of 2 Kc to approximately 250 Kc, such as the Audio Oscillator TS-382A/U.

(2) Rotate the RANGE SELECTOR to its 0.5 volt setting, and with the oscillator properly terminated and connected to the Multimeter input terminals, with a reasonably short length of shielded cable feed a 2 Kc signal of arbitrary but known level (approximate 0.2 to 0.5 volts) to the Multimeter noting its reading.

(3) Repeat the procedure of paragraph (2) above at exactly the same input level, but with 250 Kc instead of 2 Kc. If the indication of the Multimeter differs from that of the previous paragraph adjust it to the same reading by resetting trimmer capacitor C-117.

(4) Rotate the RANGE SELECTOR to its 5 volt position and with a signal of suitable level from the oscillator, repeat the procedure of paragraphs (2) and (3) above to obtain the proper adjustment of the input trimmer capacitor C-107.

6. THE RANGE SELECTOR RESISTORS.

a. Resistors R-124, R-125, and R-126, connected in the B section of RANGE SELECTOR S-102 are wire-wound non-inductive resistors constructed with bi-filar windings. Erroneous meter indications may be observed if one or more of these resistors develops a discontinuity in one of its bi-filar windings. For example, if the 4500-ohm resistor R-124 is the defective component, its value of resistance will change to double its correct rating, (or to 9000 ohms). With the RANGE SELECTOR set on the .05 V. or 50 V. position, the meter indication will then show half-scale, instead of full-scale, deflection when an input signal of .05 V. or 50 V. is applied at the INPUT and GND. terminals of the instrument. If, on the other hand, the meter indication is unreasonably high, while the RANGE SELECTOR position and input signal are the same as that stated immediately above, then the 450-ohm resistor R-125 is partially open, and requires replacement. (See figure 6-3.)

b. Whenever a doubt exists concerning the accuracy of these attenuator resistors, an ohmmeter check of R-124, R-125, and R-126 must be performed. If any

of these components shows an ohmmeter reading of twice its nominal value, as indicated on the schematic circuit diagram figure 6-4, this is a definite indication that the component should be replaced to maintain accuracy of the Multimeter.

c. Resistors R-117 and R-118 are connected in the A section of RANGE SELECTOR S-102. Their values are critical in the accurate tracking of the instrument. If a tracking error occurs in switching between the 0.5 V. and the 5 V. position of the RANGE SELECTOR, this is an indication that the 2-megohm 1-watt resistor R-117 has changed in value. The change may have been caused by an overload condition or by normal aging of the component. To remedy the defect, replace R-117 with a known accurate resistor meeting the detailed requirements of its description as listed in the Maintenance Parts List of this instruction book.

7. VOLTAGE MEASUREMENTS.

(See table 6-1.)

a. Voltage measurements are indispensable aids in the isolation of defective components. The voltages shown in table 6-1 may be taken as representative normal operating values for comparison purposes. The voltages shown are measured between the indicated points and ground, if not otherwise designated, using two separate voltmeters. Readings were obtained with a 20,000 ohms-per-volt instrument, and with an electronic voltmeter. The voltmeter range used should not exceed approximately twice the expected voltage value.

b. In order to take voltage measurements within the equipment, the chassis must be removed from its housing.

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by personnel. Extreme caution should be observed when working with the equipment.

TABLE 6-1. VOLTAGE MEASUREMENTS

(All D-C voltages are from indicated point to chassis ground unless otherwise indicated. Tolerance on all values is ±10%.)

Tube	Pin	Reading obtained with 20,000 ohms-per-volt voltmeter	Reading obtained with electronic voltmeter
**V-101	1	*290 A-c	...
	3	147	150
	4	147	150
	6	*290 A-c	...
	7	350	350
**V-102	1	212	217
	2	223	225
	3	147	150
	4	147	150
	5	350	350
	6	350	350
	7	212	217
**V-103	1	77	84
	2	87	88
	3	147	150
	4	147	150
	5	212	217
	6	235	245
	7	87	88

* Indicates a-c voltage from pin 1 of V-101 to ground, and pin 6 of V-101 to ground, taken with 1000 ohms-per-volt meter.

** Indicates a-c heater potential between pins 3 and 4 is 6.3 volts.

*** Indicates no reading.

Note: CR-101 produces 8.6 v AC between its AC input terminals, with all tubes inserted in their sockets. The rectifier produces 6.3 volts DC with all tubes inserted in their sockets.

TABLE 6-1. VOLTAGE MEASUREMENTS—Contd.

(All D-C voltages are from indicated point to chassis ground unless otherwise indicated. Tolerance on all values is ±10%.)

Tube	Pin	Reading obtained with 20,000 ohms-per-volt voltmeter	Reading obtained with electronic Voltmeter
V-104	1	. . .	12
	2	32	35
	3	0	0
	4	6.3	. . .
	5	128	138
	6	128	138
	7	32	35
V-105	1	. . .	—1.5
	3	0	0
	4	6.3	6.3
	5	70	75
	6	37	42
V-106	1	. . .	—1.5
	2	0	0
	3	0	0
	4	6.3	6.3
	5	55	60
	6	50	55
	7	0	0
**V-107	1	203	203
	2	223	225
	3	147	150
	4	147	150
	5	. . .	57
	6	55	58
	7	58	61
**V-108	1	350	350
	2	350	350
	3	147	150
	4	147	150
	5	203	203
	6	203	203
	7	206	212
V-109	1	87	88
	2	0	0
	4	0	0
	5	87	88
	7	0	0

* Indicates a-c voltage from 1 of V-101 to ground, and pin 6 of V-101 to ground, taken with 1000 ohms-per-volt meter.

** Indicates a-c heater potential between pins 3 and 4 is 6.3 volts.

*** Indicates no reading.

Note: CR-101 produces 8.6 v AC between its AC input terminals, with all tubes inserted in their sockets. The rectifier produces 6.3 volts DC with all tubes inserted in their sockets.

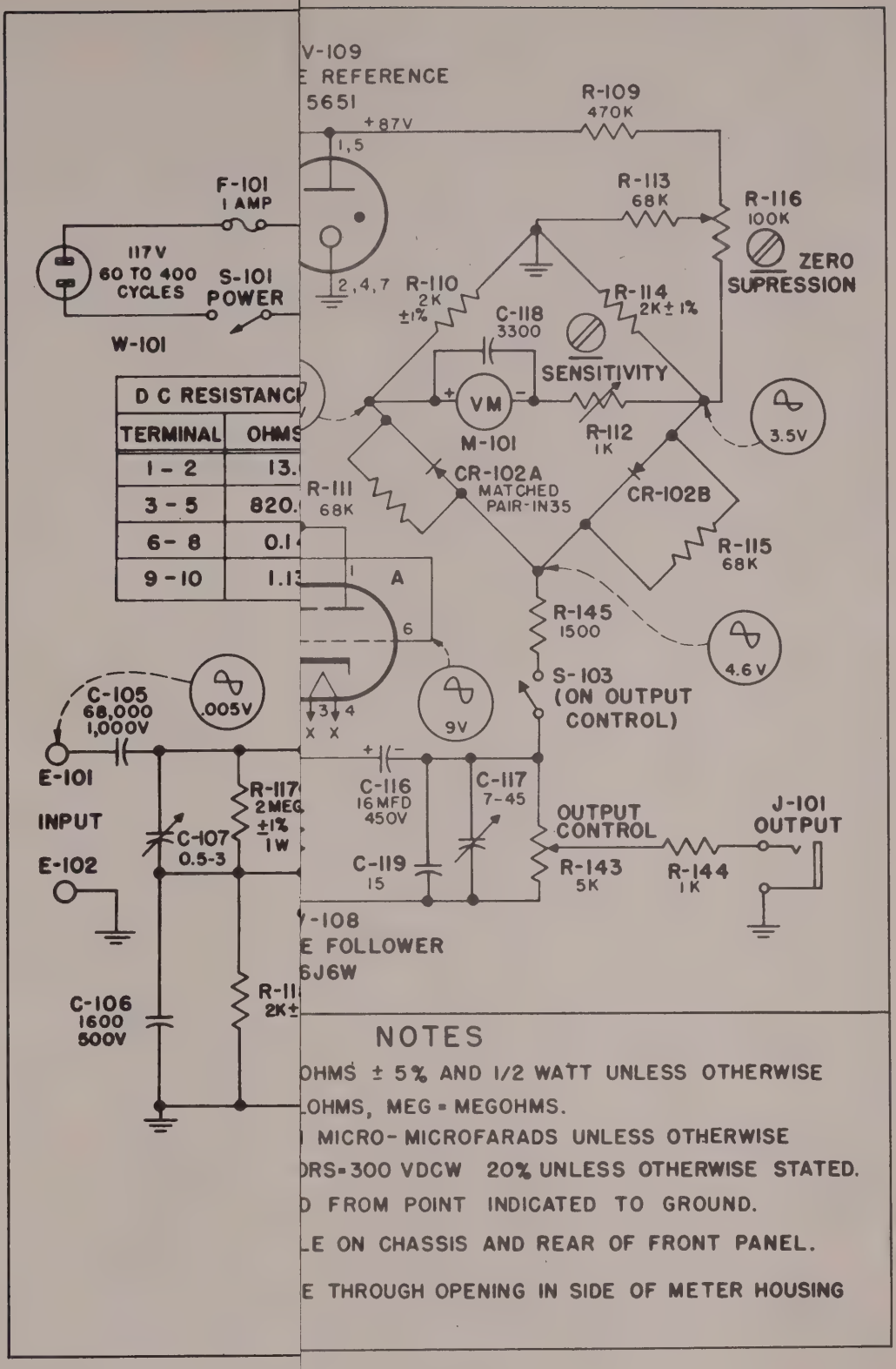


Figure 6-5. Electronic Multimeter ME-6C/U Schematic Circuit Diagram

TABLE 6-1. VOLTAGE MEASUREMENTS—Contd.

(All D-C voltages are from indicated point to chassis ground unless otherwise indicated. Tolerance on all values is ±10%.)

Tube	Pin	Reading obtained with 20,000 ohms-per-volt voltmeter	Reading obtained with electronic Voltmeter
V-104	1	. . .	12
	2	32	35
	3	0	0
	4	6.3	. . .
	5	128	138
	6	128	138
	7	32	35
V-105	1	. . .	—1.5
	3	0	0
	4	6.3	6.3
	5	70	75
	6	37	42
V-106	1	. . .	—1.5
	2	0	0
	3	0	0
	4	6.3	6.3
	5	55	60
	6	50	55
	7	0	0
**V-107	1	203	203
	2	223	225
	3	147	150
	4	147	150
	5	. . .	57
	6	55	58
	7	58	61
**V-108	1	350	350
	2	350	350
	3	147	150
	4	147	150
	5	203	203
	6	203	203
	7	206	212
V-109	1	87	88
	2	0	0
	4	0	0
	5	87	88
	7	0	0

* Indicates a-c voltage from 1 of V-101 to ground, and pin 6 of V-101 to ground, taken with 1000 ohms-per-volt meter.

** Indicates a-c heater potential between pins 3 and 4 is 6.3 volts.

*** Indicates no reading.

Note: CR-101 produces 8.6 v AC between its AC input terminals, with all tubes inserted in their sockets. The rectifier produces 6.3 volts DC with all tubes inserted in their sockets.

D C RESISTANCE	
TERMINAL	OHMS
1 - 2	13.0
3 - 5	820.0
6 - 8	0.14
9 - 10	1.13

NOTES

1. RESISTANCE VALUES IN OHMS ± 5% AND 1/2 WATT UNLESS OTHERWISE STATED. W = WATT, K = KILOHMS, MEG = MEGOHMS.
2. CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE STATED. PAPER CAPACITORS = 300 VDCW 20% UNLESS OTHERWISE STATED.
3. WAVE SHAPES MEASURED FROM POINT INDICATED TO GROUND.
4. ⊘ - ADJUSTMENT AVAILABLE ON CHASSIS AND REAR OF FRONT PANEL.
5. ⊘ - ADJUSTMENT AVAILABLE THROUGH OPENING IN SIDE OF METER HOUSING

Figure 6-5. Electronic Multimeter ME-6C/U Schematic Circuit Diagram

SECTION 7
PARTS LISTS

Table 7-1 constitutes the major portion of this section and is arranged first in alphabetical order, and then in numerical order of the reference symbols used. A reference symbol is assigned to each significant electrical and mechanical component of the equipment for which a replacement may be required or to which a reference is made in the drawings and text of this instruction book.

Electronic Multimeter ME-6C/U consists of a single chassis to which the numerical series 101-199 has been assigned. The first digit, therefore, has no special significance, but all three digits, together with the prefixed letter, identify the individual component to which reference is made.

A dash appearing in the Stock Numbers column indicates that the individual stock number was not available at the time of publication.

LIST OF ABBREVIATIONS USED IN THE TABLE OF REPLACEABLE PARTS

Abbreviation	Term
	A
adj	adjust, adjustable or adjustment
AC	alternating current
AWG	American Wire Gage
amp	ampere (s)
amplr	amplifier (s)
approx	approximate or approximately
assem	assembly
	B
Bind H	binding-head
x	by (as used to express dimensions)
	C
cad	cadmium
cap	capacity
ctr	center (ed)
CT	center tap or center tapped
c to c	center to center
C	centigrade
cir	circular
coef	coefficient
cond	conductor (s)
c o	consists (ing) of
cont	contact (s)
contr	contractor
ctb	counterbore
cur	current
cyc	cycle (s)
cps	cycles per second
	D
vdcw	DC working volts
db	decibel (s)
deg	degree (s)
d	depth or deep
diam	diameter
dimen	dimensions
DC	direct current
dwg	drawing (s)
	E
ea	each
elec	electric
encl	enclosed (ure)
equip	equipment
ext	external
	F
F	Fahrenheit
fil	filament (s)
1st	first
fl	flange
ft	foot (feet)
freq	frequency (-ies)
	G
gnd	ground (ed)
	H
hdw	hardware
h	height or high
HS	hermetically sealed
hex	hexagon or hexagonal
HV	high-voltage
horiz	horizontal
hr	hour (s)
	I
impr	impregnate (ed) (ion)
"	inch (es)
incl	includes, included, inclusive, including
ID	inside diameter (s)
ins	insulating, insulated or insulator (s)
int	internal

LIST OF ABBREVIATIONS USED IN THE TABLE OF REPLACEABLE PARTS — Cont'd

Abbreviation	Term
	J
JAN	Joint Army-Navy
	L
lg	length or long
ltr	letter
lin	linear
	M
mfr	manufacturer (s)
max	maximum
meg	megohm (s)
ua	microampere (s)
mf	microfarad (s)
mmf	micromicrofarad (s)
ma	milliampere (s)
min	minimum
mtd	mounted
mtg	mounting
mtg/c	mounting center (s)
mts	mounts
	N
neg	negative
#	number (s)
	O
oper	operating
OD	outside diameter (s)
o/a	overall
	P
p/o	part of
%	per cent
ph	phase
pl	plated
±	plus or minus
pos	positive
pt/dwg	part drawing

Abbreviation	Term
	R
rad	radius
rect	rectifier
ref	reference
	S
scdr	screwdriver
secd	secondary (ies)
sect	section (s)
spcl	special
spec	specification (s)
SPDT	single pole, double-throw
SPST	single- pole, single-throw
stk	stock
sw	switch
	T
temp	temperature
term	terminal (s)
thk	thick or thickness
tubr	tubular
thd	thread (s)
	V
vert	vertical
v	volt (s) or voltage
	W
w	watt (s)
wt	weight
wd	wide or width
WW	wire-wound
w/	with
w/o	without
wnd	wound, winding (s)

TABLE 7—1. TABLE OF REPLACEABLE PARTS

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
101-199	———— ———— ————	ELECTRONIC MULTIMETER ME-6 C/U: range, .05 to 500 v AC in 6 steps, —5 to +17 db scale; ±3% accuracy; 4½ in. dia basic meter with logarithmic sensitivity response; input impedance, 2 megohms in shunt with 15 mmf; operating power, 117 v AC ±10%, 50 to 400 cycles per second, single ph, 31 W; o/a dim. 11⅝ in. lg, 5¾ in. wide, 5⅞ in. high; aluminum alloy case w/grey enamel finish; logarithmic scale divisions w/ suppressed zero; Specialty Engineering Division of Specialty Assby & Pkg Co., Brooklyn, N. Y. (mfr and contr); Navy Spec No. MIL-E-17001.	
A-101	———— *———— ————	CABINET: instrument housing; aluminum, grey enamel finish; w/laminated schematic wiring diagram; 5-¾ in. wide, 4-7/16 in. high, 11-7/32 in. long o/a; w/eight #6-32 clinch nuts for mounting panel; p/o Navy Electronic Multimeter, ME-6 C/U; Specialty Assby & Pkg Co, part no. 442-5A.	Instrument housing
A-102	———— ———— ————	COVER, TELEPHONE JACK: steel, black enamel finish; 1-1/32 in. lg, 13/16 in. wide, 9/32 in. high; ⅜ in. dia mtg hole; M&M Metal Mfg Co (mfr) type 7235A.	Water and dust shield for J-101
A-103	———— N 17-S-150263-102 ————	SEAL, WATER: c/o silicone rubber gasket, silicone rubber "O" ring, and special brass, nickel plated mtg nut w/15/32—32 thread; approx 5/16" h x ¾" OD; Radio Freq Lab (mfr) part #H-1267.	Water and dust seal for switch, S-101
C-101	3DB20-129 N 16-C-22643-2777 3330-318508784	CAPACITOR, FIXED, ELECTROLYTIC: 3 sect; 20 mf —10% +50% ea sect; 450 vdcw; —60 to 85 deg C working temp range; sealed cylindrical metal case, 2⅜" lg x 1⅜" dia; 3 solder lug type terminals, located on bottom; all pos term. ins from common neg case; mounts w/4 twist prongs 90 deg apart on bottom of case; Aerovox (mfr) Type E4C211.	Input filter +B supply, screen bypass for V-106, filter for 6.3 VDC supply
C-102	3DB1500-2 N 16-C-20979-5711 3330-317631511	CAPACITOR, FIXED, ELECTROLYTIC: 1 sect; 1500 mf —10% +250%; 15 vdcw; —60 to +85 deg C working temp range; sealed cylindrical metal case, 2" lg x 1⅜" dia; 1 solder lug type term; pos term ins from neg case; mounts w/4 twist prongs 90 deg apart on bottom of case; Aerovox (mfr) Type E4A58.	Filter for filament supply
C-103	3K3551-221 ———— 3330-376152380	CAPACITOR, FIXED, MICA DIELECTRIC: 5100 mmf ±5%; 500 vdcw; low loss bakelite case, 53/64" lg x 53/64" wide x 9/32" thk; 2 wire lead term; JAN type CM35C512J; Aerovox (mfr) Type CM358512J.	RF bypass for V-107B plate
C-104	3DA100-941 N 16-C-45804-9201 3330-317760166	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 100 000 mmf ±20%; 300 vdcw; —55 to +85 deg C ambient temp range; HS metal case, 1⅜" lg x 13/32" dia; 2 axial wire lead term; mineral oil filled; mineral oil impregnation; term mtg; w/ vinyl ins sleeve; Sprague (mfr) Type 191P10403S4.	Couple plus B voltage to V-103 control grid
C-105	3DA68-4 N-16-C-44964-5110 3330-316172005	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 68000 mmf ±20%; 1000 vdcw; —55 to +85 deg C ambient temp range; HS metal case, 1⅝" lg x 9/16 in. dia; 2 axial wire lead term; mineral oil filled; mineral oil impregnation; term mtg; w/ vinyl insulating sleeve; Sprague (mfr) Type 191P68301OS4.	D-C blocking V-104 grid
C-106	3K3510-331 ———— 3330-376144100	CAPACITOR, FIXED, MICA DIELECTRIC: 1600 mmf ±5%; 500 vdcw; —200 to +200 parts per milion per deg C temp coefficient; low loss bakelite case, 53/64 in. lg x 53/64 in. wide x 9/32 in. thk; 2 wire lead term; term mtg; JAN type CM30C162J; Aerovox (mfr) Type 1467LSTV, MC-4754.	p/o high impedence voltage divider V-104 grid
C-107	3D9003V-17 N 16-C-63861-2826 3330-312794141	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 1 sect; 0.5 to 3 mmf; 300 vdcw; 1 in. lg x 15/32 in. dia o/a dim; 1 radial wire lead term; mounted in oval hole w/ special nut; screwdriver adjust; Centralab (mfr) Part No. XA1482.	Input trimmer V-104 grid
C-108	3DA68-3 N 16-C-44964-4930 3330-316172004	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 68000 mmf ±20%; 300 vdcw; —55 to +85 deg C temp range; HS metal case, 1⅛ in. x 13/32 in. dia; 2 axial wire lead term; mineral oil filled; mineral oil impregnation; w/ vinyl insulating sleeve; Sprague (mfr) Type 191P68303S4.	D-C blocking for bias voltage, V-104 grid
C-109	3DB50-92 N 16-C-19958-8855 3330-3175590612	CAPACITOR, FIXED, ELECTROLYTIC: 1 sect; 50 mf —10% +100%; 50 vdcw; —20 to +85 deg C working temp range; tubular metal case w/outer cardboard sleeve, 1½ in. lg x 13/16 in. dia; 2 axial wire lead term; term mtg; Mallory (mfr) Type TC-39.	Couples V-104 cathode to RANGE switch S-102
C-110		Same as C-101.	Plate bypass for V-104; decoupling for V-104, 105, 106; screen bypass for V-105
C-111		Same as C-104.	D-C blocking for bias voltage to V-105 grid

*"Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated."

TABLE 7—1. TABLE OF REPLACEABLE PARTS — Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
C-112	3D9680-19 ———— ————	CAPACITOR, FIXED, MICA DIELECTRIC: 3300 mmf ±10%; 500 vdcw; low loss bakelite case, 53/64 in. lg x 53/64 in. wide; 9/32 in. thk; 2 axial wire lead term; term mtg; JAN Type CM30A332K; Aerovox (mfr) Type 1468LS; Cornell-Dubilier (mfr) Type CM30A332K.	Couples V-105 to V-106 grid
C-113	———— ———— ————	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 39 mmf ±5%; 500 vdcw; 470 mmf per mf neg temp coeff, 120 mmf tolerance; insulated; 0.562 in. lg, 0.25 in. dia; 2 axial wire lead term; term mtg; JAN type CC21TJ390J; Erie Resistor Co (mfr) part number CC21TJ390J.	V-106 grid capacitance compensation for R-124
C-114	3DA220-2 N 16-C-46201-1001 3330-316478006	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 220 000 mmf ±20%; 300 vdcw; —55 to +85 deg C temp range; HS metal case, 1⅜ in. lg x 9/16 in. dia; 2 axial wire lead term; mineral oil filled; mineral oil impregnated; term mtg; w/ vinyl insulating sleeve; Sprague (mfr) Type 191P22403S4.	Couples V-106 to V-107B grid
C-115		Same as C-103.	Bypass for V-107 grids
C-116	3DB15-59 N 16-C-19643-6905 3330-317470595	CAPACITOR, FIXED, ELECTROLYTIC: 1 sect; 16 mf —10% +50%; 450 vdcw; —10 to +50 deg C working temp range; tubular metal case w/outer cardboard sleeve, 1¾ in. lg x 15/16 in. dia; 2 axial wire lead term; term mtg; Mallory (mfr) Type TC-74.	Couples V-108 to rectifier circuit and output jack J-101
C-117	3D9045V-2 N 16-C-64133-6581 3330-313420119	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: rotary type; 1 sect; 7 to 45 mmf; 500 mmf per mf per deg C temp coeff; 500 vdcw; 0.848 in. lg x 0.643 in. wide; x 0.5 in. high o/a; 2 solder lug term; two 0.120 dia mtg holes spaced 0.438 in. C to C; screwdriver adjust; JAN Type CV11C450; Centralab (mfr) Type 822BN.	High frequency trimmer for 0.005 position of range switch, S-102
C-118		Same as C-112.	R.F. meter shunt
C-119	———— ———— ————	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 15 mmf ±10%; 500 vdcw; 750 mmf per mf per deg C neg temp coeff, 120 mmf pos tolerance; 0.400 in. lg, 0.200 in. dia; 2 radial wire lead term; term mtg; JAN-C-20A; Jan type CC20UJ150K; Erie Resistor Co (mfr) type CC20UJ150K.	Capacitance complement for C-117
CR-101	———— N 17-R-50926-8501 ————	RECTIFIER, METALLIC; magnesium—copper sulphide; single phase full wave bridge; 9.7 v AC input; 7.8 vdc at 1.1 amp output; cylindrical shape, 2 in. lg x ⅝ in. dia; two 8-32 threaded mtg studs, one at ea end; 5 solder lug type term located radially; salt-spray and humidity resistant; Mallory (mfr) Type 1S12R.	Full wave bridge rectifier for V-104, V-105, V-106 filament supply
CR-102	———— N 16-T-51735 3370-209000-1365	CRYSTAL UNIT, RECTIFYING: germanium type; 0.022 amp max continuous forward current; c/o pair of rectifying elements whose forward current characteristic is matched to ±10% at +1 volt; ¾ in. lg x 9/32 in. dia ea unit; mounts by 2 axial wire lead term; Sylvania (mfr) Type 1N35.	Rectifier for meter, M-101
E-101	———— N 17-P-69143-3176 ————	POST, BINDING: brass, nickel plated w/red phenolic insulation; ⅞ in. high above mtg surface, ⅝ in. OD; w/mtg stud 25/32 in. lg, 10-32 thread; captive cap and ins bushing; Superior Elec Co (mfr) Type DF30RC.	Input signal connector
E-102	———— N 17-P-69136-2412 8880-387193496	POST, BINDING: brass, nickel plated w/black phenolic ins; ⅞ in. high above mtg surface, ⅝ in. OD; w/mtg stud 25/32 in. lg, 10-32 thread; captive cap and ins bushing; Superior Elec Co (mfr) Type DF30BC.	Input signal ground connector
E-103	3A9048 N 17-B-72726-5151 3300-302027715	BIAS CELL: 1½ v; round button shape, 11/32 in. lg x ⅝ in. dia o/a; metallic case; mounts on spring clip; Mallory (mfr) Type BC-3.	Bias voltage for V-105 and V-106
E-104	2Z8304.57 N 16-S-34520-3864 3370-774000-1925	SHIELD, ELECTRON TUBE: brass, nickel plated; 1⅜ in. lg x 0.180 in. ID; spring loaded detent mtg; JAN Type TS102U01; Elco Corp (mfr) Type TS102U01.	V-104 tube shield
E-105		Same as E-104.	V-105 tube shield
E-106		Same as E-104.	V-106 tube shield
E-107	2Z8304.276 N 16-S-34557-8351 3370-774000-1955	SHIELD, ELECTRON TUBE: brass, nickel plated; 1¾ in. lg x 0.180 in. ID; spring loaded detent mtg; JAN Type TS102U02; Elco Corp (mfr) Type TS102U02.	V-109 tube shield
E-108	———— ———— ————	TERMINAL, STUD: 2 amp, 500 v elec rating; melamine ins; mounts by 4-40 thread stud, 7/32 in. lg; o/a dim. 15/16 in. lg x ¼ in. OD; Garde Mfg Co (mfr) Type 3449-4.	Insulated terminal connecting stud

TABLE 7–1. TABLE OF REPLACEABLE PARTS – Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
F-101	3Z1926 G 17-F-16302-80 ————	FUSE: cartridge type; 1 amp 250 v elec rating; operating data, instantaneous, 135% over load for 1 hr; ferrule type term; 1¼ in. lg x ¼ in. dia o/a; Bussman (mfr) Type AGC-1.	Power line fuse
F-102		Same as F-101.	Running spare
H-101	2Z5822-316 N 16-K-700350-251 3320-292241488	KNOB: round, black phenolic; w/brass insert for ¼ in. dia shaft, ⅜ in. lg; mounts w/2 set screws 90 deg apart; w/white indicator line; 1½ in. dia x 13/16 in. high o/a; Kurz-Kasch (mfr) Type S-380-64-BB-DD-L.	Position selector for range switch, S-102
H-102	———— N 16-K-700314-658 3320-292221770	KNOB: round, black phenolic; w/brass insert for ¼ in. dia shaft, 7/16 in. lg; no markings; 1⅛ in. dia x ⅜ in. high o/a; w/white plastic pointer to ⅝ in. radius; w/two set screws; Kurz-Kasch (mfr) Type S-308-64-BB-40275.	Control knob for A-C output control
H-103	———— *17-H-69701-1151 ————	HOLDER, BIAS CELL: beryllium copper w/bakelite insulator; nickel plated; holds bias cell by spring clip, 1 mtg hole 0.120 in. dia; w/1 solder lug type term; for mounting bias cell Mallory Type BC-3; Specialty Assby & Pkg Co (mfr) pt/dwg no. 442-E-26; Marked E-103.	Holder r bias cell, E-103
I-101	2Z5952 G 17-L-6297 8870-938000-375	LAMP, INCANDESCENT: 6-8 v, 1 watt, 0.15 amp; miniature bayonet base; T-3¼ clear bulb; type C2 tungsten filament; 1-3/16 in. max o/a height; GE (mfr) Type 47.	Pilot lamp
J-101	2Z5534 N 17-J-39248-4418 8850-735850	JACK, TELEPHONE: accommodates 2 cond plug; contact arrangement J1, MBCA Ref Dwg Group 4; 1-3/16 in. lg x 13/16 in. dia o/a dim.; mounts in ⅜ in. dia hole; moisture and fungus proofed; JAN Type JJ-034; Switchcraft (mfr) Type XA-995.	Signal output jack
M-101	———— ———— ————	METER: multiscale; 44 ua to 1388 ua 4½ in. OD metal case; barrel 3½ in. OD, 1-9/16 in. deep behind flange; ±2% accuracy; D'Arsonval movement; "logarithmic" sensitivity response; 76 scale divisions on upper volts RMS scale; marked from 0.5 to 5.0 volts; 44 divisions on low DB scale; marked from —5 to +17 db; 3 mtg holes equally spaced on 2-1/16 in. radius; 2 solder lug term; special scale markings; hermetically sealed; Hickok (mfr) Type 48HS; Specialty Assby & Pkg Co (contr) part #442-E-29.	AC voltage and decibel indicator
R-101	3RC30BF153L N 16-R-50335-751 3300-381317120	RESISTOR, FIXED, COMPOSITION: 15000 ohms ±5%; 1 W; "F" temp characteristic; 0.750 in. lg, 0.280 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN Type RC30BF153J; AB (mfr) Type GB-1535.	Decoupling V-104, V-105, V-106
R-102	3RC20BF154J N 16-R-50677-431 3300-381167180	RESISTOR, FIXED, COMPOSITION: 150 000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN Type RC20BF154J; AB (mfr) Type EB-1545.	Grid bias for V-102 and plate load for V-103
R-103	3RC20BF393J N 16-R-50443-446 3300-381169360	RESISTOR, FIXED, COMPOSITION: 39000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF393J; AB (mfr) type EB-3935.	Part of screen voltage divider for V-103
R-104	3RC20BF224J N 16-R-50713-431 3300-331168160	RESISTOR, FIXED, COMPOSITION: 220 000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF224J; AB (mfr) type EB-2245.	Part of screen voltage divided for V-103
R-105	———— ———— ————	RESISTOR, VARIABLE: composition; 1 sect; 100,000 ohms ±20%; 2 W; "D" taper; 3 solder lug type term; ¼ in. dia shaft; ½ in. lg from mtg surface; w/scdr slot adjust; high torque; mounts by #3/8-32 bushing ⅜ in. lg; CTS (mfr) type SX1887.	Part of voltage divider for V-103 grid bias
R-106	3RC20BF474J N 16-R-50821-431 3300-381169840	RESISTOR, FIXED, COMPOSITION: 470,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF474J; AB (mfr) type EB-4745.	Part of voltage divider for V-103 grid bias adjust
R-107	3RC20BF104J N 16-R-50632-431 3300-381166200	RESISTOR, FIXED, COMPOSITION: 100,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF104J; AB (mfr) type EB-1045.	Voltage dropping plate of V-109
R-108		Same as R-104.	Part of voltage divider for V-103 grid
R-109		Same as R-106.	Voltage dropping, suppression adjust

*"Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated."

TABLE 7–1. TABLE OF REPLACEABLE PARTS – Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
R-110	———— ———— ————	RESISTOR, FIXED, COMPOSITION: 2000 ohms ±1%; ½ W; "F" temp characteristic; 13/16 in. lg; 11/64 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; Elektra Mfg Co type DC½.	Part of bridge rectifier circuit for meter, M-101
R-111	3RC20BF683J N 16-R-50551-431 3300-381170620	RESISTOR, FIXED, COMPOSITION: 68,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; JAN type RC20BF683J; AB (mfr) type EB-6835.	Shunt for rectifier CR-102A
R-112	3RA5713 N 16-R-90754-3621 ————	RESISTOR, VARIABLE: wire-wound; 1000 ohms ±10%; 2 W; 3 solder lug term; molded phenolic body; 1.280 in. max dia x 0.620 max d; ¼ in. dia shaft, ½ in. lg from mtg surface; lin taper; mtg bushing ⅜—32 thd x ⅜ in. lg; high torque; JAN type RA20A2SA102AK; Spec JAN-R-19; CTS (mfr) type RA20A2SA102AK.	Sensitivity adjustment, high end of meter scale
R-113		Same as R-111.	Limiting suppression voltage circuit
R-114		Same as R-110.	Part of bridge rectifier circuit for meter, M-101
R-115		Same as R-111.	Shunt for rectifier CR-102B
R-116		Same as R-105.	Suppression adjustment for low end of meter scale
R-117	———— ———— ————	RESISTOR, FIXED, COMPOSITION: 2 meg ±1%; 1 W; "F" temp characteristic; 15/16 in. lg, 9/32 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; Elektra Mfg Co (mfr) type DC-1.	Signal input impedance, V-104 grid
R-118		Same as R-110.	Signal input impedance, V-104 grid
R-119	3RC20BF510J N 16-R-49444-431 3300-381169960	RESISTOR, FIXED, COMPOSITION: 51 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF510J; AB (mfr) type EB-5105.	Parasitic suppressor, V-104 grid
R-120	3RC20BF205J N 16-R-51046-431 3300-381166880	RESISTOR, FIXED, COMPOSITION: 2 meg ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resstant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF205J; AB (mfr) type EB-2055.	Grid leak, V-104
R-121	3RC20BF102J N 16-R-49921-431 3300-381166080	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF102J; AB (mfr) type EB-1025.	Cathode load, V-104
R-122	3RC20BF103J N 16-R-50281-431 3300-381166140	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF103J; AB (mfr) type EB-1035.	Cathode load, V-104
R-123		Same as R-122.	Plate load, V-104
R-124	3Z6450-29 N 16-R-80297-9899 3350-391850333	RESISTOR, FIXED, WIRE-WOUND: non-inductive; 4500 ohms ±½%; 6 W; 105 deg C max ambient operating temp; 1⅝ in. lg, ⅜ in. dia; insulating lacquer; 2 axial wire lead term; term mtg; temp coeff +.002% per deg C; Instrument Resistor Co (mfr) type BLAN.	Part of signal voltage divider, V-105 grid
R-125	3Z5992E5-2 ———— ————	RESISTOR, FIXED, WIRE-WOUND: non-inductive; 450 ohms ±½%; ½ W; 105 deg C max ambient operating temp; ⅝ in. lg x 3/16 in. dia; moisture proof insulating lacquer; 2 axial wire lead term; term mtg; temp coeff +.002% per deg C; Instrument Resistor Co Type WLAN-⅝.	Part of signal voltage divider, V-105 grid
R-126	———— ———— ————	RESISTOR, FIXED, WIRE-WOUND: non-inductive; 50 ohms ±½%; ½ W; 105 deg C max ambient operating temp; ⅝ in. lg x 3/16 in. dia; moisture proof insulating lacquer; 2 axial wire lead term; term mtg; temp coeff +.002% per deg C; Instrument Resistor Co Type WLAN-⅝.	Part of signal voltage divider, V-105 grid
R-127		Same as R-104.	Plate load, V-105
R-128	3RC20BF334J N 16-R-50758-431 3300-381166264	RESISTOR, FIXED, COMPOSITION: 330,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF334J; AB (mfr) type EB-3345.	Grid leak, V-105

TABLE 7—1. TABLE OF REPLACEABLE PARTS — Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
R-130	———— ———— ————	RESISTOR, FIXED, WIRE-WOUND: non-inductive; 2.6 ohms ±½%; ½ W; 300 deg C max ambient operating temp; 9/16 in. lg x 7/32 in. dia; ceramic sleeve covering; resistant to moisture and fungus; 2 axial wire lead term; term mtg; Boykin-Fruth (mfr) type SM-P.	Part of negative feed back impedance, V-105 cathode
R-131	3RC20BF105J N 16-R-50974-431 ————	RESISTOR, FIXED, COMPOSITION: 1 meg ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF105J; AB (mfr) type EB-1055.	Screen dropping, V-105
R-132		Same as R-106.	Grid leak, V-106
R-133		Same as R-107.	Isolating
R-134		Same as R-107.	Plate load, V-106
R-135	3RC20BF564J N 16-R-50857-431 3300-381170240	RESISTOR, FIXED, COMPOSITION: 560,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF564J; AB (mfr) type EB-5645.	Screen dropping, V-106
R-136		Same as R-106.	Grid leak, V-107
R-137		Same as R-101.	Cathode load for V-107B and cathode impedance for V-107A
R-138	3RC20BF153J N 16-R-50335-431 3300-381167120	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg x 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF153J; AB (mfr) type EB-1535.	Plate load, V-107A
R-139		Same as R-107.	Voltage divider, fixed bias for V-107 grids
R-140	3RC20BF333J N 16-R-50416-431 3300-381168940	RESISTOR, FIXED, COMPOSITION: 33000 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg x 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF333J; AB (mfr) type EB-3335.	Voltage divider, fixed bias, for V-107 grids
R-141	3RC42BF73J ———— 3300-381604461	RESISTOR, FIXED, COMPOSITION: 47000 ohms ±5% 2 W; "F" temp characteristic; 0.750 in. lg x 0.370 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC42BF473J; AB (mfr) type HB-4735.	Cathode load, V-108
R-142		Same as R-141.	Cathode load, V-108
R-143	———— ———— ————	RESISTOR, VARIABLE: wirewound; 1 sect; 5000 ohms ±5%; 2 W; "D" taper; 3 solder lug term; 1⅜ in. dia x 1⅛ in. deep incl switch term; ¼ in. dia shaft, ¾ in. lg from mtg surface; mtg bushing ⅜-32 thd x ⅜ in. lg; w/SPDT switch elec rating 3 amp, 125 v AC, operates at start of rotation; Centralab (mfr) Type S22-013-006.	AC output control
R-144		Same as R-121.	Limiting output connector J-101
R-145	3RC20BF152J N 16-R-49966-431 3300-381167060	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±5%; ½ W; "F" temp characteristic; 0.406 in. lg, 0.175 in. dia; ins; resistant to humidity; 2 axial wire lead term; term mtg; JAN type RC20BF152J; AB (mfr) type EB-1525.	Voltage dropping to meter rectifier circuit
S-101	3Z9863-42A N 17-S-70412-4406 ————	SWITCH, TOGGLE SPST: 15 amp, 125 v AC; black phenolic body 1-9/64 in. lg x 41/64 in. wide x 1-1/16 in. deep including term; bat type handle 1-5/32 in. lg including bushing; 2 solder lug term; mtg bushing 15/32—32 thd x ½ in. lg from mtg surface; JAN type ST-42A; Cutler-Hammer (mfr) type ST-42A.	Power OFF-ON switch
S-102	3Z9825-62.395 N 17-S-64603-8201 3360-395499487	SWITCH, ROTARY: 2 sections; 2 poles, 6 throws; silver alloy contacts; phenolic switch sections; 2-3/16 in. lg x 1⅞ in. high x 1⅝ in. wide; mtg bushing ⅜—32 thd x ⅜ in. lg; ¼ in. dia shaft, ⅞ in. lg from mtg surface; moisture and fungus resistant; shorting type contacts; Oak (mfr) type 41648-H2.	Range selector for meter, M-101
T-101	———— ———— ————	TRANSFORMER, POWER, STEP-UP AND STEP-DOWN: 117 v, 50 to 400 cyc, single ph; 3 output windings; HV secd. 290 v to ground at 28 ma CT; filament secd, 6.3 v at 2.28 ma CT; metallic rect secd, 8.6 v at .53 amp; thermosetting plastic encapsulation; resistant to humidity; Class I Grade A in acc/w MIL-T-27; 2" x 2" mtg centers; 3" lg x 3½ x 2¾ max dim.; Stanley Transformer Co (mfr) part #442-E-58; Specialty Assby & Pkg Co (contr) pt/dwg #442-E-58.	Power transformer

TABLE 7—1. TABLE OF REPLACEABLE PARTS — Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
TB-101	———— *———— ————	TERMINAL BOARD: phenolic board, grade LTS-E4 as per MIL-P-14a; includes 6 term style no. 4, MBCA Ref Dwg Group 21; w/o barriers; o/a dim. 3-9/16 in. lg, 1¾ in. wide, 3/32 in. thk excluding term; two 0.140 in. dia mtg holes, 1-9/16 in. C to C; marked R-124, R-125, R-126, C-109, C-111; Specialty Assby & Pkg Co (mfr & contr) pt/dwg no. 442-E-21; p/o Navy Electronic Multimeter, ME-6 C/U.	Mounting plate for R-124, R-125, R-126, C-109, C-111
TB-102	———— *———— ————	TERMINAL BOARD: phenolic board, grade LTS-E4 as per MIL-P-14a; includes 10 term style no. 7, MBCA Ref Dwg Group 21; w/o barriers; o/a dim. 2-5/16 in. long, 2 in. wide, 3/32 in. thk excluding term; two 0.152 in. dia mtg holes, 1⅜ in. C to C; marked R-110, R-114, R-144, R-145, R-111, CR-102A, CR-102B; Specialty Assby & Pkg Co, pt/dwg no. 442-E-22; p/o Navy Electronic Multimeter, ME-6 C/U.	Mounting plate for R-110, R-114, R-144, R-145, R-111, CR-102A, CR-102B
V-101	2J6X4W N 16-T-57840-50 ————	ELECTRON TUBE: JAN type 6x4 W; full wave sect; miniature 7 pin base; Spec JAN-1A.	Rectifier
V-102	2J6005 N 16-T-56198-50 3300-298420100	ELECTRON TUBE: JAN type 6005/6AQ5W; beam pentode; miniature 7 pin base; Spec JAN-1A.	Series voltage regulator
V-103	2J5654 N 16-T-56191-50 ————	ELECTRON TUBE: JAN type 5654/6AK5W; pentode amplifier; miniature 7 pin base; Spec JAN-1A.	D-C amplifier
V-104		Same as V-103.	Cathode follower input stage
V-105		Same as V-103.	First voltage amplifier
V-106		Same as V-103.	Second voltage amplifier
V-107	2J6J6W N 16-T-56365-0000 ————	ELECTRON TUBE: JAN type 6J6W; twin triode; miniature 7 pin base; Spec JAN-1A.	Amplifier-limiter, cathode follower
V-108		Same as V-107.	Cathode follower
V-109	2J5651 N 16-T-75651 3370-331000-5655	ELECTRON TUBE: JAN type 5651; gas discharge type of voltage ref tube; miniature 7 pin base; Spec JAN-1A.	Voltage reference stage
W-101	———— *———— ————	CABLE ASSEMBLY, POWER, ELECTRICAL: Underwriters Lab Type SV; 2 conductors, stranded, no. 18 AWG; "Buna S" insulation, and "Buna S" jacket; 7 feet 4 in. o/a length; molded Buna S plug cap at one end; conductors on second end extend 1½ in. beyond end of jacket, wires tinned; Cornish Wire Co (mfr); Specialty Assby & Pkg Co pt/dwg no. 442-E-64.	Input power cable
W-102	———— *———— ————	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: single conductor no. 20 AWG, JAN type SRIR; w/tinned copper braided shield; w/o insulating jacket; extreme o/a length, excluding branches 3 in.; braided shield terminated at first end w/solderless ground shield connector; inner conductor extends 1 in. beyond shield; second end termination of shield w/solderless ground shield connector and bare #20 tinned copper wire 1½ in. lg, inner conductor extends 1 in. beyond shield; Specialty Assby & Pkg Co. pt/dwg no. 442-E-70.	Shielded conductor from pin 7 of XV-108 to C-181
XF-101	———— ———— ————	FUSEHOLDER: extractor post type; elec rating 125 v, 15 amp; accommodates cartridge fuse 1¼ in. lg x ¼ in. dia; nickel plated brass clip type contacts; 2 in. lg x 11/16 in. dia o/a; 2 solder lug type term; single ½ in. dia mtg hole; Bussman (mfr) type HKP-HJ.	Fuseholder, F-101
XF-101A	———— ———— ————	CAP, FUSEHOLDER: phenolic w/nickel plated brass insert; o/a dim., ⅝ in. lg, ⅝ in. dia; twist lock type mounting marked "fuse"; accommodates type 3AG or AGC fuses; Bussman Mfg Co (mfr). Part of fuseholder XF-101.	
XF-101B	———— ———— ————	BODY, FUSEHOLDER: extractor post type; max elec rating 125 v, 15 amp; accommodates fuse 1¼ in. lg, ¼ in. dia; phenolic body; nickel plated brass clip type contacts; o/a dim. 1¾ in. lg, 11/16 in. dia; 2 solder lug type term; single ½ in. dia mtg hole reqd; Bussman Mfg Co (mfr). Part of fuseholder XF-101.	
XF-102		Same as XF-101.	Spare fuseholder

*"Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated."

TABLE 7—1. TABLE OF REPLACEABLE PARTS — Cont'd

REFERENCE SYMBOL	STOCK NUMBERS Std. Navy Signal Corps Air Force	NAME OF PART AND DESCRIPTION (including government, mfr's and contractor's nos.)	LOCATING FUNCTION
XI-101	————	LIGHT, INDICATOR: w/smooth, frosted green lens ½ in. dia; accommodates size T-3¼ miniature bayonet base lamp; black nickel finish; 1 mtg hole 11/16 in. dia; accommodates up to ¼ in. thk panel; 2 solder lug term located at opposite sides of base; 2 in. lg x 15/16 in. dia o/a; Drake (mfr) type 50.	Pilot light holder I-101
XI-101A	————	LENS, INDICATOR LIGHT: ½ in. dia hemispherical green glass; o/a dim. ⅝ in. lg, ⅝ in. dia; black nickel plated brass bezel; screw type mtg with 9/16—32 thread, 3/16 in. lg; Drake Mfg Co (mfr). Part of Indicator Light XI-101.	
XI-101B	————	LAMPHOLDER: accommodates miniature bayonet base lamp, MBCA Ref Dwg Group 7; nickel plated brass shell; o/a dim. 1-9/16 in. lg, 1 in. dia; 2 solder lug type term; mounts in 11/16 dia mtg hole; with 9/16—32 thread for attaching lens; Drake Mfg Co (mfr). Part of Indicator Light XI-101.	
XV-101	2Z8677.94 N 16-S-62603-6674	SOCKET, ELECTRON TUBE: 7 contact miniature; one-piece shock shield above chassis base mtg; two ⅛ in. dia mtg holes on ⅞ in. mtg centers; mica filled bakelite body, ⅝ in. dia x 3/16 in. high excluding term; silver pl beryllium copper cont; w/metal shock shield 0.805 in. dia; w/ctr shield 0.095 in. ID; JAN type TS102P01; Elco Corp (mfr) type TS102P01.	Tube socket, V-101
XV-102		Same as XV-101.	Tube socket, V-102
XV-103		Same as XV-101.	Tube socket, V-103
XV-104		Same as XV-101.	Tube socket, V-104
XV-105		Same as XV-101.	Tube socket, V-105
XV-106		Same as XV-101.	Tube socket, V-106
XV-107		Same as XV-101.	Tube socket, V-107
XV-108		Same as XV-101.	Tube socket, V-108
XV-109		Same as XV-101.	Tube socket, V-109

TABLE 7–2. CROSS REFERENCE PARTS LIST

Designation	Key Symbol
JAN TYPES	
CM30B512J	C-103
CM30C162J	C-106
CM30B332K	C-112
CC21TJ390J	C-113
CV11C450	C-117
CC20UJ150K	C-119
TS102U01	E-104
TS102U02	E-107
JJ-034	J-10
RC30BF153J	R-101
RC20BF154J	R-102
RC20BF393J	R-103
RC20BF224J	R-104
RC20BF474J	R-105
RC20BF104J	R-107
RC20BF683J	R-111
RA20A2SA103AK	R-112
RC20BF510J	R-119
RC20BF205J	R-120
RC20BF102J	R-121
RC20BF103J	R-122
RC20BF105J	R-131
RC20BF564J	R-135
RC20BF153J	R-138
RC20BF333J	R-140
RC42BF473J	R-141
RC20BF152J	R-145
ST42A	S-101
TF1A03YY	T-101
6X4W	V-101
6005/6AQ5W	V-102
5654/6AK5W	V-103
6J6W	V-107
5651	V-109
TS102P01	XV-101
STD. NAVY STOCK NOS.	
	A-101
	A-102
	A-103
N16-C-22643-2777	C-101
N16-C-20979-5711	C-102
	C-103
N16-C-45804-9201	C-104
N16-C-44964-5110	C-105
	C-106
N16-C-63861-2826	C-107
N16-C-44964-4930	C-108
N16-C-19958-8855	C-109
	C-112
	C-113
N16-C-46201-1001	C-114
	C-116
N16-C-64133-6581	C-117
	C-119
	CR-101
N16-T-51735	CR-102
	E-101
	E-102

Designation	Key Symbol
STD. NAVY STOCK NOS. — Cont'd	
N17-B-72726-5151	E-103
N16-S-34520-3858	E-104
N16-S-34557-8343	E-107
	E-108
G17-F-16302-80	F-101
N16-K-700350-251	H-101
N16-K-700314-658	H-102
17-H-69701-1151	H-103
G17-L-6297	I-101
N17-J-39248-4418	J-101
	M-101
N16-R-50335-751	R-101
N16-R-56077-431	R-102
N16-R-50443-446	R-103
N16-R-50713-431	R-104
	R-105
N16-R-50821-431	R-106
N16-R-50632-431	R-107
	R-110
N16-R-50551-431	R-111
N16-R-90754-3621	R-112
	R-117
N16-R-49444-431	R-119
N16-R-51046-431	R-120
N16-R-49921-431	R-121
N16-R-50281-431	R-122
N16-R-80297-9899	R-124
	R-125
	R-126
N16-R-50758-431	R-128
	R-130
N16-R-50974-431	R-131
N16-R-50857-431	R-135
N16-R-50335-431	R-138
N16-R-50146-431	R-140
	R-141
	R-143
N16-R-49966-431	R-145
N17-S-70412-4406	S-101
N17-S-64603-8201	S-102
	T-101
	TB-101
	TB-102
N16-T-56840-50	V-101
N16-T-76005	V-102
N16-T-75654	V-103
N16-T-56365	V-107
N16-T-75651	V-109
	W-101
	W-102
	XI-101
	XF-101
N16-S-62603-6674	XV-101
SIG C TYPES	
	A-101
	A-102
	A-103
3DB20-129	C-101

TABLE 7–2. CROSS REFERENCE PARTS LIST

Designation	Key Symbol
SIG C TYPES — Cont'd	
3DB1500-2	C-102
	C-103
3DA100-941	C-104
3DA68-4	C-105
	C-106
3D9003V-17	C-107
3DA68-3	C-108
3DB50-92	C-109
	C-112
	C-113
3DA220-2	C-114
	C-116
3D9045-15	C-117
	C-119
	CR-101
	CR-102
	E-101
	E-102
3A9048	E-103
2Z8304.57	E-104
2Z8304.276	E-107
	E-108
3Z1926	F-101
2Z5822-316	H-101
	H-102
	H-103
2Z5952	I-101
2Z5534	J-101
	M-101
3RC30BF153J	R-101
3RC20BF154J	R-102
3RC20BF393J	R-103
3RC20BF224J	R-104
	R-105
3RC20BF474J	R-106
3RC20BF104J	R-107
	R-110
3RC20BF683J	R-111
3RA5713	R-112
	R-117
3RC20BF510J	R-119
3RC20BF205J	R-120
3RC20BF102J	R-121
3RC20BF103J	R-122
3Z6450-29	R-124
3Z5992E5-2	R-125
	R-126
3RC20BF334J	R-128
	R-130
3RC20BF105J	R-131
3RC20BF564J	R-135
3RC20BF153J	R-138
3RC20BF333J	R-140
3RC42BF473J	R-141
	R-143
3RC20BF152J	R-145
3Z9863-42A	S-101
3Z9825-62.395	S-102

Designation	Key Symbol
SIG C TYPES — Cont'd	
	T-101
	TB-101
	TB-102
2J6X4W	V-101
2J6005	V-102
2J5654	V-103
2J6J6W	V-107
2J5651	V-109
	W-101
	W-102
	XI-101
	XF-101
2Z8677.94	XV-101
AF STOCK NOS.	
	A-101
	A-102
	A-103
3330-318508784	C-101
3330-317631511	C-102
	C-103
3330-317760166	C-104
3330-316172005	C-105
	C-106
3330-312794141	C-107
3330-316172004	C-108
3330-317590612	C-109
	C-112
	C-113
3330-316478006	C-114
	C-116
3330-313420119	C-117
	C-119
	CR-101
3370-209000-1365	CR-102
	E-101
8880-387193496	E-102
3300-302027715	E-103
3370-774000-1925	E-104
3370-774000-1955	E-107
	E-108
	F-101
3320-292241488	H-101
3320-292221770	H-102
	H-103
8870-938000-375	I-101
8850-735850	J-101
	M-101
3300-381317120	R-101
3300-381167180	R-102
3300-381169360	R-103
3300-381168160	R-104
	R-105
3300-381668940	R-106
3300-38116620	R-107
	R-110
3300-381170620	R-111

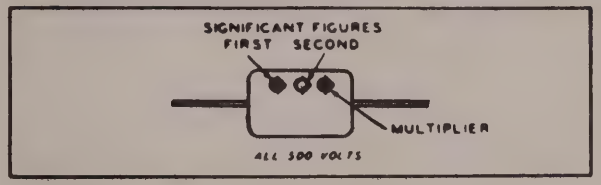
TABLE 7–2. CROSS REFERENCE PARTS LIST

Designation	Key Symbol
AF STOCK NOS. — Cont'd	
	R-112
	R-117
3300-381169960	R-119
3300-381166880	R-120
3300-381166080	R-121
3300-381166140	R-122
3300-391850333	R-124
	R-125
	R-126
	R-128
	R-130
	R-131
	R-135
	R-138
3300-381168940	R-140
3300-381604461	R-141
	R-143
	R-145
	S-101
3360-395499487	S-102
	T-101
	TB-101
	TB-102
	V-101
3300-298420100	V-102

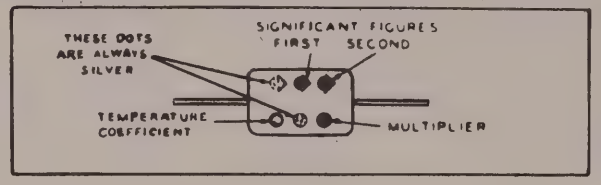
TABLE 7–3. APPLICABLE COLOR CODES

CAPACITOR COLOR CODES

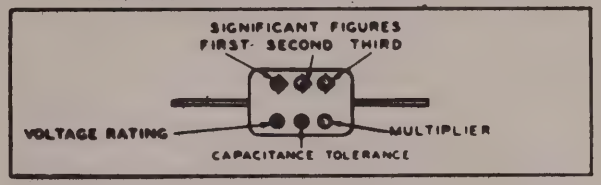
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



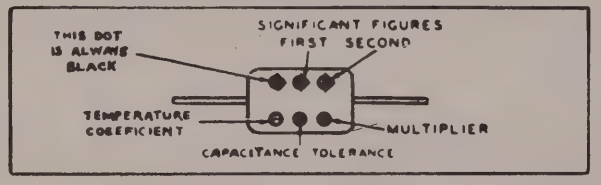
JAN 6 DOT COLOR CODE FOR PAPER DIELECTRIC CAPACITORS



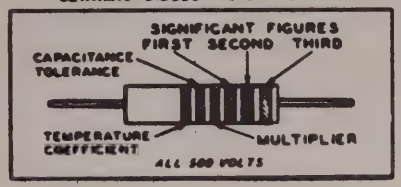
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6 DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

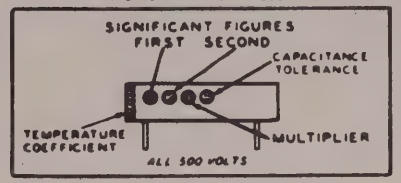


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

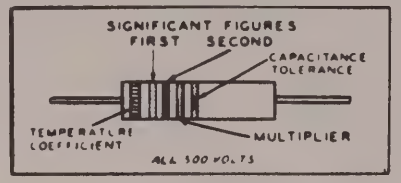


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



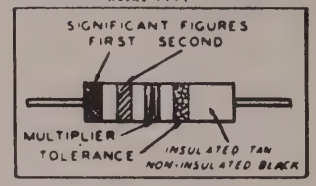
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS		CAPACITORS						
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1000	3	ORANGE	1,000	1000	1000	300	D
	10000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

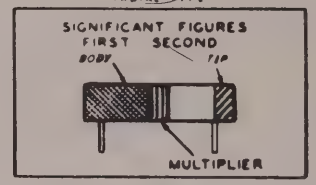
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

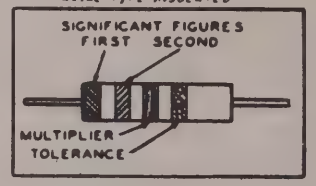


RADIAL TYPE

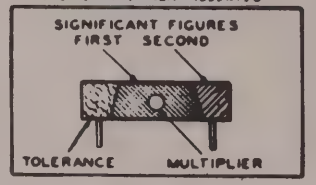


JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON INSULATED



[AG 413.6 (17 Dec 53)]

BY ORDER OF THE SECRETARY OF THE ARMY:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:

WM. E. BERGIN,
Major General, United States Army,
The Adjutant General.

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