

TM 11-5549C

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ELECTRONIC MULTIMETER ME-6D/U



DEPARTMENT OF THE ARMY • *MARCH 1956*

TEMPORARY CORRECTION T-1 TO INSTRUCTION BOOK FOR ELECTRONIC MULTI-METER ME-6D/U

This temporary correction is in effect immediately on all equipments starting with serial no. 80 and on all sets already in the field after Navy Field Change 1-ME-6D/U has been made.

This temporary correction changes the book to reflect a factory equipment change made after the book was printed. This change was made to correct a low frequency instability in the equipment.

Make the following corrections in pen and ink. Then insert this temporary correction in the instruction book just after the front cover and just before the title page.

<u>PAGE</u>	<u>PARA & LINE or FIG & LOCATION</u>	<u>ACTION</u>
6-9/6-10	6-2	Center Under R-119 change "100K" to "150K"
7-7	---	--- Change data under Symbol Desig. R-119 as follows: 1. In line 1 of the description change "100,000 ohms" to "150,000 ohms". 2. Change MIL type from "RC30BF104J" to "RC30BF154J". 3. Change AB type from "GB-1045" to "GB-1545". 4. Change SNSN "N16-R-50632-751" to "N16-R-50677-751".
7-11	Table 7-2	Make the following changes under R-119: 1. Change MIL type "RC30BF104J" to "RC30BF154J" 2. Change SNSN "N16-R-50632-751" to "N16-R-50677-751"

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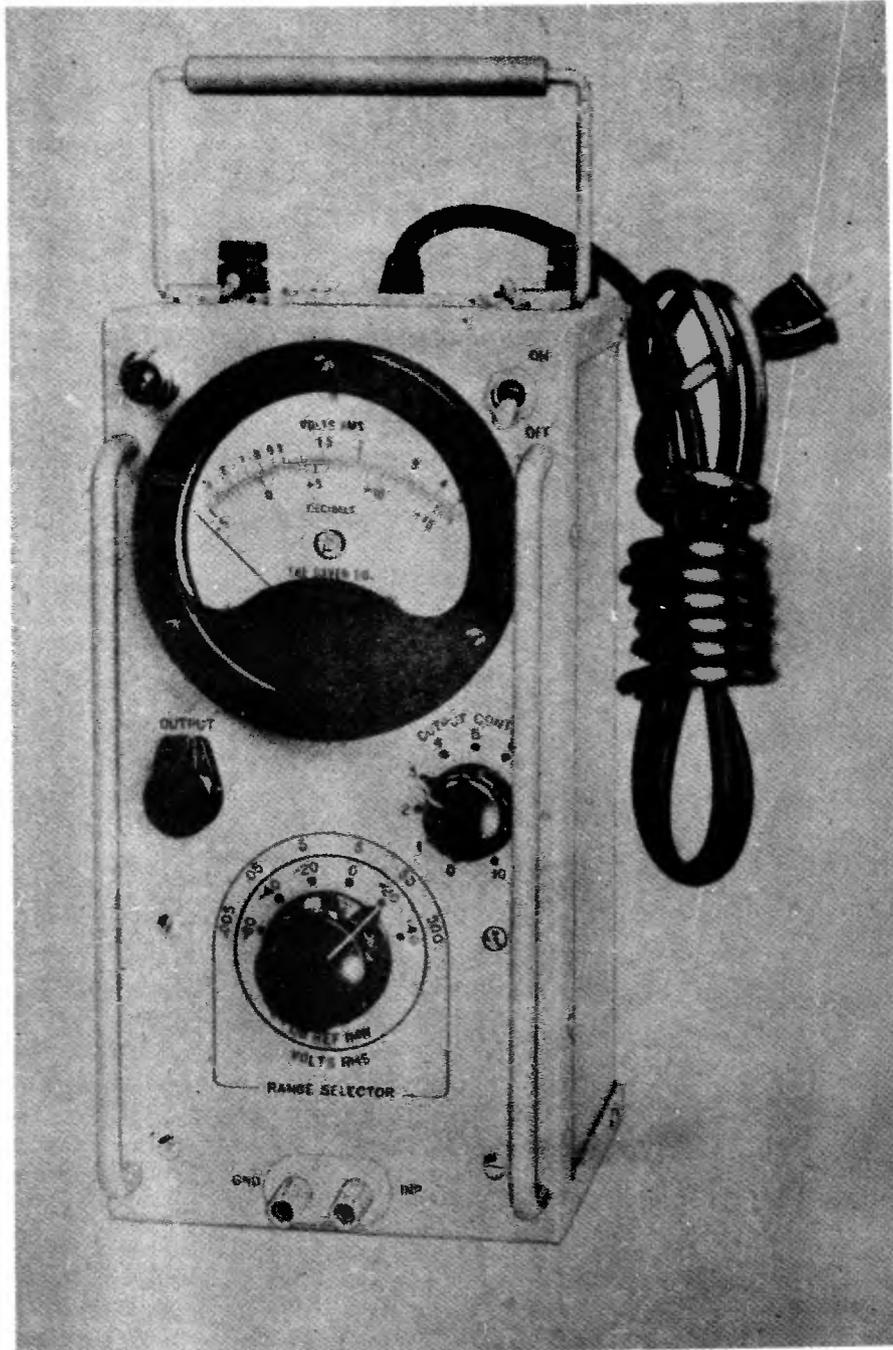


Figure 1-1. Electronic Multimeter ME-6D/U, Equipment Supplied

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-6D/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-6D/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 4500 can be achieved. Essentially distortionless waveshape is obtainable up to at least 23 volts a-c output.

3. GENERAL PHYSICAL CHARACTERISTICS.

a. The Electronic Multimeter ME-6D/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 multimeter case. The chassis is held in its metal cabinet by means of six standard slotted

head machine screws. A 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. The overall dimensions of the equipment, including the embossed feet at the base of the cabinet, are 11-7/32 inches long, 6½ inches wide, and 5-13/16 inches deep, excluding fuseholder, knobs, handle and cable.

4. GENERAL ELECTRICAL CHARACTERISTICS.

a. The Electronic Multimeter ME-6D/U consists essentially of a multi-stage amplifier terminated by electron tube type 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 the 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 components replacement.

c. Electronic Multimeter ME-6D/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 for a suitable output level. 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.

TABLE 1-1. EQUIPMENT SUPPLIED

Quantity per Equipment	Name of Unit	Nomenclature	Overall Dimensions			Volume	Weight
			Height	Width	Depth		
1	Electronic Multimeter	ME-6D/U	5-13/16	6½	11-7/32	0.245	9.6
2	Instruction Books	NAVSHIPS 92423	11	8½	3/16	—	2/3

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

d. The equipment operates from 117 volts $\pm 10\%$, 50 to 400 cycles, single phase a-c. A full-wave high-voltage rectifier circuit supplies approximately 250 volt d-c. A voltage-regulator system consisting of a gaseous type voltage regulator and a barreter type constant current regulator tube supplies voltage regulation for reliable operation of the amplifiers and the meter rectifier within the equipment.

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.

None required.

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-6D/U	9½	10½	18	1.06	20.00

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

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

Tube Type	Application	Quantity
Electron Tubes		
5879	Miniature, pentode amplifier	1
6AH6	Miniature, pentode amplifier	2
5726/6AL5W	Miniature, twin diode	1
OA2WA	Miniature, voltage regulator	1
2A12	Octal, constant current regulator	1
Indicator Lamp		
47	Incandescent, min. bayonet base	1
		Total 7
Fuse		
Type	Rating	Quantity
F02GR500A	0.5 ampere	2 incl. 1 spare

9. QUICK REFERENCE DATA.

- a. Nomenclature Electronic Multimeter ME-6D/U
- b. Contract number and date NObsr-59640, dated 24 June 1953
- c. Contractor The Daven Company
191 Central Avenue
Newark, N.J.
- d. Cognizant Naval Inspector Inspector of Naval Material,
USN, Newark, New Jersey
- e. Number of packages involved per complete shipment of equipment 1
- f. Total cubical contents
Crated 1.06 cubic ft.
Uncrated 0.245 cubic ft.
- g. Total weight
Crated 20 lbs.
Uncrated 9.6 lbs.
- h. Power supply requirements 117 volts $\pm 10\%$, 50 to 400 cycles, single phase a-c.
- i. Power consumption of equipment Approximately 24 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.
- l. Voltage meter scale range5 to 5, with 3 scale markings above and below this range, providing for overlap.
- m. Decible meter range -65 to $+57$ db
- n. Decibel conversion basis001 watt reference level in 600 ohm line.
- o. Meter ranges (1) 500 microvolts to 5 millivolts
(2) 5 millivolts to 50 millivolts
(3) 50 millivolts to 500 millivolts
(4) 0.5 to 5 volts
(5) 5 volts to 50 volts
(6) 50 volts to 500 volts

(1) -65 db to -43 db
(2) -45 db to -23 db
(3) -25 db to -3 db
(4) -5 db to $+17$ db
(5) $+15$ db to $+37$ db
(6) $+35$ db to $+57$ db
- p. Input impedance 2 megohms in shunt with 25 micromicrofarads.
- q. Instrument accuracy $\pm 3\%$ from 15 cycles to 250 Kc. per second.
- r. Stability $\pm 1\%$ over line variation from 105 to 125 volts a-c.
- s. Output control Variable resistor in plate circuit of final amplifier stage; panel markings arbitrarily calibrated.
- t. Amplifier undistorted output Up to 23 volts a-c, supplied from an internal impedance not greater than 10,00 ohms.
- u. Maximum input voltage Not to exceed 500 volts r-m-s, or 707 volts peak.
- v. Amplifier gain 4500
- w. Bandwidth of internal amplifier 15 cps to 250 Kc $\pm 3\%$.

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
6D/U	117 V. 50-400	Design differs radically from previous models. Mechanically not interchangeable	Electrical elements not interchangeable with models previously supplied

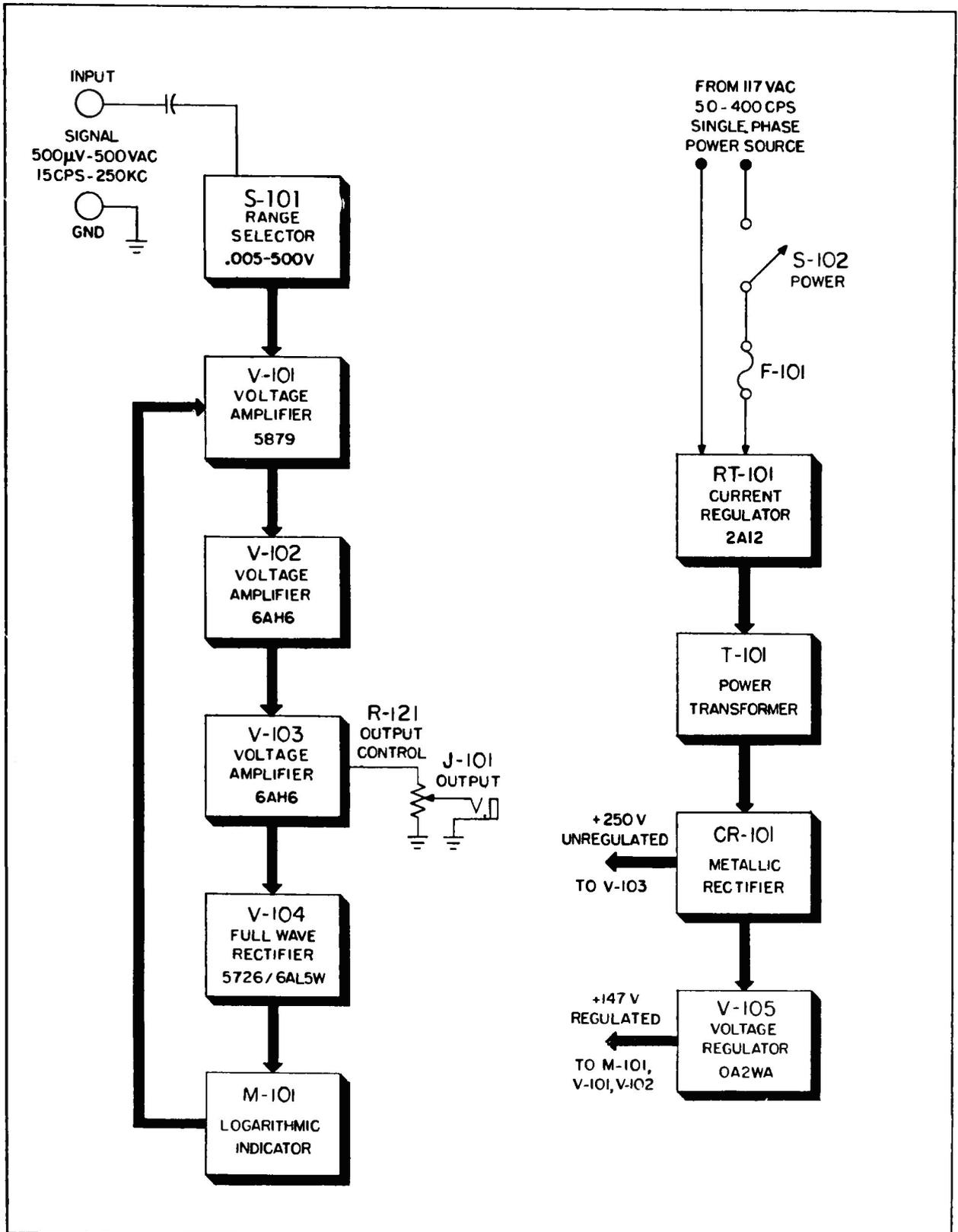


Figure 2-1. Electronic Multimeter ME-6D/U, Functional Block Diagram

SECTION 2 THEORY OF OPERATION

1. SUMMARY.

(See Figure 2-1)

a. Electronic Multimeter ME-6D/U consists essentially of a multi-stage amplifier V-101 to V-103 having a six position input attenuator controlled by RANGE selector S-101, terminated by a bridge type rectifier circuit, and the specially designed meter M-101. A gaseous type voltage regulator which in conjunction with a constant current bar-reter type of regulator in the primary circuit serves to stabilize overall operation of the instrument. Meter indications that are proportional to the logarithm of the rectified current, over the 10 to 1 range, are obtained by means of the microammeter'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-101 a portion of the amplified energy available from the meter rectifier circuit.

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 minimum position, permits the signal under measurement to appear at OUTPUT jack J-101, located at 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 4500.

c. The equipment contains the power supply circuits necessary to convert the primary power of 117 volts $\pm 10\%$, 50 to 400 cycles per second, single phase, to the required screen and plate voltages. A 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 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 Multi-

meter ME-6D/U produces proper d-c voltages for use in the amplifiers. The transformer high voltage output of 215 volt r-m-s is fed into a metallic rectifier for rectification and then into a capacitive input RC type of filter for filtering. Approximately 250 volts d-c is developed across C-117B at the junction of R133 and R134 and supplied to the high potential electrodes of V-103, regulated voltage from the gaseous voltage regulator supplies the electrodes of V-101 and V-102. Additional regulation is obtained thru the use of a constant current regulator RT-101. The following components are included in the power supply:

(1) Regulator Ballast Lamp RT-101

(2) Power transformer T-101 and its associated rectifier CR-101

(3) Resistor-Capacitor filter system

(4) Voltage Regulator V-105

b. REGULATOR, BALLAST LAMP RT-101—

In order to obtain good stability with line voltage variations a regulator ballast lamp is employed in the primary circuit of transformer T-101. The regulator consists of two resistance elements, one element always remains active in the circuit whereas the other element is in shunt with a pair of contacts actuated by a bi-metallic strip. The contact on the bi-metallic strip is normally open allowing a limited current to flow through both resistance elements for about twenty seconds. When heated by the active resistance element the contacts short a portion of the controlling resistor and thereby allows full regulated current to flow into the primary of the transformer. The purpose of an additional resistance element is to allow a limited amount of current to flow through the regulator when the set is cold, since the filaments and discharged capacitors draw an excessive current for a few seconds during a warm-up period.

c. POWER TRANSFORMER T-101 — Power transformer T-101 is of the step-up and step-down type and is normally operated through the 88 volt primary winding 1-2, which is in series with RT-101 ballast lamp, however, for emergency operation it is capable of operation at 117 volts a-c, 50 to 400 cycles per second, single phase, at its input terminals 1-3. (See Section 6, par. 9) Two output windings are provided as follows:

(1) A high voltage secondary, terminals 7 and 8, connected to the metallic full wave bridge

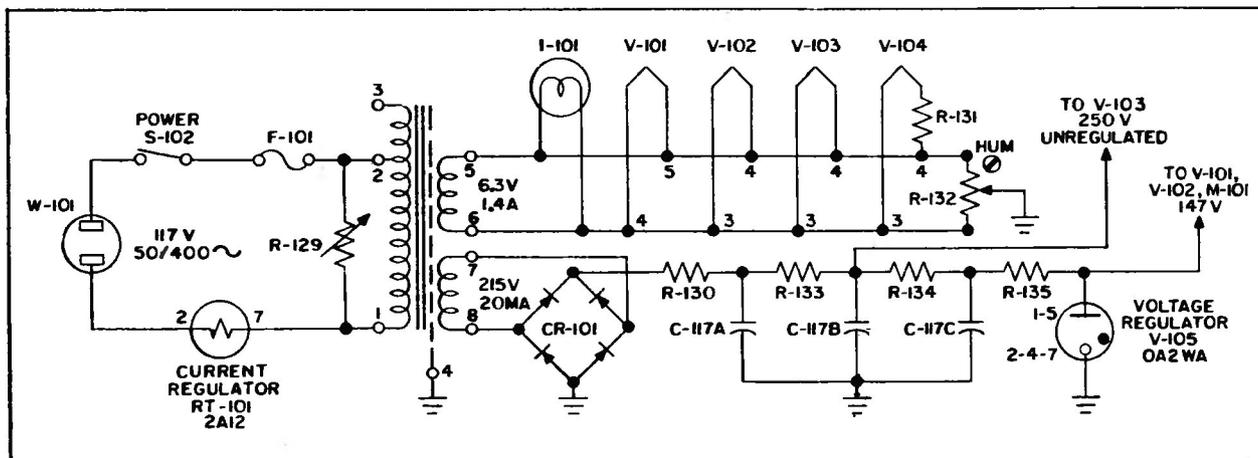


Figure 2-2. Power Supply Circuit, Sectionalized Schematic Diagram

rectifier CR-101. This winding is rated at 30 ma. d-c, at 215 volts r-m-s.

(2) A filament secondary, rated at 6.3 volts across terminals 5 and 6, at 1.4 amperes, for supplying heater power to the following four stages in the equipment: Three amplifier stages V-101, V-102, V-103, and one rectifier stage, V-104. A balancing potentiometer R-132 is also connected across the filament winding for minimum hum adjustment.

d. RESISTOR-CAPACITOR FILTER SYSTEM—Adequate ripple filtering is achieved through the use of resistors R-133, R-134 and capacitors C117A, C117B, C117C. Resistor R-130 serves to limit the charging current from the rectifier into C-117A to a safe value. Additional a-c ripple suppression is attained in the network consisting of R-135 and the voltage regulator V-105, which supplies the low level amplifier stages.

e. VOLTAGE REGULATOR STAGE V-105—A voltage regulator V-105, OA2WA, is used to stabilize voltages supplying the screen grid and plate circuits of V-101 and V-102. A voltage to balance out the contact potential of V-104 is also supplied through resistor R-128 to the ZERO SUPPRESSION potentiometer R-127.

3. SPECIAL FEATURES OF THE EQUIPMENT.

a. GENERAL—The Model ME-6D/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, and db from -65 to +57 with a maximum error of $\pm 3\%$ 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:

Position	Volts	Db
1	.0005 to .005	-65 to -43
2	.005 to .05	-45 to -23
3	.05 to .5	-25 to -3
4	0.5 to 5	-5 to +17
5	5 to 50	+15 to +37
6	50 to 500	+35 to +57

b. UNIFORM PERCENTAGE OF ACCURACY—Electronic Multimeter ME-6D/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.

4. THE AMPLIFYING AND LIMITING CIRCUIT.
(See Figure 6-2.)

a. GENERAL — The high sensitivity of Electronic Multimeter ME-6D/U is obtained by employing a full-wave rectifier, consisting of two diodes V-104, in the output of a three stage wide-band amplifier circuit. In order to keep within the linear range of the amplifier circuit, a compensated attenuator is connected in the grid circuit voltage amplifier, V-101. The degree of attenuation is determined by the setting of the double-deck rotary RANGE selector S-101. (See sub-paragraph b. below, for detailed description of the attenuator action). The main portion of the amplifier consists of stages V-101 through V-104. Feedback voltage is coupled from the output of the final stage, to the cathode of the first voltage amplifier V-101, for the purpose of maintaining a high order of linearity and stability. The function of each stage is summarized briefly as follows:

Tube Type	Application	Quantity
5879	Miniature, pentode amplifier	1
6AH6	Miniature, pentode amplifier	2
5726/6AL5W	Miniature, twin diode	1
0A2WA	Miniature, voltage regulator	1
2A12	Octal, constant current regulator	1

b. ATTENUATOR ACTION — The a-c signal 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, two megohms in shunt with about 25 micromicrofarads, is sufficiently high so that its loading effect upon cir-

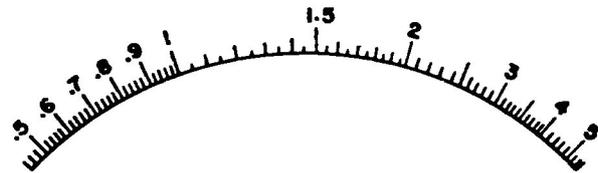


Figure 2-3. A Representative Logarithmic Meter Scale

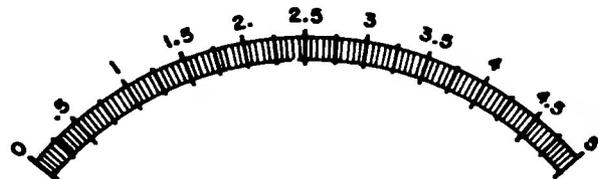


Figure 2-4. A Representative Linear Meter Scale

cuits being measured is at a minimum. The input blocking capacitor C-101 in conjunction with the common voltage divider resistors R-101 and R-102 allows a total of 500 volts r-m-s to be applied to the input of the instrument without causing damage. Reference to schematic circuit diagram figure 6-2, and to figure 2-5, shows that the selector switch S-101 consists of two sections. Section 1 of the switch serves to connect resistors R-101 and R-102 to ground in position one, and to transfer these resistors through to the second section in the remaining positions; this section also connects the compensating capacitors C-102, C-103, and C-104 in shunt with resistors R-101 and R-102 in positions 2 to 6 inclusive. Section 2 is used primarily for connecting the grid of V-101 to the tapped down part of the voltage divider resistors and compensating capacitors C-105, C-106 and C-107.

When small input voltages up to five millivolts are applied, no dividing action takes place; resistors R-101 and R-102 are grounded, and the high end connects to the grid of V-101 for grid return purposes only. The actual input impedance consists of the resistances R-101 and R-102 in shunt with all stray capacitance from the input binding posts through the switch elements and finally, the tube socket input capacitance of the amplifier stage V-101. This complex impedance will range to values lower than two megohms at the highest frequency for which the Multimeter is designed.

The action for other values of input voltage is as follows: Rotating the selector knob to its .05 position causes the movable arm of S-101 to contact the junction of (R-101 - R-102) and R-103, and an attenuation factor of 10 is achieved; note

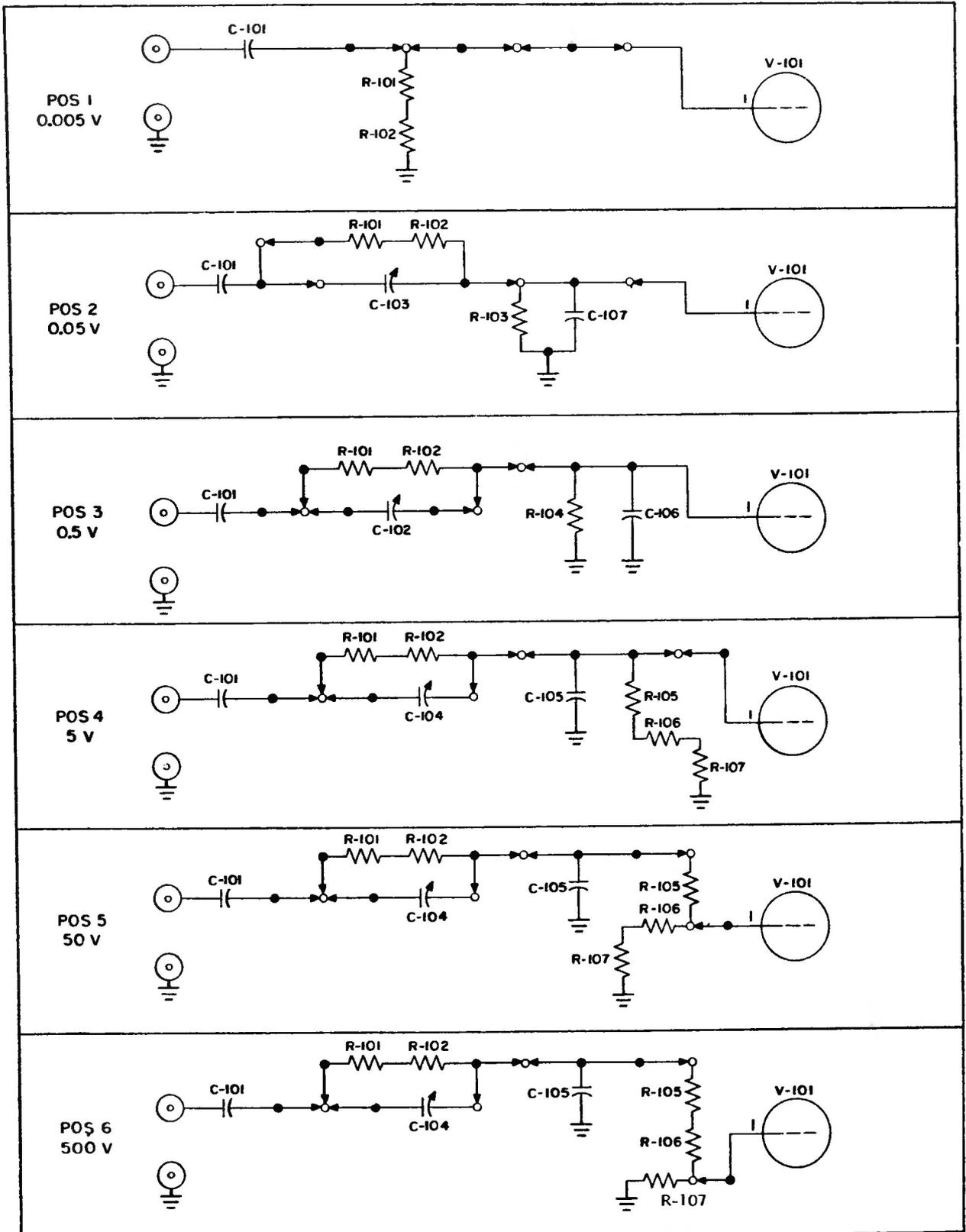


Figure 2-5. Range Selector S-101, Functional Schematic

that in this and in the subsequent positions of the selector switch, frequency compensating capacitors are used to compensate for frequency effects; as an example, in position two the arithmetical products of (R-101 - R-102) C-103 are equal to R-103 C-107.

When the knob is rotated to its .5v position, the movable arm of S-101 then contacts the junction of (R-101 - R-102) and R-104, and an attenuation factor of 100 is applied to input signals over the range .05 to .5 volts. Positions 4, 5, and 6 (.5 volts, 50 volts and 500 volts ranges) differ in the switching operation from those previously used. In these positions the compensating capacitors C-104 and C-105 remain in the circuit at all times; voltage division is attained by moving the arm of the selector switch S-101 to the junctions of R-105, R-106, and R-107 for the required attenuation.

Common compensating capacitors are used since the small stray capacitance at the input to the grid circuit of V-101 is an extremely small fraction of C-105 which is 3900 micro-microfarads. A total attenuation factor of 100,000 to 1 is obtainable for full scale readings, or one million to one for minimum (500 microvolts) to maximum (500 volts) readings.

c. BIAS CIRCUITS—Bias for the three amplifier stages is obtained by conventional means using cathode resistors and their associated by-pass capacitors. Tubes V-101, V-102 and V-103 are biased by R-108, R-113 and R-118 and by-passed by C-108, C-111 and C-113 respectively.

5. A-C SIGNAL PATH.

a. Reference to either the functional block diagram, figure 2-1 or the schematic circuit diagram, figure 6-2, 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 1000 cycles per second in frequency and 0.002 volts in amplitude, is connected to the input circuit, and RANGE selector S-101 is set to its extreme counter-clockwise .005 v. position, the full signal appears at grid pin 1 of voltage amplifier V-101. The total gain of V-101 is about one. Therefore, the output signal of this stage, coupled from its load circuit through the blocking capacitor C-110 to the grid pin 1 of V-102 is 0.0018 volts. The normal amplification of the 5879 pentode employed in this stage is about 20. 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 slightly less than one.

c. The second stage voltage amplifier V-102 uses a type 6AH6 pentode which yields a voltage gain of about 97. The output signal from V-102 is developed across the plate resistor R-116 and fed through the blocking capacitor C-112 to the grid pin of V-103 where a voltage of 0.175 volts is obtained due to the normal gain of this stage.

Note that V-102 is included in the overall feedback loop but has no feedback network in the pass band around itself. Negative feedback to control extremely low frequency transient disturbances does exist by virtue of a common impedance formed by C-109C and R-115. The negative voltage developed across this impedance is fed back into V-102 through R-111 and C-110 to stabilize the instrument against random line and selector switching transients.

d. The third voltage amplifier V-103 uses a 6AH6 pentode tube, a gain of 50 is obtained in this stage. Approximately 8.8 volts are developed across the plate resistor R-120 and the high frequency peaking inductance L-101. Normally this a-c voltage is impressed across the metering circuit through C-114 and the normally closed contacts of J-101. Inserting a plug into J-101 transfers the a-c output to the high side of OUTPUT CONTROL R-121, where it may be attenuated as desired, and the tip contact of J-101. Cathode resistor R-118 and its a-c by-pass capacitor C-113 are connected in series with R-109 in the cathode circuit of V-101, causing feed back current to flow through R-109. The screen grid capacitor C-115 is tied to the high side of the feedback resistor R-109 instead of to ground to maintain proper feedback phase relationship. Shunt peaking coil L-101 is used to maintain high frequency response essentially flat up to 250 kilocycles per second.

A rising frequency characteristic occurs beyond the required band pass range due to tuning of the stray capacity by L-101 out of the pass band and is in some degree due to reversal of phase at the extreme end of the pass band.

Unregulated voltages are applied to both the plate and screen grid circuits; due to the action of the ballast regulator RT-101 however, these voltages are held to a maximum variation of about 3% when the line voltage is varied from 105 to 125 volts. Values of circuit components in this stage have been chosen so that the current flowing through the indicating meter and rectifier is held to less than 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.

e. The output circuit consists of a two conductor jack J-101, equipped with a set of single pole double throw switching contacts, and an OUTPUT CONTROL potentiometer R-121. Inserting a single circuit telephone plug such as PL-51 into OUTPUT jack J-101 permits further use of the signal as a source for driving an oscilloscope or an additional amplifier. The impedance of this circuit depends upon the setting of the potentiometer R-121.

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.

(1) The 5726/6AL5W, V-104, diodes are connected to form a full wave rectifying system; one half of the diode conducts during the positive alternation, and the other half during the negative alternation of the same cycle. The current flowing through these diodes develops a potential across resistors R-124 and R-125.

(2) During the positive part of the cycle, the junction of pin 1 of V-104 and R-124 assumes a positive potential with respect to the junction of pin 2 and R-15. (The diode pins 2 and 5 of V-101 do not conduct during the positive part of the cycle.) During the negative part of the cycle, the diode connected between pin 2 and pin 5 conducts while the other diode does not. This junction of pin 2 and R-125 therefore becomes more negative with respect to the junction of pin 1 and R-124. Reference to the schematic circuit diagram shows that the indicating meter M-101 is connected through its positive terminal to the junction of pin 1 and R-124, its negative terminal to the junction of pin 2 and R-125. D-C current flows from the high potential junction, through the meter

movement to the low potential junction, causing a deflection of the meter pointer. The use of this full wave action provides an accurate average reading of meter M-101 even though an asymmetrical wave form is applied to the input terminals of the Multimeter. The turnover error caused by reversing the polarity of signals at the INPUT terminals likewise is minimized through the use of the full wave arrangement.

(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 SELECTOR S-101 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-126. This control allows for an adjustment of about $\pm 12\%$. The indicating meter is of the suppressed type, designed to have approximately 10% 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-105, through ZERO SUPPRESSION control R-127, to both sides of the meter in balanced bridge arrangement. By adjusting 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 $\pm 25\%$. 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-6D/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 $\pm 10\%$, 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. Sets equipped with a shielded line cord terminated in a UP-121M plug are automatically grounded through the shield and a grounding blade on the plug (See schematic diagram figure 6-2).

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 subjected 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 eight screws which hold the cover to the instrument housing, and pull the cover out. Inspect all tubes to see that they are seated properly in their sockets, and that tube shields are properly placed over tubes V-101, V-102, V-103, and V-104. Replace the cover over the instrument housing and replace the eight screws holding the cover securely in place.

Note

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

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 $\pm 1\%$ 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-101 to the proper position to accommodate the test signal. The meter indications of both instruments should agree. If discrepancies in excess of $\pm 5\%$ are obtained, Electronic Multimeter ME-6D/U requires calibration.

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

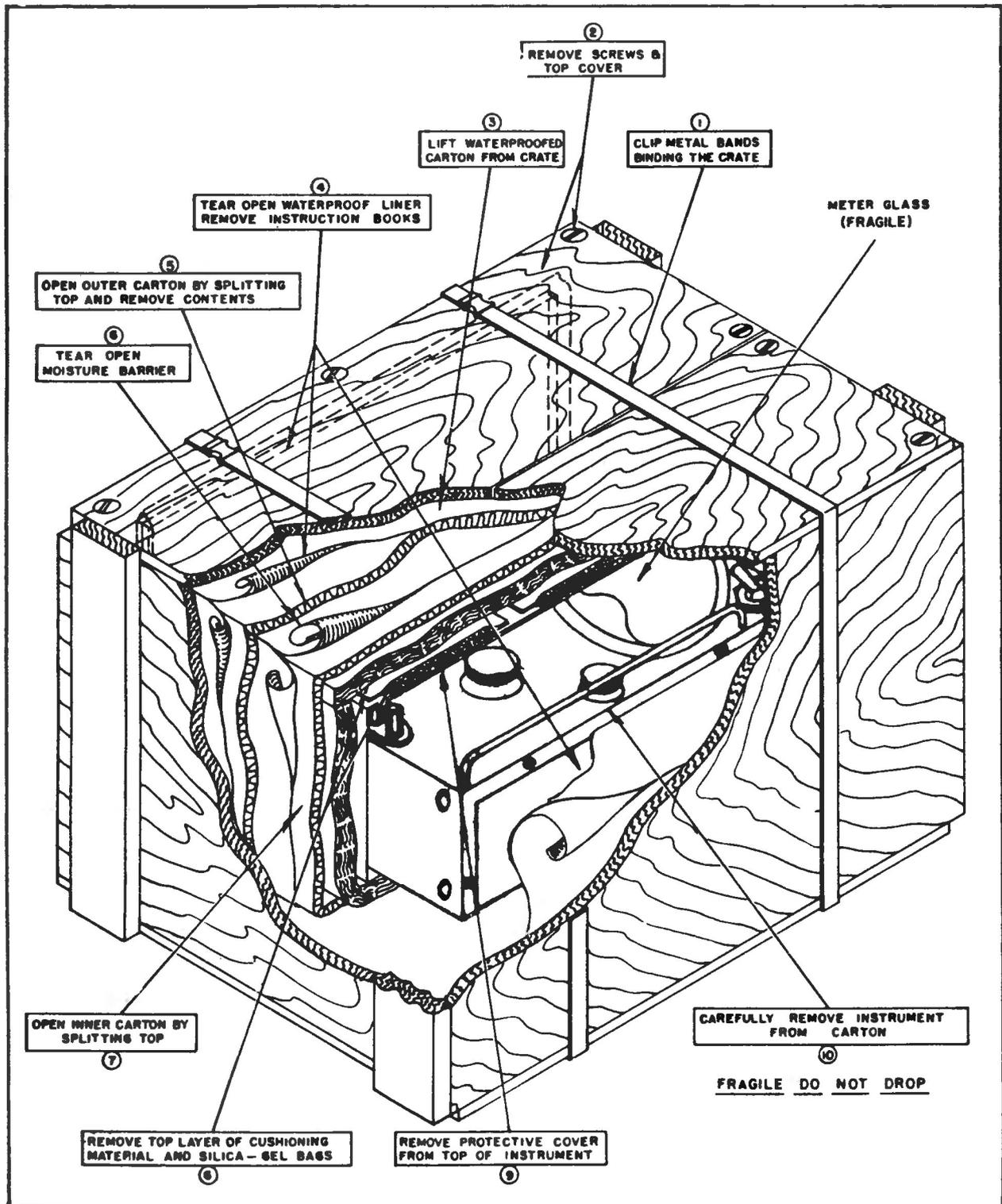


Figure 3-1. Electronic Multimeter ME-6D/U, Unpacking Procedure

SECTION 4 OPERATION

1. GENERAL.

Electronic Multimeter ME-6D/U is designed to measure sine-wave voltage 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 $\pm 10\%$, 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 and decibel 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, increases the output level. 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-102—This switch controls the application of primary power to the equipment. After the switch is placed ON, the green pilot lamp 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 super-imposed on a d-c potential should not exceed 1000 volts. Failure to observe this precaution may cause breakdown of the instrument's input circuit.

(3) OUTPUT CONTROL R-121—This potentiometer serves to control the output voltage when the instrument is used as a high gain amplifier. In its extreme counter-clockwise position, the signal available at OUTPUT jack J-101 is at its maximum amplitude when the OUTPUT control R-121 is in the extreme clockwise position. Approximately 23 volts is available at this jack when maximum allowable signal input is fed into the INPUT jacks. The output impedance varies with the setting of the OUTPUT control the highest impedance being ten thousand ohms.

(4) RANGE SELECTOR S-101—This six-position 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-101	Attenuation Factor (Full-Scale)
.05 V.	10-to-1
.5 V.	100-to-1
5. V.	1,000-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-121 is advanced from its minimum position and a plug is inserted in J-101. A maximum signal of 23 volts a-c potential is available at this jack if RANGE SELECTOR S-101 is set so that the meter deflection is full-scale with the OUTPUT CONTROL in its maximum position.

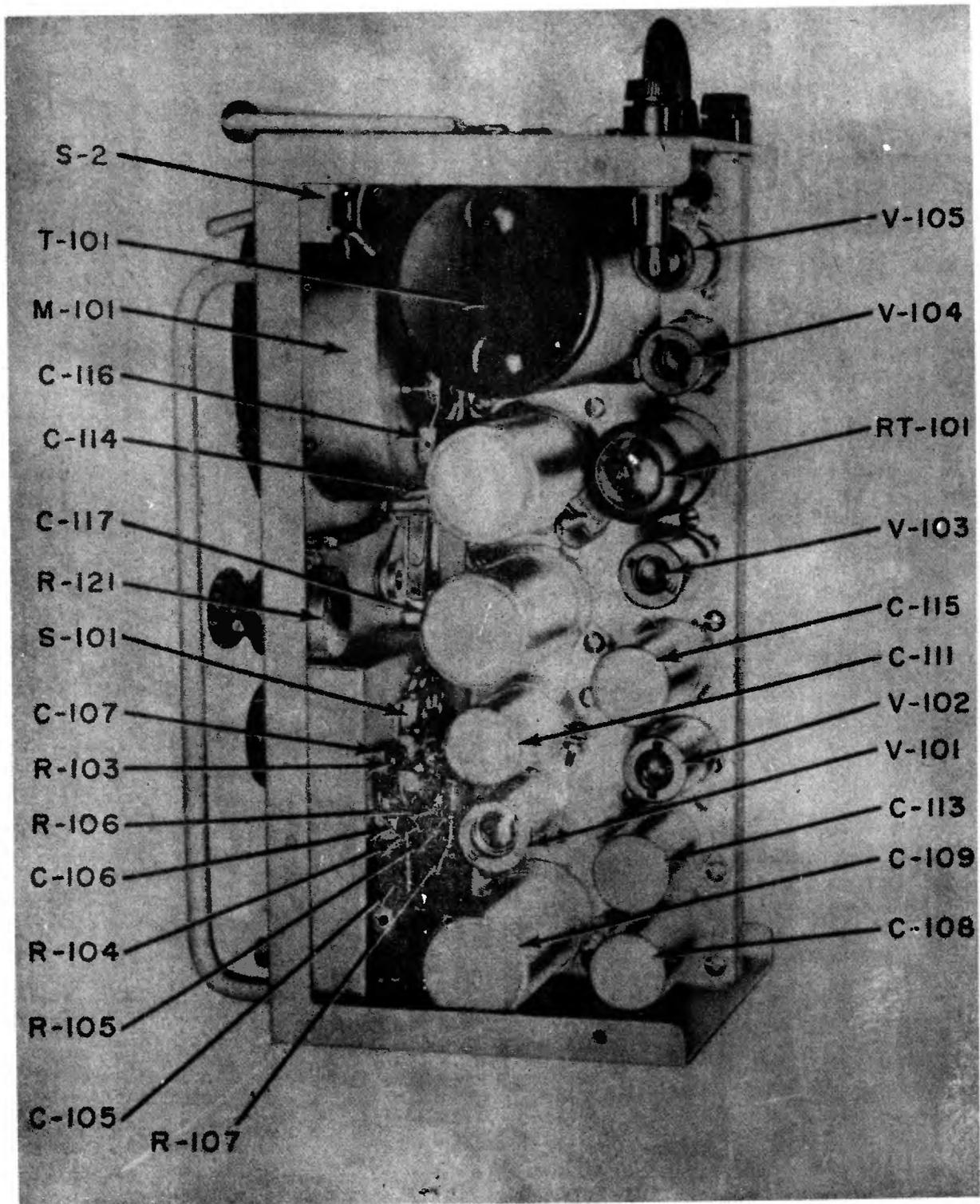


Figure 5-1. Electronic Multimeter ME-6D/U, Right Side

SECTION 5 PREVENTIVE MAINTENANCE

1. BASIC CONSIDERATIONS.

a. Electronic Multimeter ME-6D/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 23 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 rechecked, 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 inspection 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 electrolytic capacitors, 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	<p>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.</p> <p>Switch action of RANGE SELECTOR and POWER switch, 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.</p>
Monthly	General, Visual and Mechanical	<p>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-101, V-102, V-103, and V-104 only. With power applied to the equipment, the heaters of all tubes should light, and the voltage-reference stage V-105 should glow. All components should be secure and rigidly mounted, with no evidence of loose hardware.</p>

TABLE 5-1. MAINTENANCE TEST SCHEDULES—Cont'd

Period	Check	Performance
<p>Quarter-annually</p>	<p>Electrical</p>	<p style="text-align: center;">DANGER</p> <p>With operating power applied, potentials of 250 volts d-c and 215 volts a-c are present in the chassis. USE EXTREME CARE IN HANDLING THE INSTRUMENT OUTSIDE OF ITS HOUSING.</p> <p>Turn equipment on and allow a ten minute warm-up period. Perform the calibration check, as outlined in Paragraph 3 of Section 3.</p> <p>Check the B+ voltage. 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 $\pm 2\%$ or better between R-133 and R-134 and chassis ground. Use voltmeter scale of 250 volts or higher.</p> <p>Check the regulated B+ at pin 1 or 5 of the voltage regulator tube V-105 0A2WA, the voltage should read about 147 volts. These two checks will immediately establish whether or not some major component has failed.</p> <p>Voltage measurements should be taken at the contacts of all tube sockets, and the measurements compared with the representative values show in Table 5-2 of 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.</p> <p>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.</p> <p>Make the performance checks as specified in Paragraph 2, Section 6.</p>
	<p>General and Electrical</p>	

Note

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

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 0.5-ampere, 250-volt, and is located in the LINE fuseholder adjacent to the handle on the top surface of the multimeter case. 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 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-101, V-102, V-103, and V-104 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.

A special type of tube holder commonly called “top hat” is used to secure V-105 and RT-101 against vibration and handling hazards. Tubes V-105 and RT-101 may easily be removed by carefully pressing the protruding tab on the top ring in an upward direction until a few threads are disengaged, after this initial action the top tube retainer ring can readily be removed.

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
5879	6.3	150	300 ¹	-3	150 ¹	1.8	0.4	1000	700
6AH6	6.3	175	300 ¹	-2	150	10	2.5	9000	5000
5726/6AL5W	6.3	300	.....	.....	.....	9	.....	.....	.....
0A2WA	.....	.....	155 ²	.....	.....	30 ¹	.....	.....	.....

¹Absolute maximum ratings.

²Starting voltage, operating voltage is 150 V d-c.

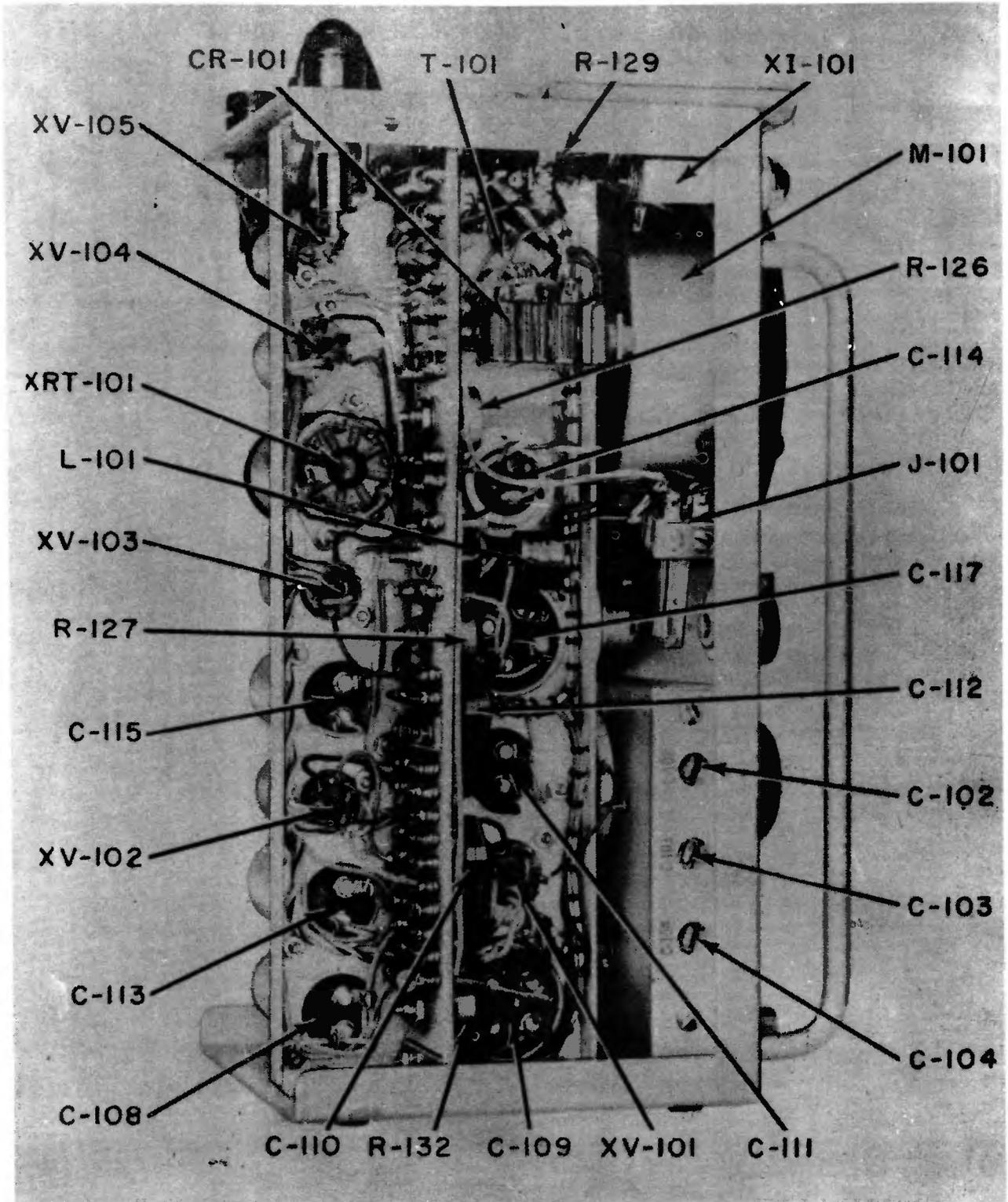


Figure 5-2. Electronic Multimeter ME-6D/, Left Side

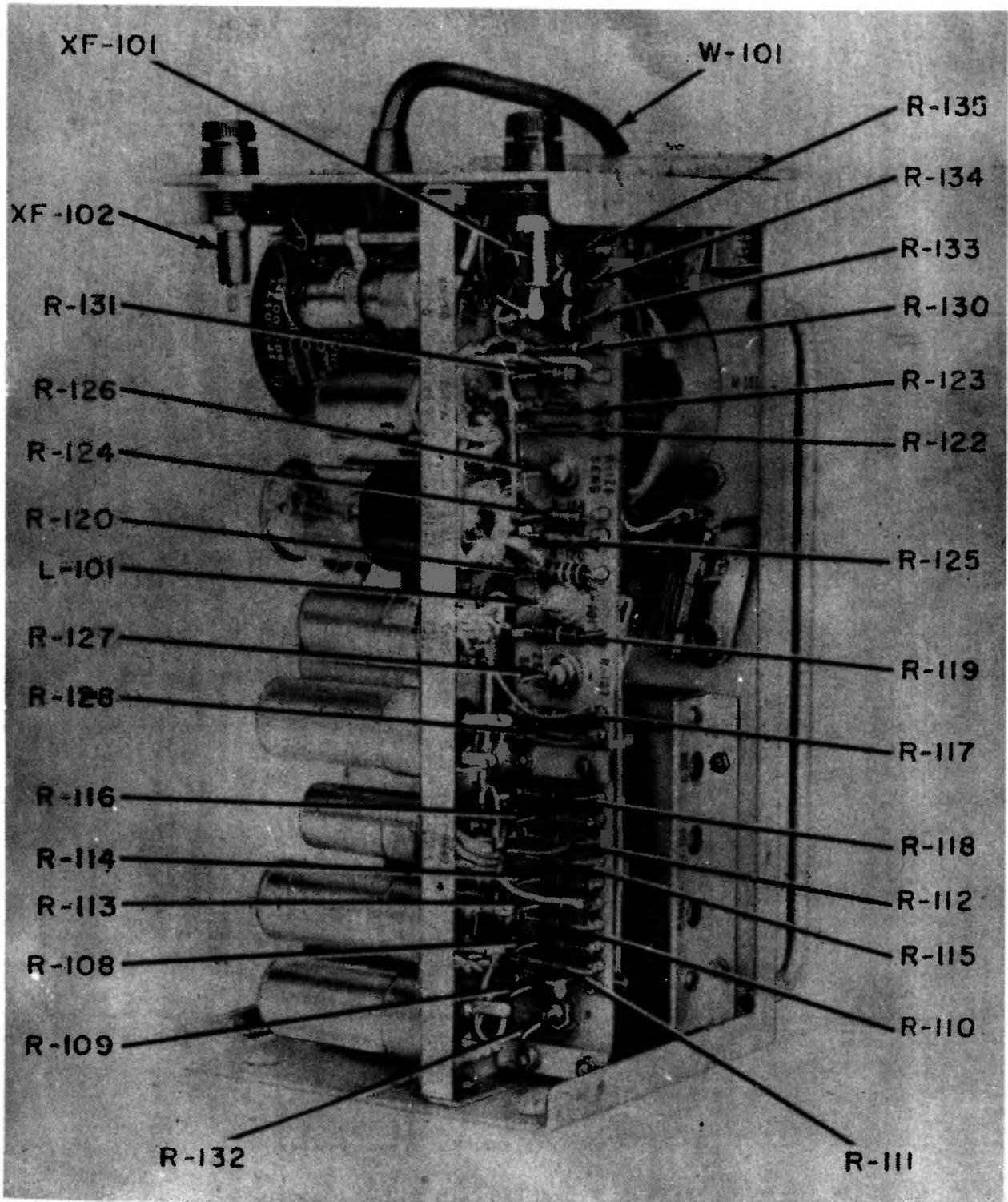


Figure 5-3. Electronic Multimeter ME-6D/U, Rear View

SECTION 6 CORRECTIVE MAINTENANCE

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form DD-787, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest District Printing and Publication Office.

1. MAINTENANCE PROCEDURES.

Before any attempt is made to service Electronic Multimeter ME-6D/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 6-2, 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 15 cyc. to 250 kc, 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 $\pm 1\%$. 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-6D/U.

(2) Set the RANGE SELECTOR to its 500 V. position, connect the output leads of the signal generator to the INPUT and GND. terminals of the Electronic Multimeter, and apply a 500-volt $\pm 1\%$ signal from the signal generator. The Multimeter should indicate a precise full-scale 500 V. deflection.

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

(4) Rotate the RANGE SELECTOR counter-

-clockwise to its 50 V. position, and apply the same 50-volt $\pm 1\%$ signal from the signal generator that was used in step (3), above. The Electronic Multimeter should indicate a precise full-scale 50 V. deflection.

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

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

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

(8) Rotate the RANGE SELECTOR an additional step counter-clockwise to its .5 V. position, and apply the same 0.5-volt $\pm 1\%$ signal from the signal generator that was used in step (7) above. The Electronic Multimeter should indicate a precise full-scale 0.5 volt deflection.

(9) With the RANGE SELECTOR still at its 0.5 V. position apply a .05-volt $\pm 1\frac{1}{2}\%$ signal from the signal generator. This signal should produce a .05-volt indication, at the low end of the Multimeter scale.

(10) Rotate the RANGE SELECTOR counter-clockwise to its .05 V. position, and apply the same .05-volt $\pm 1\frac{1}{2}\%$ signal from the signal generator that was used in step (9), above. The Electronic Multimeter should indicate a precise full-scale .05 volt deflection.

Note

If steps (9) and (10) do not produce the meter indications of .05 volt at the low end of the meter scale, this is an indication that the instrument is inaccurately calibrated. The procedure for recalibrating the instrument, by accurately setting SENSITIVITY control R-126 and ZERO SUPPRESSION control R-127 is explained in paragraph 6-2b(16) thru (21) below. (Figure 5-3 shows location of these adjustments.)

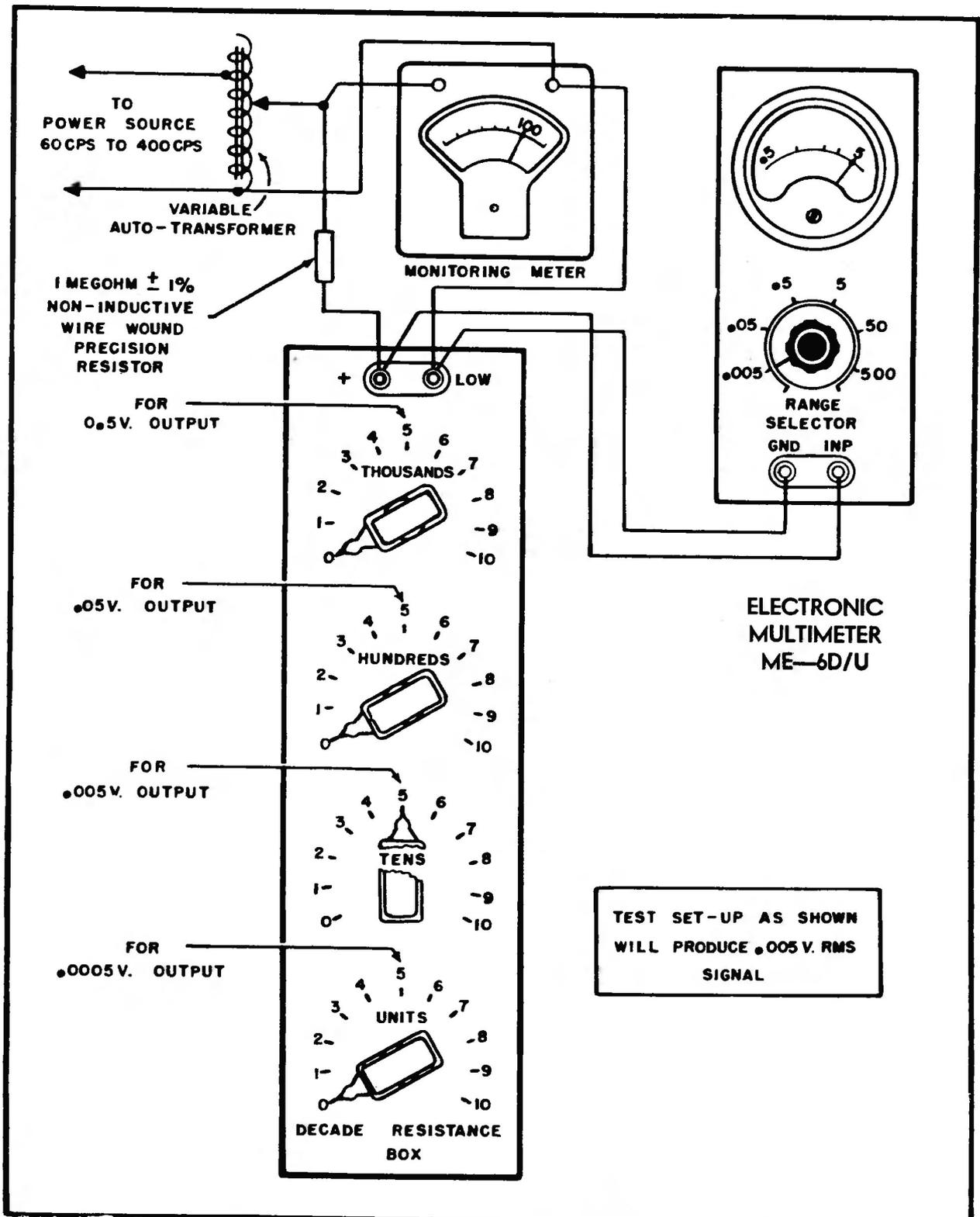


Figure 6-1. Test Set-up for Checking .005 V., .05 V., and 0.5 V. Positions of Range Selector

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

(12) Rotate the RANGE SELECTOR to its extreme counter-clockwise .005 V. position, and apply the same .005-volt $\pm 1\%$ signal from the signal generator that was used in step (11), above. The Electronic Multimeter should indicate a precise full-scale .005 volt deflection.

(13) If the signal source is capable of producing an output of .0005 volt, $\pm 1\%$, 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.

(14) The tests specified in paragraphs (6), (8), (10) and (12) should be repeated using the following frequencies 15 cps, 1000 cps, 100 kc and 250 kc, if proper equipment is available.

(15) The above procedure provides an accurate and thorough performance check of the Electronic Multimeter ME-6D/U for the frequency range from 15 cps to approximately 250 kilocycles per second. Discrepancies in excess of $\pm 3\%$ in the performance described above suggests the need for adjustment of the SENSITIVITY control R-126 and ZERO SUPPRESSION control R-127. The procedure for adjusting SENSITIVITY and ZERO SUPPRESSION is as follows:

(16) Place the POWER switch S-102 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 1000 c.p.s.) to INPUT and GND. terminals E-101 and E-102.

(18) Rotate RANGE SELECTOR S-101 to the .05 V. 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-126, until full-scale indication is obtained. This adjustment is available on the resistor board after removing bottom cover of the meter housing. (See figure 5-3.)

(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-127 until the indication is .05 volt at the low end of the scale. This adjustment is also available on the

resistor board after removing bottom cover. (See figure 5-3.)

(21) Since the adjustment 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-101 is obtained.

(22) The procedure for adjusting the trimmer capacitors, C-102, C-103 and C-104 to provide uniformity of response up to 250 kc is described in paragraph 6-6 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 $\pm 1\frac{1}{2}\%$ 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 $\frac{1}{4}\%$ 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 6-1 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.

(6) A 1-megohm $\pm 1\%$ precision wire-wound non-inductive resistor.

d. PROCEDURE FOR CHECKING WITH POWER SOURCE AND AUXILIARY EQUIPMENT—See Figure 6-1—To check the performance of Electronic Multimeter ME-6D/U with the 117-volt power source and the auxiliary equip-

ment 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) 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 and set the RANGE SELECTOR on the 500 V. position. Monitor the output of the transformer with the auxiliary a-c voltmeter capable of indicating 500 volts with an accuracy of $\pm\frac{1}{2}\%$. Vary the control on the auto-transformer until the a-c voltmeter indicates a precise output of 500 volts $\pm\frac{1}{2}\%$, the ME-6D/U Meter should indicate a precise 500 volt full-scale deflection.

WARNING

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 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-6D/U instrument. Failure to observe this precaution may result in shock.

(3) 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 $\pm\frac{1}{2}\%$. This signal should produce a 50-volt indication on the Multimeter, at the low end of the scale.

(4) Rotate the RANGE SELECTOR counterclockwise to its 50 V. position and apply the same 50 volt $\pm\frac{1}{2}\%$ 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.

(5) 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 $\pm\frac{1}{2}\%$. This signal should pro-

duce a 5-volt indication on the Multimeter, at the low end of the scale.

(6) Rotate the RANGE SELECTOR counterclockwise to its 5 V. position, and apply the same 5-volt $\pm\frac{1}{2}\%$ signal that was used in step (5), above, with the same monitoring set-up. The Electronic Multimeter should indicate a precise full-scale 5-volt deflection.

(7) 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 6-1, 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 $\pm\frac{1}{2}\%$. Vary the auto-transformer control until the monitoring meter shows an output of 100 volts $\pm\frac{1}{2}\%$. 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-6D/U meter, at the low end of the scale.

(b) Rotate the RANGE SELECTOR counterclockwise to its .5 V. position, and apply the same 0.5-volt $\pm\frac{1}{2}\%$ 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-6D/U meter, at the low end of the scale.

(d) Rotate the RANGE SELECTOR counterclockwise to its .05 V. position, and apply the same .05-volt $\pm\frac{1}{2}\%$ 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 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-6D/U meter, at the low end of the scale.

(f) Rotate the RANGE SELECTOR to 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-6D/U meter, at the low end of the scale.

(8) The above procedure is an accurate and thorough performance check of Electronic Multimeter ME-6D/U. Discrepancies in excess of $\pm 3\%$ in the performance described above suggests the need for adjustment of the SENSITIVITY control R-126 and ZERO SUPPRESSION control R-127. 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 saw-tooth sweep generator incorporated in the scope, or by using an a-c electron tube voltmeter, such as a duplicate Electronic Multimeter ME-6D/U. If a tracking error is observed and it cannot be corrected by the SENSITIVITY and ZERO SUPPRESSION controls, refer to paragraph 6-7 for instructions.

b. If an oscilloscope is used, be sure to interconnect the ground terminal of the scope to GND. terminal E-102 on the Multimeter. Solder a 50,000-ohm, $\frac{1}{2}$ 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. Judgement 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-101 is at the proper setting to accommodate the amplitude of the input signal.

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

(1) Apply two volts to the input terminals. Then two millivolts is present at the grid pin 1 of V-101 when RANGE SELECTOR is in the 5 V. position.

(2) This two millivolt signal is an apparent value, the actual effective value is much less however, due to feedback action across the cathode feedback resistor R-109, the effective value being equal to the sum of the input grid voltage and degenerative voltage across R-109.

The gain of V-101 is slightly less than one (Normally the gain of a 5879 is about 20 but is reduced in this circuit because of the feedback voltage described above.). A signal output voltage of approximately 0.0018 volts should be present at the plate pin 8 of V-101.

(3) The second stage voltage amplifier V-102 has a gain of about 97. The output of this stage may be measured at the grid pin 1 of V-103 and should be 0.175 volts.

(4) The third stage voltage amplifier V-103 has a gain of about 50. A signal voltage of 8.8 volts should be present at either the plate pin 5 of V-103 or at the junction of resistors R-122 and R-123 which are in series with the rectifier V-104.

(5) The normal operating characteristics of the Rectifier V-104 can be checked by measuring the a-c voltage across resistors R-124 or R-125 to ground. Approximately 1 volt a-c should be indicated.

(6) By inserting a plug into J-101 an output voltage of approximately 9.4 volts should be indicated, with the OUTPUT control at its maximum position.

4. MEASURING FEEDBACK FACTOR.

a. A measurement of the feedback factor is desirable in order to ascertain the stability and overall performance of the ME-6D/U. Procedure for making this determination follows:

(1) Rotate RANGE SELECTOR S-101 to its 5 V. position, and apply operating power to the equipment with the back cover removed.

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 with the back cover removed.

(2) Obtain a signal source capable of delivering an a-c signal of about 1000 cycles per second, of such an amplitude as to produce an indication on the meter; note the decibel meter indication.

(3) Solder a short length of wire across the resistor board terminals of the precision 1.8 ohm

resistor R-109. Short circuiting this resistor removes the feedback voltage from the amplifier circuit, and full gain of the amplifier will be obtained. The meter reading noted in (2) above should increase about 26 decibels.

(4) This feedback factor 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 10 db.

b. It is always well to check the feedback factor with the aid of an oscilloscope. Connect the scope probe to plate circuit of V-103 at the terminal of C-114. 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 display is sinusoidal, without changing the RANGE SELECTOR setting.

c. SUMMARY—The increase in reading of meter M-101 with R-109 shorted is the feedback factor of the instrument.

5. PEAKING COIL L-101.

L-101 is adjusted in manufacture and normally requires no further adjustment. The exceptions are when L-101 is replaced or when any rewiring has been done which might materially affect the distributed capacitance of the set. To adjust L-101 proceed as follows:

a. Set RANGE SELECTOR S-101 to the .005 volt position.

b. Apply a 1,000 cycle signal from a generator and a suitable rf attenuator to the input terminals E-101 and E-102. Monitor the signal at the input terminals with an a-c voltmeter, capable of indicating .002 volts r-m-s.

c. Adjust the signal voltage until an indication of .002 volts is read on the ME-6D/U Meter. Note reading on monitoring voltmeter.

d. Change the generator frequency to 250 kc and apply a signal level of identical amplitude as noted on the monitoring voltmeter in c. above. Note indication on the ME-6D/U Meter.

e. If reading obtained differs from the .002 volt reading in c. above, adjust L-101 until it is the same.

f. In order to check the accuracy of adjustment,

a frequency response spot check should be made by maintaining a constant input level and checking at 150 kc, 175 kc, 200 kc and 225 kc.

6. TRIMMER ADJUSTMENTS

a. Three trimmer capacitors are used in the RANGE SELECTOR switch S-101 to compensate for reactive effects on the frequency response. These adjustment have been accurately set at the factory and no further adjustments should be necessary; however, if resistors R-101 and R-102 are replaced at any time, or if other components in the selector switch assembly are replaced or rewired, it will be necessary to readjust these trimmers. To realize proper performance throughout the frequency range of the instrument, and to correct for reactances which effect the 250 kc upper limit, the following procedure should be followed:

(1) Using a stable sine-wave generator capable of delivering 5 volts over the frequency range of 1000 cycles to 250 kc, check that the amplifier has a flat frequency response, as determined in paragraph 5f above, before proceeding with the trimmer adjustments.

(2) Connect an a-c voltmeter, capable of indicating .02 volt, 0.2 volt and 2.0 volts r-m-s with an accuracy of $\pm\frac{1}{2}\%$, across the input terminals E-101 and E-102.

(3) Set the RANGE SELECTOR to the .05 V position, and apply exactly .02 volt signal at 100 kc to the input terminals.

(4) Using a non-metallic screwdriver blade, adjust trimmer C-103 until a .02 volt reading is indicated on the ME-6D/U Meter.

(5) Set the RANGE SELECTOR to the 0.5 V position and adjust the input signal to exactly 0.2 volt at 100 kc.

(6) Adjust trimmer C-102 as in (4) above until a 0.2 volt reading is indicated on the ME-6D/U Meter.

(7) Set the RANGE SELECTOR to the 5.0 V position and adjust the input signal to exactly 2.0 volts at 100 kc.

(8) Adjust trimmer C-104 as in (4) above until a 2.0 volt reading is indicated on the ME-6D/U Meter.

7. THE RANGE SELECTOR RESISTORS.

a. All resistors used in the range selector are of the stable metallic film type and will provide indefinite periods of accurate operation.

b. Whenever a doubt exists concerning the accuracy of these attenuator resistors, an ohmmeter

check first, of R-101 and R-102 should be performed, followed by a check of the complete string.

c. Resistors R-101 and R-102 may easily be checked by setting the RANGE SELECTOR switch S-101 on the .005 volt range and checking with the ohmmeter test probe between pin 1 of V-101 and ground.

d. Resistors R-107, R-106, R-105, R-104, and R-103 may likewise be tested as in paragraph c above by manipulating the RANGE SELECTOR knob to the 500, 50, 5, 0.5, 0.05 ranges respectively. (See figure 2-5)

8. DISASSEMBLY OF RANGE SELECTOR.

In the event that replacement of components in the RANGE SELECTOR assembly is required, the following procedure should be performed:

(a) Remove RANGE SELECTOR knob from front of panel.

(b) Unscrew the eight machine screws and remove back cover.

(c) Loosen four machine screws holding the attenuator shield and loosen selector switch nut on the front panel.

(d) Remove the four machine screws which fasten the main chassis assembly to the case.

(e) Pivot chassis away from attenuator cover for clearance, unsolder the ground lead and the grid lead to V-101, ease the attenuator back from front panel and unsolder leads connected to the input terminals E-101 and E-102.

(f) RANGE SELECTOR may now be carefully removed from the tube side of chassis assembly.

9. POWER TRANSFORMER.

If the current regulator RT-101 should fail and a replacement is not immediately available, the ME-6D/U can still provide service by making the following temporary changes:

(a) Solder a short jumper wire between terminals 2 and 7 of socket XRT-101.

(b) Unsolder the lead from terminal 2 of T-101 (the 88 V tap) and solder it to terminal 3 (the 115 V tap).

Note: When RT-101 is replaced, remove the jumper wire from socket XRT-101 and transfer the lead from terminal 3 of T-101 back to terminal 2.

10. LOAD RESISTOR R-129

This resistor is adjusted in manufacture and normally requires no further adjustment. However, after replacement of any major component which would effect the circuit load, such as T-101, the following procedure should be followed:

(a) Remove fuse F-101 and connect an a-c milliammeter capable of indicating 200 ma across the fuseholder terminals.

(b) Insert line plug into a variac, connect the input of the variac to an a-c source and adjust the voltage to 100 V.

(c) Turn POWER switch S-102 to ON and observe the milliammeter; after a 30 second warm up period the milliammeter should indicate approximately 195 ma. If the current reading is over 200 ma, disconnect the power cord from the variac and readjust R-129 by moving the slider toward the front panel (in the direction of maximum resistance).

11. HUM CONTROL R-132.

For minimum hum adjustment proceed as follows:

a. Connect a shielded lead, terminated by a PL-55 plug, to the vertical input terminal of an oscilloscope.

b. Insert the PL-55 plug into the OUTPUT jack J-101.

c. Adjust R-132 for minimum line frequency ripple.

12. 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.

CAUTION

Care should be exercised to avoid short circuiting the filament pins or any tube socket pins carrying B+ voltage while making measurement, otherwise damage to current regulator R-101 may result.

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

WARNING

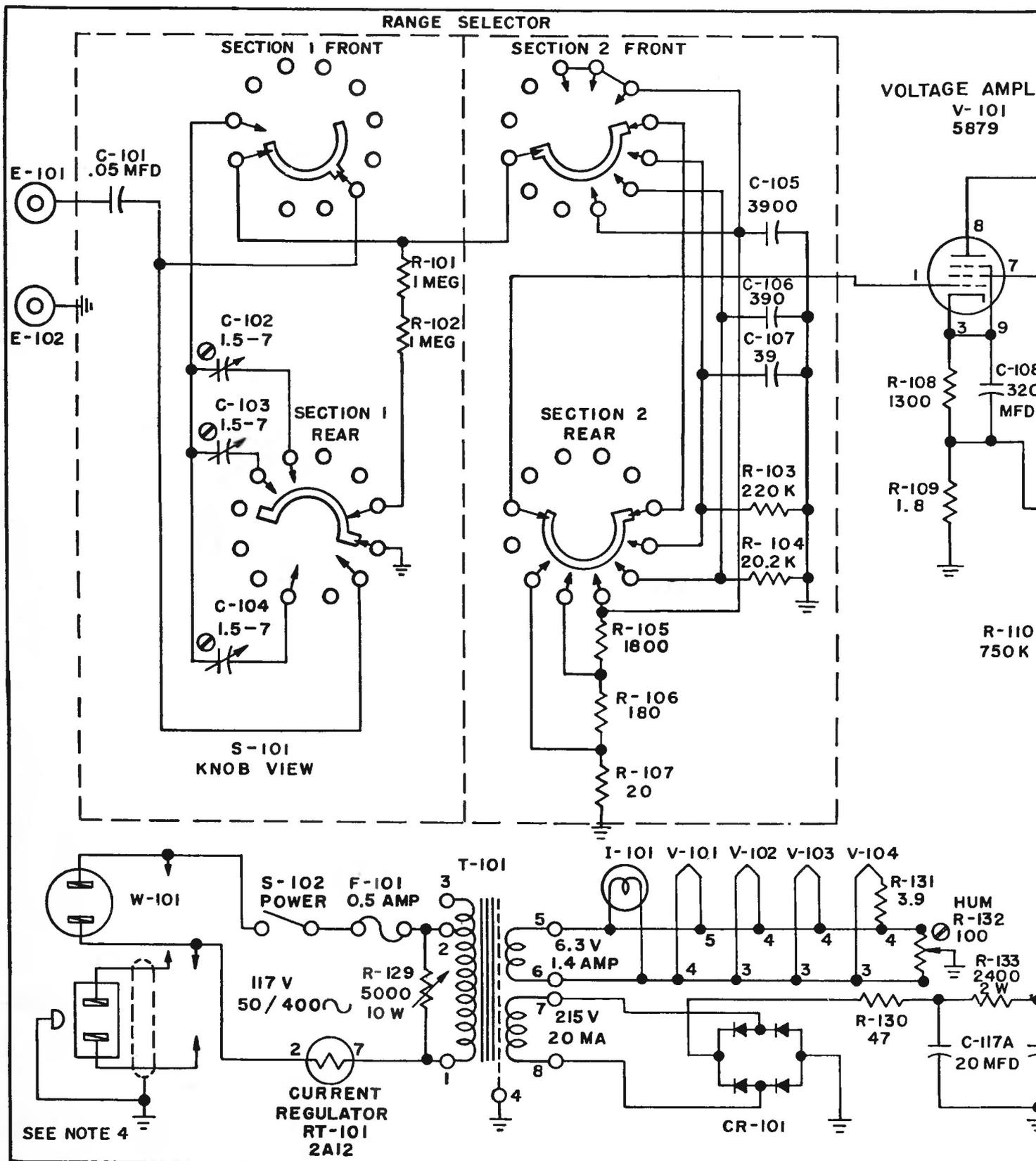
This equipment employs voltages which are dangerous and may be fatal if contacted by personnel. Extreme caution should be observed when working with the equipment.

TABLE 6-1. VOLTAGES MEASUREMENTS

(All D-C voltages and resistances are from indicated point to chassis ground;
all resistances are in ohms.)

Tube	Pin	Resistance Pin-to-Ground Reading Obtained with 20,000 Ohms/Volt Instrument	Voltage Pin-to-Ground Reading Obtained with 20,000 Ohms/Volt Instrument	Voltage Pin-to-Ground Reading Obtained with Electronic Voltmeter
V-101 5879 Voltage Amplifier	1	2,000,000*	0	0
	3	1,300	0.85	0.94
	7	1,500,000	31.0	38.0
	8	700,000	60.0	64.0
V-102 6AH6 Voltage Amplifier	1	500,000	-0.15	-0.36
	5	650,000	32.0	36.0
	6	800,000	60.0	64.0
	7	390	0.67	0.73
V-103 6AH6 Voltage Amplifier	1	1,000,000	0	0
	5	620,000	95.0	105.0
	6	650,000	120.0	132.0
	7	270	1.35	1.5
V-104 5726/6AL5W Rectifier	1	1,400	0.2	0.2
	2	1,400	0.2	0.2
	5	∞	0.25	0.34
	7	∞	0.1	0.14
V-105 0A2WA Stabilizer	1	550,000	140	150
	5	550,000	140	150
	2	0	0	0
	4	0	0	0
	7	0	0	0

*With RANGE SELECTOR switch set to the .005 V position



ELECTRONIC MULTIMETER ME-6D/U

SCHEMATIC DIAGRAM

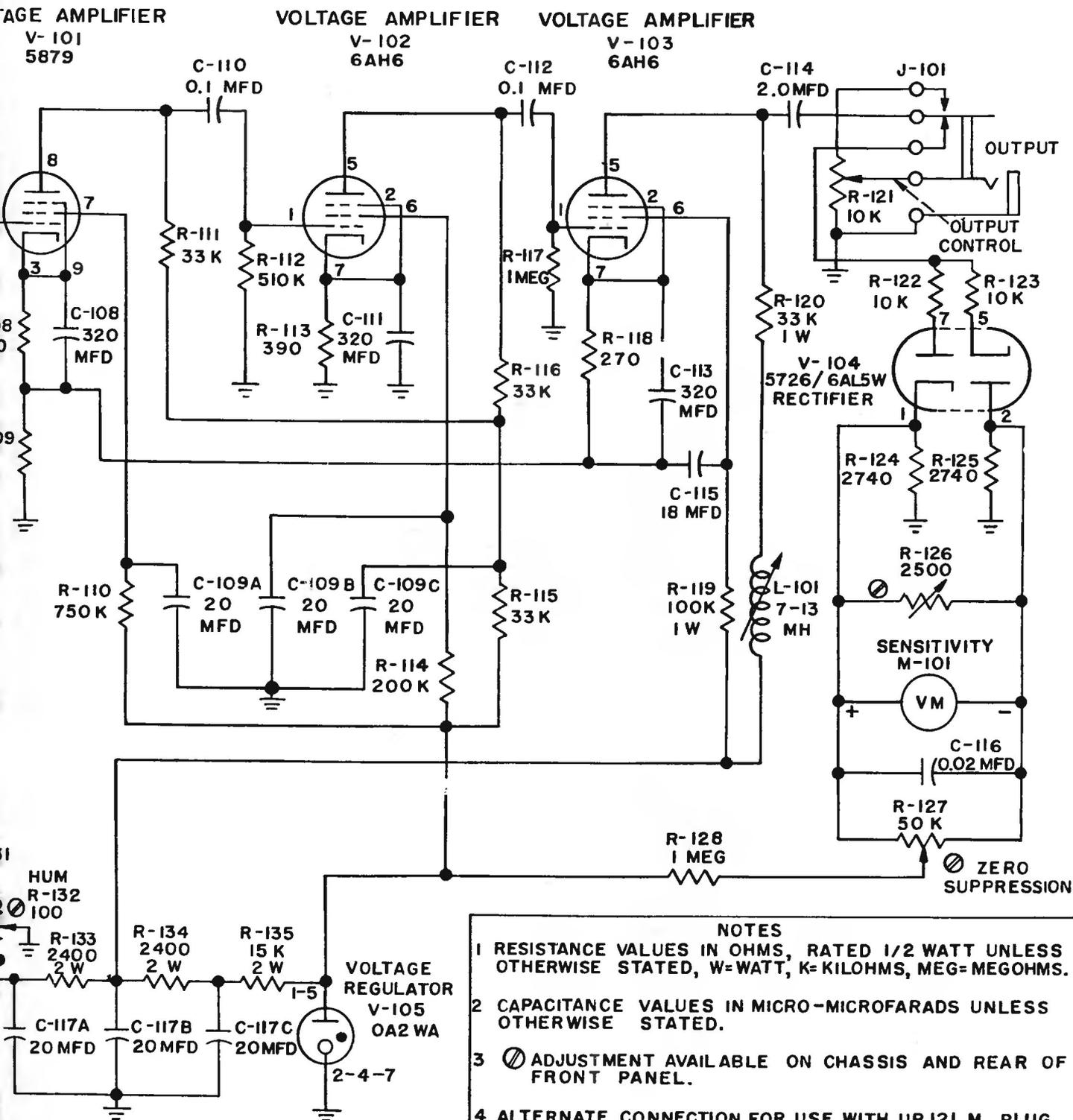


Figure 6-2. Electronic Multimeter ME-6D/U, Schematic Diagram

**SECTION 7
PARTS LIST**

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-6D/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	Abbreviation	Term
	A		H
AC	alternating current	h	height or high
AWG	American Wire Gage	HV	high-voltage
amp	ampere (s)		I
approx	approximate or approximately	in.	inch (es)
		incl	includes, included, inclusive, including
	B	ID	inside diameter (s)
x	by (as used to express dimensions)	insul	insulated
	C		J
c to c	center to center	JAN	Joint Army-Navy
C	centigrade		K
cond	conductor (s)		
contr	contractor		K
cps	cycles per second	kc	kilocycle (s)
	D		L
vdew	DC working volts	lg	length or long
db	decibel (s)		M
°	degree (s)		
d	depth or deep	mfr	manufacturer (s)
dia	diameter	max	maximum
dim.	dimensions	MBCA	Munition Board Cataloging Agency
DC	direct current	meg	megohm (s)
	F	ua	microampere (s)
fl	flange	mf	microfarad (s)
ft	foot (feet)	mmf	micromicrofarad (s)
freq.	frequency (-ies)	ma	milliampere (s)

**LIST OF ABBREVIATIONS USED IN THE
TABLE OF REPLACEABLE PARTS.—Contd.**

Abbreviation	Term	Abbreviation	Term
MIL	Military		R
min	minimum	Ref. Dwg.	Reference Drawing
mtd	mounted	Group ()	Group ()
mtg	mounting		S
		sect	section (s)
		spec	specification (s)
	N	SPST	single-pole, single-throw
neg	negative	std	standard
no. or #	number (s)		T
		temp.	temperature
		term.	terminal (s)
	O	thd	thread (s)
OD	outside diameter (s)	thk	thick or thickness
o/a	overall		V
		v	volt (s) or voltage
	P		W
p/o	part of	w	watt (s)
%	per cent	wd	wide or width
ph	phase	w/	with
±	plus or minus		
pt/dwg	part drawing		

TABLE 7-1. TABLE OF REPLACEABLE PARTS

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
101-199	F16-Q-172858-100 7CAC-587940	ELECTRONIC MULTIMETER ME-6D/U: range .0005 to 500 v AC in 6 steps, -5 to +17 db scale; $\pm 3\%$; 4½ in. dia. basic meter with logarithmic sensitivity response; input impedance, 2 meg-ohms in shunt with a maximum capacity of 30 mmf; operating power 117 v AC $\pm 10\%$, 50 to 400 cps, single ph, 24 w; o/a dim. 11-7/32 in. lg, 5-13/16 in. wide, 6½ in. high; aluminum alloy case w/grey enamel finish; logarithmic scale divisions w/suppressed zero; The Daven Co., Newark, N.J. (mfr and contr); Navy Spec No. MIL-E-17001.	
A-101	Low failure item, if required requisition from ESO referencing NAV-SHIPS 900,180A.	COVER: Electronic Multimeter; aluminum, grey enamel finish; w/schematic wiring diagram; 5-13/16 in. wide, 5½ in. high, 10½ in. lg o/a; w/eight #6-32 pem fasteners for mounting panel; p/o Navy Electronic Multimeter ME-6D/U; The Daven Co., (mfr an contr) part/dwg No. D-1386-50.	Dust cover
A-102	N16-C-650002-159	COVER, TELEPHONE JACK: steel, black enamel finish; 1-3/32 in. lg, 13/16 in. wide, approx ¾ in. high; ¾ in. dia mtg hole; Switchcraft (mfr) Type No. 515.	Water and dust shield for J-101
AT-101	Assemble from component parts. 7CDV	ATTENUATOR, variable: special; input impedance 2 meg; output impedance variable from 2 meg to 20 ohms; 15 cycles to 250 kc frequency range; 5 steps, 20 db per step; 4-5/16 in. wide, 1½ in. deep o/a dim. excluding switch shaft and bushing; 4 solder lug terminals; four .157 in. dia mtg holes on 2-21/32 in. by 3-15/16 in. mtg centers and ¾-32 thd x ¼ in. lg bushing; the attenuator is divided into two sections w/electrostatic shield between sections, switch provided with water seal feature, fungus proofed; The Daven Co. (mfr and contr) part/dwg no. C-1386-36.	Range selector
C-101	N16-C-44257-1817 3330-056250504	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 50,000 mmf $\pm 10\%$; 600 vdcw; MIL type CP25A1EF503K; spec MIL-C-25A.	D-C blocking, input
C-102	N-16-C-63900-6761 3330-312922272	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 1 sect; 1.5 to 7 mmf; 500 vdcw; JAN type CV11A070; spec JAN-C-81.	Trimmer in AT-101
C-103		Same as C-102.	Trimmer in AT-101
C-104		Same as C-102.	Trimmer in AT-101
C-105	N16-C-32430-6143 3330-376149250	CAPACITOR, FIXED, MICA, DIELECTRIC: 3900 mmf $\pm 5\%$; 500 vdcw; MIL type CM35E392J; spec MIL-C-5A.	Corrector in AT-101
C-106	N16-C-29898-3409 3330-314382165	CAPACITOR, FIXED, MICA, DIELECTRIC: 390 mmf $\pm 5\%$; 300 vdcw; EMM type CM15E391J.	Corrector in AT-101
C-107	N16-C-27366-1134 3330-056200865	CAPACITOR, FIXED, MICA, DIELECTRIC: 39 mmf $\pm 5\%$; 300 vdcw; EMM type CM15E390J.	Corrector in AT-101
C-108	For replacement use SNSN N16-C-20572-2852. 3330-055600149	CAPACITOR, FIXED, ELECTROLYTIC: 1 sect; 320 mf; 15 vdcw; JAN type CE31E321E; spec JAN-C-62.	Cathode By-Pass V-101

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
C-109A, C-109B, C-109C	For replacement use SNSN N16-C-22631- 1801. 3330-055600150	CAPACITOR, FIXED, ELECTROLYTIC: 3 sect; 20/20/20 mf; 450 vdcw; JAN type CE33E209R; spec JAN-C-62.	C-109A, plate By-Pass, V-101 C-109B, screen By-Pass, V-102 C-109C, plate By-Pass, V-102
C-110	For replacement use SNSN N16-C-45773- 8069. 3330-056550024	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect; 100,000 mmf $\pm 10\%$; 400 vdcw; MIL type CN43EE104K; spec MIL-C-91A.	Plate coupling, V-101
C-111		Same as C-108.	Cathode By-Pass, V-102
C-112		Same as C-110.	Plate coupling V-102
C-113		Same as C-108.	Cathode By-Pass, V-103
C-114	N16-C-49197-7294 3330-317095005	CAPACITOR, FIXED, PAPER: 2 mf $\pm 10\%$; 600 vdcw; MIL type CP41B1FF205K; spec MIL-C-25A.	Plate coupling V-103
C-115	For replacement use SNSN N16-C-19693- 8993. 3330-317484950	CAPACITOR, FIXED, ELECTROLYTIC: 1 sect; 18 mf; 450 vdcw; JAN type CE31E180R; spec JAN-C-62.	Screen By-Pass, V-102
C-116	For replacement use SNSN N16-C-43142- 8895. 3330-056550048	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 sect, 20,000 mmf $\pm 20\%$; 120 vdc; MIL type CN22EY203M; spec MIL-C-91A.	Meter By-Pass
C-117A, C-117B, C-117C		Same as C-109A, B & C.	C-117A, C-117B, C-117C, plate supply filter
CR-101	N17-R-51455-1025 3370-680100-1275	RECTIFIER, METALLIC: selenium; single phase full wave bridge; 215v AC input; 240v dc at 50 ma output; square shape, 1 1/8 in. lg x 11/16 in. square excluding terminals; hole through center w/clearance for #6-32 thd screw; 5 solder lug terminals located radially; salt spray resistant coating; Mallory (mfr) No. 4B8R1N26TI.	Plate supply rectifier
E-101, E-102	Low failure item, if required requisition from ESO referencing NAV SHIPS 900.180A.	POST, BINDING: brass, copper flashed and gold plated; 3/8 in. high above mtg surface (open), 3/8 in. OD; w/mtg stud 29/32 in. lg, 8-32 thread; knurled captive screw cap, jack top; Davenco pt/dwg A-1386-72 (Note: This item is supplied in pairs).	Input signal and Ground Connections
E-103, E-104	Low failure item, if required requisition from ESO referencing NAV SHIPS 900.180A. 3320-082355201	INSULATOR, PLATE: steatite, Grade L-4B per Spec JAN-1-10 treated with Dow Corning #200 solution; rectangular shape w/rounded corners, item code no 217 MBCA Ref Dwg Group 9; 1 1/2 in. lg, 3/4 in. wide, 7/32 in. thk; two .170 in. dia mtg holes .750 in. c to c; .047 in. deep locating shoulder on one end, both ends recessed to accommodate Davenco above binding posts, w/teflon gasket; Davenco pt/dwg no. A-1386-69 (Note: This item is supplied in pairs).	Insulators, for E-101 and E-102
E-105	N16-S-34576-6514 3370-774000-2185	SHIELD, ELECTRON TUBE: JAN type TS103U02 for noval tube 1-15/16 in. high; spec JAN-S-28A.	V-101 tube shield

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
E-106	N16-S-34567-8350 3370-774000-1955	SHIELD, ELECTRON TUBE: JAN type TS102U02 for miniature tube 1¾ in. high; spec JAN-S-28A.	V-102 tube shield
E-107		Same as E-106.	V-103 tube shield
E-108	N16-S-34520-3861 3370-774000-1925	SHIELD, ELECTRON TUBE: JAN type TS102U01 for miniature tube 1¾ in. high; spec JAN-S-28A.	V-104 tube shield
E-109	Assemble from component parts. 3370-738500-1756	RETAINER, ELECTRON TUBE: for long 7 pin miniature tubes; stainless steel top hat 13/16 in. OD and one threaded stainless steel post 2¾ in. lg equipped with mtg ring, 2 hex nuts and a lock-washer; Times Facsimile (mfr) Top Hat retainer w/Type 1T hat and #257 post.	V-105 retainer
E-109A	N16-R-503580-251	HAT, trimmed: stainless steel; 13/16 in. OD, 21/32 in. ID, 1-7/16 in. lg, 9/16 in. high; Times Facsimile (mfr) Type No. 1T.	
E-109B	N16-R-503580-442	POST: stainless steel; 2¾ in. lg; both ends threaded; requires #18 drill hole for mounting; equipped with ¾ in. dia mtg ring located 1½ in. above mtg surface, 2 hex nuts and lockwasher; Time Facsimile (mfr) Type No. 257.	
E-110	Assemble from component parts. 3370-719000-2197	RETAINER, ELECTRON TUBE: for tube with T-9 bulb; one stainless steel top hat 7-7/32 in. OD and one threaded stainless steel post 3¼ in. lg equipped with 2 hex nuts and a lockwasher; Time Facsimile (mfr) Top Hat retainer w/Type 2T hat and #32 post.	RT-101 retainer
E-110A	N16-R-503580-441	HAT, trimmed: stainless steel; 1-7/32 in. OD, 13/16 in. ID, 1-27/32 in. lg. 23/32 in. high; Times Facsimile (mfr) Type No. 2T.	
E-110B	N16-S-800661-175	POST: stainless steel; 3¼ in. lg, both ends threaded; requires #18 drill hole for mounting; equipped with 2 hex nuts and a lockwasher; Times Facsimile (mfr) Type #32.	
E-111	For replacement use SNSN N16-K-700314-658. 3320-083351485	KNOB: round w/pointer; black bakelite; for ¼ in. dia shaft; double #8/32 set screw; white line marking; 1-3/32 in. dia, 21/32 in. h o/a; brass insert; shaft hole .406 in. deep; Daven Co. (mfr and contr) part/dwg No. A-1386-82 (similar to Navy type RE10F479C Type A).	Control knob for A-C output control
E-112	For replacement use SNSN N16-K-700350-251. 3320-083351326	KNOB: round w/pointer; black bakelite; for ¼ in. dia shaft; double #8/32 set screw; white line marking; 1-9/16 in. dia, ¾ in. h o/a; brass insert; shaft hole .469 in. deep; Daven Co. (mfr and contr) part/dwg No. A-1386-80 (similar to Navy type RE10F479C Type B).	Position selector for range switch S-101
E-113	Shop manufacture.	GASKET: neoprene, Armstrong Cork Co. Type DC-100 or equal per spec. MIL-G-6183; style 1, MBCA Ref Dwg Group 75 (Revised); 4-9/16 in. OD, 3¾ in. ID, 5/32 in. thk; three .218 in. dia holes spaced 120° apart on 2-1/16 in. radius; Daven Co. (mfr and contr) pt/dwg No. A-1386-19, p/o Navy Electronic Multimeter ME-6D/U.	Water seal for M-101
E-114	Shop manufacture.	INSULATOR, PLATE: plastic, Type PBE-P per spec MIL-P-3115B, natural color; 1¾ in. square, ¼ in. thk, w/13/16 in. dia hole in center; four .152 in. dia mtg holes on 1½ in. square mtg centers; Daven Co. pt/dwg No. A-1386-28 p/o Navy Electronic Multimeter ME-6D/U.	Insulates C-114 from chassis

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
E-115	Shop manufacture.	PLATE, CAPACITOR MOUNTING: plastic, Type PBE-P per spec MIL-P-3115B, natural color; holds capacitors by 4-40 thd screws; two .152 in. dia mtg holes on 3/8 in. mtg centers; fungus proofed; Daven Co. (mfr and contr) pt/dwg No. B-1386-30 p/o Navy Electronic Multimeter ME-6D/U.	Mounting plate for C-102, C-103 and C-104
F-101	N17-F-16302-65 8870-112000-748	FUSE: cartridge type; 1/2 amp, 250 v; ferrule terminals; 1 1/4 in. lg; 1/4 in. dia; MIL type F02GR500A; Spec MIL-F-15160 Bussman (mfr) Type AGC-1/2.	Power line fuse
F-102		Same as F-101	Spare fuse
I-101	G17-L-6297 8870-938000-375	LAMP, INCANDESCENT: 6-8v; 0.15 amp; miniature bayonet base; T-3-1/4 clear bulb; type C2 tungsten filament; 1-3/16 in. max. o/a height; GE (mfr) Type 47.	Pilot lamp
J-101	N17-J-39365-2081 8850-753195	JACK, TELEPHONE: accommodates 2 cond 0.25 in. dia plug; contact arrangement JI-1C, MBCA Ref Dwg Group 4; 7/8 in. lg, 1 in. wide x 1-15/16 in. high o/a dim.; mounts in 3/8 in. dia hole; moisture and fungus proofed; special w/construction per spec JAN-J-641; Switchcraft (mfr) Type 3J1104.	Signal output jack
L-101	N16-C-74076-1570 3340-060717130	COIL, RADIO FREQUENCY: adjustable 7.2-12.5 mh at 250 kc; 45 ohms max DC resistance; single pie universal winding; untapped; unshielded; hollow phenolic coil form 1-7/16 in. lg x 3/8 in. dia; 1/2 in. lg x 5/8 in. dia o/a dim. of coil exc. term., mtg attachments and tuning devices; adjustable iron core, screw driver adjustment at threaded end of coil; 2 solder lug term. located radially; mounts by 1/4-28 threaded end; Daven Co. (mfr and contr) pt/dwg No. B-1386-24; p/o Navy Electronic Multi-Meter ME-6D/U.	Peaking coil
M-101	N17-M-29387-1152 7CAC-589073-4	METER: multiscale; 60 ua to 600 ua; 4 1/2 in. OD; metal case; barrel 3 3/4 in. OD; 1-11/16 in. deep behind flange; ±2% accuracy; D'Arsonval movment; logarithmic sensitivity response; 76 scale divisions on upper volts RMS scale, marked from 0.5 to 5.0 volts; 44 divisions on lower DB scale, marked from -5 to +17 db; 3 mtg holes equally spaced on 2-1/16 in. radius; 2 solder lug terminals; special scale markings; Q.V.S. model 450 Type 282; Daven Co. (contr) pt/dwg No. C-1386-41.	A C Voltage and decibel indicator
R-101	For replacement use N16-R-73308-2814. 3350-382000-5981	RESISTOR, FIXED, METAL FILM: 1 meg ±1%; 1/2 watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead; Concarb (mfr) Type NA15.	Attenuator resistor
R-102		Same as R-101.	Same as R-101
R-108	For replacement use N16-R-E3221-5813. 8350-382000-3528	RESISTOR, FIXED, METAL FILM: 220,000 ohms ±1%; 1/2 watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead; Concarb (mfr) Type NA15.	Same as R-101
R-104	N16-R-73113-1101 3350-382000-27245	RESISTOR, FIXED, METAL FILM: 20,200 ohms ±1%; 1/2 watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead; Concarb (mfr) Type NA15.	Same as R-101
R-105	N16-R-73008-4700 3350-382000-2495	RESISTOR, FIXED, METAL FILM: 1800 ohms ±1%; 1/2 watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead; Concarb (mfr) Type NA15.	Same as R-101

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
R-106	N16-R-72916-7613 3350-382000-1951	RESISTOR, FIXED, METAL FILM: 180 ohms $\pm 1\%$; $\frac{1}{2}$ watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead; Concarb (mfr) Type NA15.	Same as R-101
R-107	N16-R-72825-4551 3350-382000-1391	RESISTOR, FIXED, METAL FILM: 20 ohms $\pm 1\%$; $\frac{1}{2}$ watt derated to zero % at 150° C; 5/32 in. dia x 15/32 in. lg less term; rubberized enamel coating; resistant to humidity; two axial wire lead term; Concarb (mfr) Type NA15.	Same as R-101
R-108	N16-R-49948-431	RESISTOR, FIXED, COMPOSITION: 1300 ohms $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF132J; spec MIL-R-11; A B (mfr) Type EB-1325.	Cathode resistor V-101
R-109	N16-R-80876-7039 3350-383000-1256	RESISTOR, FIXED, METAL FILM: 1.8 ohms $\pm 1\%$; $\frac{1}{2}$ watt; .037%/°C from -60° C to +100° C temperature coefficient; 13/64 in. dia x $\frac{1}{2}$ in. lg less term; hermetically sealed in heat resistant glass tube; two axial wire lead term; terminal mounted; Daven Co. (mfr and contr) Davohm Series 850.	Feed back resistor
R-110	N16-R-50911-431	RESISTOR, FIXED, COMPOSITION: 750,000 ohms $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF754J; spec MIL-R-11; A B (mfr) type EB7545.	Screen resistor V-101
R-111	N16-R-50416-431 3350-098000-4871	RESISTOR, FIXED, COMPOSITION: 33,000 ohms; $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF333J; spec MIL-R-11; A B (mfr) type EB-3335.	Plate load V-101
R-112	N16-R-50839-438 3350-098000-6231	RESISTOR, FIXED, COMPOSITION: .51 meg $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF514J; spec MIL-R-11; A B (mfr) type EB-5145.	Grid resistor V-102
R-113	N16-R-49732-431 3350-098000-2831	RESISTOR, FIXED, COMPOSITION: 390 ohms $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF391J; spec MIL-R-11; A B (mfr) type EB-3915.	Cathode resistor V-102
R-114	N16-R-50704-431 3350-098000-5731	RESISTOR, FIXED, COMPOSITION: 200,000 ohms; $\pm 5\%$ $\frac{1}{2}$ watt; MIL type RC20BF204J; spec MIL-R-11; A B (mfr) type EB-2045.	Screen resistor V-102
R-115		Same as R-111.	De coupling V-102
R-116		Same as R-111.	Plate load V-102
R-117	N16-R-50974-431 3350-098000-6551	RESISTOR, FIXED, COMPOSITION: 1 meg $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF105J; spec MIL-R-11; A B (mfr) type EB-1055.	Grid resistor V-103
R-118	N16-R-49687-431 3350-098000-2671	RESISTOR, FIXED, COMPOSITION: 270 ohms $\pm 5\%$; $\frac{1}{2}$ watt; MIL type RC20BF271J; spec MIL-R-11; A B (mfr) type EB-2715.	Cathode resistor V-103
R-119	N16-R-50632-751 3350-128000-5955	RESISTOR, FIXED, COMPOSITION: ^{150,000} 100,000 ohms; $\pm 5\%$; 1 watt; MIL type RC30BF104J; spec MIL-R-11; A B (mfr) type GB-1045.	Screen resistor V-102
R-120	N16-R-50416-751 3350-128000-5475	RESISTOR, FIXED, COMPOSITION: 33,000 ohms $\pm 5\%$; 1 watt; MIL type RC30BF333J; spec MIL-R-11; A B (mfr) type GB-3345.	Plate load V-103
R-121	N16-R-87681-8650 3350-772500-6155	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms $\pm 20\%$; $\frac{1}{2}$ watt; JAN type RV3ATRD103D w/water seal shaft and bushing; spec JAN-R-94; CTS (mfr) type WS-35 Pt #BM5638.	A C Output control

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
R-122	_____ For replacement use N16-R-73092-6938. 3350-382000-2668	RESISTOR, FIXED, METAL FILM: 10,000 ohms $\pm 1\%$; $\frac{1}{2}$ watt; MIL type RN15X1002F; spec MIL-R-10509A; Concarb (mfr) type NA15.	Bridge resistor M-101
R-123	_____	Same as R-122.	Same as R-122
R-124	_____ N16-R-73021-5538 3350-382000-25366	RESISTOR, FIXED, METAL FILM: 2740 ohms $\pm 1\%$; $\frac{1}{2}$ watt; MIL type RN15X2741F; spec MIL-R-10509A; Concarb (mfr) type NA15.	Cathode resistor V-104A
R-125	_____	Same as R-124.	Cathode resistor V-104B
R-126	_____ For replacement use SNSN N16-R-87418- 7019. 3350-769400-2245	RESISTOR, VARIABLE, COMPOSITION: 2500 ohms $\pm 20\%$; $\frac{1}{2}$ watt; std A taper, MBCA Ref Dwg Group 3; 3 solder lug terminals; metal case; $\frac{3}{8}$ in. dia x $\frac{23}{64}$ in. deep; slotted metal shaft, $\frac{1}{8}$ in. dia x $\frac{1}{2}$ in. lg from mtg surface; normal torque; insulated contact arm w/o off position; mounted by $\frac{1}{4}$ -32 thd x $\frac{3}{8}$ in. bushing, non-turn device located on $\frac{3}{8}$ in. radius at 9 o'clock; CTS (mfr) Series 65 Pt #AY1453.	Sensitivity adjust- ment, high end of meter scale
R-127	_____ For replacement use SNSN N16-R-87848- 7055. 3350-769400-3961	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms $\pm 20\%$; $\frac{1}{2}$ watt; std A taper, MBCA Ref Dwg Group 3; 3 solder lug terminals; metal case; $\frac{3}{8}$ in. dia x $\frac{23}{64}$ in. deep; slotted metal shaft, $\frac{1}{8}$ in. dia x $\frac{1}{2}$ in. lg from mtg surface; normal torque; insulated contact arm w/o off position; mounted by $\frac{1}{4}$ -32 thd x $\frac{3}{8}$ in. bushing, non-turn device located on $\frac{3}{8}$ in. radius at 9 o'clock; CTS (mfr) Series 65 Pt #BM5639.	Suppression adjustment for low end of meter scale
R-128	_____	Same as R-101.	Voltage dropping meter rectifier circuit
R-129	_____ N16-R-43637-7014 3350-044000-3795	RESISTOR, ADJUSTABLE: wire-wound; body style no. 81 MBCA Ref Dwg Group 2; inductive winding; 5000 ohms $\pm 10\%$; 10 watts; $1-\frac{3}{4}$ in. lg x $\frac{5}{16}$ in. dia excluding terminals; vitreous enamel coated; 3 solder lug terminals (2 fixed and one sliding) mounts w/6-32 x $2\frac{1}{4}$ in. screw through center; Ohmite (mfr) Type-Dividohm no. 1033.	Current adjust- ment for RT-101
R-130	_____ N16-R-49426-431 3350-098000-1851	RESISTOR, FIXED, COMPOSITION: 47 ohms $\pm 5\%$; $\frac{1}{2}$ watt; MIL type; RC20BF470J; MIL-R-11; A B (mfr) type EB-4705.	Voltage dropping; plate supply filter
R-131	_____ N16-R-68292-3686 3350-454000-2311	RESISTOR, FIXED: W.W. 3.9 ohms $\pm 10\%$; $\frac{1}{2}$ watt; JAN type RU3B3R9K; JAN-R-184.	Voltage dropping, V-104 filament
R-132	_____ N16-R-87023-9586 3350-769500-1315	RESISTOR, VARIABLE, COMPOSITION: 100 ohms $\pm 20\%$; $\frac{1}{2}$ watt; std A taper, MBCA Ref Dwg Group 3; 3 solder lug terminals; metal case; $\frac{3}{8}$ in. dia x $\frac{23}{64}$ in. deep; slotted metal shaft, $\frac{1}{8}$ in. dia x $\frac{1}{2}$ in. lg from mtg surface; normal torque; insulated contact arm w/o off position; mounted by $\frac{1}{4}$ -32 thd x $\frac{3}{8}$ in. bushing, non-turn device located on $\frac{3}{8}$ in. radius at 9 o'clock; CTS (mfr) Series 65 Pt #AY1458.	Hum adjusting control
R-133	_____ N16-R-50021-126 3350-146000-3697	RESISTOR, FIXED, COMPOSITION: 2400 ohms $\pm 5\%$; 2 watt; MIL type RC42BF242J; spec MIL-R-11; A B (mfr) type HB-2425.	Voltage dropping, plate supply filter
R-134	_____	Same as R-133.	Same as R-133

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
R-135	N16-R-50335-6321 3350-146000-4557	RESISTOR, FIXED, COMPOSITION: 15,000 ohms $\pm 5\%$; 2 watt; MIL type RC42BF153J; spec MIL-R-11; A B (mfr) type HB-1535.	Same as R-133
RT-101	N16-R-85005-6321 3350-061500-4125	REGULATOR, BALLAST LAMP: current rating 180 ma to 220 ma; voltage rating 15 v to 30 v; for AC/DC use; ballast tube type, T-9 bulb, 2 $\frac{1}{8}$ in. max seated height; octal base for socket mounting, base wiring prongs 2 and 7; hermetically sealed, equipped with internal switch which shorts out portion of resistance after 30 sec; Amperite (mfr) Type No. 2A12.	Line voltage regulator
S-101	N17-S-63717-1901 3360-073114195	SWITCH, ROTARY: 2 sections; 4 poles; 6 positions; silver contacts gold flashed; ceramic sections; 1 $\frac{1}{8}$ in. lg x 1-11/16 in. wd; 1-15/16 in. h o/a; mtg bushing $\frac{3}{8}$ -32 thd x $\frac{3}{8}$ in. lg; $\frac{1}{4}$ in. dia shaft, $\frac{7}{8}$ in. lg from mtg surface; water sealed shaft and bushing; divided spacers between ceramic section provide for mounting shield; Oak (mfr) Pt # 64868-H2C per Daven Co. Dwg. No. A-1386-10.	Switch for AT-101
S-102	For replacement use SNSN N17-S-70512-4406. 3360-39853395	SWITCH, TOGGLE, SPST: JAN type ST-42A; spec JAN-S-23; with special water seal feature; C. H. 8803-K-10.	Power ON-OFF switch
T-101	N17-T-73462-1301 3340-063903970	TRANSFORMER, POWER STEP-UP AND STEP-DOWN: hermetically sealed metal case; 115 v AC $\pm 10\%$; 50 to 400 cycles, single ph; primary tapped at 88 v; 2 output windings; HV secondary 215 X max at 30 ma; filament secondary 6.3 v at 1.50 amps; 3 $\frac{1}{4}$ in. lg, 2-9/16 in. dia w/2-9/16 in. square mtg flange; 8 solder lug terminals on one end; four .177 in. dia mtg holes on 2-3/32 in. square mtg centers; electrostatic shield between primary and secondary; class 1 Grade A in acc/w MIL-T-27; Cycle Transformer Corp (mfr) type D-160; Daven Co. (contr) pt/dwg No. C-1386-44.	Power transformer
TB-101	Shop manufacture.	TERMINAL BOARD: laminated phenolic board, type PBE-P per spec MIL-P-3115; includes 46 term style no 4, MBCA Ref Dwg Group 21; w/o barrier; 10-5/16 in. lg, 1 $\frac{1}{8}$ in. wd, $\frac{1}{8}$ in. thk o/a excluding term; six .152 in. dia mtg holes on $\frac{7}{8}$ in. x 6-1/16 in. and $\frac{7}{8}$ in. x 9-15/16 in. mtg centers; marked with component designations, SENS., ZERO ADJ. HUM and TB-101; fungus proofed; Daven Co. (mfr and contr) pt/dwg no. B-1386-27; p/o Navy Electronic Multimeter ME-6D/U.	Mounting plate for various electrical components
V-101	N16-T-75879	ELECTRON TUBE: USN type 5879; pentode amplifier, miniature 9 pin base; spec MIL-T-12616.	Voltage amplifier
V-102	N16-T-56185	ELECTRON TUBE: MIL type 6AH6; pentode amplifier; miniature 7 pin base; spec MIL-B-1B.	Voltage amplifier
V-103		Same as V-102.	Same as V-102
V-104	N16-T-75726	ELECTRON TUBE: MIL type 5726/6AL5W; twin diode, miniature 7 pin base; spec MIL-E-1B.	Meter rectifier
V-105	N16-T-52001-3	ELECTRON TUBE: USN type 0A2WA voltage regulator; BU SHIPS Spec 14 Sept. 1953.	Plate voltage regulator

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

Reference Symbol	Stock Numbers Signal Corps Standard Navy Air Force	Name of Part and Description	Locating Function
W-101	N17-C-48190-1511	CABLE ASSEMBLY, POWER, ELECTRICAL: Underwriters Lab Type SJ; 2 conductors, stranded, no. 18 AWG; "Buna S" insulation, and "Buna S" jacket; 7 ft. 10 in. o/a length; molded Buna S #52R plug cap at one end; conductors on second end extend 6½ in. beyond end of jacket; wire tinned; #371 grommet located approx 7 ft. from heel of plug to center of grommet. Cornish (mfr) #2569 Issue 1 per; Daven Co. dwg no. B-1386-20. Note: A cable assembly which utilizes a shielded line cord, terminated on one end with a UP-121M plug, can be used as a replacement for the above cable assembly. See Figure 6-2.	Input power cable
XF-101	N17-F-74266-5-31	FUSEHOLDER: extractor post type; 250 v; 15 amp; accommodates one ¼ in. dia x 1¼ in. lg fuse; phenolic body; brass contacts; not clip type; 1½ in. lg x 11/16 in. dia o/a dim. excluding terminals; 2 solder lug terminals; mounts by ⅝ in. -24 thd portion; requires ½ in. dia panel hole; equipped with test hole in knob and designed to meet 200 hr salt spray test; Bussman (mfr) Type No. HKP-HJ.	Fuse holder for F-101
XF-102		Same as XF-101.	Spare fuse holder
XI-101		LIGHT, INDICATOR: w/faceted, green lens ½ in. dia; accommodates size T-3¼ miniature bayonet base lamp; nickel plated; mounts in 11/16 in. dia mtg hole; accommodates up to ¼ in. thk panel; 2 solder lug terminals located at opposite sides of base; 2 in. lg x 15/16 in. dia o/a; Drake Mfg. Co. (mfr) Type 50.	Pilot light holder, I-101
XI-101A	N17-L-250307-751		
XI-101B	N17-L-76655-8931	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; 1 solder lug term; mounts in 11/16 in. dia mtg hole; with 9/16-32 thd for attaching lens; Drake Mfg. Co. (mfr). Part of Indicator Light XI-101.	
XRT-101	N16-S-63515-4151	SOCKET, ELECTRON TUBE: octal; JAN type TS101P01; spec JAN-S-28A; Cinch (mfr) pt. no. 51B16203.	Socket for RT-1
XV-101	N16-S-64063-6714	SOCKET, ELECTRON TUBE: 9 contact; miniature; JAN Type TS103C01; spec JAN-S-28A.	Tube socket, V-101
XV-102	N16-S-62603-6702	SOCKET, ELECTRON TUBE: 7 contact; miniature; JAN type TS102P01; spec JAN-S-28A.	Tube socket, V-102
XV-103		Same as XV-102.	Tube socket, V-103
XV-104		Same as XV-102.	Tube socket, V-104
XV-105		Same as XV-102.	Tube socket, V-105

TABLE 7-2. CROSS REFERENCE PARTS LIST

Key Symbol	Jan (or Mil) Designation	Std. Navy Stock Number	Signal Corps Stock Number	Air Force Stock Number
A-101				
A-102				
AT-101		N16-C-650002-159		7CDV
C-101	CP25A1EF503K	N16-C-44257-1817		3330-056250504
C-102	CV11A070	N16-C-63900-6761		3330-312922272
C-105	CM35E392J	N16-C-32430-6143		3330-376149250
C-106	CM15E391J	N16-C-29898-3409		3330-314382165
C-107	CM15E390J	N16-C-27366-1134		3330-056200865
C-108	CE31E321E	N16-C-20572-2852		3330-055600149
C-109	CE33E200R	N16-C-22631-1801		3330-055600150
C-110	CN43EE104K	N16-C-45773-8069		3330-056550024
C-114	CP41B1FF205K	N16-C-49197-7294		3330-317095005
C-115	CE31E180R	N16-C-19693-8993		3330-317484950
C-116	CN22EY203M	N16-C-43142-8895		3330-056550048
CR-101		N17-R-51455-1025		3370-630100-1275
E-101				
E-103				
E-105	TS-103U02	N16-S-34576-6514		3320-082355201
E-106	TS-102U02	N16-S-34557-8350		3370-774000-2185
E-108	TS-102U01	N16-S-34520-3861		3370-774000-1955
E-109				3370-774000-1925
E-109A		N16-R-503580-251		3370-738500-1756
E-109B		N16-R-503580-442		
E-110				3370-719000-2197
E-110A		N16-R-50380-441		
E-110B		N16-S-800661-175		
E-111		N16-K-700314-658		3320-083351485
E-112		N16-K-700350-251		3320-083351326
E-113				
E-114				
E-115				
F-101	F02GR500A	N17-F-16302-65		8870-112000-748
I-101		G17-L-6297		8870-938000-375
J-101		N17-J-39365-2081		8850-753195
L-101		N16-C-74076-1570		3340-060717130
M-101		N17-M-29387-1152		7CAC-589073-4
R-101		N16-R-73308-2814		3350-382000-5981
R-103		N16-R-73221-5551		3350-382000-3528
R-104		N16-R-73113-1101		3350-382000-27245
R-105		N16-R-73008-4700		3350-382000-2495
R-106		N16-R-72916-7613		3350-382000-1951
R-107		N16-R-72825-4551		3350-382000-1391
R-108		N16-R-49948-431		
R-109		N16-R-80876-7039		3850-383000-1256
R-110	RC20BF754J	N16-R-50911-431		
R-111	RC20BF333J	N16-R-50416-431		3350-098000-4871
R-112	RC20BF514J	N16-R-50839-438		3350-098000-6231
R-113	RC20BF391J	N16-R-49732-431		3350-098000-2831
R-114	RC20BF204J	N16-R-50704-431		3350-098000-5731
R-117	RC20BF105J	N16-R-50974-431		3350-098000-6551
R-118	RC20BF271J	N16-R-49687-431		3350-098000-2671
R-119	RC30BF104J	N16-R-50632-751		3350-128000-5955
R-120	RC30BF333J	N16-R-50416-751		3350-128000-5475
R-121		N16-R-87681-8650		3350-772500-6155
K-122	RN15X10002F	N16-R-73092-6938		3350-382000-2668

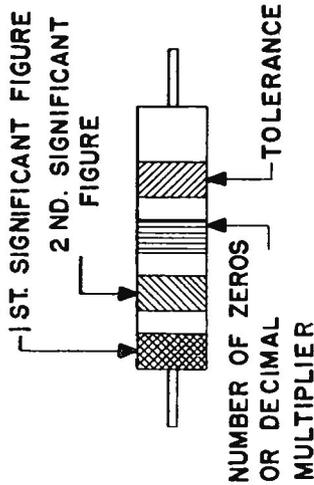
TABLE 7-2. CROSS REFERENCE PARTS LIST—Cont'd

Key Symbol	Jan (or Mil) Designation	Std. Navy Stock Number	Signal Corps Stock Number	Air Force Stock Number
R-124	RN15X2741F	N16-R-73021-5538		3350-382000-25366
R-126		N16-R-87418-7019		3350-769400-2245
R-127		N16-R-87848-7055		3350-769400-3961
R-129		N16-R-43637-7014		3350-044000-3795
R-130	RC20BF470J	N16-R-49426-431		3350-098000-1851
R-131	RU3B3R9K	N16-R-68292-3686		3350-454000-2311
R-132		N16-R-80723-9586		3350-769500-1315
R-133		N16-R-50021-126		3350-146000-3697
R-135	RC42BF153J	N16-R-50335-936		3350-146000-4557
RT-101		N16-R-85005-6321		3350-061500-4125
S-101		N17-S-63717-1901		3360-073114195
S-102	ST-42A	N17-S-70412-4406		3360-395853395
T-101	TF1A03YY	N17-T-73462-1301		3340-063903970
TB-101				
V-101		N16-T-75879		
V-102	6AH6	N16-T-56185		
V-104	5726/6AL5W	N16-T-75726		
V-105		N16-T-52001-3		
W-101		N17-C-48190-1511		
XF-101		N17-F-74266-9231		
XI-101A		N17-L-250307-751		
XI-101B		N17-L-76655-8931		
XRT-101	TS101P01	N16-S-63515-4151		
XV-101	TS-103C01	N16-S-64063-6714		
XV-102	TS102P01	N16-S-62603-6702		

TABLE 7-3. APPLICABLE COLOR CODES

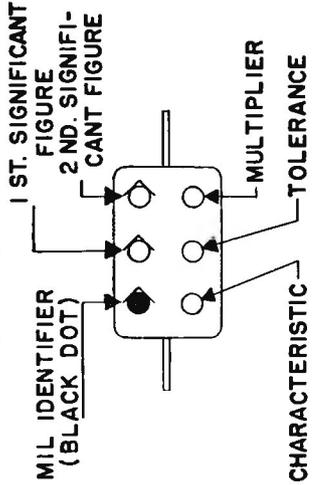
Resistor Color Codes

JAN Color Code For Fixed Composition Resistors

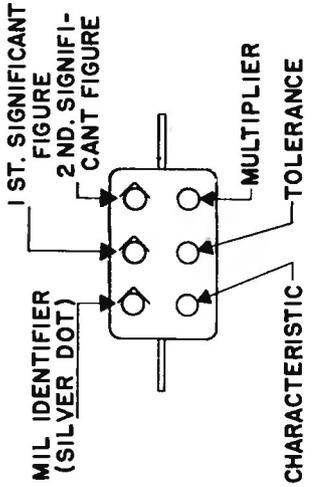


Capacitance Color Codes

JAN 6 dot color code for mica dielectric capacitors per MIL-C-5



JAN 6 dot color code for paper dielectric capacitors per MIL-C-91A



RESISTORS

CAPACITORS

Tolerance (percent ±)	Decimal Multiplier	Significant Figure or Number of Zeros	Color	Multiplier ¹	Tolerance (percent ±)	Characteristic
—	—	0	Black	1	20 (M)	Paper A
—	—	1	Brown	10	—	E
—	—	2	Red	100	2 (G) ³	C
—	—	3	Orange	1000	30 (N) ²	D
—	—	4	Yellow	10,000 ²	—	E
—	—	5	Green	—	—	F
—	—	6	Blue	—	—	—
—	—	7	Purple	—	—	—
—	—	8	Gray	—	—	—
—	—	9	White	—	—	—
5 (J)	0.1	—	Gold	0.13	5 (J) ³	—
10 (K)	—	—	Silver	—	10 (K)	—
20 (M)	—	—	No Color	—	—	—

¹ The multiplier is the factor by which the two significant figures are multiplied to yield the nominal capacitance.
² Applicable to paper capacitor only.
³ Applicable to mica capacitors only.

TABLE 7-4. LIST OF MANUFACTURERS

Abbreviation	Prefix	Name	Address
AB	CBZ	Allen-Bradley	155 E. 44th Street New York, New York
---	CAGK	Amperite Co., Inc.	561 Broadway New York 12, New York
---	CFA	Bussman Mfg. Company	2538 W. University Ave. St. Louis 7, Missouri
CTS	CTC	Chicago Telephone Supply Co.	Elkhart, Indiana
	CMG	Cinch Mfg. Co.	15 E. 26th Street New York, New York
Concarb	CCC	Continental Carbon Co.	13900 Loraine Avenue Cleveland, Ohio
Cornish	—	Cornish Wire Company	50 Church Street New York, New York
CH	CAE	Cutler Hammer	1333 W. St. Paul Avenue Milwaukee, Wisconsin
	---	---	Cycle Transformer Corp. 356 Glenwood Avenue East Orange, New Jersey
---	CDN	Daven Co., The	191 Central Ave. Newark 4, New Jersey
---	CAYS	Drake Mfg. Co.	1713 W. Hubbard Street Chicago 22, Illinois
EMM	CMF	Electromotive Mfg. Co.	Willimantic, Connecticut
GE	CG	General Electric Co. (Lamp Division)	133 Boyd Street Newark, New Jersey
Mallory	CMA	P. R. Mallory & Co., Inc.	41 E. 42nd Street New York, New York
Oak	COC	Oak Mfg. Company	467 Hillside Avenue Westfield, New Jersey
	---	COM	Ohmite Manufacturing Co. 3601 Howard Street Skokie, Illinois (Chicago suburb)
Q.V.S.	---	Q.V.S. Inc.	14 Hadden Place East Orange, New Jersey
---	CBIN	Switchcraft, Inc.	1328-30 N. Halstead St. Chicago 22, Illinois
---	CACA	Times Facsimile Corp.	540 W. 58th Street New York 19, New York

By Order of *Wilber M. Brucker*, Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

DISTRIBUTION:

Active Army:

CNGB (1)
Tec Svc, DA (1) except CSIGO (15)
Hq CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Sig Sch (5)
Sig Sec, Gen Depots (10)
Sig Depots (10)
Sig Fld Maint Shops (2)
Sig Lab (5)

Units organized under following
TOE's:
11-7R, Sig Co, Inf Div (2)
11-16R, Hq & Hq Co, Sig Bn,
Corps or Abn Corps (2)
11-57R, Armd Sig Co (2)
11-127R, Sig Rep Co (2)
11-128R, Sig Depot Co (2)

11-500R (AA-AE), Sig Svc Org
(2)
11-557C, Abn Sig Co (2)
11-587R, Sig Base Maint Co (2)
11-592R, Hq & Hq Co, Sig Base
Depot (2)
11-597R, Sig Base Depot Co (2)

NG: State AG (6); units—none.

USAR: None.

For explanation of abbreviations used, see SR 320-50-1.