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NAVSHIPS 91415

INSTRUCTION BOOK  
*for*  
MULTIMETER  
ME-25A/U

LIBRARY



*Manufactured by*

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10514 Dupont Avenue

Cleveland 8, Ohio

BUREAU OF SHIPS

NAVY DEPARTMENT



*Contract NObsr-43313*

*Approved by BuShips: 5 February 1951*

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DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

Code 993-100  
5 February 1951

From: Chief, Bureau of Ships  
To: All Activities concerned with the  
Installation, Operation and Main-  
tenance of the Subject Equipment

Subj: Instruction Book for Multimeter ME-25A/U  
NAVSHIPS 91415.

1. NAVSHIPS 91415 is the instruction book for the subject equipment and is in effect upon receipt.
2. When superseded by a later edition, this publication shall be destroyed.
3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.
4. All requests for NAVSHIPS Electronic publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the applicable maintenance bulletin and the BUSHIPS ELECTRON.

H. N. WALLIN  
Chief of Bureau





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### CONTRACTUAL GUARANTEE

The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or nonconformance shall be given by the Government to the Contractor within one year of the delivery of the defective or nonconforming article, unless a different period of Guaranty is specified in the schedule. If required by the Government within a reasonable time after such notice, the Contractor shall, with all possible speed, correct or replace the defective or nonconforming article or part thereof. When such correction or replacement requires transportation of the article or part thereof, shipping costs, not exceeding the usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing articles or, if only parts of such articles are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the schedule. If the Government does not require a correction or replacement of a defective or nonconforming article, the Contractor, if required by the contracting officer, within a reasonable time after the notice of defect or nonconformance, shall repay such portion of the contract price of the article as is equitable in the circumstances.

### INSTALLATION RECORD

Contract Number NObsr-43313	Date of Contract, 19 May 1949
<i>Serial Number of Equipment</i> .....	
<i>Date of Acceptance by the Navy</i> .....	
<i>Date of Delivery to Contract Destination</i> .....	
<i>Date of Completion of Installation</i> .....	
<i>Date Placed in Service</i> .....	

Blank spaces in this table shall be filled in at time of installation.

## REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised). The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the BUREAU OF SHIPS MANUAL or superseding instructions.

## ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available, the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

## SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the BUREAU OF SHIPS MANUAL or superseding instructions on the subject of radio safety precautions to be observed.

The use of this equipment involves voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working on equipment employing high voltages.

While every practicable safety precaution has been incorporated in ship and shore electronics equipment, the following rules must be strictly observed:

### KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casual-

ties always remove power and discharge and ground circuits prior to touching them.

### DON'T SERVICE OR ADJUST ALONE.

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

### DON'T TAMPER WITH INTERLOCKS.

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

## RESUSCITATION

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



Figure 1-1. Multimeter ME-25A/U with Cover in Place

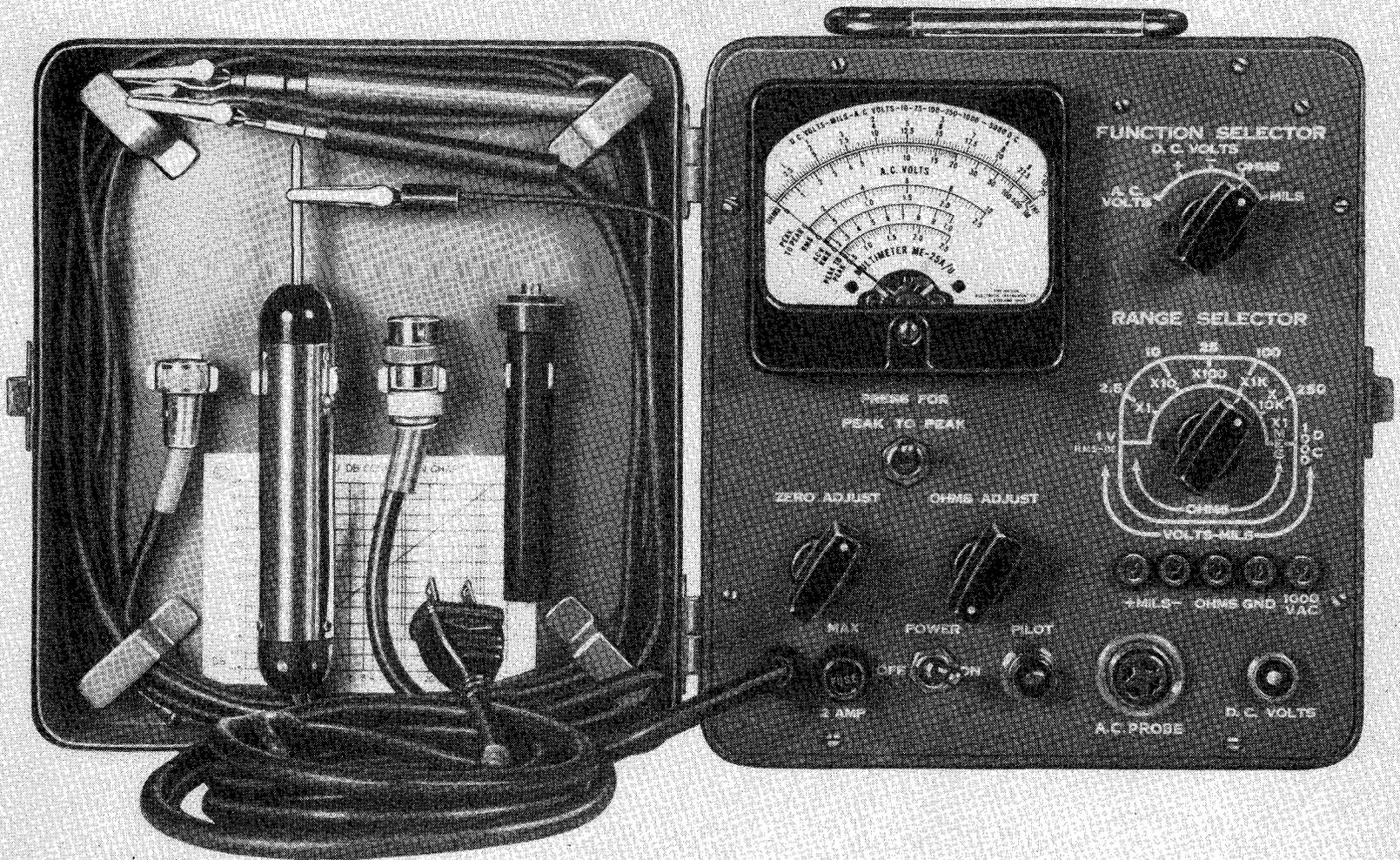


Figure 1-2. Multimeter ME-25A/U and Accessories

## SECTION I

### GENERAL DESCRIPTION

#### 1. PURPOSE.

Multimeter ME-25A/U is a portable combination electronic AC voltmeter for measurement of peak-to-peak and RMS voltages; DC voltmeter, ohmmeter and milliammeter which can be advantageously used wherever it is necessary to make current, resistance and voltage measurements with the use of only one instrument. Circuit design permits measurements to well over 100 mc with the accuracy and the high impedance input of an electronic DC voltmeter and electronic ohmmeter. In addition, current measurements up to 1000 milliamperes may be made.

#### 2. BRIEF DESCRIPTION.

*a.* PHYSICAL.—Multimeter ME-25A/U, as shown in Figure 1-1, has a smooth gray lacquer case with a gray panel and green and white designations. All switches and connectors are clearly designated and the large meter has scales easily readable. The case is furnished with a steel bail-type handle at one end and four extruded metal feet at the other. A special compartment for carrying and storing all cables and test leads is in the cover.

The AC power line cord is permanently attached. In addition, five separate leads and a special high voltage adapter are also furnished. Two 48" unshielded leads are furnished for making resistance, current and 1000 volt AC measurements. One of these leads is red with a plug tip on one end and a red test prod with screw-on alligator clip on the other. The other lead, ground, is black and has a plug tip on one end and a black test prod with screw-on alligator clip on the other.

A shielded test lead with a single contact microphone connector on one end and a test prod, incorporating a 3.3 megohm isolating resistor, on the other, is furnished for DC voltage measurements. A special high voltage adapter incorporating a 53.2 megohm resistor is furnished for use in conjunction with the shielded DC test lead when utilizing the 5000 volt DC range.

An AC probe and shielded cable assembly is furnished for making AC voltage measurements up to 250 volts. This cable is 48" long with a microphone

connector on one end and the special AC probe on the other. The rectifier is housed in the probe. In addition to this, a 5" black ground lead is furnished with an alligator clip on one end and a threaded tip on the other which is connected directly into the special AC probe, and used as a ground connection when measuring frequencies above 50 mc. When measuring 1000 volts AC, use the 1000 VAC jack on the front panel of the instrument.

*b.* FUNCTIONAL.—Multimeter ME-25A/U is designed to perform all the electrical functions of an instrument of its type with the light loading effect of a high impedance input:

(1) It will measure direct currents up to 1000 milliamperes.

(2) It will measure resistance up to 1000 megohms.

(3) It will measure DC voltages up to 5000 volts.

(4) It will measure AC voltages up to 250 volts with a special AC probe and cable assembly, and 1000 volts through the 1000 VAC jack on the front panel.

*c.* ELECTRICAL.—The basic principle of the meter circuit is an electronic bridge similar to the Wheatstone bridge in principle with the resistance of two arms being the resistance of two triode sections of a type 12AU7 tube. The meter is electrically balanced across the tube by the remainder of the meter circuit without input. Input to the grid of a tube effectively unbalances the circuit and causes the meter to read. Input to the grid is through a voltage dividing network. An AC probe is used to rectify the AC for AC voltage measurements. A dry battery is used as a source of DC for ohmmeter measurements. The milliammeter circuit is of standard design.

#### 3. REFERENCE DATA.

*a.* Nomenclature: Multimeter ME-25A/U, Electronic Volt-Ohm-Milliammeter.

*b.* Contract Number: NObsr-43313. Date: 19 May 1949.

*c.* Contractor: The Hickok Electrical Instrument Company.

*d.* Cognizant Naval Inspector: Inspector of Naval Material, Cleveland, Ohio.

**GENERAL  
DESCRIPTION**

**NAVSHIPS 91415  
ME-25A/U**

**Section 1  
Paragraph 3(e)**

*e.* Number of Packages Involved per Complete Shipment of Equipment, Including Spare Parts Boxes: One.

*f.* Total Cubical Content:           Crated: 3291 cu. in.  
  Uncrated: 541 cu. in.

*g.* Total Weight:                           Crated: 41 lbs.  
  Uncrated: 13 lbs.

*b.* Frequency Range: 50 cycles to 100 mc.

*i.* Characteristics of Power Supply Required for Operation:

(1) Voltages: 105-125 volts, 50-1600 cycles AC.  
                  1.5 volts, DC (one self-contained dry battery BA-30, not supplied with equipment.)

(2) Current Drain per Each Voltage Supply:  
    Ohmmeter: 0.3 amperes, maximum.

*j.* Input Impedance:

(1) DC: 13.3 megohms,  
          with test prod MX-1101/U, 66.5 megohms.

(2) AC: 7 mmf shunted by 13 megohms with AC probe.

          10 mmf shunted by 5 megohms on 1000 V.  
          A.C. range.

*k.* Power Consumption: 12 watts at 115 volts.

*l.* Overall Accuracies:

(1) D-C Current Ranges:  $\pm 3\%$  of full scale.

(2) D-C Voltage Ranges: (four lower ranges)  $\pm 4\%$  of full scale.

(3) D-C Voltage Ranges: (250, 1000 and 5000 volts)  $\pm 5\%$  of full scale.

(4) A-C Voltage Ranges:  $\pm 5\%$  of full scale.

(5) Ohmmeter Ranges: within  $3^\circ$  of arc from absolute value of resistance indicated on meter scale.

*m.* Special Features of Multimeter ME-25A/U:

Features found in the ME-25A/U not found in the earlier ME-25/U or OBQ series instruments are as follows:

(1) Indications based on peak-to-peak value of the AC voltage being measured, and calibrated in terms of peak-to-peak and RMS value.

(2) Additional RMS AC voltage range of 1000 volts.

(3) High voltage DC extension probe which increases the DC range to 5000 volts.

(4) A 0-1 volt RMS range.

The Model OBQ series did not have an enclosing cover for the case, but had a separate compartment for the leads in the case.

4. EQUIPMENT DATA.

TABLE 1-1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	OVERALL DIMENSIONS		VOLUME		WEIGHT	
		A—CRATED B—UNCRATED	HEIGHT—WIDTH—DEPTH	A—CRATED B—UNCRATED	A—CRATED B—UNCRATED		
1	Multimeter	A: 13½" x 12½" x 19½" B: 9¾" x 8⅞" x 6⅝"		A: 3291 cu. in. B: 541 cu. in.	A: 41 lbs. B: 13 lbs.		
1	A-C Probe and Cable Assembly		48"				
1	Ground Lead		48"				
1	Test Lead—Shielded		48"				
1	Test Lead—Unshielded		48"				
1	Ground Lead		5"				
1	High Voltage Adapter		5-3/16" long, ⅝" dia.				

TABLE 1-2. REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME AND DESCRIPTION
1	Dry Battery, BA-30
1	Power Supply Source, 105-125 volts, 50-1600 cycles, AC

5. TUBE COMPLEMENT.

TABLE 1-3. TUBE COMPLEMENT

TUBE	TYPE	FUNCTION
V-101	12AU7	Bridge Circuit
V-102	6X4	Power Rectifier
V-103	6AL5	A-C Probe Rectifier

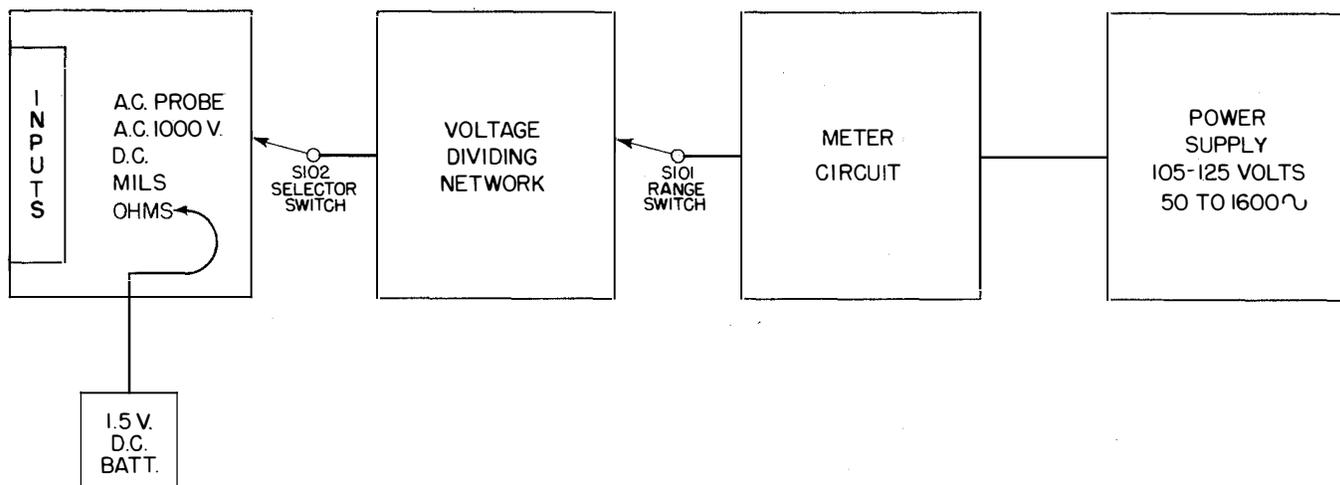
SECTION 2  
THEORY OF OPERATION

Figure 2-1. Basic Circuits in Block Form

## 1. GENERAL.

During the following discussions, reference to the block diagram of Multimeter ME-25A/U, Figure 2-1, and the schematic wiring diagram, Figure 6-13, will facilitate the understanding of the basic operation of the circuits used in this equipment.

## a. METER CIRCUIT. (See Fig. 2-2)

A type 12AU7 tube, V101, is connected in an electronic bridge circuit, and with voltages applied to either grid, the deflection of the meter which is connected in the plate circuits will be proportional to the DC voltage applied to the grid.

## b. DC VOLTMETER CIRCUIT. (See Fig. 2-3)

The input to the DC voltmeter circuits is taken through the DC probe incorporating an isolating resistor, and applied through the RANGE SELECTOR network to the metering circuit.

## c. AC VOLTMETER CIRCUIT. (See Fig. 2-4)

AC voltages up to 250 volts are applied to the RF probe utilizing a type 6AL5 tube connected in a voltage doubling circuit. The DC voltage which results from the rectification of the AC voltage in this probe is applied through the RANGE SELECTOR network to the metering circuits in the same manner that the DC voltage is applied. Calibration of the meter circuits is such that the indication will be based on the peak-to-peak value of the AC voltage being measured, but calibrated in terms of either its RMS or peak-to-peak value.

For measurements on the 1000 volt AC range the voltage is applied to, and rectified by, a type 1N34 crystal. The RF probe is not used for these measurements.

## d. OHMMETER CIRCUIT. (See Fig. 2-6)

A self-contained 1.5 volt dry battery is used in connection with a voltage dividing network to permit the measurement of resistances throughout the range of the equipment. The voltage output from this dividing network is applied to the metering circuits and the indication made proportional to the value of the resistance being measured.

## e. MILLIAMMETER CIRCUIT. (See Fig. 2-7)

Milliampere measurements are made by conventional means of measuring the millivolts drop across calibrated shunts with the meter indicating in terms of milliamperes for the various ranges.

## f. POWER SUPPLY CIRCUIT. (See Fig. 2-8)

A type 6X4 tube, V102, is connected as a full-wave rectifier and supplies DC operating potentials for the metering circuit. A 6.3 volt filament winding is employed for supplying all heater voltages. The primary of the transformer is fused by means of F101 located on the front panel.

## 2. CIRCUIT ANALYSIS.

## a. BASIC METER CIRCUIT.

Figure 2-2 illustrates the basic meter circuit used for all measurements except DC MILS and 0-1000 VOLTS AC. A twin-triode V101, type 12AU7, is electrically connected as shown. With no voltage on either grid, ZERO ADJUST control R109 is set so that the meter reads zero. In operation, one of the grids is always grounded and a voltage applied to the opposite grid. Assume a case where grid No. 2 is grounded and a negative voltage applied to grid No. 1. This will cause a decrease in current through triode

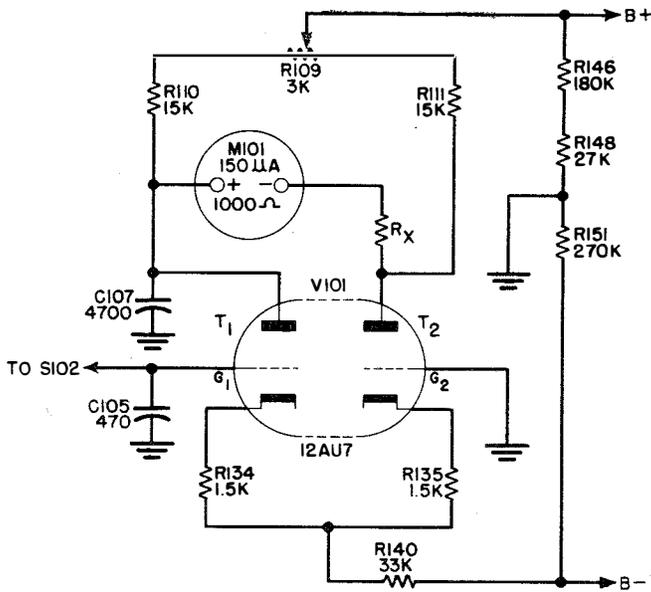


Figure 2-2. Basic Meter Circuit

T1. As a result, the voltage applied to the meter from the plate through R110 will increase. At the same time, the voltage across common cathode resistor R140 will decrease. When the voltage across R140 decreases it also effectively decreases the potential of the cathode of triode No. T2. This is effectively the same thing as a positive increase of grid No. 2 which is maintained at ground potential, causing triode T2 to draw more current. When T2 draws more current its plate goes more negative with respect to its potential when no voltage is being applied to the measuring circuits. As a result of the combination of the plate of T1 going more positive and plate of T2 going more negative, an unbalance exists and current is forced through the meter in such a direction as to make it read up scale. In the same manner, if grid No. 1 had been maintained at ground potential and a positive voltage applied at grid No. 2, the same action would take place causing the meter to read up scale. If a positive voltage were applied to grid No. 1, or a negative voltage applied to grid No. 2, the meter would read in a reverse direction.

$R_x$  as indicated in Figure 2-2, is an adjustable calibrating resistor. A separate potentiometer is used in place of  $R_x$  for calibration of AC volts RMS, AC volts peak-to-peak, DC volts and ohms measurements.

b. DC VOLTMETER CIRCUIT.

DC voltages up to 1000 volts are applied directly

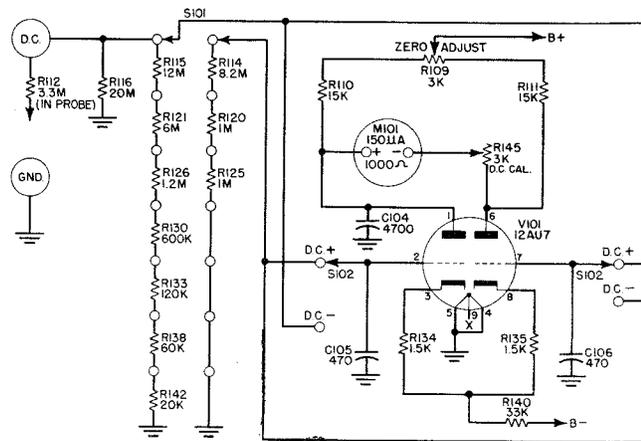


Figure 2-3. DC Voltmeter Circuit

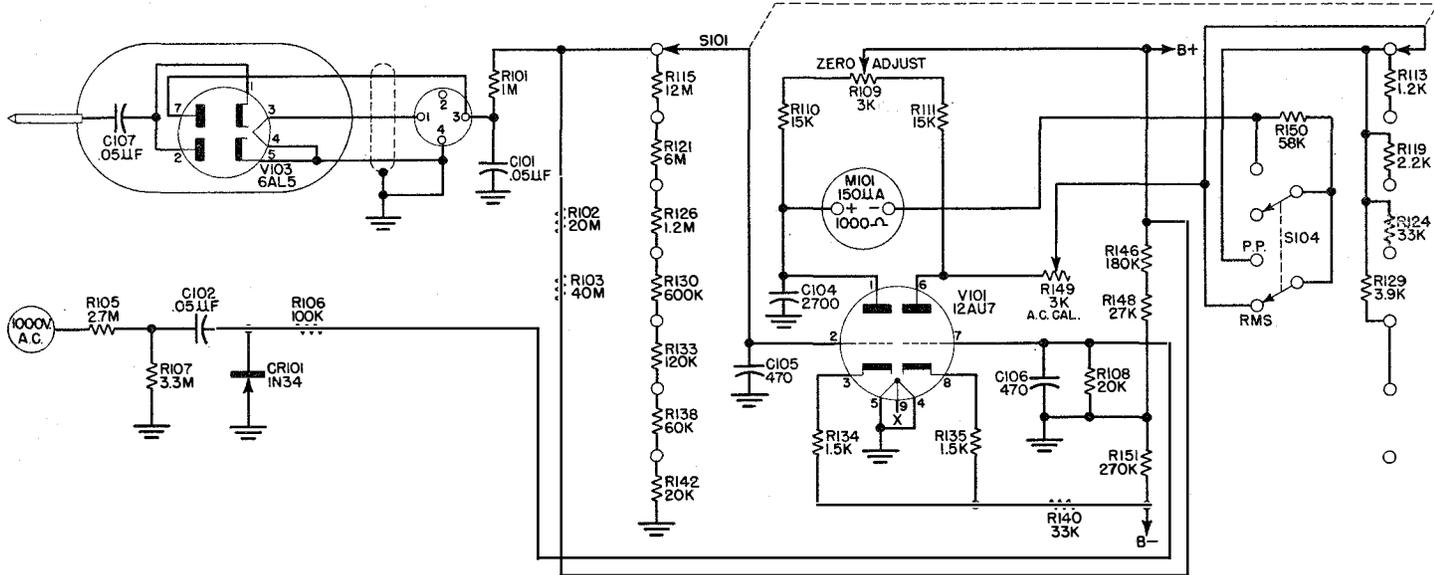
through the DC probe illustrated in Figure 2-3. This probe carries an isolating resistor of 3.3 megohms, R112, to prevent capacity loading of the circuits under test. For 5000 volt DC measurements the voltage extension probe, MX-1101/U (E114), illustrated in Figure 3-4, is screwed on the end of the regular DC probe. This high voltage probe contains an isolating and voltage dropping resistor of 53.2 megohms. Voltages to be measured are applied from the probe to the high end of the voltage dividing network on RANGE SELECTOR switch S101. Voltages from this network are taken to grid pin 7 of V101 for measurements of DC voltages positive with respect to ground, and to pin 2 of V101 for measurements of voltages negative with respect to ground.

The voltage dividing network of S101 is shunted to ground by means of R116, a 20 megohm resistor, as the sensitivity of the measuring networks is such that this value of resistance is required to effect proper calibration. An additional section is used on S101 and comprises R114, R120 and R125 which are used respectively on the 1, 2.5 and 10 volt ranges. The purpose of these resistors is to permit a small amount of contact potential to be developed on the grid which is not being used in connection with the main voltage dividing network section of S101. Figure 2-3 illustrates that the unused or inactive grid is connected to the slider arm on this section of the switch. Both grids, pins 2 and 7, are bypassed to ground by C105 and C106 respectively. The purpose of these bypass condensers is to prevent any possible stray AC which might be picked up and fed to the grids affecting the calibration of the equipment.

**THEORY OF OPERATION**

**NAVSHIPS 91415  
ME-25A/U**

**Section 2  
Paragraph 2(c)**



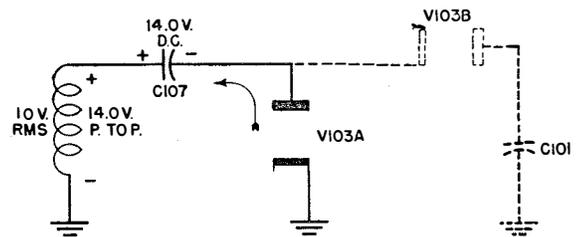
**Figure 2-4. AC Voltmeter Circuit**

**c. AC VOLTMETER CIRCUIT.**

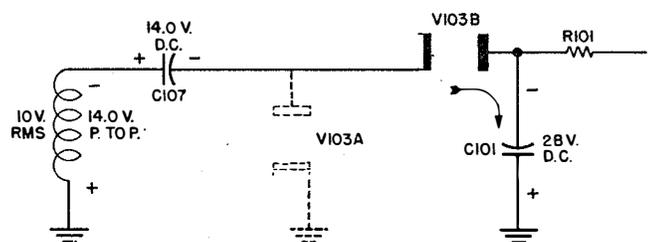
With reference to Figure 2-4, there are two inputs for AC voltage measurements, one through the voltage doubling probe circuit utilizing a type 6AL5 tube, V103, which serves for measurements up to 250 volts throughout a frequency range of approximately 20 cycles to over 100 mc. In the case of the input to the 1000 volt range, the frequency limits are from 50 to 3000 cycles approximately. At 12,000 cycles the error is approximately 5%.

Figures 2-5A and 2-5B illustrate the electrical circuits which provide for the indication of the indicating meter to be proportional to the peak-to-peak value of the AC voltage being measured. In the case illustrated, it is assumed that the voltage being measured is 10 volts RMS. This corresponds to a peak voltage in each direction of 1.4 times 10, or 14 volts peak. In the case of Figure 2-5A it is assumed that the voltage delivered to one-half of the dual diode V103A is positive with respect to ground. During the first half cycle C107 is charged to this peak value of 14 volts as illustrated in Figure 2-5A. It is assumed that the charge on C107 remains at 14 volts during the next half cycle which is illustrated in Figure 2-5B. During this half cycle in which the applied voltage to the diode is negative with respect to ground, the 14 volts is additive to the 14 volts already appearing on C107, causing C101 to become charged to a total of 28 volts negative with respect to ground. This DC voltage is applied through decoupling resistor R101 to the high side of the voltage dividing network of the RANGE SELECTOR switch S101. A bucking voltage is also applied at this junction from the B+ supply through resistors R102 and calibrating resistor R103, in series. R103 is so adjusted that the voltage from the B+ supply effectively bucks out the contact potential voltage developed at plate pin 7 of V103. As a result of this, when changing ranges it is gen-

erally not necessary to appreciably have to readjust ZERO ADJUST control R109.



**Figure 2-5A. Electrical Circuit, Positive with Respect to Ground.**



**Figure 2-5B. Electrical Circuit, Negative with Respect to Ground**

Voltage from RANGE SELECTOR switch S101 is applied to grid pin 2 of the vacuum tube voltmeter tube V101. Condenser C105 connected from this grid to ground serves as a filtering network for any possible AC which might be picked up by the preceding circuits. Grid pin 7 of V101 is returned to ground through R108, bypassed by C106. The purpose of R108 is to serve only as part of the voltage dividing network when the 1000 volt AC range is being used. With the meter M101 effectively connected between

the two plates of V101, pins 1 and 6, and with no voltage applied, the ZERO ADJUST control R109 is so adjusted that the meter indicates zero. As AC voltages are applied the corresponding negative DC voltage is applied at grid pin 2 of V101, causing an unbalance in the bridge circuit of V101, and resulting in a corresponding increase in current through meter M101 which is calibrated in terms of applied AC voltage.

When switch S104 is operated to the PEAK-TO-PEAK position, the meter is calibrated in terms of the peak-to-peak value of the applied voltage. The negative side of the meter is effectively connected through the range calibration resistors R113, R119, R124 or R129, on ranges 1, 2.5, 10, 25, 100 and 250 respectively, through AC calibration potentiometer R149, to the plate pin 6 of V101. When S104 is operated for RMS indication, the meter is returned directly through R150 to calibration potentiometer R149 and to plate pin 6 of V101.

In making voltage measurements on the 1000 volt AC range, the meter indication is proportional to the average value of the applied AC voltage, but calibrated in terms of its RMS value. This voltage is applied through a dividing network consisting of R105 and R107 through C102, a DC blocking condenser, to rectifier CR101, a type 1N34 crystal. The rectified voltage from the anode of CR101 is taken through decoupling resistor R106 to grid pin 7 of V101. This grid is returned to ground by dividing network resistor R108 and is bypassed to ground by C106.

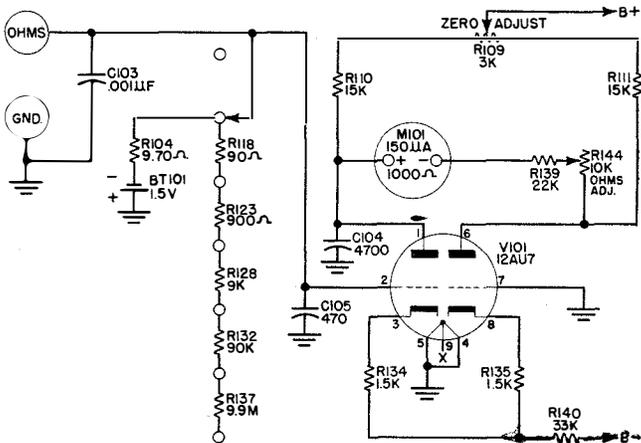


Figure 2-6. Ohmmeter Circuit

d. OHMMETER CIRCUIT.

On the main panel two pin jacks are used for connection of external resistances to the resistance measurement circuit of the ohmmeter section. Pin 7 of the vacuum tube voltmeter tube, V101, is operated at ground potential and grid pin 2 is fed from the 1.5 volt battery BT101 through a series of calibration resistors on the OHMS section of the RANGE SELECTOR switch. With no resistance connected externally, grid pin 2 is operated at a negative potential of 1.5

volts, regardless of the range being used. Under this condition the OHMS ADJUST control R144, located on the panel, is operated to bring the meter to full scale, or infinity ohms. With the ohms input circuit short-circuited, the ZERO-ADJUST control is operated to cause the indicator to read at the extreme left, or zero ohms. With an unknown resistor connected across the OHMS and GND input terminals and the RANGE SELECTOR switch operated to the proper range, a voltage will appear at pin 2 of V101. The meter M101 is calibrated in terms of the unknown resistance by virtue of the fact that the voltage appearing at the grid is proportional to this external resistance.

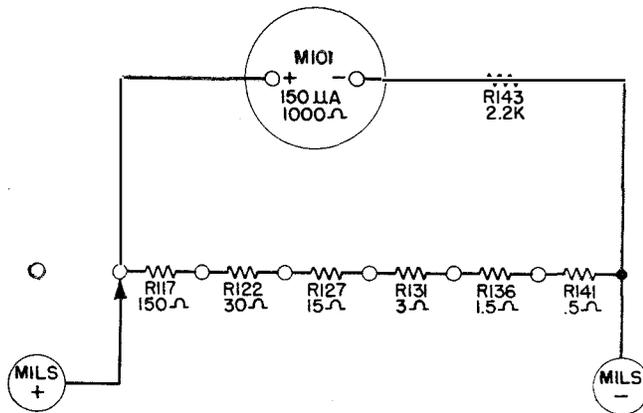


Figure 2-7. Milliammeter Circuit

e. MILLIAMMETER CIRCUIT.

The milliammeter, as shown in Figure 2-7, is of the conventional type and will measure up to 1000 milliamperes. The circuit is so designed that as the higher ranges are used the effective internal resistance is decreased. To avoid possible damage to the meter, always start with the highest range.

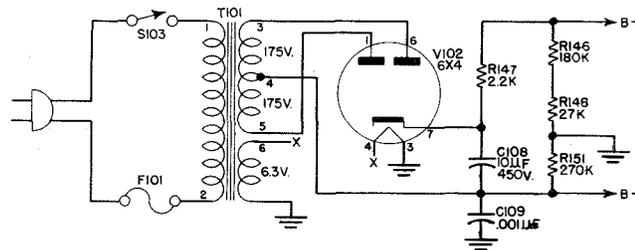


Figure 2-8. Power Supply Circuit

f. POWER SUPPLY CIRCUIT.

All voltages, with the exception of the 1.5 volt battery BT101, for the operation of Multimeter ME-25A/U are obtained from the power supply utilizing T101. The primary of this transformer is connected to the power supply line cord through fuse F101 located on the front panel, and also through S103, the POWER OFF-ON switch, also located on the front panel.

The transformer has two secondary windings, one of 350 volts center-tapped, which is fed to the rectifier tube V102, type 6X4, connected for full-wave rectification. The DC output from this tube is filtered by C108 and the negative side bypassed to the chassis by C109. The DC output is further filtered by R147 and applied to a network consisting of R146 and R148 in series from B+ to ground, and R151 from B- to ground. The DC voltage developed across this net-

work is approximately 150 volts. A 6.3 volt secondary winding is also provided for the operation of all heaters of the tubes used.

The instrument is nominally designed to operate on a supply line of 50 to 60 cycles, 105 to 125 volts, but in an emergency can be operated from a power source with a frequency up to 1600 cycles.

## SECTION 3

### INSTALLATION AND ADJUSTMENT

#### 1. INSTALLATION.

*a. HOUSING.*—Multimeter ME-25A/U is housed in a case consisting of the main body with a cover secured in place by slip hinges and one draw bolt. Suitable brackets and fasteners are secured within the cover to provide for storage of the operating cables, AC probe, DC extension probe and line cord. A rubber gasket is also provided between the main body and the cover. (See Fig. 3-3)

*b. UNPACKING.*—As shipped, each equipment is packed in a substantial wooden case which is suffi-

ciently sturdy and affords sufficient protection to the equipment to permit it to remain exposed to the weather for an indefinite time. When opening the packing case and removing the equipment (see Fig. 3-2), care should be taken not to dent or otherwise damage the metal housing of the equipment.

*c. OPERATING LOCATION.*—In general, with very few exceptions, any location where suitable AC input power is available will be a satisfactory operating location for the equipment.

#### Note

The equipment has been designed to operate equally well in any convenient operating position, although it is characteristic of electrical indicating meters of high sensitivity to exhibit less pivot friction when operated with the pivots vertical. In this position the face of the meter is horizontal.

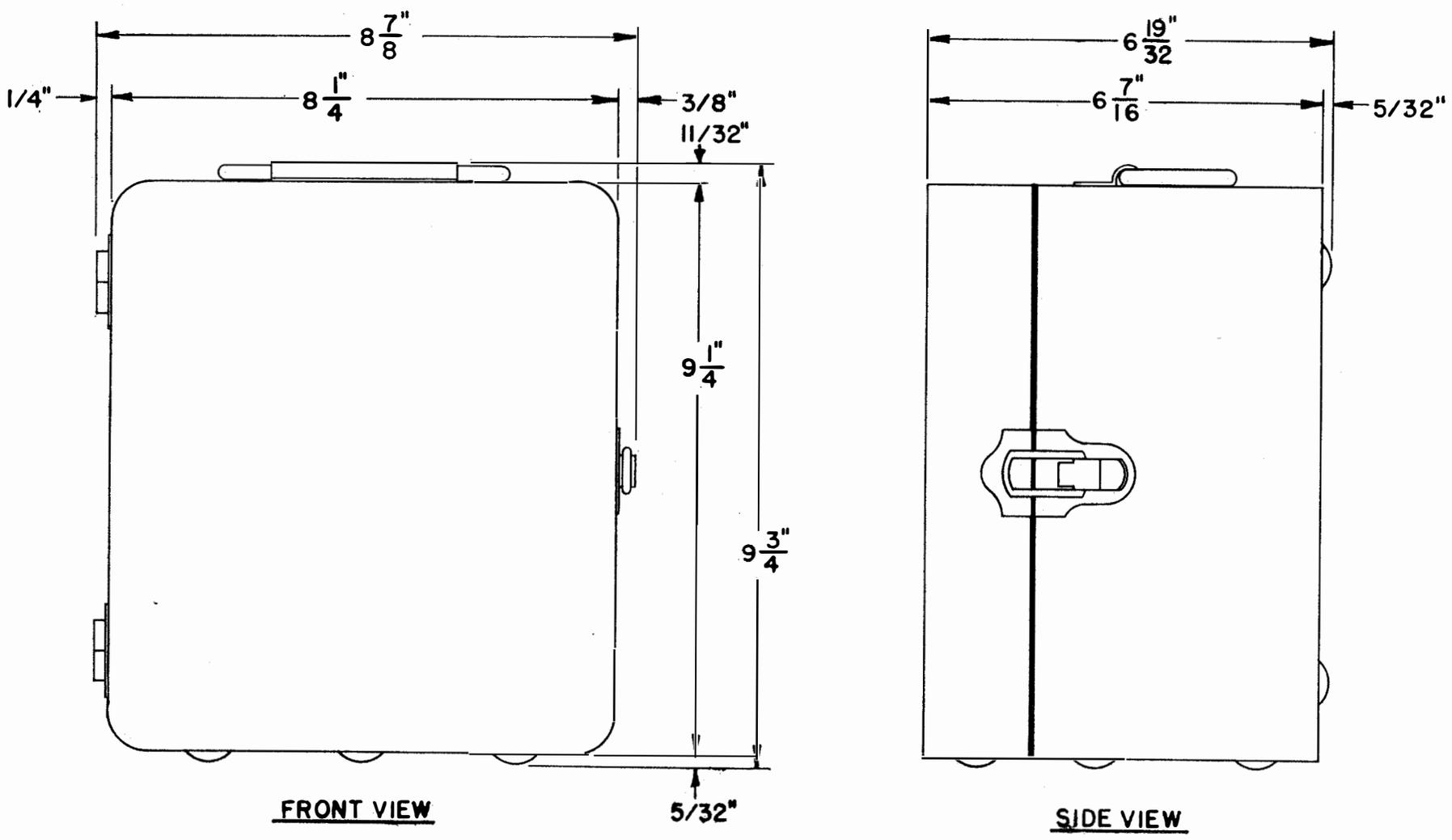


Figure 3-1. Overall Outline Dimensions of Multimeter ME-25A/U

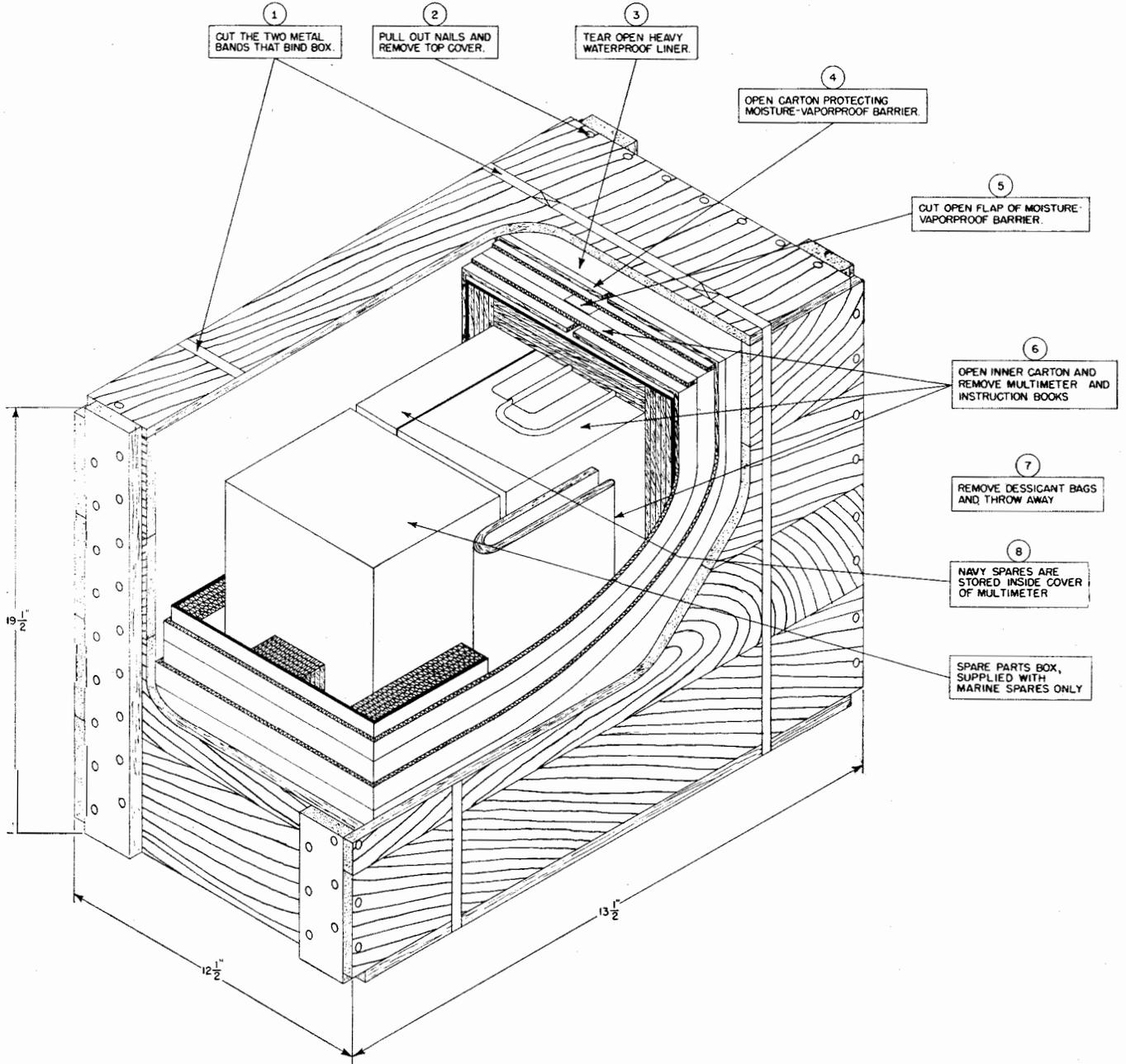


Figure 3-2. Cutaway View of Export Packaging

3-4

ORIGINAL

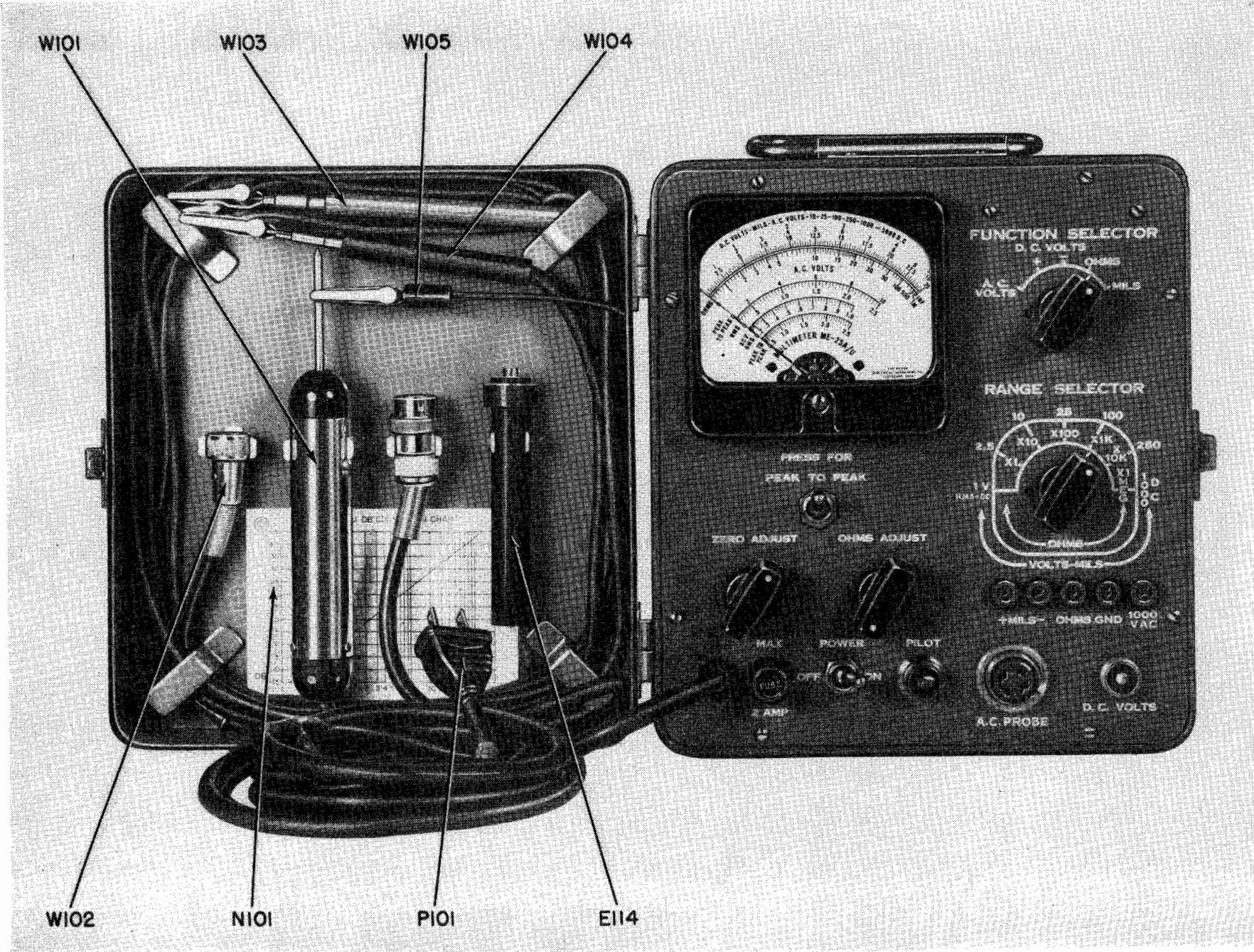


Figure 3-3. Multimeter ME-25A/U with Cable Compartment in Cover

*d.* ATTACHING OPERATING CABLES.

(1) AC LINE CORD—A 6-foot AC line cord is permanently attached to the instrument and contains a standard 2-prong male AC line plug on the unattached end.

(2) TEST CABLES:

(a) Unshielded black test lead W104, either with or without alligator clip 0101 connected to the end, is used as a common connection for all DC, ohms and low frequency AC measurements, except as explained in paragraph 5(f), Section 4. This lead is also used in connection with milliamperage measurements. In all previous measurements the pin plug of this lead should be connected to either the GND pin jack, or when it is being used for milliamperage measurements, to the positive or negative MILS jack.

(b) For all DC voltage measurements the shielded DC cable W102 is used with its cable connector attached to the DC VOLTS connector on the main panel. For measurements to 5000 volts, Adapter E114 is attached to the end of this probe.

(c) For AC voltage measurements up to 250 volts, AC probe W101 is used and its cable connector attached to the AC PROBE connector on the main panel.

(d) The red unshielded cable W103 is used for the 1000 volt AC measurement with its pin plug end inserted in the 1000 VAC jack. This lead is also used for milliamperage measurements.

(e) A short black unshielded lead is supplied for use as a ground connection between the R.F. probe and ground at higher R.F. frequencies, above about 30 mc.

2. ADJUSTMENT.

**Warning**

THE VOLTAGES WHICH ARE UTILIZED IN THIS EQUIPMENT ARE DANGEROUS TO HUMAN LIFE. BEFORE REMOVING THE EQUIPMENT FROM ITS CASE FOR INSPECTION, THE AC LINE CORD SHOULD BE DISCONNECTED FROM THE AC SUPPLY. SHOULD IT BE NECESSARY TO TAKE VOLTAGE READINGS WITHIN THE INSTRUMENT, MAKE SURE HANDS ARE DRY, USE TEST PRODS INSULATED FOR AT LEAST 1000 VOLTS, AND IN ALL POSSIBLE CASES MAKE ALL READINGS AND ADJUSTMENTS WITH ONE HAND IN A POCKET.

*a.* INSPECTION.—Before applying AC power to this equipment for the first time, inspect the entire equipment as follows:

(1) Make certain that all test leads, as illustrated in Figure 3-4, are in the cover of the instrument. Carefully check for mechanical damage to connectors or cables.

(2) Loosen the eight screws securing the instrument to the case and inspect chassis to make certain that all tubes are undamaged and in their proper sockets.

(3) Give the entire equipment a careful mechanical inspection to make certain there are no damaged components.

(4) Replace instrument in case.

*b.* TESTS PRECEDING OPERATION.—The following measurements should be made prior to placing the equipment in operation:

(1) With a continuity checker, test of cables W103, W104 and W105 should show the resistance to be approximately zero ohms.

(2) Check W102 with an ohmmeter, and the resistance from the center contact of the cable connector to the prod end should be approximately 3.3 megohms. Infinity resistance should be found between the outer part of the cable connector and the inner connection.

(3) Cable test probe W101 can be checked with an ohmmeter and should be approximately 6 ohms between pins 1 and 4. There should be infinity ohms between pin 3 and any other pin. There should be zero ohms between pin 4 and the cable connector outer shell.

(4) With the POWER switch turned ON, an ohmmeter check of the resistance between the two plugs of the AC line supply should show approximately 25 ohms. If it should vary substantially from this value or show no continuity, inspect fuses and wiring for cause of the trouble.

*c.* INITIATING OPERATION.—With the AC line cord connected into any convenient source of 115 volts plus or minus 10%, 50 to 60 cycles, AC, the equipment is put into operation by operating the POWER switch to ON. The PILOT light should come on immediately, and after approximately three to five minutes of warmup time the equipment should be stabilized and ready for operation.

*d.* REPLACING OPERATING CABLES.—When replacing the test leads and power cord in the cable compartment provided in the cover of Multimeter ME-25A/U, the following procedure should be followed (See Figure 3-3):

(1) Place the instrument face up with the cover hinged onto the case.

(2) Secure the probe section of W101 to the second clamp from the left on the cover, and insert the cable under the corner brackets in a counter clockwise direction. The male plug end of this cable is secured to the third clamp from the left.

(3) Next, place the connector end of test lead W102 in the first clamp on the left and wind the cable around the corner brackets in a counter clockwise direction.

(4) Secure the prods of test leads W103 and W104

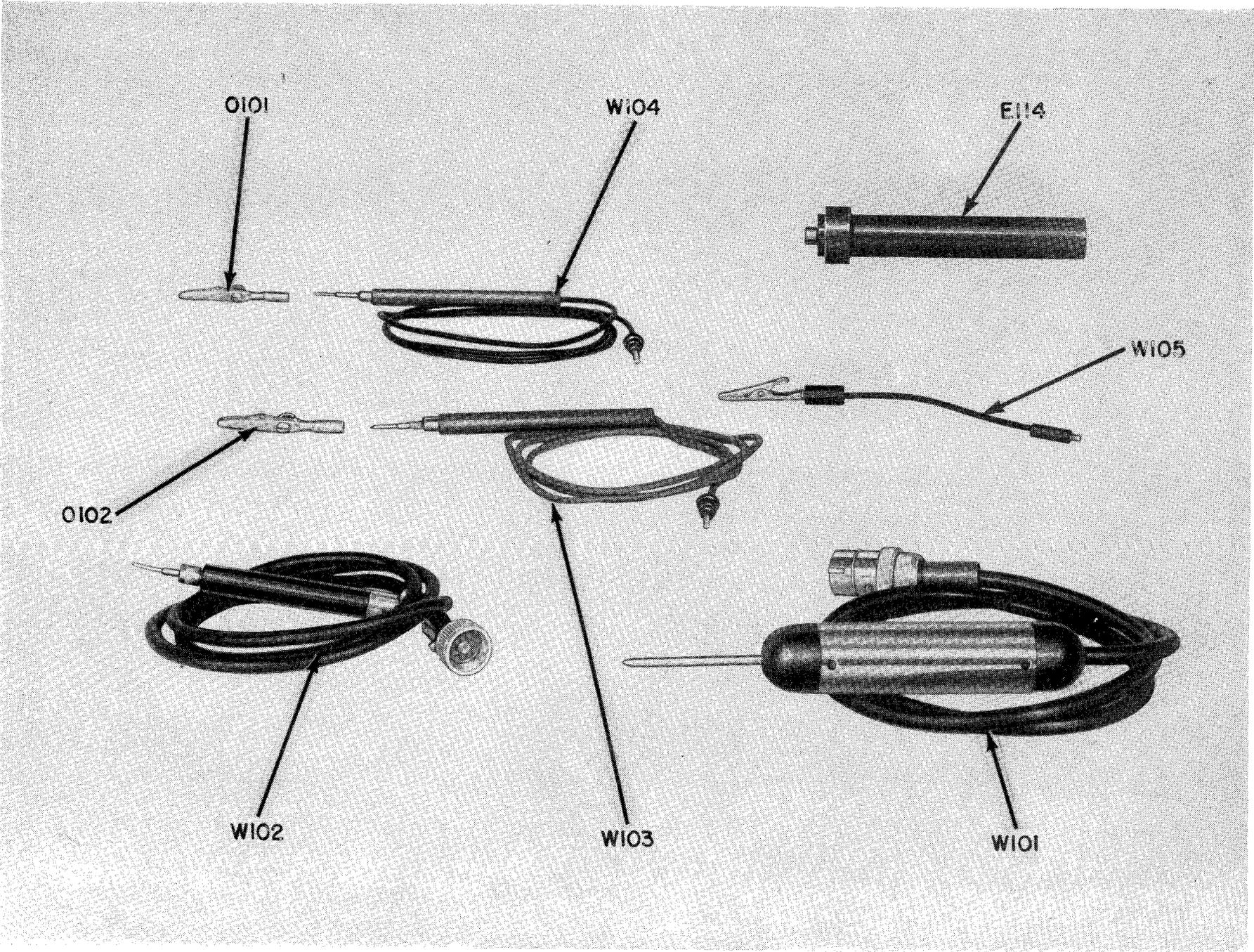


Figure 3-4. Operating Test Cables



to the bracket in the upper left hand corner of the cover compartment and wind the cables around the brackets in a clockwise direction until these two leads are completely secured.

(5) Connect the alligator clip of W105 to the prod tip of W101 as shown in Figure 3-3, and place Adapter

MX-1101/U (E114) in the clamp at the extreme right of the cover compartment.

(6) The power line cord should be placed under the bracket in the lower right hand corner of the cable compartment and wound in a clockwise direction until the entire cord is secured.

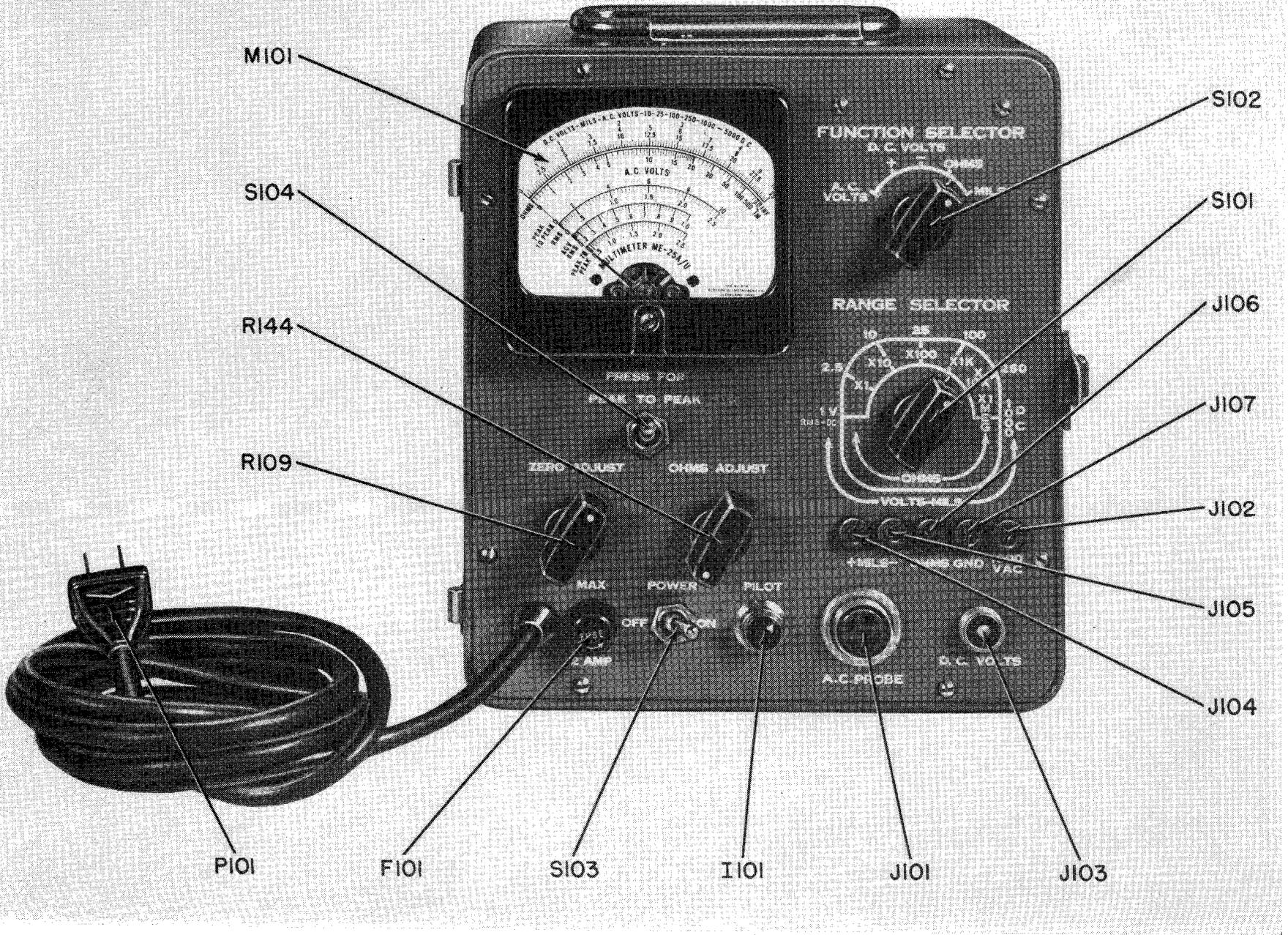


Figure 4-1. Panel Connectors and Controls

## SECTION 4

### OPERATION

#### 1. FUNCTION OF EQUIPMENT.

Multimeter ME-25A/U is designed to permit the service technician to make measurements of AC voltages throughout the range of approximately 0.1 volt to 250 volts, utilizing a high impedance probe which permits measurements to be made in the frequency range of approximately 60 cycles to over 100 mc. The capacity loading of the probe is approximately 7 mmf. AC voltages may be read in terms of their RMS value or their peak-to-peak value.

AC voltages up to 1000 volts may be measured by a special jack provided. In this case the voltages are indicated in terms of their RMS value.

DC voltages from approximately 0.1 volt to 1000 volts may be measured without the use of the auxiliary high voltage adapter probe. With the use of this probe the DC voltage ranges are extended to 5000 volts. The input impedance of the DC measuring circuits is approximately 13.3 megohms for measurements up to 1000 volts, and approximately 66.5 megohms for measurements to 5000 volts.

Resistance measurements from approximately 0.2 ohms to 1000 megohms can also be made. Milliampere measurements from approximately 50 microamperes to one ampere are provided.

#### 2. CONTROLS AND THEIR FUNCTIONS.

*a.* POWER SWITCH.—Operating this control to the ON position connects the internal circuits to a suitable source of supply voltage for their operation when the line cord is plugged into such suitable source.

*b.* FUNCTION SELECTOR.—This control connects the internal measuring circuits to permit the measurement of:

- (1) AC volts, either through the probe or from the 1000 VAC jack on the front panel,
- (2) DC voltages, either positive or negative with respect to ground,
- (3) resistance measurements in ohms, or
- (4) current measurements in milliamperes.

*c.* RANGE SELECTOR.—Permits the selection of various ranges of measurements as selected by the FUNCTION SELECTOR.

*d.* PRESS FOR PEAK TO PEAK.—This is a spring loaded switch which, in its NORMAL position, provides for AC measurements in terms of the RMS value of the voltage being measured. When pressed, meas-

urements are then made in terms of the peak-to-peak value of the AC voltage being measured, except for the 1000 volt AC range.

*e.* ZERO ADJUST.—This control permits the electrical adjustment of the indicating meter pointer to zero in connection with the measurement of AC VOLTS, DC VOLTS, and OHMS.

*f.* OHMS ADJUST.—With test leads not connected across any source of resistance, this control is used to adjust the meter to full scale, or infinity ohms.

#### *g.* TERMINALS:

AC PROBE—Input panel connector for AC voltage measurements when using the AC probe.

DC VOLTS—An input connection for DC voltage measurements when using the DC probe.

+MILS— —Input connections for use with two unshielded leads when making milliamperere measurements.

OHMS—Input connection for red unshielded lead when making resistance measurements.

GND—Common ground connection input for use in connection with ohms measurements, DC voltage measurements and AC voltage measurements.

1000 VAC—Input terminal for use in connection with the 1000 volt range AC measurements.

#### 3. PRELIMINARY OPERATION.

*a.* The test leads, AC probe and cable assembly, high voltage adapter and AC power line cord are placed in the cover compartment, as shown in Figure 3-3, for storage and carrying. By removing the cover from the case the test leads are easily accessible for removal or replacement. The AC power line cord is permanently attached to the main panel.

*b.* To insure accurate measurements of the unknown, make sure that the meter needle rests at zero on the scale when no power is applied. This adjustment is made mechanically by means of the ZERO ADJUST screw shown on the front of the meter in Figure 4-1. Adjust until the needle rests on the zero of the AC scale.

*c.* Connect the AC power line cord to a source of 105-125 volts, 50-60 cycles, AC.

*d.* Operate the POWER switch to ON. The PILOT light should light. Approximately three minutes are required for the tubes to heat sufficiently for stable

operation. As the power drain of the Multimeter ME-25A/U is small, approximately 12 watts at 115 volts, it is advisable, if the unit is to be used intermittently, that it be left on. The FUNCTION switch should not be left in the OHMS position.

#### 4. CAUTIONS.

a. DO NOT ATTEMPT TO MEASURE AC VOLTAGES OVER 250 VOLTS THROUGH PROBE.

b. Measure AC voltages from 250 to 1000 by connecting W101 to the 1000 VAC jack on the front panel.

c. Voltage measurements are made with the meter across the circuit; current measurements with the meter in series with the circuit, and resistance measurements with at least one terminal of the resistor free from any associated circuit.

#### 5. AC VOLTAGE MEASUREMENTS.

a. Operate the POWER switch to ON.

b. Connect the special AC probe and cable assembly to the panel connector AC PROBE.

c. Rotate the SELECTOR switch to AC VOLTS.

d. Rotate the RANGE switch to the correct range for the voltage under test. If this range is unknown, choose the highest range.

e. Check the electrical zero setting of the meter needle. If further adjustment of this is necessary, rotate the ZERO ADJUST knob until the needle reads zero on the AC VOLTS scale.

f. AC MEASUREMENTS.—Connect the ground lead from the GND jack of Multimeter ME-25A/U to the GROUND OF THE UNIT UNDER TEST (usually the chassis). It is desirable above 30 mc to use the short ground lead (W105) from the probe housing to the chassis of the unit under test.

g. Make connection to the unknown voltage, if under 250 volts, with the prod of the special AC probe. If the voltage is between 250 and 1000 volts, make connection with the red lead to the 1000 VAC jack, the SELECTOR switch being turned to the 1000 volt range.

b. Switch S104 should be operated to either the PEAK-TO-PEAK or RMS position, depending upon the type of voltage information desired. There is no one volt peak-to-peak range, the 2.5 volt range being the most sensitive for such measurements.

i. Read the value of the voltage from the AC scale corresponding to the position of the RANGE switch.

j. With reference to Section 2, Theory, paragraph 2c and Figures 2-5A and 2-5B explain the method used in which two diodes are connected in series to give a resultant indication which is proportional to the peak-to-peak value of the AC voltage being meas-

ured. In a case of a sine wave the peak-to-peak voltage delivered may be divided by 2.8 to obtain the RMS equivalent of that voltage being measured. In the case of assymetrical waves, however, this relationship no longer necessarily exists. Figure 4-2 illustrates a typical assymetric wave in which the positive excursion is 50 volts and the negative excursion 10 volts. If a half wave diode rectifier had been used and connected in the conventional manner in which the plate of the diode is fed from the AC voltage with the cathode grounded, the resulting DC voltage would be proportional to the positive excursion, or equal to 50 volts. If this type of rectification were used and the meter calibrated in terms of the equivalent RMS voltage, the meter would have indicated 50 divided by 1.4, or approximately 35.5 volts. If, however, the rectifier tube were connected as in the case of the ME-25A/U so that the resultant DC voltage were proportional to the peak-to-peak value, or 60 volts, then the resultant indication on the meter if calibrated on the basis of RMS equivalent value would have been 60 divided by 2.8, or 21.4 volts. It would be evident from Figure 4-2 that the actual RMS value of the voltage being measured would probably not be either 35.5 volts or 21.4 volts, but something considerably less than these values.

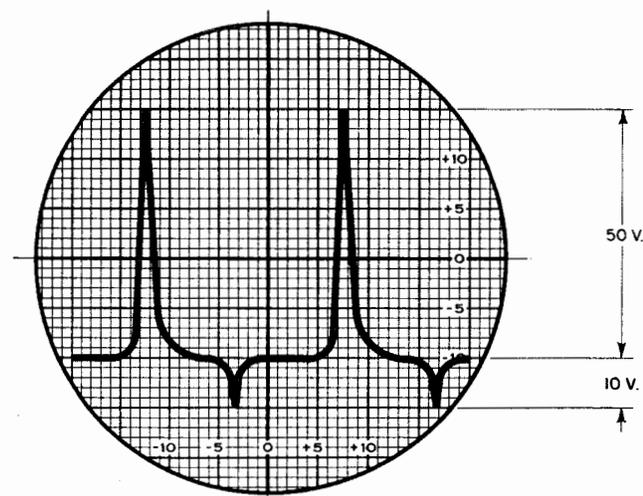


Figure 4-2. Typical Assymmetric Wave

#### 6. DECIBEL MEASUREMENTS.

Figure 4-3 shows the relationship between decibels and voltage based on 0 DB being .001 watt at 600 ohms and .006 watts at 600 ohms. As an example, if a voltage measurement on the 600 ohm line were found to be 40 volts, the relative DB based on .001 watt level would be +35 DB. If the 0 DB level were to be based on .006 watt on a 600 ohm line, a 40 volt measurement would have indicated approximately +27 DB. In order to refer voltage measurements to other than the 600 ohm line, or to other than .001 or .006 watts, 0 DB reference, the following formula may be

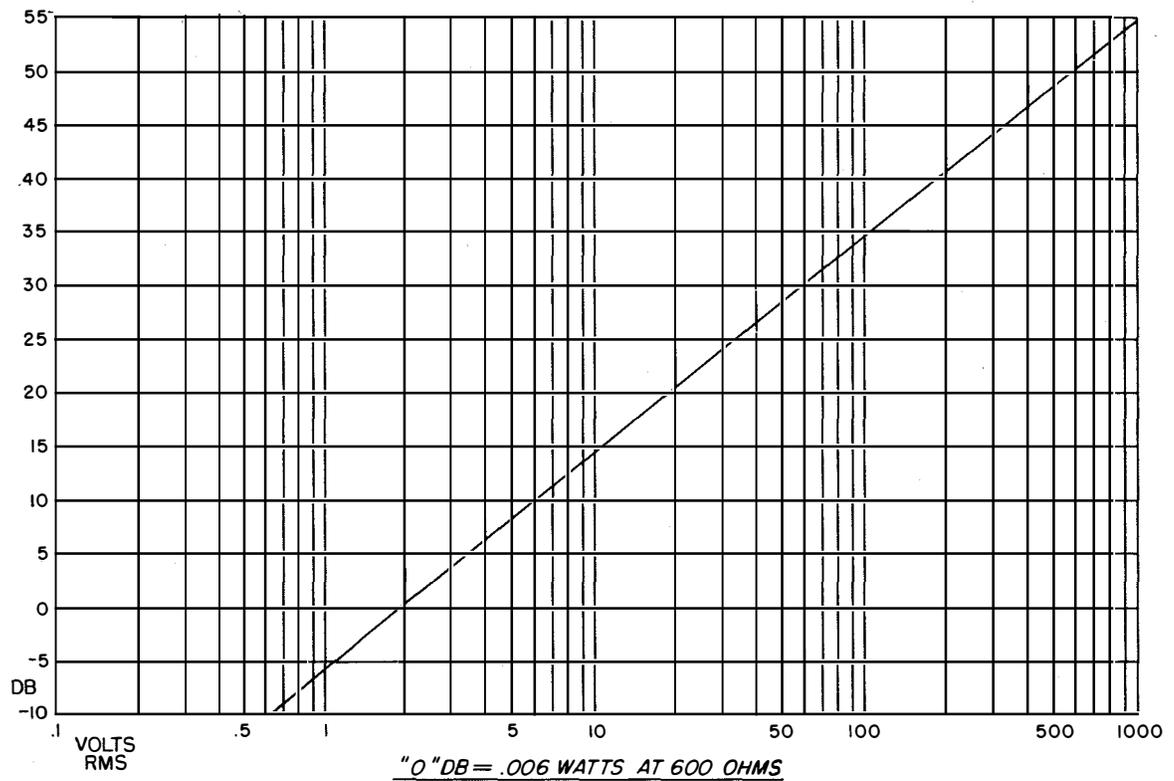
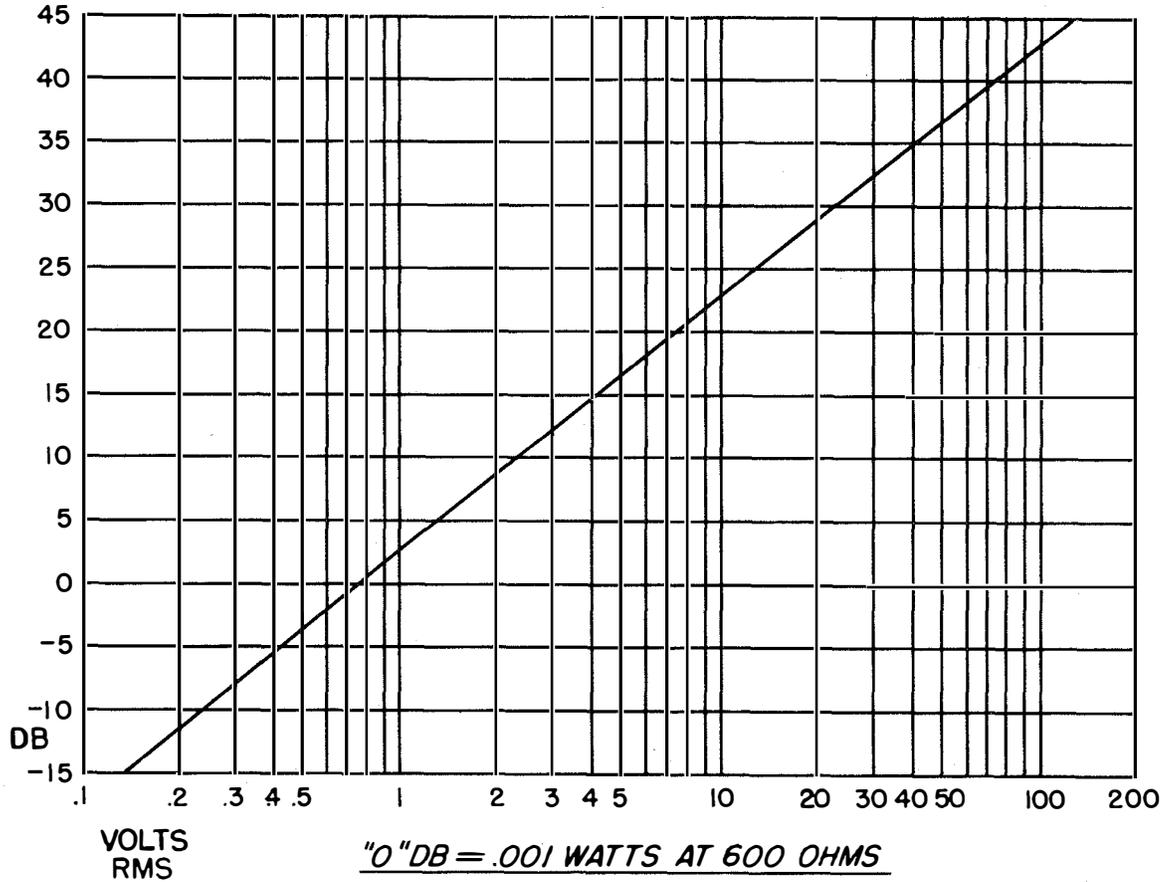


Figure 4-3. Charts Showing Relationship Between DB and Voltage

used:  $DB = 20 \log \frac{E_2}{E_1}$ . In this formula  $E_1$  represents the reference voltage at a reference impedance, and  $E_2$  represents the measured voltage. As an example, assume that the reference wattage (0 DB) is equal to 10 milliwatts, or .010 watt, and the reference impedance to be 5000 ohms. The formula  $W = \frac{E_1^2}{R}$  will permit the calculation of the reference voltage for 0 DB as follows:

$$E_1^2 = (5000) (.01) = 50$$

$$E = \sqrt{50} = 7.1$$

To find the voltage equivalent to a +10 DB level using the original basic formula would be as follows:

$$10 = 20 \log \frac{E_2}{E_1}$$

$$0.5 = \log \frac{E_2}{7.1}$$

$$E_2 = (3.16) (7.1) = 22.4 \text{ volts} = +10 \text{ DB}$$

#### 7. CORRECTION FOR DUTY CYCLES—AC VOLTAGE MEASUREMENTS.

As illustrated in Figure 4-4, nominally no correction for duty cycles would be necessary as long as the duty cycle is greater than .001. At .007 the error will be approximately 5%. For duty cycles less than this, the approximate K factor may be obtained from the chart in Figure 4-4. The true voltage with a known duty cycle can be obtained by multiplying the indicated reading by the K factor as indicated by the chart of Figure 4-4. This chart is essentially correct for repetition rates from 100 cycles to 5000 cycles.

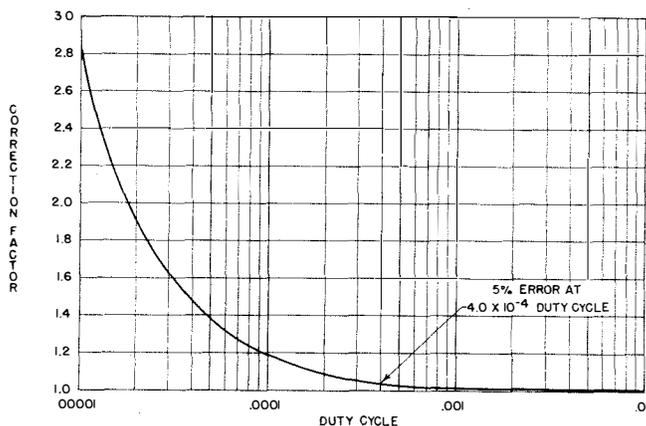


Figure 4-4. Correction Factor for Various Duty Cycles

#### 8. DC VOLTAGE MEASUREMENTS.

- Operate the POWER switch to ON.
- Rotate the SELECTOR switch to +DC VOLTS.
- Rotate the RANGE switch to the correct range for the voltage under test.
- Check the electrical zero setting of the meter needle.
- Connect the ground lead from the GND jack to

the GROUND SIDE OF THE VOLTAGE UNDER TEST.

f. Make the other connection to the unknown voltage by means of the DC probe and read the value from the proper scale. If the meter deflects in the reverse direction, operate the SELECTOR switch to —DC VOLTS.

g. If the voltage to be measured is between 1000 and 5000 volts DC, attach the high voltage adapter MX-1101/U (E114) to the DC probe and set the SELECTOR switch to the 1000 VOLT DC position. Then read the voltage on the 0-5 scale, and multiply by 1000.

The nominal input impedance for DC measurements up to 1000 volts is approximately 13 megohms. If the voltage being measured is of sufficient magnitude to be able to read on the 5000 volt range, the installation of adapter MX-1101/U may be used to provide for an input impedance of approximately 66.5 megohms, thereby causing less loading on the circuit under test.

#### 9. RESISTANCE MEASUREMENTS.

- Operate the POWER switch to ON.
- Rotate the SELECTOR switch to OHMS.
- Rotate the RANGE switch to the correct range for the resistance under test.
- Make sure that power is disconnected from the equipment being checked. Connect the two leads used for resistance measurements to the OHMS and GND jacks. Short the two leads and adjust the needle of the meter to zero position by means of the ZERO ADJUST control. Open the leads and adjust to full scale (INF) with the OHMS ADJUST control. Normally the infinity adjustment remains constant for all ranges. Should V101 develop any gas, it may be necessary to readjust to infinity for the highest, or X1 megohm range.

e. Connect to the resistance, making sure that one end of the resistance has been disconnected from any associated circuits.

#### Caution

BE SURE THAT THE OHMMETER CIRCUIT IS NOT CONNECTED ACROSS ANY SOURCE OF VOLTAGE.

#### 10. CURRENT MEASUREMENTS.

- Rotate the SELECTOR switch to MILS.
- Rotate the RANGE switch to the correct range for the measurement to be made.

#### Caution

IF THE CURRENT IS UNKNOWN, ALWAYS START WITH THE HIGHEST MILS RANGE.

- Connect the two leads to the +MILS— jacks and connect into the circuit, maintaining correct polarity.
- Read the value of the current from the scale corresponding to the position of the RANGE switch.

## SECTION 5

### PREVENTIVE MAINTENANCE

#### 1. GENERAL.

Preventive maintenance is the removing of possible trouble which might later cause the equipment to become inoperative. Primarily, this includes periodic inspection, checking, cleaning and tightening of contacts and components. Certain suggestions can be made for such a program, but local conditions will largely determine the exact details.

The guide to the program will be found in Table 5-1, ROUTINE MAINTENANCE CHART. By carefully following this chart, troubles can be detected and remedied before causing actual breakdown of the equipment.

#### 2. LUBRICATION.

No lubrication is required.

#### 3. CLEANING.

##### Warning

##### DISCONNECT POWER CORD.

a. GENERAL.—The chassis is best blown out with dry compressed air or cleaned with a dry cloth and

a soft dry paint brush of suitable size. It may be necessary to use carbon tetrachloride on a cloth to clean ceramic high voltage insulators. On chassis surfaces, however, carbon tetrachloride should not be used as there is danger of softening the tropicalizing paint which covers them. Dust should be cleaned off thoroughly, both inside and outside the case.

Inspection should be combined with cleaning, since every part of the equipment can be observed at that time, and cleaning may inadvertently break or loosen a connection.

All exposed lug and screw connections, plug and socket connections, and electron tube pins should be checked for tightness. Cable ends should be properly dressed to prevent short circuits or strain on wires and lugs.

##### Caution

Faulty electrical contacts can cause equipment failure at a critical time. Evidences of heating or breakdown such as carbonized surfaces, overheated resistors with discolored surfaces, and discolored metal parts should be noted. Though there may be no damage, potential trouble is indicated.

TABLE 5-1. ROUTINE MAINTENANCE CHART

**ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO REQUIREMENTS OF CHAPTER 67  
OF THE "BUREAU OF SHIPS MANUAL" OF THE LATEST ISSUE.**

It is presumed that all maintenance operations will be scheduled by the Electronic Officer. The following Table is given as a basis for such a schedule.

#### Warning

Before removing the case, disconnect the power cable. After removal of the case, discharge any capacitors in the power supplies.

#### MONTHLY

- a. Remove fuses one at a time. Clean and burnish ends and clips as needed.
- b. Check tube pins and socket contacts for corrosion. Clean as needed.
- c. Check all tubes in a tube tester. Replace weak tubes.
- d. Replace any tubes missing from tested emergency spares after first testing in proper socket.
- e. Check operation of all panel controls.
- f. Blow out dust with dry compressed air.
- g. Check for rust and corrosion. Clean and touch up with paint as needed.

All knobs should be checked for looseness and tightened if necessary. Occasionally knobs become loose and fail to rotate their controls; thus, a loose knob may give the impression of fault in a variable circuit.

Rough handling of the instrument will sometimes jar parts or wires out of position or abrade them; such damage should be repaired. Rust or corrosion on painted surfaces should be cleaned and sanded smooth, and the spot covered with touchup paint. Unpainted surfaces will not ordinarily corrode unless exposed to salt water or some other corrosive agent. Should corrosion occur, it should be cleaned off thoroughly, taking care not to let the scrapings fall into the unit, and the spot touched up with clear varnish or tropicalizing paint. Paint or varnish should not be used too close to switch or tube socket contacts.

*b.* TUBES.

Compressed air or a brush will usually suffice to remove dust from the tubes. Be careful to clean tubes that operate at a high temperature, as a layer of dust would interfere with heat radiation and raise the operating temperature. After cleaning, make sure that all tubes are properly seated in their sockets and all tube clamps locked.

Tubes should be removed from their sockets periodically and the pins inspected. Any dirt and corrosion

found should be removed from the pins with crocus cloth and from socket contacts with the round blade of a burnishing tool.

The plate connectors used on high voltage rectifier tubes may lose their spring tension as a result of overheating. The tension should be increased when necessary.

*c.* FUSES.

Fuses should be removed and checked for corrosion and looseness, either of which can cause eventual trouble. A clean cloth moistened with carbon tetrachloride will usually suffice for cleaning the fuses and clips, but in some cases it may be necessary to use crocus cloth or fine sandpaper. When replacing, make sure that the fuses are tight in their clips.

*d.* HIGH-VOLTAGE INSULATORS.

Ceramic and other insulators for voltages under 600 volts are usually tropicalized. They should be kept clean, but care should be taken not to remove the special paint. The use of solvents is not recommended.

Ceramic insulators for voltages greater than 600 volts are not tropicalized. They should be kept clean to prevent the possibility of arc-overs. It may be necessary to use a cloth moistened with carbon tetrachloride or some other solvent.

# 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 NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. 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 and 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 any Electronics Officer.

**FAILURE REPORT—ELECTRONIC EQUIPMENT**  
NAVSHIPS (NBS) 383 (REV. 8-45)  
(FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 384)

SHIP NUMBER AND NAME OR STATION \_\_\_\_\_

CHECK ONE:  RADIO

EQUIPMENT MODEL DESIGNATION \_\_\_\_\_

TYPE NUMBER AND NAME OF MAJOR UNIT IN \_\_\_\_\_

TUBE TYPE, INCLUDING PREFIX LETTERS \_\_\_\_\_

TUBE MANUFACTURER \_\_\_\_\_

FAILURE OCCURRED IN:

STORAGE  OPERATIC

HANDLING  OTHER (SPECIFY \_\_\_\_\_)

INSTALLING

NATURE OF FAILURE AND REMARKS \_\_\_\_\_

NOTICE.—Read notes on reverse side. Add: Serial forms and envelopes may be obtained from nearest BMO.

NAME OF PERSON MAKING REPORT \_\_\_\_\_ DATE \_\_\_\_\_

**ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)**  
NAVSHIPS (NBS) 383 (REV. 11-45)

ORGANIZATION PERFORMING MAINTENANCE \_\_\_\_\_ NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE \_\_\_\_\_

\* REPORT NO. \_\_\_\_\_ DATE \_\_\_\_\_

NOTICE.—Read notes on cover prior to preparing this form.

EQUIPMENT INVOLVED

Navy  Army  USMC  JAM  Commercial  Other \_\_\_\_\_ (Specify)

Radio  Radar  Sonar  Wire  Test  Test  Power  Sound  Other \_\_\_\_\_ (Specify)

EQUIPMENT MODEL DESIGNATION \_\_\_\_\_ SERIAL NUMBER OF EQUIPMENT \_\_\_\_\_ NAME OF CONTRACTOR \_\_\_\_\_ CONTRACT NO. \_\_\_\_\_

TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED \_\_\_\_\_ SERIAL NUMBER OF UNIT \_\_\_\_\_ CONTRACT OR PO DATA OF UNIT \_\_\_\_\_ DATE EQUIPMENT RECEIVED \_\_\_\_\_

**ITEM WHICH FAILED**

THIS SIDE FOR TUBES		THIS SIDE FOR PARTS (NOTE 9)		
TUBE TYPE, INCLUDING PREFIX LETTERS	SERIAL NO. (NOTE 8)	NAME OF PART	CIRCUIT SYMBOL (e.g. R-134)	NAVY TYPE NO.
TUBE MANUFACTURER	CONTRACT NO. (NOTE 8)	SERIAL NO.	*CONTRACT DATA	*DATE RECD.
FAILURE OCCURRED IN	GUARANTEED HOURS (NOTE 8)	DATE OF ACCEPTANCE (NOTE 8)	*CHECK-OFF OR TAG DATA (NOTE 9)	*MANUFACTURER'S DATA (NOTE 8)
<input type="checkbox"/> Storage <input type="checkbox"/> Operation	ACTUAL HOURS	DATE OF FAILURE	BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)	
<input type="checkbox"/> Handling <input type="checkbox"/> Other (Specify in remarks)	TYPE OF FAILURE (NOTE 7)	TUBE CIRCUIT SYMBOL		
<input type="checkbox"/> Installing	NATURE OF FAILURE AND REMARKS (NOTE 6) (CONTINUE ON BACK)			

CONCLUSION:

Normal  Shortage  Misclassification  Failure  Transportation breakage  Other \_\_\_\_\_ (Specify)

\*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.

16-50881-1 U. S. GOVERNMENT PRINTING OFFICE

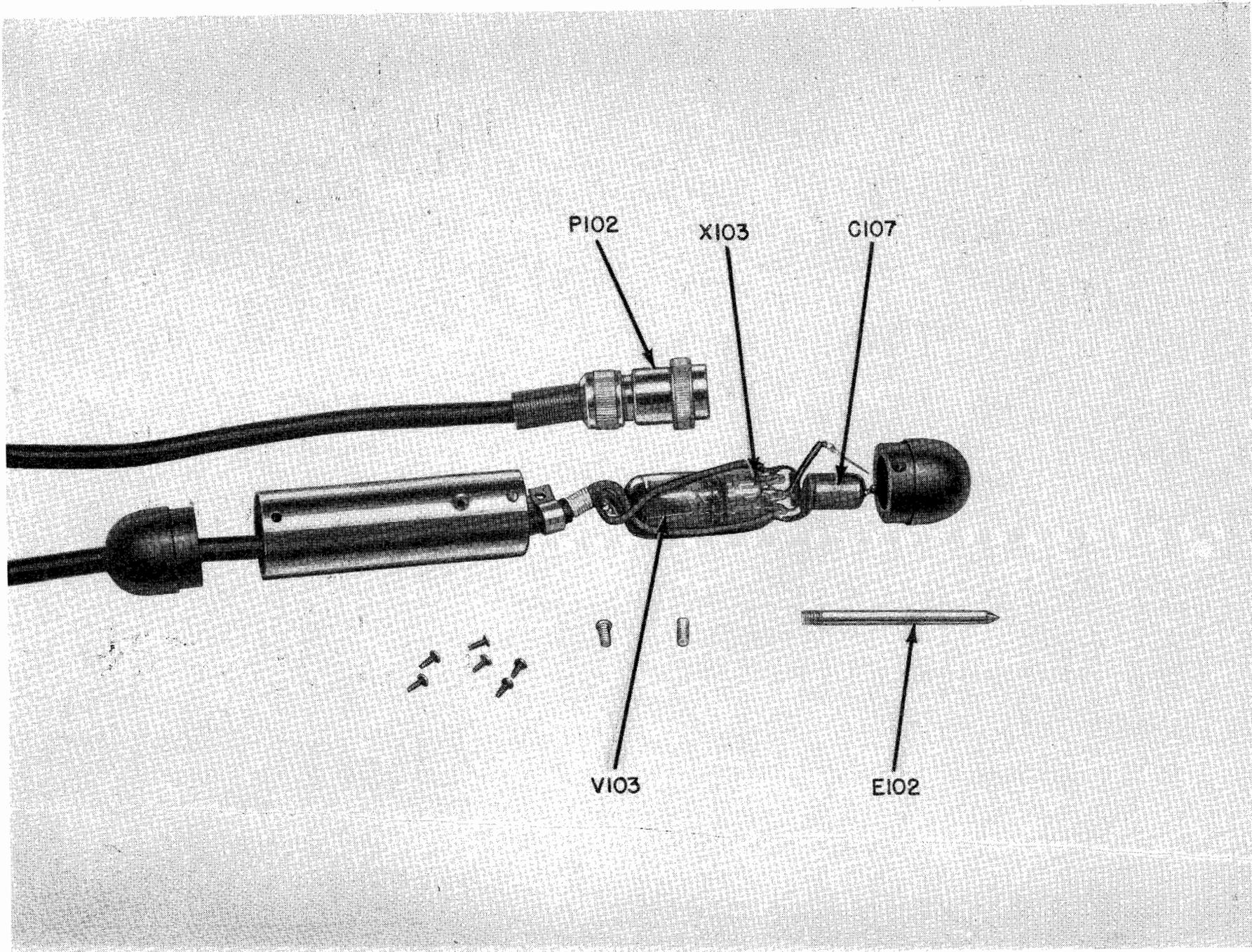


Figure 6-1. AC Probe, Cover Removed

## SECTION 6 CORRECTIVE MAINTENANCE

### 1. REMOVAL OF CASE.

- a. Remove the eight screws from the front panel.
  - b. Remove the case from the chassis and panel.
- Figures 6-3 through 6-9 are internal views of the unit showing the location of tubes and component parts.

### 2. TUBE MAINTENANCE.

- a. In case of failure of the type 6AL5 tube in the probe, it will be impossible to adjust the meter to zero for AC voltage measurements on the lower AC ranges. This tube is readily replaced by first removing the ground clamp screw and the three small screws at each end of the metal sleeving. Then the rear plug and metal sleeving may be moved back far enough to permit removal of the tube. Figure 6-1 is a view of the probe with the cover removed.

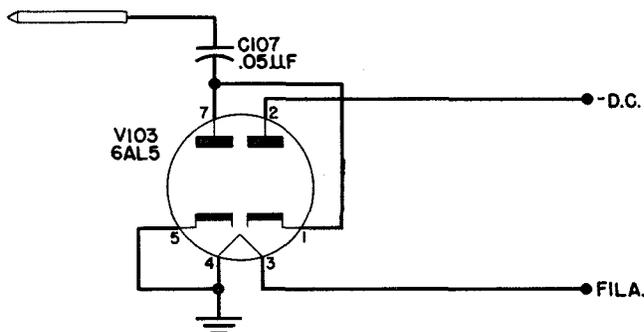


Figure 6-2. Electrical Circuits of AC Probe

- b. Replace any tubes not functioning properly. The location of these tubes is shown in Figures 6-3 and 6-6. Any good tube of the same type as that employed may be used for replacement, but replacement of V101 may necessitate calibration control adjustments.

### 3. CALIBRATION.

- a. Remove the case in the same manner outlined in paragraph 1.
- b. Support the instrument with the panel in a vertical position while making calibration adjustments.
- c. Plug the unit into a 105-125 volt, 50-60 cycle, AC power source. Allow a three minute warm-up period.
- d. Turn the SELECTOR switch to MILS and mechanically reset the meter needle to zero if necessary.
- e. AC VOLTS CALIBRATION.
  - (1) Adjust the meter needle to zero with the ZERO ADJUST control R109, Figures 6-3 and 6-6. No external voltage should be applied for this adjustment.
  - (2) Operate the SELECTOR switch to the AC VOLTS position.
  - (3) Turn the RANGE switch to any position. The range selected for the adjustment of calibration resistors is not important as long as a satisfactory

standard voltage is available for calibration which would be covered by the range selected. With reference to the schematic wiring diagram, Figure 6-13, it will be noted that the AC calibration potentiometer R149 is connected through the PRESS FOR PEAK TO PEAK switch, S104. With this switch in the PEAK-TO-PEAK position, R150 is shorted out and AC calibration accomplished by the adjustment of R149. For this reason, in calibrating the instrument this switch should be operated to this PEAK-TO-PEAK position and calibration potentiometer R149 adjusted until the indication on the meter corresponds with the known standard of voltage being applied. In this connection, it should be noted that if the calibration voltage were, for example, 2.5 volts RMS, the indication would be 2.82 times this, or 7.05 volts on the 10 volt range.

After R149 has been properly adjusted, S104 can be returned to the NORMAL position and calibration checked to see if by measuring RMS voltages the indication is correct. If it is not correct for RMS measurements, calibrating resistor R150 should be adjusted to effect correct calibration. Changing of R150 will in no way affect the PEAK-TO-PEAK calibration since it is shorted out when measuring peak-to-peak voltages.

(4) If recalibration is required on the 1000 volt AC range, it should be effected by the adjustment of resistance R108. Resistors R105, R106 and R107 should be checked to be sure they are at their approximately correct values.

### f. DC VOLTS CALIBRATION.

- (1) Set the SELECTOR switch to DC VOLTS.
- (2) Set the RANGE switch to the range corresponding to the known DC voltage about to be applied.
- (3) Apply a known DC voltage. If the meter does not indicate the proper voltage, adjust potentiometer R145 (See Fig. 6-3 and 6-6) until the meter indicates the applied voltage. This calibration corrects for either +DC or -DC.

### g. OHMS-MILS CALIBRATION.

No calibration is normally necessary on OHMS or MILS except in case of resistor failure in the dividing network. Figure 6-7 shows the RANGE SELECTOR switch and associated components.

### 4. DRY CELL.

One dry battery BA-30 is utilized in this instrument, and is operated as a source of DC necessary in making resistance measurements. If it is impossible to bring the meter to full scale deflection on any scale, it is probable that the voltage of the dry battery is low. To replace this:

- (1) Remove the case from the chassis in accordance with paragraph 1. (See Figure 6-4)
- (2) Remove the dry battery from its clamps.
- (3) Replace the dry battery with a fresh cell, taking care to maintain the correct polarity.

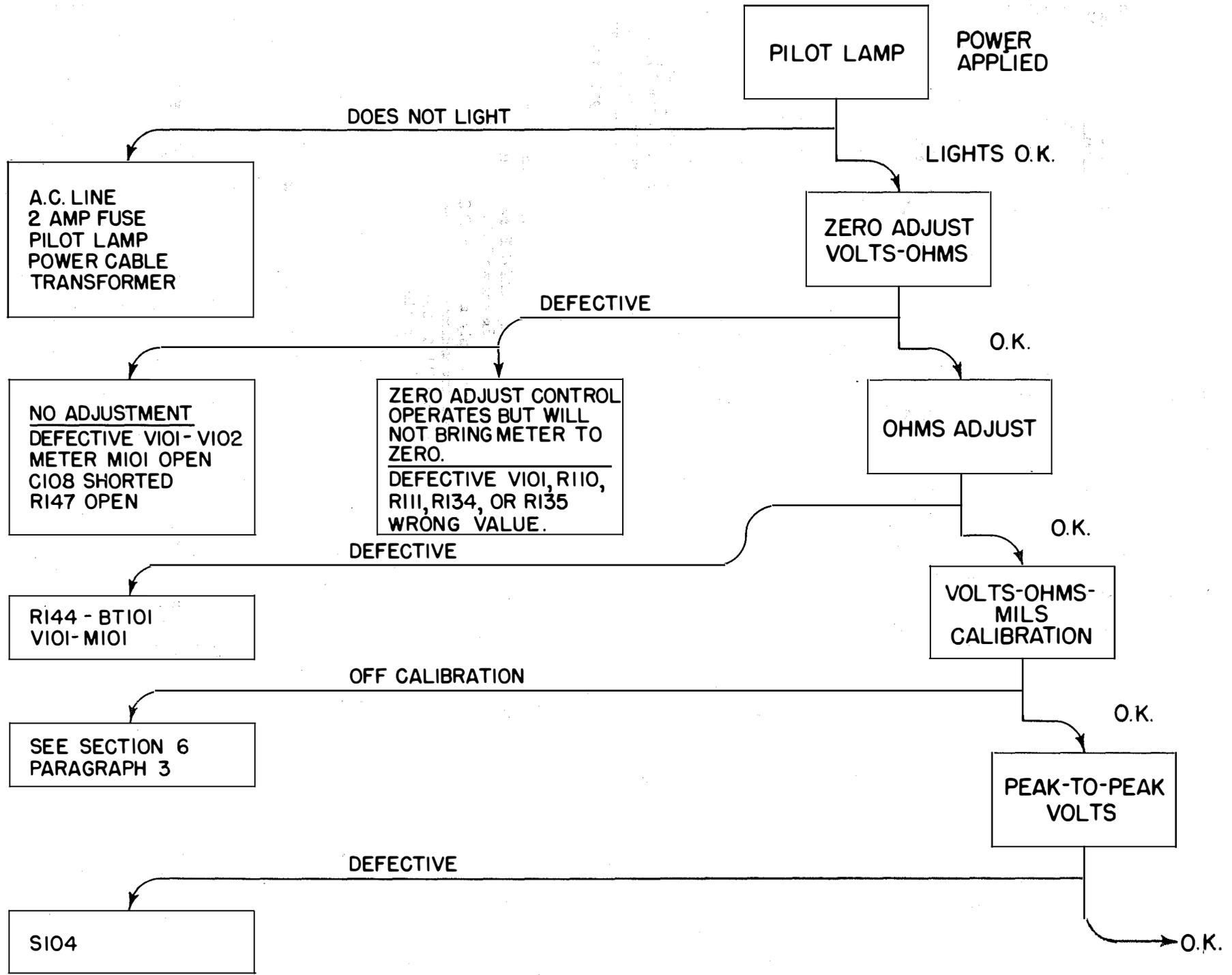


TABLE 6-1. TROUBLE SHOOTING CHART

ORIGINAL

6-5

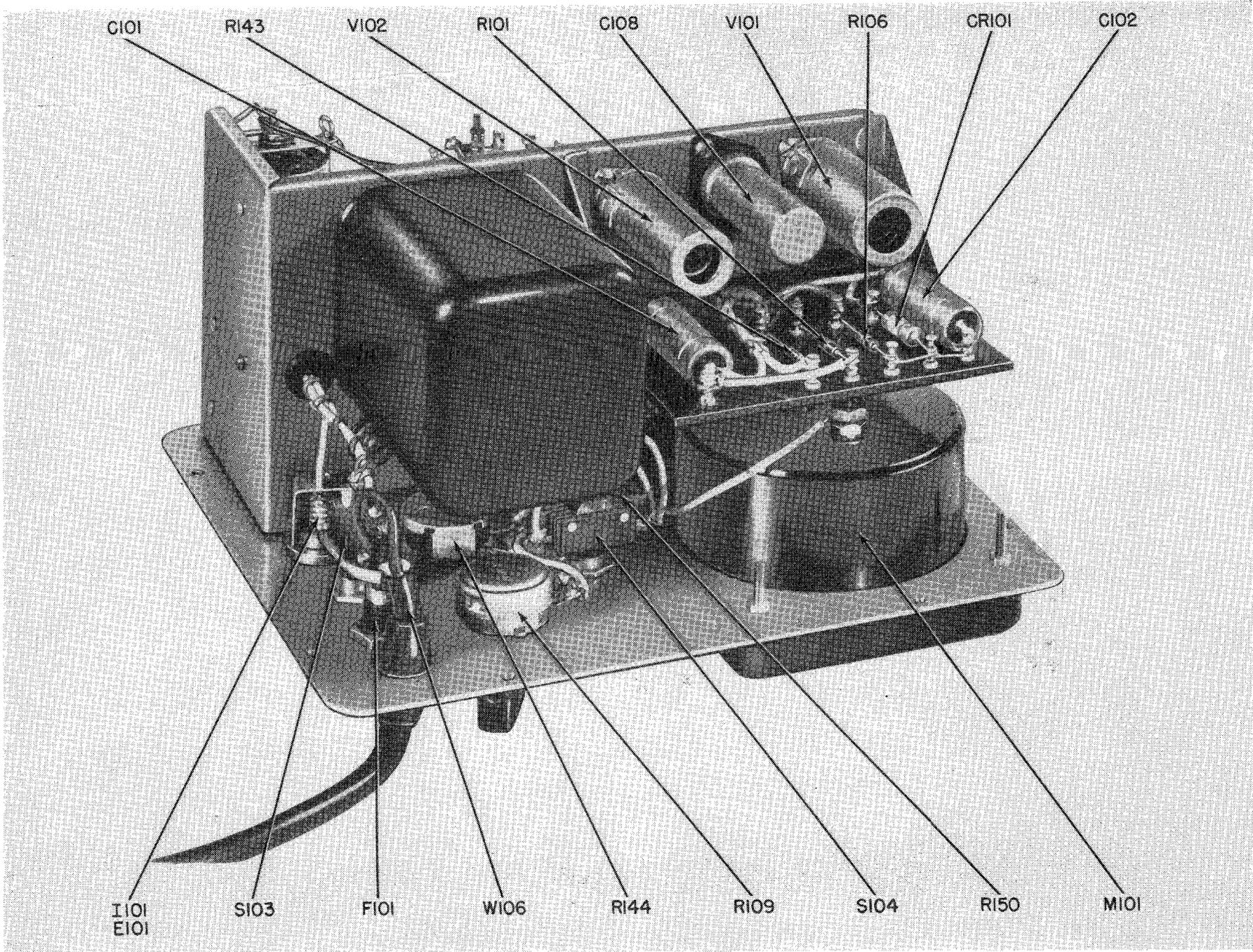


Figure 6-3. Multimeter ME-25A/U, Case Removed, Top View

ORIGINAL

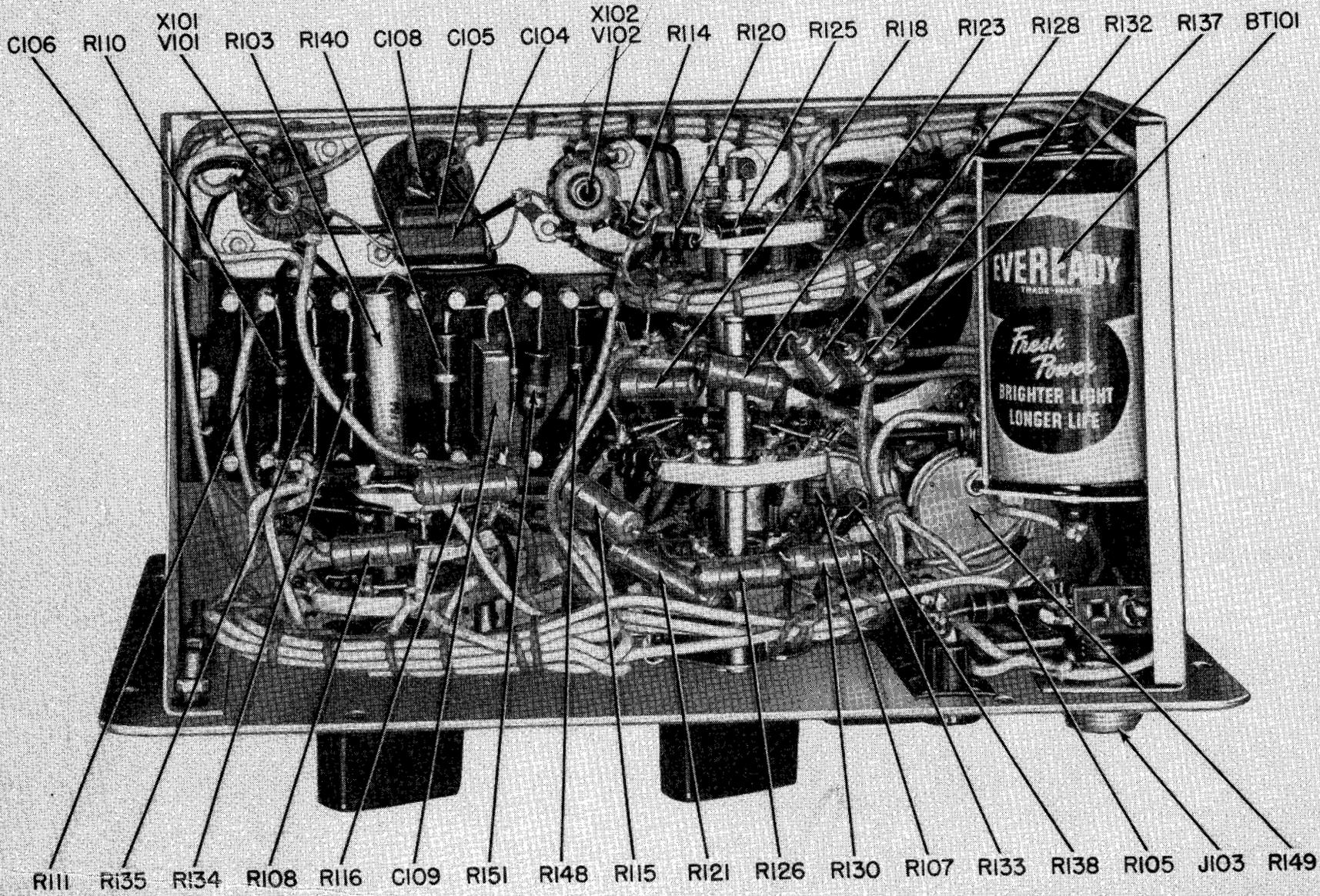


Figure 6-4. Multimeter ME-25A/U, Case Removed, Bottom View

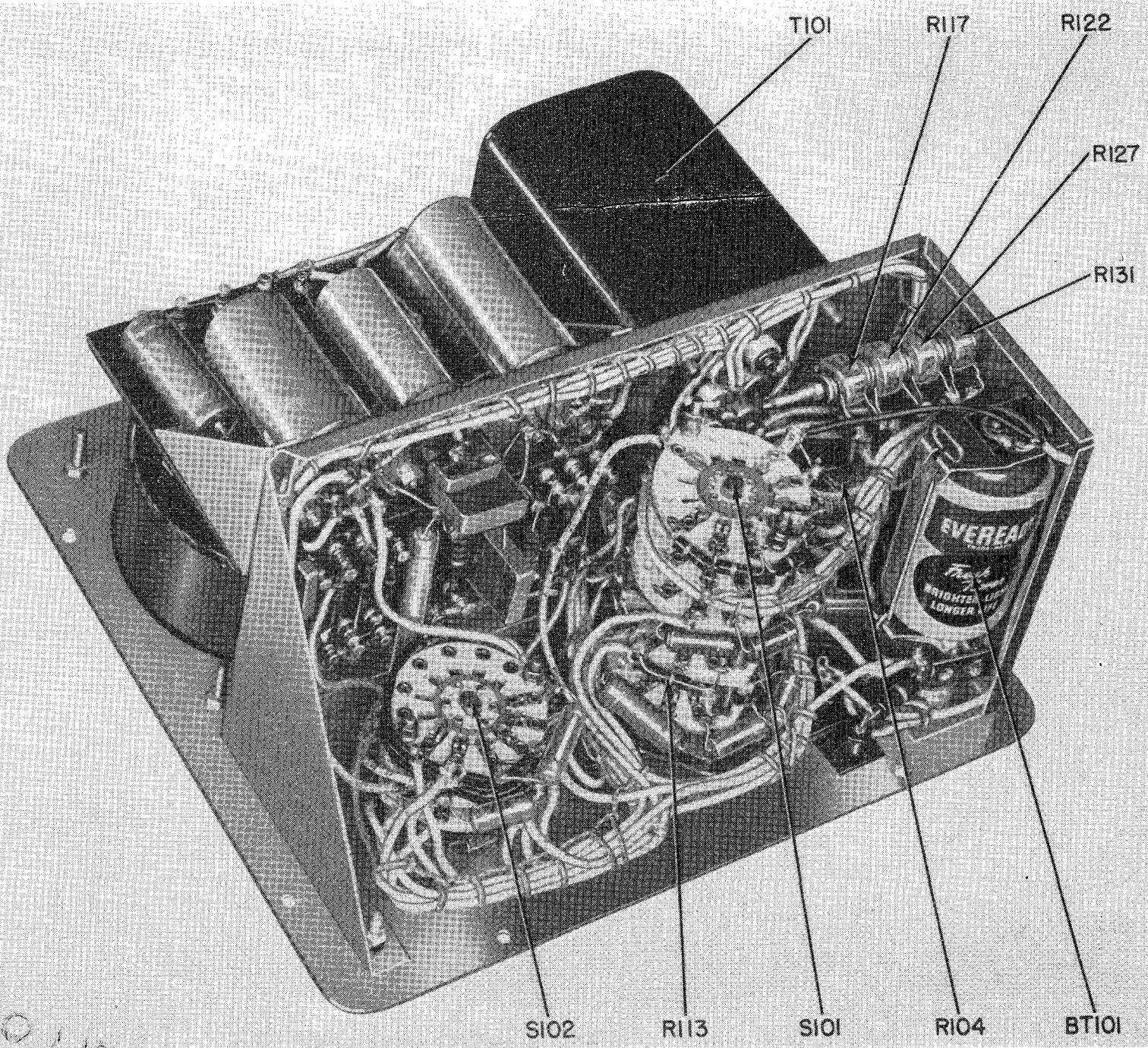


Figure 6-5. Multimeter ME-25A/U, Case Removed, Rear Oblique View

ORIGINAL

6-7

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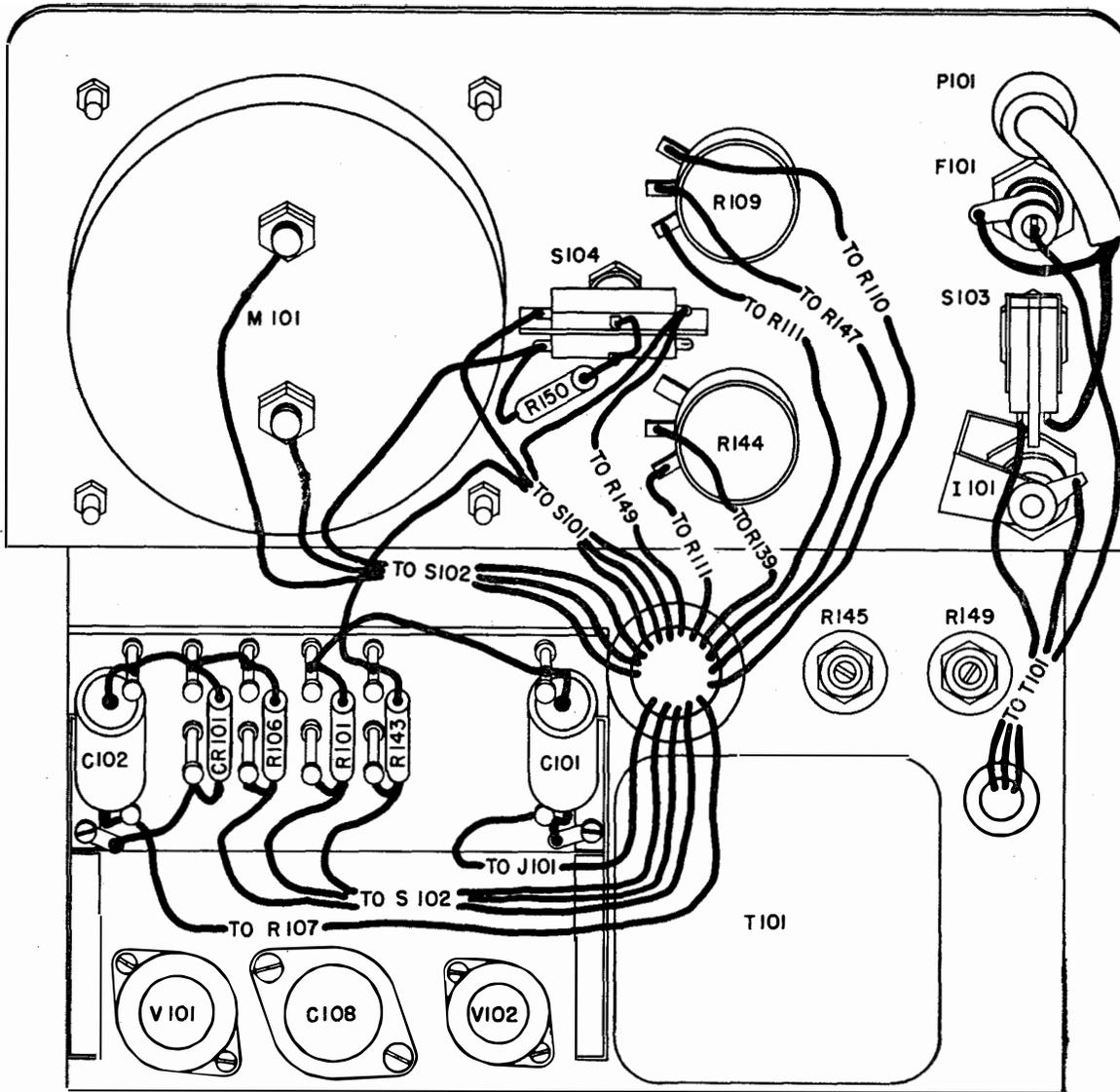


Figure 6-6. Location of Components on Upper Terminal Board  
(See Inset for Perspective)

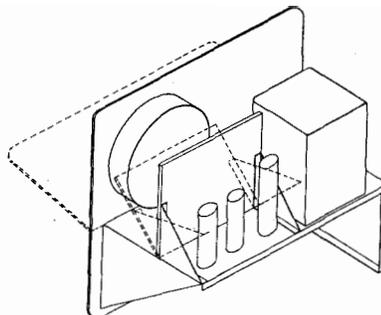


Figure 6-6. (Inset)

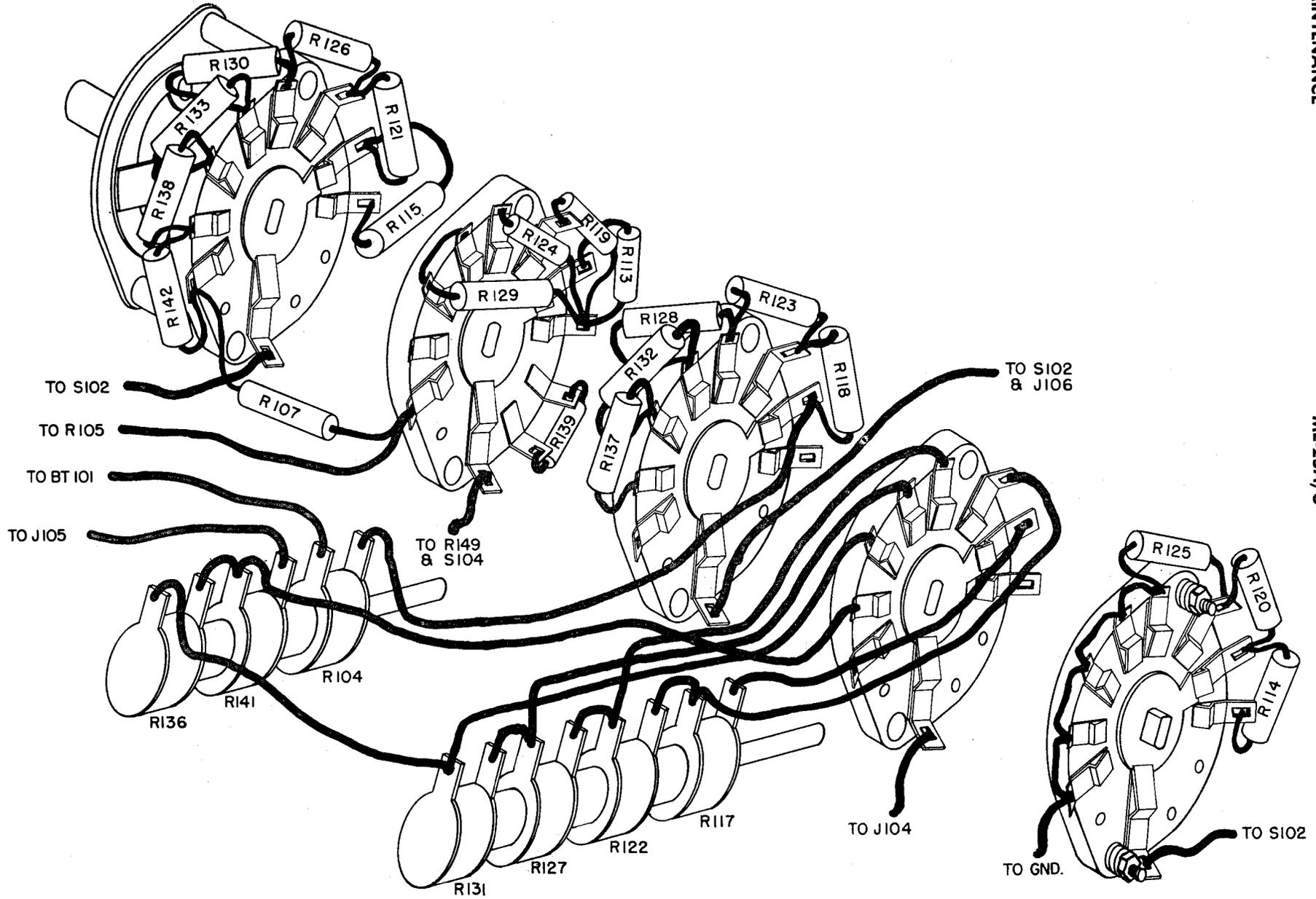
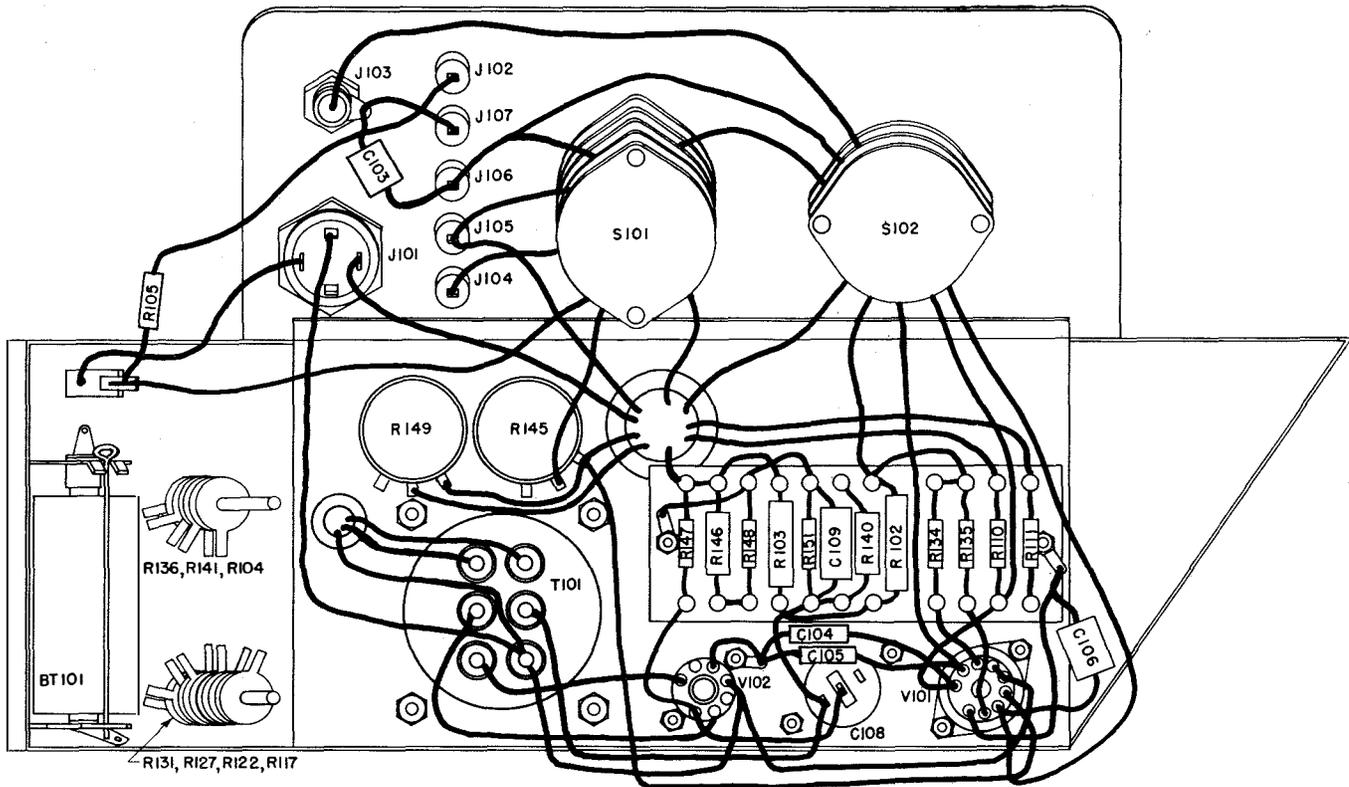
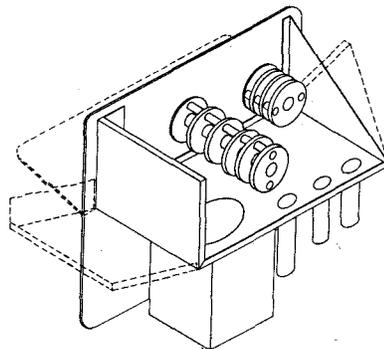


Figure 6-7. Range Selector Switch and Associated Components



**Figure 6-8. Location of Components on Lower Terminal Board**  
(See Inset for Perspective)



**Figure 6-8. (Inset)**

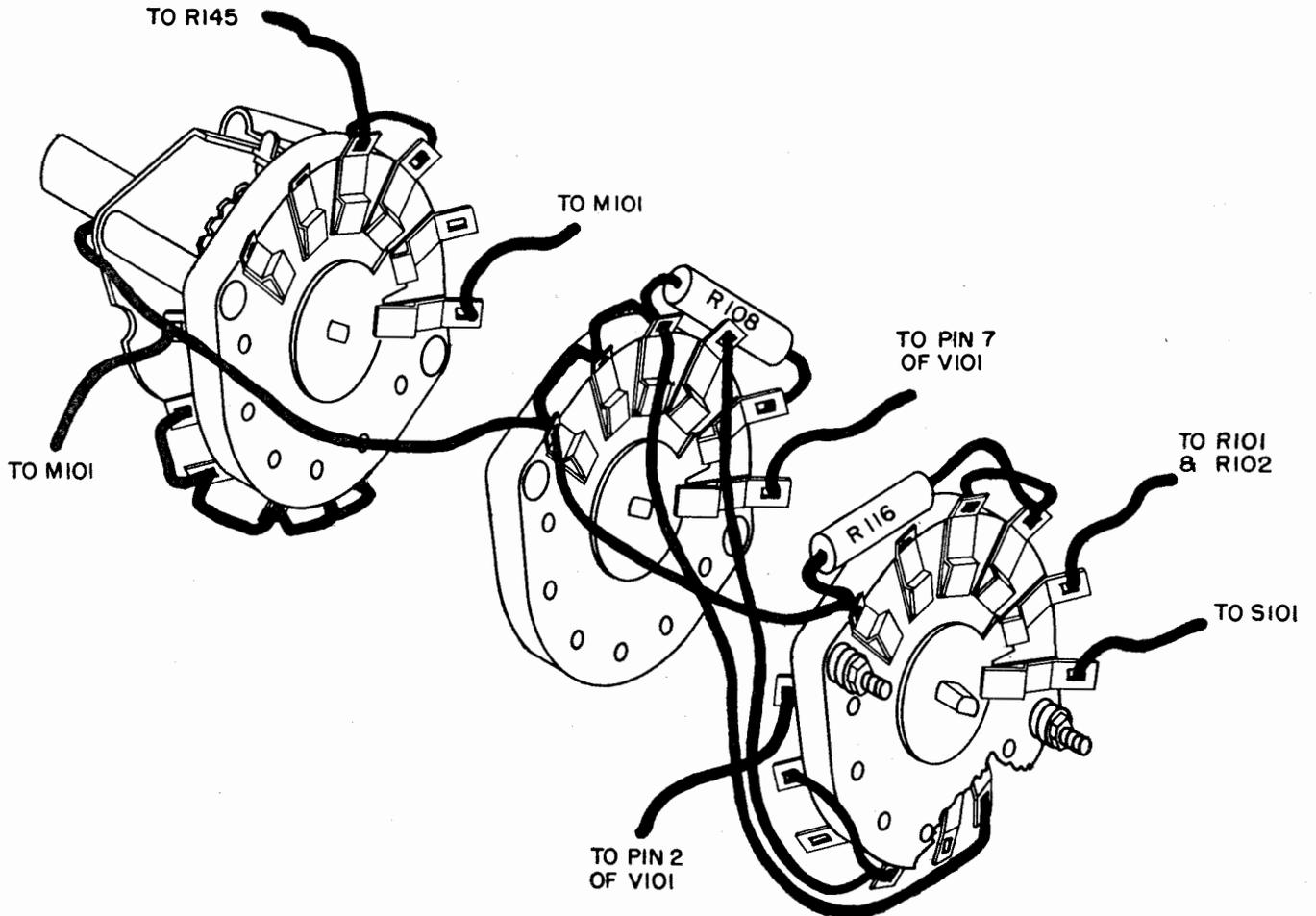


Figure 6-9. Function Selector Switch and Associated Components

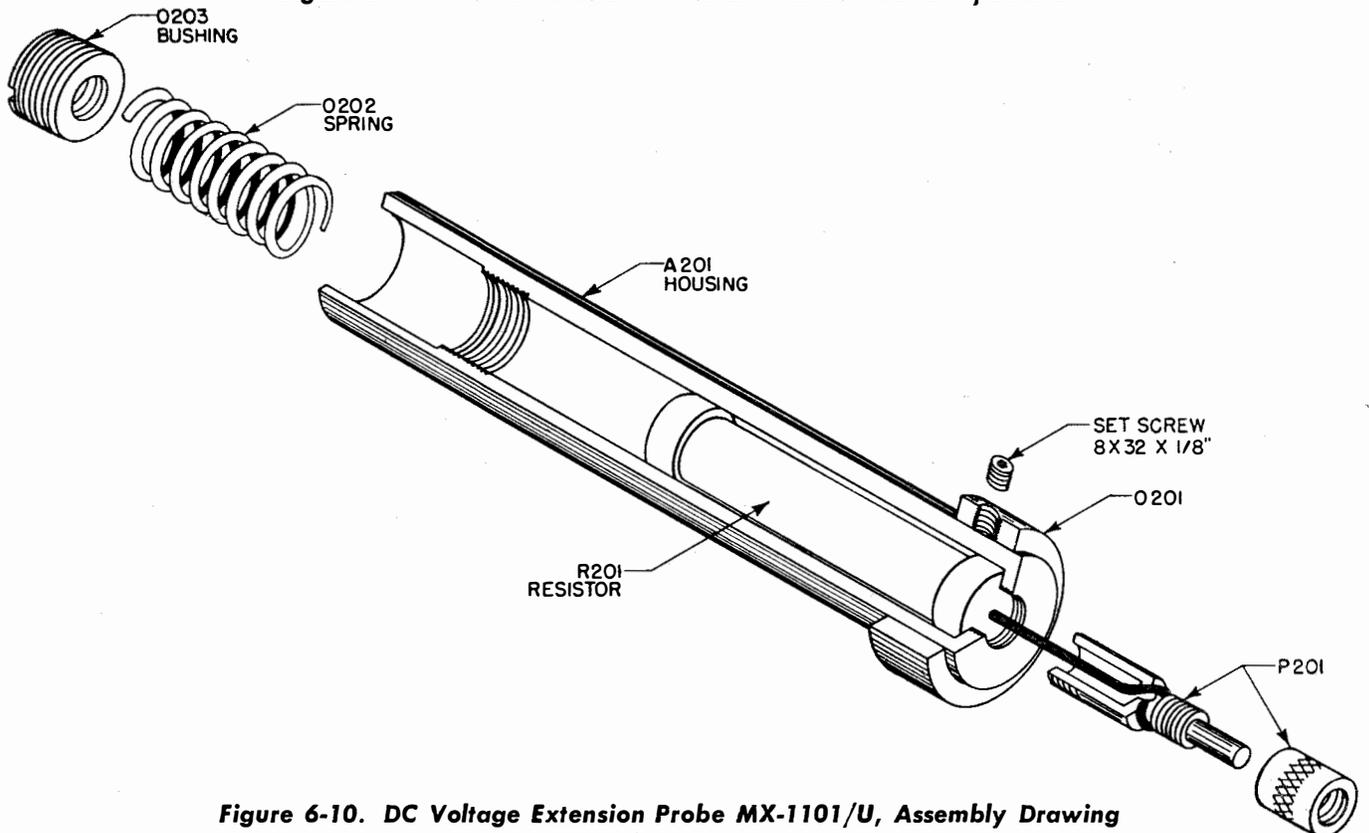
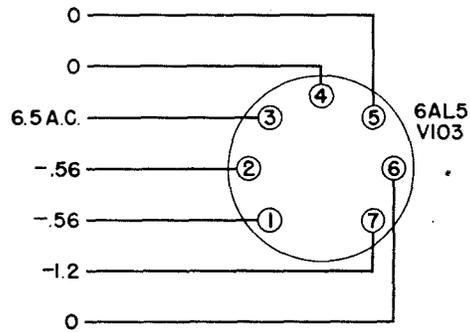
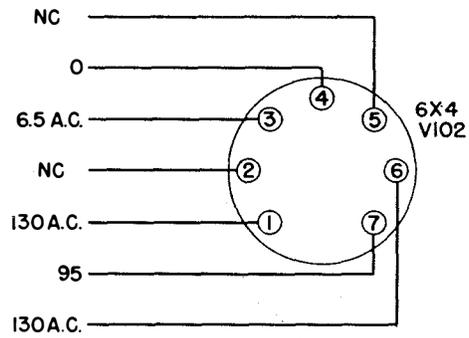
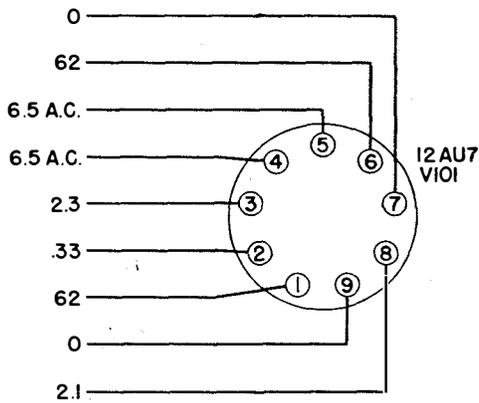


Figure 6-10. DC Voltage Extension Probe MX-1101/U, Assembly Drawing



NC=NO CONNECTION  
ALL VOLTAGES +D.C.  
UNLESS OTHERWISE NOTED.  
VOLTAGE MEASURED TO GROUND  
WITH AN ELECTRONIC VOLTMETER  
SUCH AS ME-25/U

VOLTAGE DATA  
WITH RESPECT TO CHASSIS

Figure 6-11. Pictorial Diagram, Voltage Data

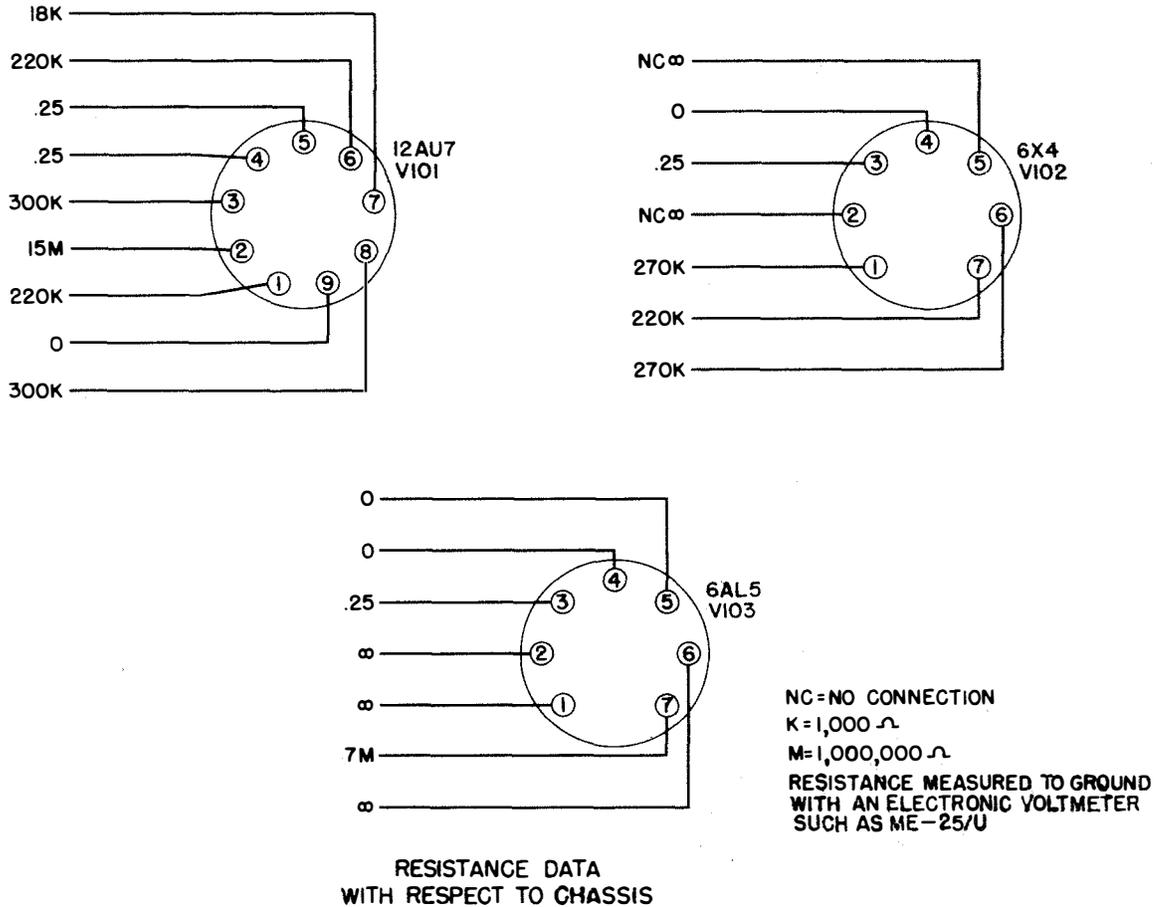


Figure 6-12. Pictorial Diagram, Resistance Data

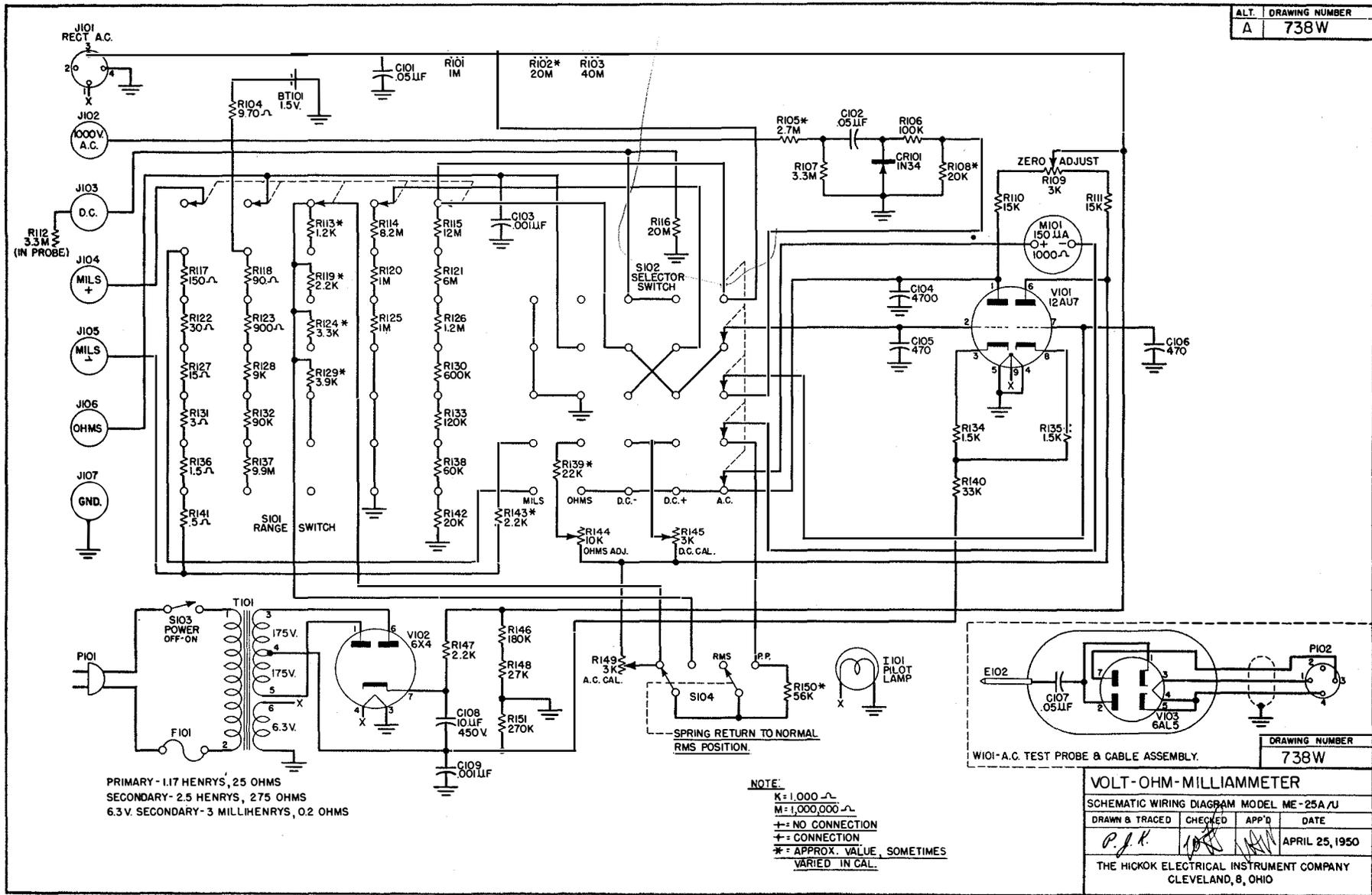


Figure 6-13. Schematic Diagram, Multimeter ME-25A/U

TABLE 7-1. LIST OF MAJOR UNITS

SYMBOL GROUP	NAME OF MAJOR UNIT	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE
100-199	METER, multimeter: Army-Navy Multimeter ME-25A/U; electronic volt-ohm-milliammeter, input 115 v, 1 ph, 50 to 1600 cyc; portable; meter ranges 0 to 1000 v AC RMS in 7 steps, 0 to 250 v AC peak to peak in 5 steps, 0 to 1000 v DC in 7 steps, 0 to 1000 ma DC in 6 steps, 0 to 1000 meg in 6 steps; basic meter sensitivity 150 ua full scale, basic meter resistance across term 1000 ohms p/m 10%, input resistance DC v 13 meg, with Test Prod MX-1101/U 66.5 megohms, input impedance AC v equivalent to resistance of not less than 12 meg in parallel w/ capacitance of not more than 7 mmf; 4" rectangular meter, meter accuracy 2% full scale; gray enameled steel case w/ cover, 9 $\frac{3}{4}$ " h x 8 $\frac{1}{8}$ " wd x 6 $\frac{19}{32}$ " d o/a; incl test leads, AC and DC probes, 7 ft power cord for connecting to AC power; has polarity reversing switch for DC v measurement, includes Army-Navy Test Prod MX-1101/U which extends DC v range to 5000 v, AC prod is of the capacity-diode rect type, DC prod has 3.3 meg isolating resistor in handle, conversion chart provided for making db measurements using AC ranges, leads and accessories stowed in cover of case and secured by clips; Navy Spec #RE-9300-B plus addendum #1; Hickok part #902-153.	3F3324-9 N17-M-28071-1551
200 - 299	PROD, test: Army-Navy Test Prod MX-1101/U; high voltage multiplier to permit measurements of DC voltages up to 5000 v; p/o Army-Navy Multimeter ME-25A/U; consists of a resistor in a red phenolic ins housing, resistor is terminated at 1 end by a nickel pl brass prod and at the other end by a threaded bushing for coupling to the regular DC prod, supplied w/ detachable alligator clip; 53.2 meg resistor, rated at 2 w; approx $\frac{5}{8}$ " diam x 5 $\frac{1}{4}$ " lg, less detachable alligator clip, $\frac{1}{8}$ " diam collar on prod end; couples to regular DC prod by means of 10-32 internal thd in term bushing; Hickok part/dwg #16975-31.	3F3705-19 N17-P-84837-7361

TABLE 7-2. LIST OF REPLACEABLE PARTS

REFER- ENCE DESIG- NATION	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS
A-101	6F500-17 N17-C-250001-147	CASE: combination transit and instrument type; steel, light gray enamel finish; dimensions 9 $\frac{3}{4}$ " high x 8 $\frac{7}{8}$ " wd x 6 $\frac{19}{32}$ " deep over all including handle, hinges etc; single compartment for instrument, clips on inside of lid to secure test leads and accessories when not in use; one hinged metal handle on top; two separable hinges and one pull down type trunk latch, db conversion chart on inside surface of cover, includes rubber gasket 0-103 between cover and case; Hickok part/dwg #3145-211.	Housing for the ME-25A/U and accessories.
BT-101	3A30 N17-B-58745-6541	BATTERY, dry: JAN Type #BA-30; Navy Type #19031; 1 $\frac{1}{2}$ v; cylindrical; 1 $\frac{5}{16}$ " diam x 2 $\frac{3}{8}$ " lg; metallic case; 2 flat surface term, 1 brass cap pos terminal, bottom surface of case is neg terminal; 1 "D" cell; Spec #JAN-B-18A; Mfr Ray-O-Vac #2-LP; Hickok part X2210-2.	Voltage source for resistance measurements.
C-101	3DA50-292 N16-C-44287-7140	CAPACITOR, fixed: JAN Type #CP26A1EF503M; paper dielectric; 50,000 mmf p/m 20%; 600 vdcw; no int gnd connections; Spec. JAN-C-25; Mfr. Sprague Mfg #CP26A1EF503M; Hickok part #X3105-84.	By pass in rectified ac input circuit from diode probe.
C-102		CAPACITOR, fixed: Same as C-101.	Filter in crystal rectifier circuit for 1000 volts ac.
C-103	3K3010221 N16-C-31090-4164	CAPACITOR, fixed: JAN Type #CM30B102K; mica; 1000 mmf p/m 10%; 500 vdcw; temp coef ltr B; Spec. JAN-C-5; Mfr. Cornell Dubilier Type 1; Hickok part/dwg #X3095-9.	By pass in ohms input circuit.
C-104	3K3547221 N16-C-32646-6808	CAPACITOR, fixed: JAN Type #CM35B472K; mica; 4700 mmf p/m 10%; 500 vdcw; temp coef ltr B; Spec JAN-C-5; Mfr. Cornell Dubilier Type 1D; Hickok part/dwg #X3095-17.	By pass on plate pin #1 of electronic bridge tube V-101.
C-105	3K2047121 N16-C-30114-4276	CAPACITOR, fixed: JAN Type #CM20B471K; mica; 470 mmf p/m 10%; 500 vdcw; temp coef ltr B; Spec JAN-C-5; Mfr. Cornell Dubilier Type 5; Hickok part #X3095-8.	By pass on grid pin #2 of V-101.
C-106		CAPACITOR, fixed: Same as C-105.	By pass on grid pin #7 of V-101.
C-107	3DA50-389 N16-C-44253-6687	CAPACITOR, fixed: Navy Type #484836-10; paper dielectric; 50,000 mmf p/m 10%; 400 vdcw; p/o W-101; Mfr. Aerovox P'82; Hickok part/dwg #3105-103.	Input coupling capacitor for diode probe.
C-108	3DB10-62 N16-C-19568-7337	CAPACITOR, fixed: Navy Type #482343; electrolytic; 10 mfd minus 10% plus 50%; 450 vdcw; neg term internally gnd; Mfr. Mallory Type #FP-142; Hickok part/dwg #3085-25.	Power supply filter capacitor.
C-109		CAPACITOR, fixed: Same as C-103.	By pass B- to ground.
CR-101	2J1N34 N16-T-51734-0000	CRYSTAL UNIT, rectifying: JAN Type 1N34; max inverse voltage 60, peak anode cur 40 ma max, temp range minus 50° to 70° C; cylindrical; Mfr. Sylvania part #1N34; Hickok part #3870-2.	Rectifies 1000 volt ac input to bridge circuit.
E-101	2Z5952 N17-L-6297	LAMP, incandescent: Navy Type #TB-14, Sig C Lamp LM-52; 6 to 8 v 0.15 amp; bulb T-3 $\frac{1}{4}$ clear, $\frac{1}{16}$ " diam; 1 $\frac{1}{8}$ " lg o/a; miniature bayonet base, single cont; C-2 tung fil, 3000 hrs; burn any position; Navy Spec #RE38F149D, Fed Spec #W-L-111, BuShips #9-S-4222-L; Mfr. Sylvania type #S-47; Hickok part #12270-12.	Pilot lamp.
E-102	3F3705-6.3 *N17-T-47489-5511	TIP, test prod: cont tip for diode probe lead; brass, nickel pl; #8-32 thd, $\frac{3}{16}$ " at 1 end, conical point other end; $\frac{5}{32}$ " diam x 2 $\frac{3}{16}$ " lg; incl ins jacket 1 $\frac{3}{4}$ " lg; Hickok part/dwg #16976-9; p/o W-101.	Removable contact tip for ac probe assembly.
E-103	2Z5821-142 N17-K-700073-551	KNOB: bar; black phenolic; for $\frac{1}{4}$ " diam shaft; fastened by single #8-32 set screw; white dot marking; 1 $\frac{13}{32}$ " lg x $\frac{7}{8}$ " wd x $\frac{13}{16}$ " h o/a; shaft hole $\frac{3}{4}$ " d; small metal pointer on lower front edge; Hickok part/dwg #11500-11.	Control knob for ZERO ADJUST potentiometer R-109.

E-104		KNOB: Same as E-103.	Control knob for OHMS ADJUST potentiometer R-144.
E-105		KNOB: Same as E-103.	Control knob for FUNCTION SELECTOR switch S-102.
E-106		KNOB: Same as E-103.	Control knob for RANGE SELECTOR switch S-101.
E-107	3Z3285-2.1 N17-F-74267-5075	HOLDER, fuse: extractor post type; for single 3AG cartridge type fuse 1 1/4" lg x 1/4" diam; molded black bakelite; 15 amp at 250 v max; 1 1/16" diam x 2 3/64" lg o/a; body threaded 1/2"-24 for mtg in 1 1/32" diam panel hole; 2 solder lug term; Mfr. Bussman Type HKP; Hickok part #8825-14.	Mounting receptacle for fuse F-101.
E-108	3Z770-22.1 *N17-B-78158-2433	BOARD, terminal: resistor capacitor mtg; 22 silver pl brass turret lug term; 2 rows term spaced 1 1/4" apart on 5/16" centers; phenolic board; 4 3/16" lg x 1 3/8" wd x 1/8" thk o/a; 2 mtg holes 3/16" diam spaced 3 15/16" c to c; Hickok part/dwg #X2420-63.	Mounting for resistors in power supply and bridge circuit.
E-109	2Z8304.183 N16-S-34576-6513	SHIELD, tube: JAN Type #TSF0T105; brass or copper, nickel pl; cylindrical, 1 3/32" diam open top; Bayonet type mtg; 0.950" ID x 1 15/16" lg, 1.050" max wd across protrusions; conical spring, 5/8" free lg inside top, RSW, stamped w/ JAN Type #TSF0T105; Spec #JAN-S-28A; Mfr. Eby #8988; Hickok part #X19155-140.	Shield for V-101.
E-110	2Z8304.179 N16-S-34607-8400	SHIELD, tube: JAN type #TSF0T103; copper or brass nickel pl; cylindrical, 1/2" cham open top; bayonet type mtg; 0.811" ID x 2 1/4" lg o/a, 0.930" max wd across mtg protrusions; conical spring 5/8" free lg inside top, RSW, stamped w/ JAN Type #TSF0T103; Spec JAN-S-28A; Mfr. Eby; Hickok part #X19155-138.	Shield for V-102.
E-111	3Z770-12.47 *N17-B-77986-4501	BOARD, terminal: ins mtg for fixed resistors and capacitors; 12 silver pl brass turret lug term; spacing between term 1/2" min; phenolic board; 4 3/16" lg x 3 1/2" wd x 1/8" thk o/a; 4 mtg holes 5/32" diam on 1 1/16" x 4" mtg/c; Hickok part/dwg #X2420-118.	Mounting for crystal CR-101 and associated resistors.
E-112	3Z4220-5.1 N17-P-84923-8801	PROD, test: nickel plated brass tip with red plastic insulating handle; wire secured in tip by knurled sleeve nut; will accommodate #18 AWG wire, handle 1/16" ID; 5" lg x 3/8" diam approx o/a; Mfr. American Radio Hardware part #145 red; Hickok part/dwg #16975-1; p/o W-103.	General purpose insulated test prod. Replacement part for W-103 test lead.
E-113	3Z4220-5 N17-P-84923-8791	PROD, test: nickel pl brass tip with black plastic handle; wire secured in tip by knurled sleeve nut; will accommodate #18 AWG wire, handle 1/16" ID; 5" lg x 3/8" diam approx o/a; Mfr. American Radio Hardware part #145 black; Hickok part #16975-13, dwg #16975-1; p/o W-104.	General purpose insulated test prod. Replacement part for W-104 test lead.
E-114	3F3705-19 N17-P-84837-7361	PROD, test: JAN Type #MX-1101/U; HV multiplier to permit measurements of DC voltages up to 5000 v; 53.2 meg resistor, rated at 2 w; Hickok part/dwg #16975-31; u/w W-102.	Multiplier used in conjunction with Test Lead W-102 to extend the dc voltage range of the equipment to 5000 volts.
E-115	3F3705-6.4 N17-P-84825-6001	PROD, test: contact tip for DC probe; nickel pl brass tip w/ red plastic ins handle; 4" lg x 1/16" diam o/a; sleeve 0.265" ID; wire secured in tip by knurled sleeve nut; 3/4"-32 threaded sect 1/4" lg on black sleeve; Hickok part #16975-21, dwg. #16975-19; p/o W-102.	Insulated test prod. Replacement part for W-102.
E-116	2Z9401 *N17-B-77483-8464	BOARD, terminal: general purpose insulated terminal; one insulated terminal lug; phenolic board; 3/4" lg x 3/8" wd x 1/16" thk excluding terminal and mtg lug; one 5/32" diam mtg hole; Mfr. Cinch #1512; Hickok part #20350-23, dwg. #20350-17.	Insulated mounting terminal for R-105.

\*NOTE: Not furnished as a maintenance part for Naval activities. If failure occurs, do not request replacement unless the item cannot be replaced or fabricated.

TABLE 7-2 (Cont.) LIST OF REPLACEABLE PARTS

REFER- ENCE DESIG- NATION	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS
F-101	3Z1927 N17-F-16302-130	FUSE, cartridge: Navy Type #28032-2, Sig C Cartridge Fuse FU-27; instantaneous, rated 2 amp, blowing time life for 110% load, 60 min for 135% load, and 2 min for 200% load; 250 v max; 1 time; glass body; ferrule term; $\frac{1}{4}$ " diam x $1\frac{1}{4}$ " lg; term $\frac{1}{4}$ " diam x $\frac{1}{4}$ " lg; Mfr. Littlefuse Type #312002; Hickok part/dwg #6900-2.	Protective fuse in primary circuit of transformer T-101.
H-101	6Z5200-2 N17-H-68863-4328	HOLDER, battery: locking clamp and cont device for size "D" dry cell; nickel pl brass; $2\frac{3}{4}$ " lg x $1\frac{5}{16}$ " wd x $1\frac{5}{8}$ " h o/a; 2 mtg holes $\frac{1}{8}$ " on 2" mtg/c; pos cont term identified by plus "+" sign; 2 ins conts w/ solder lug term, latch type locking bar to secure batt in clamp; Mfr. Johanson #280-1-A; Hickok part/dwg #X8825-29.	Mounting for dry cell BT-101.
H-102	6L20905-7.4 *N43-S-79150-5035	SCREW, machine: slot drive; fil hd, brass, nickel pl; #5-40 thd NC-2; 0.437" lg; threaded portion 0.187" lg; head 0.140" diam x 0.250" thk; Hickok part/dwg #19050-36.	Clamps cable in housing of test lead W-101.
H-103	6L20903-3.4 N43-S-79155-3015	SCREW, machine: slot drive; fil hd; brass, nickel pl; #3-56 thd NF-2; 0.175" lg; threaded portion 0.125" lg; head 0.156" diam x 0.025" thk; dog point; Hickok part/dwg #19040-5; p/o Test lead W-101.	Used to secure end plug to housing of probe on test lead W-101.
H-104	6L31129-13 *N43-S-33965-2065	STUD: brass, nickel pl; 0.687" lg x 0.156" diam o/a; 1 end threaded $\frac{5}{32}$ " lg w/ #4-40 NC-2 thd; straight knurl sect 0.250" lg x 0.165" diam o/a starting 0.125" from end opposite thd, has solder hole 0.375" d x 0.078" diam, supplied with black phenolic insulator, Hickok part #19290-32; Hickok part/dwg #19821-13; p/o test lead W-105.	Screw connection for ground lead. Replacement part for W-105.
H-105	2Z4928-77 *N17-H-150001-138	HANDLE: case; steel, nickel pl; $4\frac{3}{4}$ " lg x $1\frac{5}{16}$ " wd x $\frac{1}{4}$ " thk; $\frac{1}{4}$ " diam steel grip, $4\frac{1}{4}$ " lg; mtd by #18 ga Hickok part #3275-32 steel clamp and 4 #6-32 nuts and lockwashers; folds flat when not in use; Hickok part #8330-23, dwg. #8330-18; p/o case assembly A-101; u/w H-106.	Carrying handle for case.
H-106	2Z2642.28C *N17-P-403281-101	CLAMP: handle; steel 18 ga; nickel pl; mts by 4 weld bolts; 3" lg x $1\frac{17}{64}$ " wd x $\frac{19}{64}$ " h o/a; accom $\frac{1}{4}$ " diam steel case handle; Hickok part/dwg #3275-82; p/o case assembly A-101, u/w H-105.	Attaching clamp to secure handle H-105 to case.
H-107	6Z4920-17 N16-G-900133-859	GROMMET: rubber; fits $\frac{7}{16}$ " diam hole; $\frac{5}{16}$ " ID x $\frac{5}{8}$ " OD x $\frac{9}{32}$ " thk, $\frac{1}{16}$ " groove; Mfr. Continental Rubber part #3013; Hickok part #7850-6.	Protects wire leads from chassis edges.
H-108	6Z4910L N17-G-900301-451	GROMMET: rubber; fits 1" diam hole; $\frac{5}{8}$ " ID x $1\frac{3}{16}$ " OD x $\frac{5}{16}$ " thk, $\frac{1}{16}$ " groove; Mfr. Continental Rubber part #3093; Hickok part #7850-21.	Protects wire leads from chassis edges.
I-101	2Z5991-144 N17-L-76854-4021	LIGHT, indicator: w/ lens; $\frac{1}{2}$ " diam red jewel, frosted on back only; for miniature bayonet base T-3 $\frac{1}{4}$ " lamp; open frame; brass, nickel pl; $2\frac{5}{32}$ " lg x $1\frac{5}{16}$ " diam o/a; $1\frac{1}{16}$ " mtg hole, $\frac{1}{4}$ " max panel thk; horiz mtg lamp removable from front; threaded jewel; 2 solder lug term on base of socket; pol disk; Mfr. Drake Type #80; Hickok part/dwg X19350-83.	Provides ON - OFF indication. Illuminated by E-101.
J-101	2Z3065-87 N17-C-73184-9460	CONNECTOR, receptacle: Navy Type #49658; 4 slotted silver pl brass female cont, pol; straight type; Mfr. Amphenol #91-PC4F (Position #2); Hickok part/dwg #3475-5.	Panel connection for test lead W-101.
J-102	2Z3062-16 N17-C-73107-899	CONNECTOR, receptacle: Navy Type #491874; 1 round female cont; straight type; Mfr. Amphenol #78-1S red; Hickok part/dwg #10300-8.	Panel jack, connection for 1000 volts ac.
J-103	2Z7111.28 N17-C-73408-1790	CONNECTOR, receptacle: Navy Type #49659; 1 round male cont; straight type; Mfr. Amphenol #PC1M; Hickok part/dwg #X3475-4.	Panel connection for test lead W-102.
J-104		CONNECTOR, receptacle: Same as J-102.	Panel jack, plus connection for milliamperere measurement.

J-105	2Z5573.9 N17-C-73107-8985	CONNECTOR, receptacle: Navy Type #491874-A; 1 round female cont; straight type; Mfr. Amphenol Type #78-1S black; Hickok part #10300-11, dwg #10300-8.	Panel jack, minus connection for mils.
J-106		CONNECTOR, receptacle: Same as J-102.	Panel jack, connection for resistance measurements.
J-107		CONNECTOR, receptacle: Same as J-105.	Panel jack, ground connection.
M-101	3F3299-9.3 N17-M-29372-5351	METER, multi-scale: DC; scale range 0 to 10 and 0 to 25 for DC v, AC v and DC ma, 0 to 1 meg, AC v RMS 0 to 2.5, AC v RMS 0 to 1, AC v peak to peak 0 to 2.5; rectangular flush mtg case; bbl 3½" diam, 1½" d behind fl, rectangular fl 4" x 3¾" x 5⁄8"; accuracy 2%; D'Arsonval movement; 150 ua basic movement sensitivity, resistance across term 1000 ohms; calibrated for non-magnetic panel; 50 scale divisions for 2.5 v AC RMS, 1 v RMS and 2.5 v peak to peak ranges; 100 scale divisions for all other AC and DC ranges, special scale 75 line non-uniform scale for ohms, green numerals on white background for ohms ranges and 2.5 v peak to peak range, black numerals on white background for all other ranges; meter designed for use only in Multimeter ME-25A/U which contains all associated circuit components; 4 mtg studs 6-32, 5⁄8" lg on 3⁄8" ctr; 2 stud term ¼"-28 x 7⁄8" lg spaced 1½" c to c; p/o Navy Multimeter ME-25A/U, Hickok Style #902-153; Hickok Model S48G, part #480-770, dwg. #A630.	Indicating meter for all measurements and ranges.
O-101	3Z1087-15 N17-C-802585-401	CLIP: alligator; for connecting test lead to equip; copper, nickel pl; 25⁄16" lg x 5⁄16" wd x 7⁄16" h overall; 3⁄8" max jaw opening; w/ #10-32 threaded coupling; Mfr. Mueller Elec #60 with Hickok #3800-9 coupling; Hickok part/dwg #3300-23; u/w W-103.	Detachable clip connection for test lead W-103.
O-102		CLIP: Same as 0-101; u/w W-104.	Detachable clip connection for test lead W-104.
O-103	6Z8093-5 *N17-S-150263-103	SEAL, water: case to cover; black rubber; "T" shaped cross-sect w/ 0.062" rad groove in top; strip 36" lg x 0.142" wd x 0.467" thk overall; mtd in groove 0.062" wd x 3⁄8" d; Mfr. Stalwart Rubber Co. #7090-130; Hickok part/dwg #7090-130; p/o A-101.	Moisture barrier between cover and case.
O-104	3Z1087-8.1 N17-C-802584-284	CLIP- alligator; steel, cad pl; 2¼" lg x 3⁄8" wd x ½" h o/a; black plastic ins handle; solder loop connection; 3⁄8" max jaw opening; Mfr. Mueller Elec #60 HS black; Hickok part/dwg #3300-10; p/o W-105.	Clip connection for W-105. Replacement part for W-105.
O-105		CLIP: Same as 0-101; p/o E-114.	Detachable clip for test prod E-114.
P-101	2Z7560-5 N17-C-71425-4054	CONNECTOR, plug: 2 flat parallel male contacts; straight; 13⁄8" diam x 15⁄16" lg o/a excluding term; 15 amps 125 v, 10 amps 250 v; round rubber body; molded rubber insert; cable opening .240" to .312"; Mfr. Bryant Elec type #HRB; Hickok part #16525-58. (See Note #1).	Plug for connecting power cable to ac voltage source. Replacement part for W-106.
P-102	2Z3024-89 N17-C-71483-5120	CONNECTOR, plug: Navy Type #49928; 4 round male cont, pol; straight type; Mfr. Amphenol Type #MC-4-M (Pos. #2); Hickok part/dwg #3475-6; p/o W-101.	Connects diode probe lead W-101 to panel connection J-101.
P-103	2Z8671.23 N17-C-71409-5278	CONNECTOR, plug: Navy Type #49660; 1 pressure bead cont; straight type; for single cond shielded mic cable; Mfr. Amphenol #MC1F; Hickok part/dwg #3475-3; p/o W-102.	Connects dc test lead W-102 to panel connection J-103.
P-104	2Z7111.23 N17-C-71408-3050	CONNECTOR, plug: 1 round male cont, nickel pl brass 5⁄32" diam x 7⁄16" lg; straight; red phenolic head 25⁄64" diam x 3⁄8" lg; 25⁄64" diam. x 51⁄64" lg; irregular shape, red molded phenolic head; will accom #18 AWG wire; solder connection to wire; Mfr. Amphenol part #71-1S red; Hickok part/dwg #16525-29; p/o W-103.	Connects test lead W-103 to panel connections J-102, J-104, or J-106.
P-105	2Z7111.23.1 N17-C-71410-3324	CONNECTOR, plug: 1 round male cont, nickel pl brass, 5⁄32" diam x 7⁄16" lg; straight; black phenolic head 25⁄64" diam x 3⁄8" lg; 25⁄64" diam x 51⁄64" lg; irregular shape, black molded phenolic head; will accom #18 AWG wire; solder connection to wire; Mfr. Amphenol part #71-1S black; Hickok part #16525-40, dwg #16525-29; p/o W-104.	Connects test lead W-104 to panel connector J-105 or J-106.

\*NOTE: Not furnished as a maintenance part for Naval activities. If failure occurs, do not request replacement unless the item cannot be replaced or fabricated.  
NOTE #1—P-101 is listed as a replacement part only, and is not used on original equipment.

TABLE 7-2 (Cont.) LIST OF REPLACEABLE PARTS

REFER- ENCE DESIG- NATION	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS
R-101	3RC20BF105K N16-R-50975-811	RESISTOR, fixed: JAN Type #RC20BF105K; composition; 1 meg p/m 10%; ½ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18415-102.	Decoupling resistor.
R-102	3RC20BF206J N16-R-51397-431	RESISTOR, fixed: JAN Type #RC20BF206J; composition; 20 megohms p/m 5%; ½ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18416-201.	Contact bucking calibration resistor.
R-103	3Z6840 N16-R-73399-6350	RESISTOR, fixed: composition; 40 megohms p/m 1%; 1 watt; F characteristic; ⅜" lg x ¼" diam; ins, moisture resistant; 2 axial wire leads, 1½" lg, #20 AWG; polyvinyl chloride ins sleeve; Mfr. Wilkor Products Carbofilm #CP-1; Hickok part #X18550-104, dwg #A592.	Contact bucking resistor.
R-104	3RB2-9700 N16-R-78696-9401	RESISTOR, fixed: JAN Type #RB10B9R700F; ww; 9.70 ohms p/m 1%; ¼ w; Spec JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part #X18673-305 (9.70).	Part of ohms dividing network.
R-105	3RC30BF275K N16-R-51093-231	RESISTOR, fixed: JAN Type #RC30BF275K; comp; 2.7 meg p/m 10%; 1 w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type GB; Hickok part #X18425-272.	Part of 1000 volts ac divider.
R-106	3RC20BF104J N16-R-50632-431	RESISTOR, fixed: JAN Type #RC20BF104J; comp; 100,000 ohms p/m 5%; ½ w; characteristic F; Spec. JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18414-101.	Part of 1000 volts ac divider.
R-107	3RC30BF335K N16-R-51111-231	RESISTOR, fixed: JAN Type #RC30BF335K; comp; 3.3 meg p/m 10%; 1 w; characteristic F; Spec. JAN-R-11; Mfr. Allen Bradley Type GB; Hickok part #X18425-332.	Part of 1000 volts ac divider.
R-108	3RC20BF203J N16-R-50362-431	RESISTOR, fixed: JAN Type #RC20BF203J; comp; 20,000 ohms p/m 5%; ½ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18413-201.	Calibration for 1000 ac range.
R-109	3Z7330-32 N16-R-87439-4090	RESISTOR, variable: comp; 3000 ohms p/m 10%; 2 w; 3 solder lug term; encl bakelite case w/ met cover 1½" diam x ⅞" d; round metal shaft ¼" diam ¾" lg FMS; lin taper; ins cont arm, w/o off position; normal torque; mtg bushing ⅜"-32 x ⅜" lg, non-turn device on 1½" rad at 3 and 9 o'clock; Mfr. Allen Bradley part #JU3021-P3048; Hickok part/dwg #X16925-101.	Zero adjust.
R-110	3RC20BF153J N16-R-50335-431	RESISTOR, fixed: JAN Type #RC20BF153J; comp; 15,000 ohms p/m 5%; ½ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18413-151.	Plate load bridge circuit.
R-111		RESISTOR, fixed: Same as R-110.	Plate load bridge circuit.
R-112	3RC20BF335K N16-R-51110-811	RESISTOR, fixed: JAN Type #RC20BF335K; comp; 3.3 meg p/m 10%; ½ w; F characteristic; Spec. JAN-R-11; Mfr. Allen Bradley Type EB; Hickok Part #X18415-332; p/o W-102.	Isolating resistor in dc probe.
R-113	3RC20BF122K N16-R-49940-811	RESISTOR, fixed: JAN Type #RC20BF122K; comp; 1200 ohms p/m 10%; ½ w; characteristic F; Spec. JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18412-122.	Calibration for 2.5 P-P voltage.
R-114	3RC20BF825K N16-R-51281-811	RESISTOR, fixed: JAN Type #RC20BF825K; comp; 8.2 megohms p/m 10%; ½ w; characteristic F; Spec. JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18415-822.	Contact bucking resistor.
R-115	3Z6812-10 N16-R-73379-8001	RESISTOR, fixed: comp; 12 meg p/m 1%; 1 w; F characteristic; ⅜" lg x 0.325" diam; ins, moisture resistant; 2 axial wire leads; polyvinyl chloride insulating sleeve; Mfr. Wilkor Products Carbofilm CP-1; Hickok part #X18550-103, dwg #A592.	Part of ac-dc volts dividing network.
R-116	3Z6820-11 N16-R-73395-1001	RESISTOR, fixed: comp; 20 meg p/m 1%; 1 w; F characteristic; ⅜" lg x 0.325" diam; ins, moisture resistant; 2 axial wire leads; polyvinyl chloride insulating sleeve; Mfr. Wilkor Products Carbofilm CP-1; Hickok part #X18550-105, dwg #A592.	Part of dc divider network.

R-117	3RB4-1500.4 N16-R-78950-6458	RESISTOR, fixed: JAN Type #RB10B150R0F; ww; 150 ohms p/m 1%; $\frac{1}{4}$ w max continuous oper temp 105° C; Spec. JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part #X18673-318 (150).	Part of mils dividing network.
R-118	3Z6009-10 N16-R-72891-9658	RESISTOR, fixed: Navy Type #636997-1; comp; 90 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-354, dwg #A592.	Part of ohms dividing network.
R-119	3RC20BF222K N16-R-50012-811	RESISTOR, fixed: JAN Type #RC20BF222K; comp; 2200 ohms p/m 10%; $\frac{1}{2}$ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18412-222.	Calibration for 10 volts P-P range.
R-120		RESISTOR, fixed: Same as R-101.	Contact bucking resistor.
R-121	3Z6806-13 N16-R-73363-7401	RESISTOR, fixed: comp; 6 meg p/m 1%; $\frac{1}{2}$ w; characteristic F; $\frac{5}{8}$ " lg x $\frac{17}{64}$ " diam; plastic ins, moisture resistant; 2 axial wire leads; polyvinyl chloride ins sleeve; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-355, dwg #A592.	Part of ac-dc dividing network.
R-122	3RB3-3000 N16-R-78799-8259	RESISTOR, fixed: JAN Type #RB10B30R00F; ww; 30 ohms p/m 1%; $\frac{1}{4}$ w at 105° C max continuous oper temp; Spec. JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part/dwg #X-18673-309 (30).	Part of mils dividing network.
R-123	3Z6090-34 N16-R-72986-2058	RESISTOR, fixed: Navy Type #636999-1; comp; 900 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-353, dwg #A592.	Part of ohms dividing network.
R-124	3RC20BF332K N16-R-50066-811	RESISTOR, fixed: JAN Type #RC20BF332K; comp; 3300 ohms p/m 10%; $\frac{1}{2}$ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18412-332.	Calibration 25 volts P-P range.
R-125		RESISTOR, fixed: Same as R-101.	Contact bucking resistor.
R-126	3Z6801-113 N16-R-73313-2658	RESISTOR, fixed: Navy Type #637000-1; comp; 1.2 meg p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-356, dwg #A592.	Part of ac-dc dividing network.
R-127	3RB3-1500.1 N16-R-78758-2859	RESISTOR, fixed: JAN Type #RB10B15R00F; ww; 15 ohms p/m 1%; $\frac{1}{4}$ w at 105° C max continuous oper temp; Spec. JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part #X18673-306 (15).	Part of mils dividing network.
R-128	3Z6590-25 N16-R-73085-3058	RESISTOR, fixed: Navy Type #637001-1; comp; 9000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-352; dwg #A592.	Part of ohms dividing network.
R-129	3RC20BF392K N16-R-50093-811	RESISTOR, fixed: JAN Type #RC20BF392K; comp; 3900 ohms p/m 10%; $\frac{1}{2}$ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18412-392.	Calibration 100 volts P-P range.
R-130	3Z6760-16 N16-R-73279-5301	RESISTOR, fixed: Navy Type #637002-1; comp; 600,000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-357, dwg #A592.	Part of ac-dc dividing network.
R-131	3RB2-3000 N16-R-78617-8259	RESISTOR, fixed: JAN Type #RB10B3R000F; ww; 3 ohms p/m 1%; $\frac{1}{4}$ w at 105° C max continuous oper temp; Spec JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part #X18673-303 (3).	Part of mils dividing network.
R-132	3Z6690-14 N16-R-73181-8758	RESISTOR, fixed: comp; 90,000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; $\frac{5}{8}$ " lg x $\frac{17}{64}$ " diam incl sleeve; ins, moisture resistant; 2 axial wire leads; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-351, dwg #A592.	Part of ohms dividing network.
R-133	3Z6712-37 N16-R-73196-7558	RESISTOR, fixed: Navy Type #637004-1; comp; 120,000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products Carbofilm Type CP- $\frac{1}{2}$ ; Hickok part #18525-358, dwg #A592.	Part of ac-dc dividing network.
R-134	3RC20BF152J N16-R-49966-431	RESISTOR, fixed: JAN Type #RC20BF152J; comp; 1500 ohms p/m 5%; $\frac{1}{2}$ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18412-151.	Cathode resistor bridge circuit.
R-135		RESISTOR, fixed: Same as R-134.	Cathode resistor bridge circuit.

TABLE 7-2 (Cont.) LIST OF REPLACEABLE PARTS

REFER- ENCE DESIG- NATION	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS
R-136	3RB2-1500 N16-R-78584-1059	RESISTOR, fixed: JAN Type #RB10B1R500F; 1.5 ohms p/m 1%; $\frac{1}{4}$ w at 105° C max continuous oper temp; Spec JAN-R-93; Mfr. Resistance Products Type AFB; Hickok part #X18673-302 (1.5).	Part of mils dividing network.
R-137	3Z5999-13 N16-R-73376-2668	RESISTOR, fixed: Navy Type #637005-1; comp; 9.9 meg p/m 1%; 1 w; characteristic F; Mfr. Wilkor Products Carbofilm CP-1; Hickok part #X18550-91; dwg #A592.	Part of ohms dividing network.
R-138	3Z6660-48 N16-R-73159-6058	RESISTOR, fixed: Navy Type #637006-1; comp; 60,000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; Mfr. Wilkor Products #CP- $\frac{1}{2}$ ; Hickok part #X18525-359; dwg #A592.	Part of ac-dc dividing network.
R-139	3RC20BF223K N16-R-50372-811	RESISTOR, fixed: JAN Type #RC20BF223K; comp; 22,000 ohms p/m 10%; $\frac{1}{2}$ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18413-222.	Part of ohms circuit.
R-140	3RC30BF333K N16-R-50418-231	RESISTOR, fixed: JAN Type #RC30BF333K; comp; 33,000 ohms p/m 10%; 1 w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type GB; Hickok part #X18423-332.	Resistance and bridge circuit.
R-141	3RB1-5000 N16-R-78516-5829	RESISTOR, fixed: JAN Type #RB12BR5000F; ww; 0.5 ohms p/m 1%; $\frac{1}{2}$ w at 105° C max continuous oper temp; Spec JAN-R-93; Mfr. Resistance Products Type AGF; Hickok part #X18673-301 (0.5).	Part of mils dividing network.
R-142	3Z6620-188 N16-R-73112-5358	RESISTOR, fixed: comp; 20,000 ohms p/m 1%; $\frac{1}{2}$ w; characteristic F; $\frac{5}{8}$ " lg x $\frac{1}{64}$ " diam; ins, moisture resistant; 2 axial wire leads; polyvinyl chloride ins sleeve; Mfr. Wilkor Products Carbofilm CP- $\frac{1}{2}$ ; Hickok part #X18525-360, dwg #A592.	Part of ac-dc dividing network.
R-143		RESISTOR, fixed: Same as R-119.	Mils calibration resistance.
R-144	3Z7410-162 N16-R-87682-5206	RESISTOR, variable: comp; 10,000 ohms p/m 20%; 2 w; 3 solder lug term; encl bakelite case w/ metal cover $1\frac{1}{16}$ " diam x $\frac{9}{16}$ " d; round metal shaft $\frac{1}{4}$ " diam x $\frac{3}{4}$ " lg FMS; lin taper; ins cont arm, w/o off position; normal torque; mtg bushing $\frac{3}{8}$ "-32 x $\frac{3}{8}$ " lg, non-turn device on $1\frac{1}{32}$ " rad on 3 and 9 o'clock; Mfr. Allen Bradley part #JU1032-P3048; Hickok part/dwg #X16925-109.	Ohms adjust..
R-145	3Z7330-31 N16-R-90908-8156	RESISTOR, variable: ww; 3000 ohms p/m 15%; 2 w; 3 solder lug terminals; encl metal case and cover, $1\frac{1}{8}$ " diam x $1\frac{3}{32}$ " d behind mtg surface; round slotted metal shaft $\frac{1}{4}$ " diam x $\frac{3}{4}$ " lg FMS; lin taper; gnd cont arm, w/o off position; normal torque; mtg bushing $\frac{3}{8}$ "-32 x $\frac{3}{8}$ " lg; Mfr. Wirt type WC802; Hickok part/dwg #X16925-110.	DC calibration potentiometer.
R-146	3RC20BF184J N16-R-50695-431	RESISTOR, fixed: JAN Type #RC20BF184J; comp; 180,000 ohms p/m 5%; $\frac{1}{2}$ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok Part #X18414-181.	Resistance and bridge circuit.
R-147		RESISTOR, fixed: Same as R-119.	Power supply dropping resistor.
R-148	3RC20BF273K N16-R-50399-811	RESISTOR, fixed: JAN Type #RC20BF273K; comp; 27,000 ohms p/m 10%; $\frac{1}{2}$ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18413-272.	Resistance and bridge circuit.
R-149		RESISTOR, variable: Same as R-145.	AC calibration potentiometer.
R-150	3RC20BF563K N16-R-50516-811	RESISTOR, fixed: JAN Type #RC20BF563K; comp; 56,000 ohms p/m 10%; $\frac{1}{2}$ w; characteristic F; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18413-562.	AC-RMS calibration.
R-151	3RC20BF274K N16-R-50741-811	RESISTOR, fixed: JAN Type #RC20BF274K; comp; 270,000 ohms p/m 10%; $\frac{1}{2}$ w; F characteristic; Spec JAN-R-11; Mfr. Allen Bradley Type EB; Hickok part #X18414-272.	Resistance and bridge circuit.

S-101	3Z9825-19.3 N17-S-66833-3195	SWITCH, rotary: 5 pole, 7 position; 5 section; silver pl brass cont; ceramic insulation; body dimen 1 7/8" h x 1 5/8" oval, 3 7/8" o/a d behind mtg surface incl studs; solder lug term; single hole mtg, bushing 3/8-32 thd x 1/4" lg, 1/4" dia shaft 5/8" lg from mtg surface; Mfr. Centralab CRL 12272; Hickok part/dwg #X19912-197.	RANGE SELECTOR switch.
S-101A	3Z9903E-30.4 N17-S-91665-1018	SWITCH SECTION, rotary: silver plated brass contacts on ceramic wafer; single pole 7 positon, one dummy terminal; oval shape; 1 7/8" lg x 1 5/8" wd x 0.156" thk excluding contacts and terminals; two 1/8" diam mtg holes spaced 1 1/16" c to c; Mfr. #1 wafer section only of Centralab #12272; Hickok part/dwg #19912-212; p/o S-101. (Note #)	Wafer section for S-101. Selects ac and dc voltage ranges.
S-101B	3Z9903E-30.5 N17-S-91665-1016	SWITCH SECTION, rotary: silver plated brass contacts on ceramic wafer; single pole 7 positions, 3 dummy terminals; oval shape; 1 7/8" lg x 1 5/8" wd x 0.156 thk excluding contacts and terminals; two 1/8" diam mtg holes spaced 1 1/16" c to c; Mfr. #2 wafer section only of Centralab #12272; Hickok part/dwg #19912-213; p/o S-101.	Wafer section for S-101. Selects compensating resistors for peak to peak voltage ranges.
S-101C	3Z9903E-30.6 N17-S-91665-1017	SWITCH SECTION, rotary: silver plated brass contacts on ceramic wafer; single pole 7 positions; oval shape; 1 7/8" lg x 1 5/8" wd x 0.156" thk excluding contacts; two 1/8" diam mtg holes spaced 1 1/16" c to c; Mfr. #3, #4 & #5 wafer sections only of Centralab #12272; Hickok part/dwg #19912-214; p/o S-101. (Note #)	Wafer section for S-101. Selects resistance ranges.
S-101D		SWITCH SECTION, rotary: Same as S-101C; p/o S-101. (Note #)	Wafer section for S-101. Selects milliamper ranges.
S-101E		SWITCH SECTION, rotary: Same as S-101C; p/o S-101. (Note #)	Wafer section for S-101. Selects compensating resistors for dc voltage ranges.
S-101F	3Z3345-5 N17-D-20001-110	DETENT: index mechanism; steel cad plated; spring and ball type mechanism, seven positions, normal torque, flattened shaft, locating lug; 1 7/8" x 1 3/8" x 4 5/8" approx o/a including strut screws and hardware; two 5-40 strut screws on 1 9/16" centers for mounting switch wafers, 3/8"-32 threaded bushing for mtg in panel; number 19912-197 stamped in index plate; supplied with all hardware, less wafer sections; Mfr. index mechanism only for Centralab #12272; Hickok part/dwg #19912-215; p/o S-101.	Shaft and index mechanism for S-101.
S-102	3Z9825-58.174 N17-S-66076-8575	SWITCH, rotary: 5 pole, 5 positions; 3 sect; silver pl brass cont; ceramic ins; 1 7/8" h x 1 5/8" wd x 1 1/2" d behind mtg surface; shorting type cont; solder lug term; single hole mtg, bushing 3/8"-32 x 1/4" lg; Mfr. Centralab #CRL-11569; Hickok part/dwg #X19912-193.	FUNCTION SELECTOR SWITCH.
S-103	3Z9863-12A N17-S-70777-8626	SWITCH, toggle: JAN Type #ST-12-A; SPST; 5 amp at 125 v DC, 2 amp at 250 v DC, resistive load, 3 amp at 125 v DC, 1.5 amp at 250 v DC inductive load; locking action 2 position; Spec JAN-S-23; Mfr. Arrow, Hart and Hegeman part #82301-B; Hickok part/dwg #X19911-14.	ON - OFF power switch.
S-104	3Z9863-52R N17-S-73956-7205	SWITCH, toggle: JAN Type #ST52R; DPDT; 30/125/250 v DC at 10/0.75/0.5 amp, 125/250 v AC at 15/6 amp resistive load, 30 v DC at 10 amp inductive load; no ctr position, up position normally "ON", momentary "ON" in down position, normally open; Spec JAN-S-23; Mfr. Cutler-Hammer part #8831K5; Hickok part #X19911-35.	PEAK TO PEAK voltages
T-101	2Z9613.579 N17-T-74154-8651	TRANSFORMER, power: Navy Type #304650; fil and plate type; pri input 115 v, 50 to 1200 cps, 1 ph; 2 output wnd; #1 sec 300 v at 25 ma CT, #2 sec 6.3 v at 2 amp; Mfr. Chicago Transformer Type #K2C4-B0, part #9195; Hickok part/dwg #X20800-32.	Supplies ac potentials for heaters and rectifier power supply.
V-101	2J12AU7 N16-T-58241	TUBE, electron: JAN Type #12AU7; twin triode amplr; Mfr. RCA; Hickok part #X20874-69.	Electronic bridge circuit tube.
V-102	2J6X4 N16-T-56840	TUBE, electron: JAN Type #6X4; full wave h vacuum rect; Mfr. RCA; Hickok part #20874-68.	Rectifier.
V-103	2J6AL5 N16-T-56195	TUBE, electron: JAN Type #6AL5; twin diode; Mfr. RCA; Hickok part #X20874-51; p/o W-101.	AC voltage rectifier in probe of W-101.

NOTE #—For replacement use S-101B, Standard Navy Stock Number N17-S-91665-1016.

TABLE 7-2 (Cont.) LIST OF REPLACEABLE PARTS

REFER- ENCE DESIG- NATION	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS
W-101	3E8000-48.13 N17-L-63205-7691	LEAD, test: mic cable, 3 cond #22 AWG stranded copper, ea cond 26 strands #34 AWG, $\frac{1}{64}$ " synthetic rubber insulation, color coded black-white and red, cotton wrap, $16" \times \frac{5}{34}"$ tinned copper shielding, cotton wrap, $\frac{1}{32}"$ black neoprene jacket, 0.290" OD; 48" lg; special diode probe assembly on 1 end and Amphenol #MC4F mic connector on other end; Hickok part/dwg #X16970-18; includes W-105, W-101, P-102, X-103, C-107, V-103 and E-102.	Diode probe lead for measuring ac potentials from 0 to 250 volts.
W-102	3E8000-44.2 N17-L-63205-8851	LEAD, test: mic cable, 1 cond #22 AWG stranded copper, 7 strands #30 AWG, rubber insulation, $16" \times \frac{5}{34}"$ tinned copper shield, cotton wrap, neoprene jacket, 0.245" OD; 48" lg excluding terminations; Hickok #16975-21 prod on 1 end, Amphenol #MC1F mic connector on other end; 3.3 meg isolating resistor in prod; Hickok part #X3030-46, dwg. #3030-29; consists of W-109, E-115, P-103 and R-112.	Test lead for measuring dc potentials from 0 to 1000 volts.
W-103	3E8000-48.1 N17-L-63205-4185	LEAD, test: 1 copper cond #18 AWG stranded, 41 #34 AWG strands, paper wrapped $\frac{1}{32}"$ red rubber ins; 4 ft lg incl term; Amer Radio Hdwe Part #145 red test prod on 1 end and Amphenol Part #71-1S red tip plug on other end; Hickok part/dwg #X12450-152; consists of W-108, E-112 and P-104.	Test lead for Mils Plus, Ohms and 1000 volts ac.
W-104	3E8000-48 N17-L-63205-4190	LEAD, test: 1 copper cond #18 AWG stranded, 41 #34 AWG strands, paper wrapped, $\frac{1}{32}"$ black rubber ins; 4 ft lg incl term; Amer Radio Hdwe Part #145 black test prod on 1 end and Amphenol Part #71-1S black tip plug on other end; Hickok part #X12450-153, dwg. #12450-152; consists of W-107, E-113 and P-105.	Test lead for Mils Minus and Ground.
W-105	3E8000-5.1 N17-L-63386-2427	LEAD, test: 1 #18 AWG stranded copper RI cond, 41 #34 AWG strands, paper wrap, $\frac{1}{32}"$ black insulation; approx $3\frac{1}{4}"$ lg excluding terminations; Mueller Elec Type #60 black ins alligator clip on 1 end, Hickok part #19821-13 #4-40 threaded term stud on other end; Hickok part/dwg #X12450-165; p/o W-101, consists of W-107.	Ground lead for use with W-101, connects to housing of diode probe.
W-106	3E7350.1-84.7 *N17-C-48236-1801	CABLE ASSEMBLY, power: underwriters type SJ, 2 #18 AWG stranded cond, 300 v working, cotton wrap rubber ins, cotton filler, cotton braid, rubber jacket, color coded black and white; 7 ft lg incl terminations; 2 cont male rubber appliance plug Corwire #52R molded on 1 end, other end stripped $\frac{3}{4}"$ and tinned, molded rubber strain relief Corwire #20 attached 3" from stripped end; Mfr. Corwire part #X3675-9; Hickok part/dwg #X3675-9.	Power connection to ac main.
W-107	1A818.18 N15-W-2195-5100	WIRE, electrical: ins, 0.140" OD o/a; 1 cond #18 AWG; tinned copper; stranded, 65 strands #36 AWG; cotton wrap, rubber insulation, 0.043" thk; rated 5000 v; color coded black; Mfr. Belden part #8899; Hickok part #23900-288; p/o W-104 and W-105.	Replacement part for W-104 and W-105.
W-108	1B818.151 N15-W-2195-5200	WIRE, electrical: ins, 0.140" OD o/a; 1 cond #18 AWG; tinned copper; stranded, 65 strands #36 AWG; cotton wrap, rubber insulation, 0.043" thk; rated 5000 v; color coded red; Mfr. Belden part #8899; Hickok part #23900-289; p/o W-103.	Replacement part for W-103.
W-109	1B3022-1 N17-C-48146-1300	CABLE, special purpose: microphone; one #23 AWG stranded copper cond, tinned copper weld strands, steel core; 7 strands #31 AWG; syn ins; tinned copper braid shield, celanese serve, rubber jacket; 0.250" OD 4 ft lg; Mfr. Essex Wire #S-1115-W; Hickok part #3025-27; p/o W-102.	Replacement part for W-102.
W-110	1B3022-3.2 N17-C-48147-2526	CABLE, special purpose: microphone; 3 cond #22 AWG stranded copper ea cond; 26 strands #34 AWG; $\frac{1}{64}"$ syn rubber insulation, color coded black, white and red; cotton wrap, tinned copper braid shielding, cotton wrap, $\frac{1}{32}"$ black neoprene jacket; 0.290" OD; Mfr. Belden #8423-250; Hickok part #3025-33; p/o W-101.	Replacement part for W-101.

X-101	2Z8679.30 N16-S-64063-6718	SOCKET, tube: JAN Type #TSE9T101; 9 miniature cont; 1 piece saddle mtg; 2 mtg holes $\frac{1}{8}$ " diam on $1\frac{1}{8}$ " mtg/c; cylindrical, mica filled phenolic body, $\frac{47}{64}$ " max diam x approx $\frac{5}{32}$ " h excluding term; copper alloy cont, silver pl; incl ctr shield 0.180" OD and metal shock shield base; Spec. JAN-S-28A; Mfr. Eby; Hickok part #X19350-122.	Socket mounting for V-101.
X-102	2Z8677.94 N16-S-62603-6692	SOCKET, tube: JAN Type #TSE7T101; 7 cont miniature; brass saddle, top mtg; 2 mtg holes $\frac{1}{8}$ " diam on $\frac{1}{8}$ " mtg/c; round mica filled phenolic body $\frac{5}{8}$ " diam x $\frac{1}{16}$ " h excluding term and shield; beryllium copper, silver pl cont; w/ metal shock shield base, w/ ctr shield 0.180" ID; Spec JAN-S-28A; Mfr. Eby #7670 w/ brass saddle; Hickok part #X19350-120.	Socket mounting for V-102.
X-103	2Z8677.3 N16-S-62601-5965	SOCKET, tube: Navy Type #49477-B; 7 cont, miniature; retainer ring mtg; $\frac{5}{8}$ " diam chassis cutout required; round polystyrene body $\frac{45}{64}$ " diam x $\frac{3}{8}$ " h excluding term; phosphor-bronze cad pl cont; w/o metal shock shield, w/ metal ctr shield; Mfr. Amphenol part #54-7P; Hickok part/dwg #19350-29; p/o W-101.	Socket for V-103.
A-201	3G2259-1.1 *N16-H-800001-165	HOUSING, for voltage dropping resistor; red phenolic; dimensions approx. .625" OD x .250" ID x 4" lg o/a; marked "TEST PROD MX-1101/U"; threaded $\frac{3}{8}$ "-24 on one end, $\frac{1}{4}$ "-32 on other end; Hickok part/dwg #8900-35.	Insulated body part of high voltage multiplier Test Prod MX-1101/U.
O-201	3G330-6 *N16-C-599651-106	COLLAR: protective insulator, black phenolic; $\frac{7}{8}$ " OD x .630" ID x $\frac{3}{8}$ " thick; two radial mtg holes 60° apart, tapped 8-32; Hickok part/dwg #3400-7.	Protective ring or collar for end of Test Prod MX-1101/U.
O-202	2Z8877.429 *N17-S-46669-2765	SPRING: helical compression type; contact for resistor; #18 music wire; $\frac{9}{32}$ " diam x $1\frac{1}{8}$ " free length o/a; 9 turns; one end terminated in concentric loop $\frac{1}{8}$ " ID, other end unfinished; mounts in body of test prod; silver pl; Hickok part/dwg #19450-31.	Contact spring for R-201 inside of TestProd MX-1101/U.
O-203	2Z1409-199 *N16-B-800175-584	BUSHING: reducing fitting for coupling high voltage test prod to test lead; brass, nickel pl; male and female; $\frac{1}{4}$ " lg, threaded $\frac{3}{8}$ "-24 full length external and 10-32 full length internal, one end slotted $\frac{3}{64}$ " x $\frac{3}{64}$ "; Hickok part/dwg #2900-23.	Part of MX-1101/U for coupling to standard dc test lead W-102.
P-201	6Z7598-6 *N16-A-18721-1005	PLUG, threaded: couples alligator clip to test prod; brass, nickel pl; dimensions approx $1\frac{3}{16}$ " lg x $\frac{1}{4}$ " o/a; one end threaded $\frac{1}{4}$ "-32 other end threaded 10-32; Made from Amer Radio Hdwe No. 10 Phone tip plug; Hickok part/dwg #16525-95.	Coupling for alligator clip on end of Test Prod MX-1101/U.
R-201	3Z6853B2 N16-R-73399-8100	RESISTOR, fixed: comp; 53.2 meg p/m 1%; 2 w; F characteristic; $2\frac{1}{16}$ " lg x $\frac{9}{32}$ " diam; moisture resistant; 1 axial wire lead and 1 silver pl cont cap; Mfr. Wilkor Products Carbofilm #CP-2; Hickok part/dwg #X18575-96.	Dropping resistor for high voltage dc measurements located in Test Prod MX-1101/U.

\*NOTE: Not furnished as a maintenance part for Naval activities. If failure occurs, do not request replacement unless the item cannot be replaced or fabricated.  
NOTE #—For replacement use S-101B, Standard Navy Stock Number N17-S-91665-1016.

TABLE 7-3. MAINTENANCE PARTS KIT  
MARINE CORPS LOT 1

KEY SYMBOL DESIGNATION	QUANTITY
CR-101	2
E-101	2
E-102	2
F-101	2
O-101	2
O-104	2
V-101	2
V-102	2
V-103	2

TABLE 7-4. MAINTENANCE PARTS KIT  
NAVY - LOT 2

KEY SYMBOL DESIGNATION	QUANTITY
O-101	2
R-201	1



TABLE 7-5 (Cont.) CROSS REFERENCE PARTS LIST

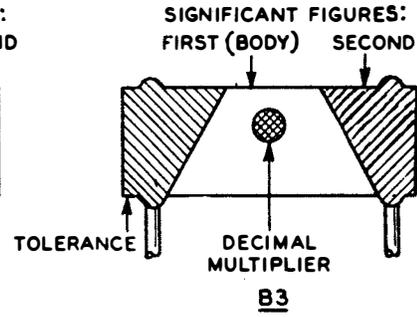
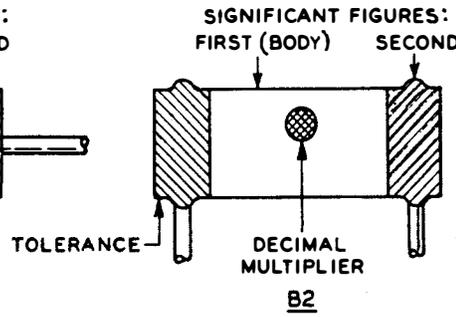
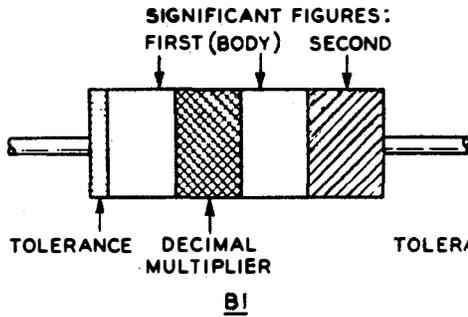
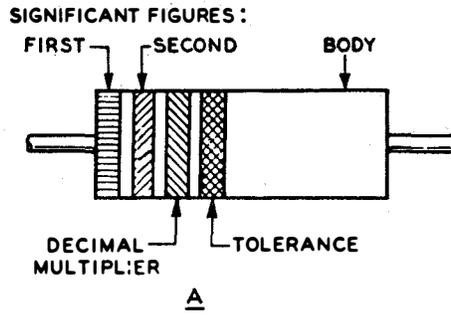
STANDARD NAVY STOCK NUMBER	KEY SYMBOL	STANDARD NAVY STOCK NUMBER	KEY SYMBOL	SIGNAL CORPS STOCK NUMBER	KEY SYMBOL
16-R-73159-6058	R-138	17-C-71483-5120	P-102	1A818.18	W-107
16-R-73181-8758	R-132	17-C-73107-8985	J-105	1B3022-1	W-109
16-R-73196-7558	R-133	17-C-73107-8990	J-102	1B3022-3.2	W-110
16-R-73279-5301	R-130	17-C-73184-9460	J-101	1B818.151	W-108
16-R-73313-2658	R-126	17-C-73408-1790	J-103	2J1N34	CR-101
16-R-73363-7401	R-121	17-C-802584-284	O-104	2J12AU7	V-101
16-R-73376-2668	R-137	17-C-802585-401	O-101	2J6AL5	V-103
16-R-73379-8001	R-115	17-D-20001-110	S-101F	2J6X4	V-102
16-R-73395-1001	R-116	17-F-16302-130	F-101	2Z1409-199	O-203
16-R-73399-6350	R-103	17-F-74267-5075	E-107	2Z2642.280	H-106
16-R-73399-8100	R-201	17-G-900301-451	H-108	2Z3024-89	P-102
16-R-78516-5829	R-141	17-H-150001-138	H-105	2Z3062-16	J-102
16-R-78584-1059	R-136	17-H-68863-4328	H-101	2Z3065-87	J-101
16-R-78617-8259	R-131	17-K-700073-551	E-103	2Z4928-77	H-105
16-R-78696-9401	R-104	17-L-6297	E-101	2Z5573.9	J-105
16-R-78758-2859	R-127	17-L-63205-4185	W-103	2Z5821-142	E-103
16-R-78799-8259	R-122	17-L-63205-4190	W-104	2Z5952	E-101
16-R-78950-6459	R-117	17-L-63205-7691	W-101	2Z5991-144	I-101
16-R-87439-4090	R-109	17-L-63205-8851	W-102	2Z7111.23	P-104
16-R-87682-5206	R-144	17-L-63386-2427	W-105	2Z7111.23.1	P-105
16-R-90908-8156	R-145	17-L-76854-4021	I-101	2Z7111.28	J-103
16-S-34576-6513	E-109	17-M-28071-1551	ME-25A/U	2Z7560-5	P-101
16-S-34607-8400	E-110	17-M-29372-5351	M-101	2Z8304.179	E-110
16-S-62601-5965	X-103	17-P-403281-101	H-106	2Z8304.183	E-109
16-S-62603-6692	X-102	17-P-84825-6001	E-115	2Z8671.23	P-103
16-S-64063-6718	X-101	17-P-84837-7361	E-114	2Z8677.3	X-103
16-T-51734-0000	CR-101	17-P-84923-8791	E-113	2Z8677.94	X-102
16-T-56195	V-103	17-P-84923-8801	E-112	2Z8679.30	X-101
16-T-56840	V-102	17-S-150263-103	O-103	2Z8877.429	O-202
16-T-58241	V-101	17-S-46669-2765	O-202	2Z9401	E-116
17-B-58745-6541	BT-111	17-S-66076-8575	S-102	2Z9613.579	T-101
17-B-77483-8464	E-116	17-S-66833-3195	S-101	3A30	BT-101
17-B-77986-4501	E-111	17-S-70777-8626	S-103	3DA50-292	C-101
17-B-78158-2433	E-108	17-S-73956-7205	S-104	3DA50-389	C-107
17-C-250001-147	A-101	17-S-91665-1016	S-101B	3DB10-62	C-108
17-C-48146-1300	W-109	17-S-91665-1017	S-101C	3E7350.1-84.7	W-106
17-C-48147-2526	W-110	17-S-91665-1018	S-101A	3E8000-44.2	W-102
17-C-48236-1801	W-106	17-T-47489-5511	E-102	3E8000-48	W-104
17-C-71408-3050	P-104	17-T-74154-8651	T-101	3E8000-48.1	W-103
17-C-71409-5278	P-103	43-S-33965-2065	H-104	3E8000-48.13	W-101
17-C-71410-3324	P-105	43-S-79150-5035	H-102	3E8000-5.1	W-105
17-C-71425-4054	P-101	43-S-79155-3015	H-103	3F3299-9.3	M-101

NAVSHIPS 91415  
ME-25A/U

PARTS LISTS

TABLE 7-5 (Cont.) CROSS REFERENCE PARTS LIST

SIGNAL CORPS STOCK NUMBER	KEY SYMBOL	SIGNAL CORPS STOCK NUMBER	KEY SYMBOL	SIGNAL CORPS STOCK NUMBER	KEY SYMBOL
3F3324-9	ME-25A/U	3RC20BF274K	R-151	3Z6812-10	R-115
3F3705-19	E-114	3RC20BF332K	R-124	3Z6820-11	R-116
3F3705-6.3	E-102	3RC20BF335K	R-112	3Z6840	R-103
3F3705-6.4	E-115	3RC20BF392K	R-129	3Z6853B2	R-201
3G2259-1.1	A-201	3RC20BF563K	R-150	3Z7330-31	R-145
3G330-6	O-201	3RC20BF825K	R-114	3Z7330-32	R-109
3K2047121	C-105	3RC30BF275K	R-105	3Z7410-162	R-144
3K3010221	C-103	3RC30BF333K	R-140	3Z770-12.47	E-111
3K3547221	C-104	3RC30BF335K	R-107	3Z770-22.1	E-108
3RB1-5000	R-141	3Z1087-15	O-101	3Z9825-19.3	S-101
3RB2-1500	R-136	3Z1087-8.1	O-104	3Z9825-58.174	S-102
3RB2-3000	R-131	3Z1927	F-101	3Z9863-12A	S-103
3RB2-9700	R-104	3Z3285-2.1	E-107	3Z9863-52R	S-104
3RB3-1500.1	R-127	3Z3345-5	S-101F	3Z9903E-30.4	S-101A
3RB3-3000	R-122	3Z4220-5	E-113	3Z9903E-30.5	S-101B
3RB4-1500.4	R-117	3Z4220-5.1	E-112	3Z9903E-30.6	S-101C
3RC20BF104J	R-106	3Z5999-13	R-137	6F500-17	A-101
3RC20BF105K	R-101	3Z6009-10	R-118	6L20903-3.4	H-103
3RC20BF122K	R-113	3Z6090-34	R-123	6L20905-7.4	H-102
3RC20BF152J	R-134	3Z6590-25	R-128	6L31129-13	H-104
3RC20BF153J	R-110	3Z6620-188	R-142	6Z4910L	H-108
3RC20BF184J	R-146	3Z6660-48	R-138	6Z4920-17	H-107
3RC20BF203J	R-108	3Z6690-14	R-132	6Z5200-2	H-101
3RC20BF206J	R-102	3Z6712-37	R-133	6Z7590-6	P-201
3RC20BF222K	R-119	3Z6760-16	R-130	6Z8093-5	O-103
3RC20BF223K	R-139	3Z6801-113	R-126		
3RC20BF273K	R-148	3Z6806-13	R-121		

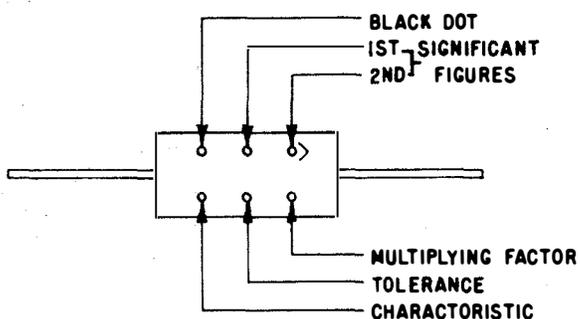


Color	First Significant Figure	Second Significant Figure	Decimal Multiplier	Tolerance
Black	0	0	1	—
Brown	1	1	10	± 1%
Red	2	2	100	± 2%
Orange	3	3	1,000	± 3%
Yellow	4	4	10,000	± 4%
Green	5	5	100,000	± 5%
Blue	6	6	1,000,000	± 6%
Violet	7	7	10,000,000	± 7%
Gray	8	8	100,000,000	± 8%
White	9	9	1,000,000,000	± 9%
Gold	—	—	0.1	± 5%
Silver	—	—	0.01	± 10%
No color	—	—	—	± 20%

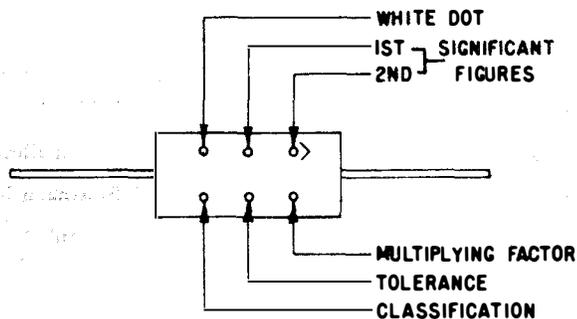
—Fixed Resistors: RMA and AWS Standard Color Codes

TABLE 7-6. APPLICABLE COLOR CODES—RESISTORS

JAN COLOR CODE  
FOR  
MOLDED MICA CAPACITORS



1946 RMA COLOR CODE  
FOR  
MOLDED MICA CAPACITORS



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE(MMF)	% TOL.	CHARA. *
BLACK	0	1	±20	A
BROWN	1	10		B
RED	2	100	±2	C
ORANGE	3	1,000		D
YELLOW	4	10,000		E
GREEN	5			F
BLUE	6			G
VIOLET	7			
GRAY	8			
WHITE	9			
GOLD		0.1	±5	
SILVER		0.01	±10	

\* THESE LETTERS INDICATE COMBINATIONS OF VARIOUS ELECTRICAL CHARACTERISTICS. FOR DETAILS SEE SPECIFICATION JAN-C-5.

NOTE: VOLTAGE RATINGS VARY WITH CAPACITANCE.

NOTE: IF BOTH ROWS OF DOTS ARE NOT ON ONE FACE; ROTATE CAPACITOR ABOUT AXIS OF LEADS TO READ SECOND ROW ON SIDE OR REAR.

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE(MMF)	% TOL.	CLASS. *
BLACK	0	1	±20	A
BROWN	1	10		B
RED	2	100	±2	C
ORANGE	3	1,000	±3	D
YELLOW	4	10,000		
GREEN	5		±5	
BLUE	6			
VIOLET	7			
GRAY	8			I
WHITE	9			J
GOLD		0.1		
SILVER		0.01	±10	

\* THESE LETTERS INDICATE COMBINATIONS OF VARIOUS ELECTRICAL CHARACTERISTICS PER RMA STANDARDS.

NOTE: VOLTAGE RATINGS VARY WITH CAPACITANCE.

NOTE: IF BOTH ROWS OF DOTS ARE NOT ON ONE FACE; ROTATE CAPACITOR ABOUT AXIS OF LEADS TO READ SECOND ROW ON SIDE OR REAR.

TABLE 7-7. APPLICABLE COLOR CODES — CAPACITORS

TABLE 7-8. LIST OF MANUFACTURERS

ABBREVIATIONS	MFR'S PREFIX	NAME	ADDRESS
Aerovox.....	CAW	Aerovox Corporation.....	742 Belleville Ave. New Bedford, Mass.
Allen-Bradley.....	CBZ	Allen-Bradley Co.....	118 W. Greenfield Ave. Milwaukee, Wis.
Amphenol.....	CPH	American Phenolic Corp.....	1830 S. 54th Ave. Chicago 50, Ill.
Amer. Radio Hdwe.....	CMH	American Radio Hardware Co., Inc.....	476 Broadway New York, N. Y.
A. H. & H.....	CHH	Arrow, Hart & Hegeman Electric Co.....	102 Hawthorne St. Hartford, Conn.
Belden.....	COG	Belden Mfg. Co.....	P. O. Box 5070A Chicago, Ill.
Bryant.....	CYD	Bryant Electric Co.....	1421 State St. Bridgeport 2, Conn.
Bussmann.....	CFA	Bussmann Mfg. Co.....	2538 W. University St. St. Louis, Mo.
Centralab.....	CBN	Central Radio Laboratory Div., Globe Union.....	900 E. Keefe Ave. Milwaukee, Wis.
Chicago Trans.....	CTR	Chicago Transformer Corp. Div., Essex Wire Corp.....	3501 W. Addison St. Chicago, Ill.
Cinch.....	CMG	Cinch Mfg. Corp.....	2339 W. Van Buren St. Chicago 12, Ill.
Continental Rubber.....		Continental Rubber Works.....	1932 Liberty St. Erie, Pa.
Cornell-Dubilier.....	CD	Cornell-Dubilier Electric Corp.....	1000 Hamilton Blvd. So. Plainfield, N. J.
Corwire.....		Cornish Wire Co.....	15 Park Row New York, N. Y.
Cutler-Hammer.....	CAE	Cutler-Hammer, Inc.....	1333 W. St. Paul Ave. Milwaukee, Wis.
Drake.....	CAYS	Drake Mfg. Co.....	1713 W. Hubbard St. Chicago 22, Ill.
Eby.....	CEB	Hugh H. Eby, Inc.....	4700 Stenton Ave. Philadelphia, Pa.
Johanson.....		Johanson Mfg. Corp.....	Boonton, N. J.
Littlefuse.....	CLF	Littlefuse, Inc.....	4765 Ravenswood Ave. Chicago, Ill.
Mallory.....	CMA	P. R. Mallory & Co., Inc.....	1941 Thomas St. Indianapolis, Ind.
Mueller.....	CBIT	Mueller Electric Co.....	1597 E. 31st St. Cleveland, Ohio
RCA.....	CRC	RCA Mfg. Co. (Radiotron Division).....	Harrison, N. J.
Ray-O-Vac.....	CFB	Ray-O-Vac Co.....	2326 Winnebago St. Madison, Wis.
RPC.....		Resistance Products Co.....	714 Race St. Harrisburg, Pa.
Sprague.....	CSF	Sprague Specialties Co.....	North Adams, Mass.
Stalwart Rubber.....		Stalwart Rubber Co.....	160 Northfield Rd. Bedford, Ohio
Sylvania.....	CHS	Sylvania Electric Products, Inc.....	500 Fifth Ave. New York 18, N. Y.
Wilkor.....	CBI	Wilkor Products Co.....	3835 W. 150th St. Cleveland, Ohio
Wirt Co.....	CWC	Wirt Company.....	5221 Green St. Philadelphia, Pa.