

TM 11-2613

WAR DEPARTMENT TECHNICAL MANUAL

VOLTOHMMETER

I-166

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27 MAY 1944

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WASHINGTON 25, D. C., 27 MAY 1944

TM 11-2613, War Department Technical Manual, Voltohmmeter I-166, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR

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Chief of Staff.

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The Adjutant General.

DISTRIBUTION:

I Bn 11 (3); I C 11 (10).

(For explanation of symbols see FM 21-6.)

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DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW—1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut—Use axes, handaxes, machetes.

3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use firearms, grenades, TNT.

5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash—Meter, control, and panels.

2. Cut—Cables and all wiring.

3. Burn—Resistors, capacitors, all technical manuals, instruction books.

4. Bury or scatter—Any or all of the above pieces after destroying their usefulness.

DESTROY EVERYTHING

SAFETY NOTICE

WHEN THIS EQUIPMENT IS USED IN CONNECTION WITH HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE, OPERATING PERSONNEL MUST EXERCISE EXTREME CARE. SAFETY REGULATIONS AND CAUTION NOTICES WHICH APPEAR THROUGHOUT THIS MANUAL MUST BE OBSERVED AT ALL TIMES. MAKE TESTS EXACTLY AS DIRECTED. PERSONNEL NOT FAMILIAR WITH THE SERVICING OF HIGH-VOLTAGE CIRCUITS SHOULD NEVER MAKE TESTS INVOLVING SUCH CIRCUITS.

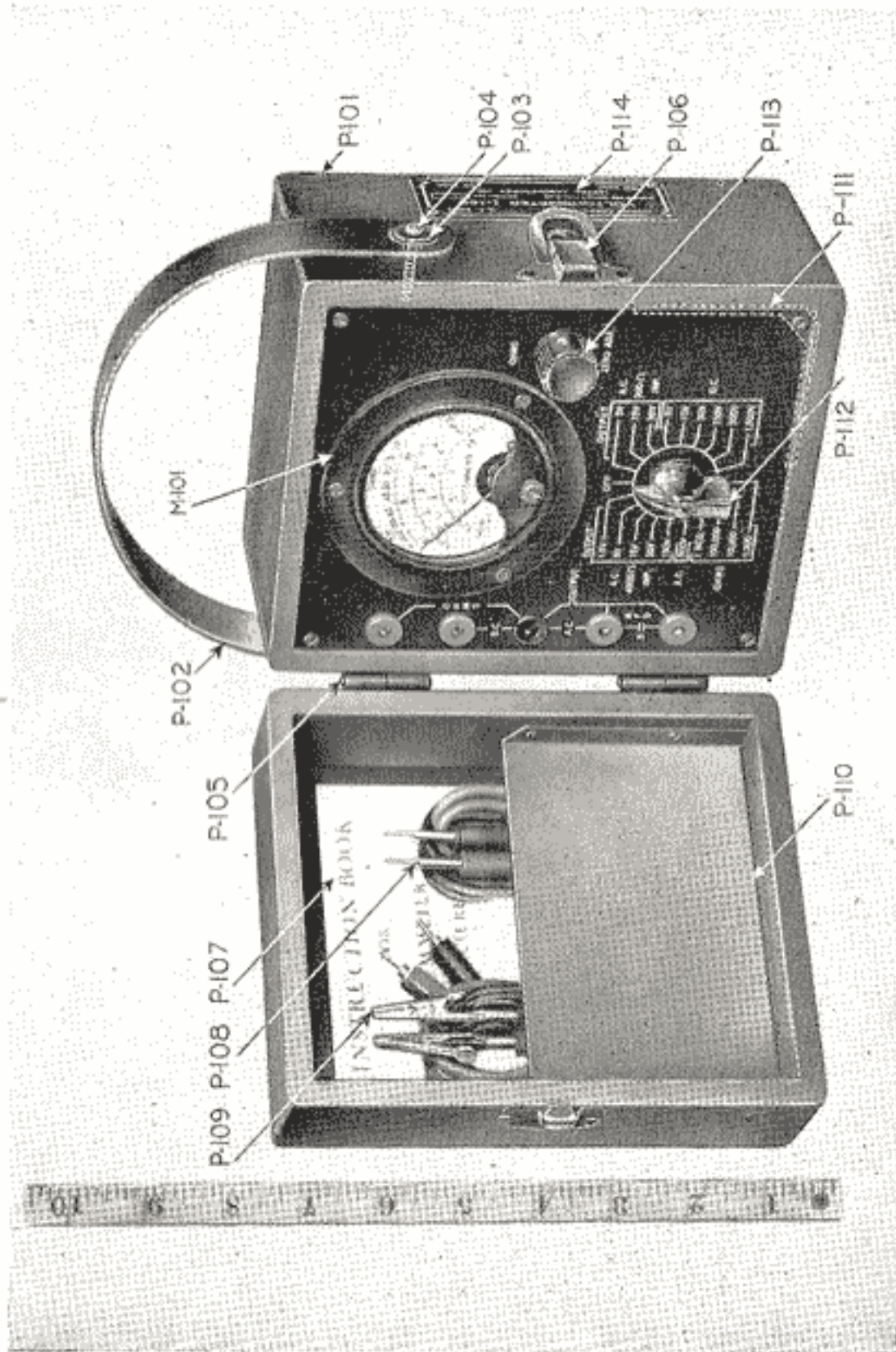


Figure 1. Voltohmmeter I-166, front view, case open.

TL-12219

SECTION I DESCRIPTION

1. GENERAL.

a. Voltohmmeter I-166 is a general purpose measuring instrument especially designed for the servicing of radio equipment. It is capable of measuring a-c and d-c voltages as well as d-c resistance in the ranges indicated in paragraph 5.

b. The instrument is entirely self-contained in a wooden carrying case 7 by 6 by 5½ inches and weighs 3.75 pounds. Contained within the lid is a compartment which has two sets of test leads, detachable clips, and two copies of TM 11-2613. Voltohmmeter I-166 uses Battery BA-31, but this battery is not supplied with it.

2. D-C VOLTAGE MEASUREMENTS.

D-c voltage measurements are made directly by applying the unknown voltage to the meter through a suitable value series resistor. Although basically the meter movement has a full scale sensitivity of 100 microamperes, it is shunted to 1 milliampere for all d-c voltage measurements. It gives the instrument an over-all sensitivity of 1,000 ohms per volt.

3. A-C VOLTAGE MEASUREMENTS.

A-c voltage measurements, including a-f voltage measurements are made by a full-wave, plug-in type, copper-oxide rectifier, connected in series with the basic d-c meter movement. The various ranges provided are possible through use of appropriate multiplier resistors in series with the meter and rectifier unit.

4. D-C RESISTANCE MEASUREMENTS.

D-c resistance is measured by connecting the unknown resistance in series with the microammeter and a known source of d-c voltage (battery).

5. MEASUREMENT RANGES AVAILABLE.

a. A-f Output Voltage.

0 to 1.5 volts	}	At 4,000 ohms impedance.
0 to 5 volts		
0 to 15 volts		
0 to 50 volts		
0 to 150 volts		
0 to 5 volts	}	At 300 ohms impedance.
0 to 15 volts		
0 to 30 volts		

b. A-c Voltage.

0 to 500 volts Sensitivity 2,666 ohms per volt.

c. D-c Voltage.

0 to 5 volts	}	Sensitivity 1,000 ohms per volt.
0 to 15 volts		
0 to 50 volts		
0 to 150 volts		
0 to 500 volts		
0 to 1,500 volts		

d. D-c Resistance.

0 to 1,000 ohms
0 to 10,000 ohms
0 to 100,000 ohms
0 to 1,000,000 ohms (1 megohm)

6. PANEL ARRANGEMENT.

a. The panel arrangement of this voltohmmeter is shown in figure 1. Below the meter dial is the selector switch which changes measurement ranges. To the right of the meter dial is the OHMS ZERO ADJ. control.

b. There are five test-lead jacks on the panel. The black jack is common to the four red jacks.

c. The top red jack is used for measuring d-c resistance. The red jack, second from top, is used for measuring d-c voltage. The red jack immediately below the black jack measures a-c and a-f output voltage. The bottom red jack is used when a series capacitor is needed to block direct current. It permits a-f measurements in circuits where d-c voltages also exist.

d. When a-f voltages are measured while using the series capacitor, the accuracy of meter readings is affected at frequencies below 500 cycles.

SECTION II

INSTALLATION AND OPERATION

7. PREPARATION FOR USE.

a. Remove the lid from the tester case. The battery must be installed before using the tester (sec. IV, par. 13).

b. Set the rotary selector switch at an appropriate range for the measurement to be made.

CAUTION: When in doubt of the voltage, use the highest range as a protection to the meter. Be careful! Do not burn it out!

c. Plug the short-handled probe of the black test lead into the black jack (common). Plug the short-handled probe of the red test lead into the appropriate red jack.

d. To measure voltage, connect the long-handled test probes to the terminals where voltages are to be measured. The red probe must go to the positive terminal. Use the black center scale for d-c measurements.

8. RESISTANCE MEASUREMENTS.

a. Resistance is measured by first shorting the long-handled test probes. Hold their metal tips together, and adjust the OHMS ZERO ADJ. control until the meter pointer is at 0 at the extreme right of the upper meter scale. Then connect the long-handled test probes to the terminals at which the resistance measurement is to be made, without regard for polarity. Read the meter on the upper scale.

CAUTION: Before taking ohmmeter measurements, be sure that no voltage exists in the circuit under test. External voltages may seriously damage the meter.

b. For the 1,000-ohm range, read the resistance directly in ohms. For the 10,000-ohm range, multiply the reading by 10. For the 100,000-ohm range, multiply the reading by 100; in the 1-megohm range, multiply the reading by 1,000.

9. A-F OUTPUT MEASUREMENTS.

a. To measure a-f output, set the selector switch to the desired range, at 300- or 4,000-ohm impedance. Use whichever more nearly matches the impedance of the circuit being measured. Read the meter on the red scale. If d-c voltage is present along with the a-f output voltage, the capacitor jack will not be accurate if the frequency of the voltage is lower than 500 cycles. Since the impedance of the capacitor varies inversely to the frequency, measurements made at higher frequencies will be more accurate.

b. Since the a-c ranges are obtained by means of a copper-oxide rectifier, waveform, temperature, and frequency will affect the accuracy of the instrument. These readings will be substantially correct for frequencies up to about 3,500 cycles, but will decrease approximately $\frac{1}{2}$ of 1 percent for every additional 1,000 cycles up to 15,000 cycles. Comparative readings should be made at approximately the same temperature in order to minimize this type of error.

CAUTION: Be careful when dealing with high-voltage circuits; over 300 volts, or even less under certain conditions, may be fatal. Make connections only when the radio set is turned off.

SECTION III FUNCTIONING OF PARTS

10. D-C VOLTAGE RANGES.

a. The basic element of this instrument is a 100-microampere, d-c meter of the D'Arsonval moving-coil type. This meter, shunted to 1 milliamper full scale, with the proper multipliers, is used to make all d-c voltage measurements directly at a sensitivity of 1,000 ohms per volt. The multipliers used for these measurements are arranged in series and are all mounted on resistor board "A" (fig. 5, part No. P-115) as follows:

- 5.0-volt range—R-107—4,900 ohms
- 15.0-volt range—R-108—10,000 ohms
- 50.0-volt range—R-110—35,000 ohms
- 150.0-volt range—R-111—100,000 ohms
- 500.0-volt range—R-112—350,000 ohms
- 1,500.0-volt range—R-113—1,000,000 ohms

b. The resistance of the meter, when shunted to 1.0 milliamper full scale, is 100 ohms. When added to the first multiplier, R-107, of 4,900 ohms, this equals exactly 5,000 ohms, the required value for a 5.0-volt range at 1,000 ohms per volt. The shunt, R-109, is mounted on resistor board "B" (fig. 5, part No. P-116).

11. D-C RESISTANCE RANGES.

a. This circuit consists of a battery in series with a protective resistance network. The meter is so adjusted that with no ex-

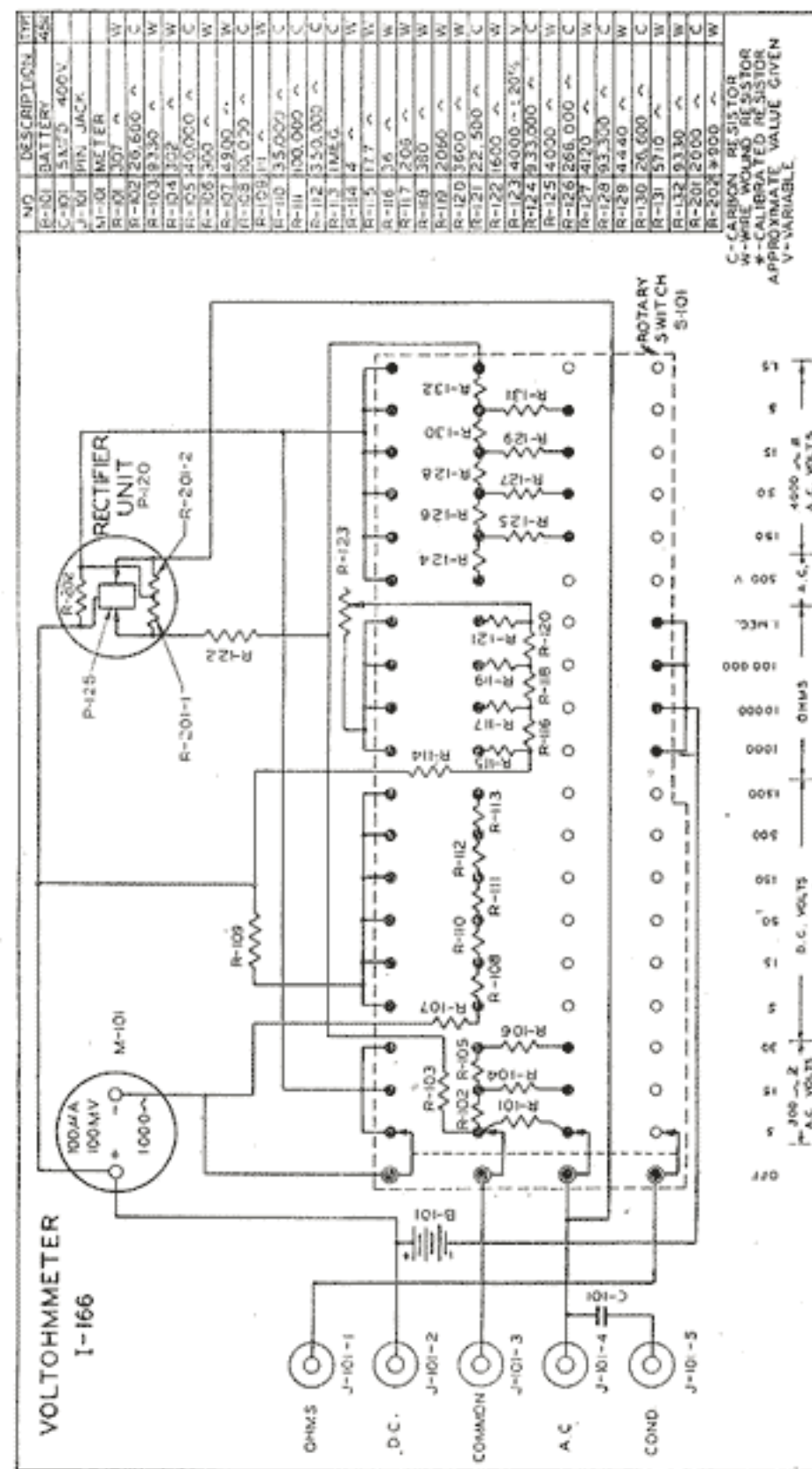


Figure 2. Schematic diagram.

TL-12220

ternal resistance, it will read exactly full scale. In order to allow for deterioration of the battery, lower voltage, and increased internal resistance, the meter is shunted to a 180-microampere full scale deflection. As the battery voltage drops, and the internal resistance of the battery increases, the sensitivity of the meter is varied by means of R-123, the OHMS ZERO ADJ. Therefore with no external resistance and the test prods shorted, full scale deflection can be obtained.

b. To obtain the lower resistance ranges, the sensitivity of the meter is decreased in three other steps of ten. All of the shunts and protective resistors are arranged on resistor board "B" (fig. 5) as follows:

- 1 megohm-range—180 microamps, full scale
- 100,000-range—1.8 milliamps, full scale
- 10,000-range—18 milliamps, full scale
- 1,000-range—180 milliamps, full scale

c. Take care in using the instrument to measure the resistance of low-current carrying devices such as instrument fuses, or internal meter resistance. This is important so that the full scale current of the range used will not damage the part under test.

CAUTION: Do not touch high-voltage terminals when making measurements on radio sets with power on. Voltages dangerous to life are present at the plate circuits of transmitters.

12. A-C VOLTAGE RANGES.

a. All a-c voltage ranges, whether high or low impedance, are made by using a dry disk rectifier to convert the alternating

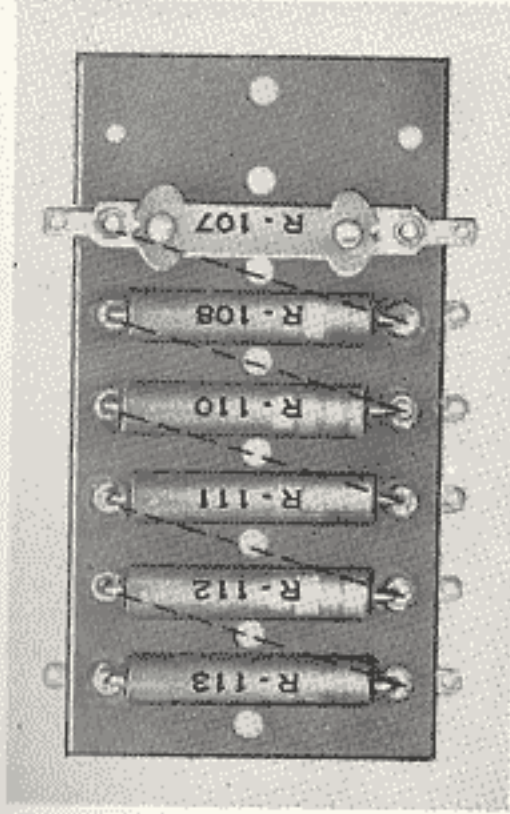
current to direct current. This rectifier is the full-wave copper-oxide type, bridged by two 2,000-ohm resistors (R-201-1 and R-201-2).

b. In order to compensate for variations in the rectifier itself, a shunt, R-202, of approximately 900-ohm resistance is used across the rectifier output. This is used to obtain a uniform sensitivity of 2,666 ohms per volt for the a-c ranges. This resistor is incorporated within the rectifier unit itself. The whole assembly is in one self-contained unit, precalibrated for use with Voltohmmeter I-166.

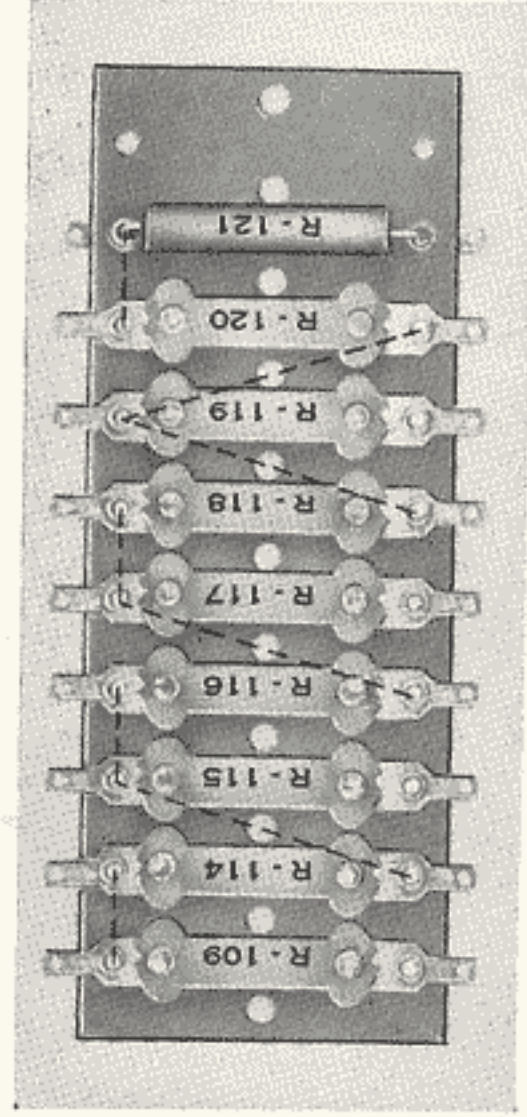
c. The 300- and 4,000-ohm impedance ranges use the same 2,666 ohms per volt basic a-c circuit with series-connected multiplier. They are loaded by the proper resistance or combination of resistances to maintain the desired output impedance. The arrangement of these multipliers and loading resistors is as follows:

Impedance	Voltage range	Multiplier on resistor board "C"	Loading resistor on resistor board "D"
300	5.0	R-103— 9,330 ohms	R-101— 307 ohms
300	15.0	R-102— 26,660 ohms	R-104— 302 ohms
300	30.0	R-105— 40,000 ohms	R-106— 300 ohms
4,000	1.5	R-122— 1,600 ohms	
4,000	5.0	R-132— 9,330 ohms	R-131—5,710 ohms
4,000	15	R-130— 26,660 ohms	R-129—4,440 ohms
4,000	50	R-128— 93,300 ohms	R-127—4,120 ohms
4,000	150	R-126—266,600 ohms	R-125—4,000 ohms
	500	R-124—933,100 ohms	

d. The 500-volt a-c range is a direct continuation of the 150-volt scale of the 4,000-ohm range. The loading resistor is omitted and R-124, 933,100 ohms, provides the additional resistance, 350 additional volts at 2,666 ohms per volt.

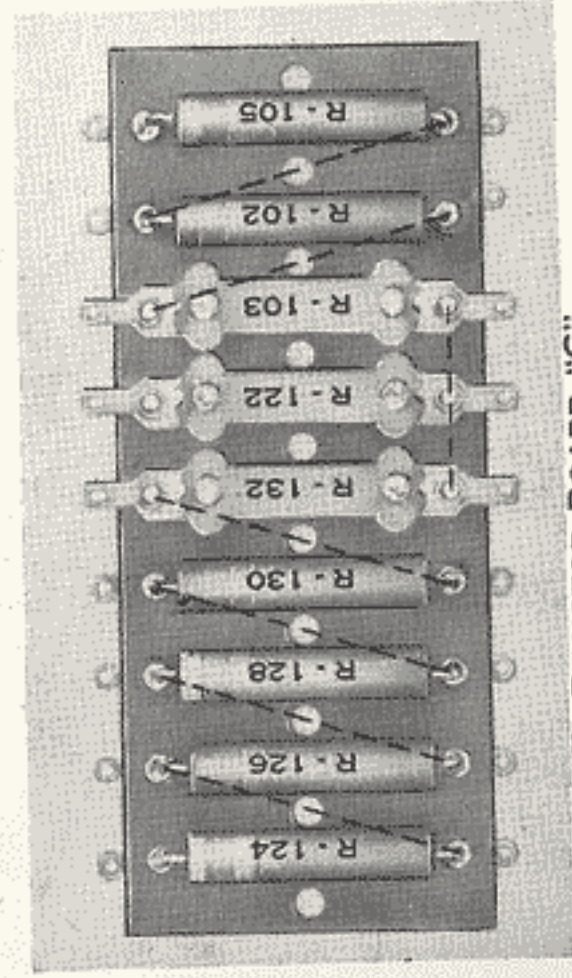


P - 115 - RESISTOR BOARD "A"

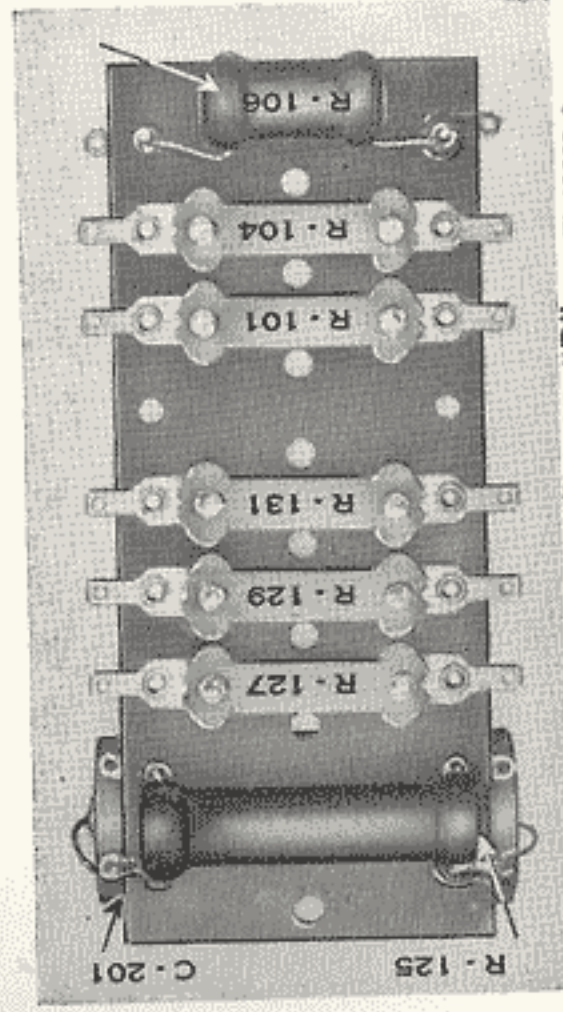


P - 116 - RESISTOR BOARD "B" TL-12223-1

Fig. 5. Resistor boards "A" and "B" assemblies



P - 117 - RESISTOR BOARD "C"



P - 118 - RESISTOR BOARD "D" TL-12223-2

Fig. 6. Resistor boards "C" and "D" assemblies

SECTION IV MAINTENANCE

UNSATISFACTORY PERFORMANCE OF THIS EQUIPMENT WILL BE REPORTED IMMEDIATELY ON W. D., A.G.O. FORM NO. 468. IF FORM IS NOT AVAILABLE, SEE TM 38-250.

13. BATTERY.

a. The voltohmmeter uses one Battery BA-31 (4½ volts) which supplies current for the ohmmeter ranges. As this battery drops in potential, due to use or shelf depreciation, the OHMS ZERO ADJ. control must be turned farther and farther to the right. When the meter pointer cannot be brought to 0 on the ohmmeter scale by advancing this control all the way, replace the battery.

b. To replace the battery, remove the four screws at the four corners of the instrument panel. The entire instrument panel, with its parts, can then be lifted out of the case. The battery can be lifted from the battery clamp.

c. Disconnect the battery from the circuit by removing the knurled terminal nuts. Connect a new battery by placing the red wire on the positive (plus) terminal, and the black lead to the negative (minus) terminal. Replace the battery in the holding clamps so that battery lugs are at the bottom and away from the interior of the tester. Replace the panel assembly in the case, and fasten it in with the four panel screws.

d. If replacement of the battery does not restore correct operation, or if the voltohmmeter does not function properly on any of its other ranges, it should be considered defective.

NOTE: Do not attempt repairs unless entirely familiar with this type of precision instrument. All repairs must be made in authorized Signal Corps repair shops.

SECTION V SUPPLEMENTARY DATA

14. Maintenance Parts List For Volt ohmmeter I-166.

NOTE: Order maintenance parts by stock number, name, and description.

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
P-108	3F3153	TEST LEAD SET: 4' long; consisting of one black lead with black probe tip and phone tip; one red lead with red probe tip and phone tip; phone tip assembly 1 1/2"; over-all length, 3/8" diam; probe tip assembly 4"; over-all length, 3/8" diam.	2
P-109	3Z1087	ALLIGATOR CLIPS: 2" over-all length; 1/8" wide; steel; nickel-plated; fits probe tip on test lead set P-108.	4
P-112	2ZK5822-22	KNOB: pointer bar; black bakelite; 1 1/4" long x 3/4" wide x 3/8" high; fastens to 1/4" diam shaft, by single set screw.	1
P-113	2Z5822-22	KNOB: round; black bakelite; 1 3/8" diam x 1 1/2" high, fastens to 1/4" diam shaft by single set screw.	1
P-115	3G1838-58.8	RESISTOR BOARD "A": natural bakelite; 3 3/8" x 1 7/8" x 1/8" thick; 5 sets carbon-resistor mounting lugs; 1 set flat resistor-mounting lugs.	1
P-116	3G1838-80.2	RESISTOR BOARD "B": natural bakelite; 5" x 1 7/8" x 1/8" thick; 1 set carbon resistor-mounting lugs; 8 sets flat resistor-mounting lugs.	1

14. Maintenance Parts List For Volt ohmmeter I-166 (contd.)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
P-117	3G1838-72.6	RESISTOR BOARD "C": natural bakelite; 4 1/2" x 1 7/8" x 1/8" thick; 6 sets carbon resistor-mounting lugs; 3 sets flat resistor-mounting lugs.	1
P-118	3G1838-72.5	RESISTOR BOARD "D": natural bakelite; 4 1/2" x 1 7/8" x 1/8" thick; 1 set capacitor-mounting lugs; 2 sets carbon resistor-mounting lugs; 5 sets flat resistor-mounting lugs.	1
P-119	2Z8674.71	SOCKET: 4-prong; wafer-type; 1 1/2" mounting centers.	1
P-120	3F7166/R2	RECTIFIER UNIT ASSEMBLY: consists of full-wave copper-oxide rectifier P-125; two 2,000-ohm 1/2 watt resistors, R-201-1, R-201-2; one 900-ohm calibrating resistor, R-202; all housed on a 4-prong base-type plug; 1 3/8" diam x 1 3/4" long, over-all.	1
P-123	6L40236-4B	KEYING WASHER: 1 3/8" OD x 3/8" ID; black bakelite.	1
P-124	6L50526-2	INSULATING WASHER: shoulder type; fiber; 1" OD x 3/8" ID x 1/8" diam shoulder; over-all thickness 3/8".	2
C-101	3DA500-138	CAPACITOR: fixed; paper; 0.5 µf; 400 v; tubular type; ± 10%, 7/8" x 2 1/8" pigtail mounting.	1
J-101-1	2Z5581-4	JACK: single; tip molded; red, with round assembly washer; 3/8" diam, flange; mounts in 1 1/2" hole, over-all body length 3/4".	4
M-101	3F871-5	MICROAMMETER: dc; 0-100 µa; 2% accuracy; 1,000-ohm resistance, 100-mv drop, D'Arsonval movement; round flush mounting; molded case; flange, 3 1/2" diam; body, 2 3/4" diam; over-all depth 1 1/2"; calibrated for 1/6" panel, A.S.A. war standard.	1

18 14. Maintenance Parts List For Volt ohmmeter I-166 (contd.)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
R-101	3Z6030G7-1	RESISTOR: fixed; wire-wound; flat-multiplier type, 307 ohms, $\pm 3\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-102	3Z6626F6-1	RESISTOR: fixed; carbon; 26,600 ohms; 1 watt, $\pm 5\%$; $1\frac{1}{4}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	2
R-103	3Z6593C3-1	RESISTOR: fixed; wire-wound; flat-multiplier type; 9,330 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{7}{16}$ " wide x $\frac{1}{8}$ " thick.	2
R-104	3Z6030B2-1	RESISTOR: fixed; wire-wound; flat-multiplier type; 302 ohms; $\pm 3\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-105	3Z6640-52	RESISTOR: fixed; carbon; 40,000 ohms; 1 watt, $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-106	3Z6030-73	RESISTOR: fixed; coated wire-wound; 300 ohms; 5 watt; $\pm 5\%$; $\frac{1}{16}$ " x 1"; pigtail mounting.	1
R-107	3Z6490-2	RESISTOR: fixed; wire-wound; flat-multiplier type; 4,900 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-108	3Z6610-95	RESISTOR: fixed; carbon; 10,000 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-109	3Z6011A1-2	RESISTOR: fixed; wire-wound; flat-multiplier type; 111 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1

14. Maintenance Parts List For Volt ohmmeter I-166 (contd.)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
R-110	3Z6635-19	RESISTOR: fixed; carbon; 35,000 ohms; 1 watt, $\pm 5\%$; $1\frac{1}{4}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-111	3ZK6700-93	RESISTOR: fixed; carbon; 100,000 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-112	3Z6735-6	RESISTOR: fixed; carbon; 350,000 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-113	3Z6801-55	RESISTOR: fixed; carbon; 1 meg; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-114	3Z5994-20	RESISTOR: fixed; wire-wound; flat-multiplier type; 4.0 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{7}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-115	3Z6001G7-2	RESISTOR: fixed; wire-wound; flat-multiplier type; 17.7 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-116	3Z6003F6-4	RESISTOR: fixed; wire-wound; flat-multiplier type; 36 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{7}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-117	3Z6020F6-1	RESISTOR: fixed; wire-wound; flat-multiplier type; 206 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-118	3Z6036-4	RESISTOR: fixed; wire-wound; flat-multiplier type; 360 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{7}{16}$ " wide x $\frac{1}{8}$ " thick.	1

14. Maintenance Parts List For Volt Ohmmeter I-166 (contd.)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
R-119	3Z6206-1	RESISTOR: fixed; wire-wound; flat-multiplier type; 2,060 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-120	3Z6360-9	RESISTOR: fixed; wire-wound; flat-multiplier type; 3,600 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-121	3Z6622E5-1	RESISTOR: fixed; carbon; 22,500 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-122	3Z6160-22	RESISTOR: fixed; wire-wound; flat-multiplier type; 1,600 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-123	2Z7280-67	RESISTOR: variable; 4,000 ohms; wire-wound; $\pm 20\%$; $\frac{1}{2}$ -watt rating; $\frac{3}{8}$ " bushing; $\frac{3}{8}$ " long shaft from end of bushing; mounts by $\frac{3}{8}$ " diam; threaded bushing.	1
R-124	3Z6793C3-1	RESISTOR: fixed; carbon; 933,000 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-125	3Z6400-54	RESISTOR: fixed; coated; wire-wound; 4,000 ohms; 10 watt; $\pm 5\%$; $\frac{1}{8}$ " x $1\frac{3}{4}$ "; pigtail mounting.	1
R-126	3Z6726F6-1	RESISTOR: fixed; carbon; 266,600 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1

14. Maintenance Parts List For Volt Ohmmeter I-166 (contd.)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit
R-127	3Z6412	RESISTOR: fixed; wire-wound; flat-multiplier type; 4,120 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-128	3Z6693C3-1	RESISTOR: fixed; carbon; 93,300 ohms; 1 watt; $\pm 3\%$; $1\frac{1}{2}$ " long x $\frac{1}{4}$ " diam; pigtail mounting.	1
R-129	3Z6444	RESISTOR: fixed; wire-wound; flat-multiplier type; 4,440 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
R-131	3Z6507A1-1	RESISTOR: fixed; wire-wound; flat-multiplier type; 5,710 ohms; $\pm 2\%$; 1 watt; eyelet mounting; $1\frac{1}{4}$ " long x $\frac{1}{16}$ " wide x $\frac{1}{8}$ " thick.	1
S-101	3Z9825-91	SWITCH: rotary type; 20-position; 4-gang; non-shorting; bank 1 and 2 (nearest panel) have full complement of contacts (19); bank 3 has contacts only on positions 1, 2, 3, 15, 16, 17, and 18, as seen from back of switch; position 1 is first counter-clockwise position from wiper arm contact; bank 4 has contacts only on positions 10, 11, 12, and 13, (viewed as above); $2\frac{3}{4}$ " diam x $1\frac{1}{2}$ " deep; mounts by $\frac{3}{8}$ " diam bushing; $\frac{3}{8}$ " long.	1

SUPPLEMENT

1944

TM 11-2613

SUPPLEMENT

to

TECHNICAL MANUAL
VOLTOHMMETER I-166

3 AUGUST 1944

The following information, published on Orders No. 6397-Phila-44, 22020-Phila-44, 22022-Phila-44, 23772-Phila-44, 24475-Phila-44, 27612-Phila-44 and 28260-Phila-44, supplements TM 11-2613, 27 May 1944. Personnel using the equipment and having custody of this technical manual will enter suitable notations at the appropriate paragraphs in the TM to indicate the presence of this supplementary information.

Page 6. Insert the following paragraph at the beginning of section III, preceding paragraph 10.

9.1. CROSS REFERENCE CHART.

a. The various manufacturers of Voltohmmeter I-166 use different reference symbols for the parts of the equipment. A

cross-reference chart of the symbols used is given below to key the references in the manual with the illustrations of the equipment covered by this supplement.

b.

Part	Reference symbols	
	TM 11-2613	Supplement
Box	P-101	43
Strap	P-102	57
Clip fastener	P-103	59
Stud	P-104	58
Hinge	P-105	Not listed.
Latch	P-106	Not listed.
Test leads	P-108	44
Alligator clips	P-109	45
Compartment bracket	P-110	Not listed.
Corner bracket	P-111	60
Pointer bar	P-112	55
Knob	P-113	56
Resistor board	P-115	Not listed.
Resistor board	P-116	Not listed.
Resistor board	P-117	Not listed.
Resistor board	P-118	Not listed.
Socket	P-119	54
Rectifier unit	P-120	38
Column (spacer)	P-121	49
Column (spacer)	P-122	48
Keying washer	P-123	Not listed.
Insulating washer	P-124	Not listed.
Rectifier	P-125	Not listed.
Insulating washer	P-126	47
Capacitor	C-101	41
Jack	J-101-1	1
Jack	J-101-2	2
Jack	J-101-3	3
Jack	J-101-4	4
Jack	J-101-5	5
Microammeter	M-101	39

Reference symbols

Part	TM 11-2613	Supplement
Resistor	R-101	6
Resistor	R-102	36
Resistor	R-103	9
Resistor	R-104	7
Resistor	R-105	35
Resistor	R-106	8
Resistor	R-107	10
Resistor	R-108	34
Resistor	R-109	11
Resistor	R-110	33
Resistor	R-111	32
Resistor	R-112	31
Resistor	R-113	30
Resistor	R-114	12
Resistor	R-115	17
Resistor	R-116	14
Resistor	R-117	18
Resistor	R-118	15
Resistor	R-119	19
Resistor	R-120	16
Resistor	R-121	29
Resistor	R-122	13
Resistor	R-123	37
Resistor	R-124	28
Resistor	R-125	20
Resistor	R-126	27
Resistor	R-127	21
Resistor	R-128	26
Resistor	R-129	22
Resistor	R-130	25
Resistor	R-131	23
Resistor	R-132	24
Resistor	R-201-1	Not listed.
Resistor	R-201-2	Not listed.
Resistor	R-202	Not listed.
Switch	S-101	40

13.1. PREVENTIVE MAINTENANCE

Page 14, Par. 13. Add the following material after paragraph 13.

a. General Instructions. The performance of the items of maintenance outlined in these paragraphs will provide, periodically, an indication of the operational condition of the test unit and assure proper electrical and mechanical upkeep.

(1) A definite time for these checks should be scheduled by the communication officer. The operator should take the readings indicated and check in the appropriate columns in the check sheets.

(2) Equipment not in use should be checked once a month for deterioration, rust, broken parts, and general operation.

(3) The maintenance items are listed in subparagraphs *b*, *c*, *d*, and *e*, below. In subparagraphs *b* and *c*, the maintenance items are numbered consecutively with an explanation of the appropriate action appearing opposite each item. The items, arranged in the same order in check list form, appear in subparagraphs *d* and *e*.

(4) Deficiencies noted will be reported to the communication officer of the unit.

b. Weekly Checks.

Item	Action
(1) External surfaces.	Remove dust, dirt, grease, and rust. Note under remark if touch-up painting is necessary.
(2) Meter.	See that the pointer is not bent, operates freely, and always returns to zero.

<i>Item</i>	<i>Action</i>
(3) Test leads and clips.	Check conditions of leads and clips. Look for broken conductors inside insulation near test prods and terminals.
(4) Control knobs, switch, and binding posts.	See that all control knobs and binding posts are tight, and that the switch and control operate normally.
(5) Batteries.	Check zero ohms adjustment as described in paragraph 13. Replace batteries if necessary and note under remarks.

c. Monthly Checks.

(1) Interior surfaces.	Remove dust and other foreign matter from the interior of the case.
(2) Selector switch.	Check operation of set for each switch position. Note under remarks if repair or adjustment is necessary.
(3) OHMS ZERO ADJ. control.	Check for smoothness of operation with selector switch in OHMS position and test leads shorted. Enter a remark if cleaning or replacement is necessary.
(4) Case.	Repaint or repair if necessary. Note under remarks.

d. Weekly Check List.

PREVENTIVE MAINTENANCE-FIELD TEST EQUIPMENT
VOLTOHMMETER I-166

Serial No.

Enter a check in the form below if the item has been found satisfactory.

ITEM	1	2	3	13	14	15
(1) External surfaces.						
(2) Meter.						
(3) Test leads and clips.						
(4) Control knobs, switch.						
(5) Batteries.						

Enter a check in the form below if the action has been completed.

ITEM	1	2	3	13	14	15
(6) Unsatisfactory items brought to attention of communication officer.						
(7) Previously reported unsatisfactory items corrected.						

REMARKS:

Date Through Signature.....
Rating.....

e. Monthly Check List.

PREVENTIVE MAINTENANCE-FIELD TEST EQUIPMENT

VOLTOHMMETER I-166

Serial No.

Enter a check in the form below if the item has been found satisfactory.

ITEM	1	2	3	4	5	6
(1) Interior surfaces.						
(2) Selector switch.						
(3) OHMS ZERO ADJ. control.						
(4) Case.						

Enter a check in the form below if the action has been completed.

ITEM	1	2	3	4	5	6
(5) Unsatisfactory items brought to attention of communication officer.						
(6) Previously reported unsatisfactory items corrected.						

REMARKS:

Date Through Signature

Rating

13.2. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Electrolytic action takes place in resistors, coils, etc., causing eventual break-down.

(2) Capacitors break down when moisture is absorbed by the dielectric.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs.

(5) Moisture provides leakage paths between battery terminals.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture-and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-step Instructions for Treating Voltohmmeter I-166.

(1) PREPARATION.

(a) Make all repairs and adjustments necessary for the proper operation of the equipment.

(b) Clean all dirt, dust, rust, fungus, oil, grease, etc., from equipment to be processed.

(2) DISASSEMBLY.

(a) Remove cover by disengaging hinges.

(b) Remove four screws holding front panel to case. Remove panel assembly.

(c) Remove battery leads from battery.

(d) Remove battery from case.

(3) MASKING. Cover the following components with masking tape as shown in figures 7 and 8.

(a) Complete selector switch, item A, figure 7.

(b) Lugs on battery leads, item B, figure 7.

(c) Five pin jacks on front panel, item A, figure 8.

(4) DRYING.

(a) Place equipment in drying oven and bake at 160° F for 2 to 3 hours.

(b) If wax should begin to melt on any of the components, decrease the temperature and increase baking time approximately 1 hour for 10° drop in temperature.

(5) VARNISHING.

(a) Spray the equipment to be treated, including the inside of the case, with three coats of moistureproofing and fungi-proofing varnish. Let the equipment dry for 15 to 20 minutes after each coat.

(b) Using a brush, apply varnish to all positions not reached by the spray gun.

(6) REASSEMBLY.

(a) Remove masking tape.

(b) Inspect all contacts. If necessary, clean with varnish remover and burnish.

(c) Reassemble and test the operation of the unit.

(7) MARKING. Mark the case with "MFP" and the date of treatment.

EXAMPLE: MFP—8 June 1944.

CAUTION

This Equipment Has Been Treated With Fungus Resistant Lacquer.

Before Replacing Any Part Or Making Any Repairs, Clean Leads Involved Of All Coating Material.

Date Treated

AUGUST, 1944

Any Parts Or Wires Replaced, Added, Or Modified, Must Be Suitably Treated With Fungus Resistant Material.

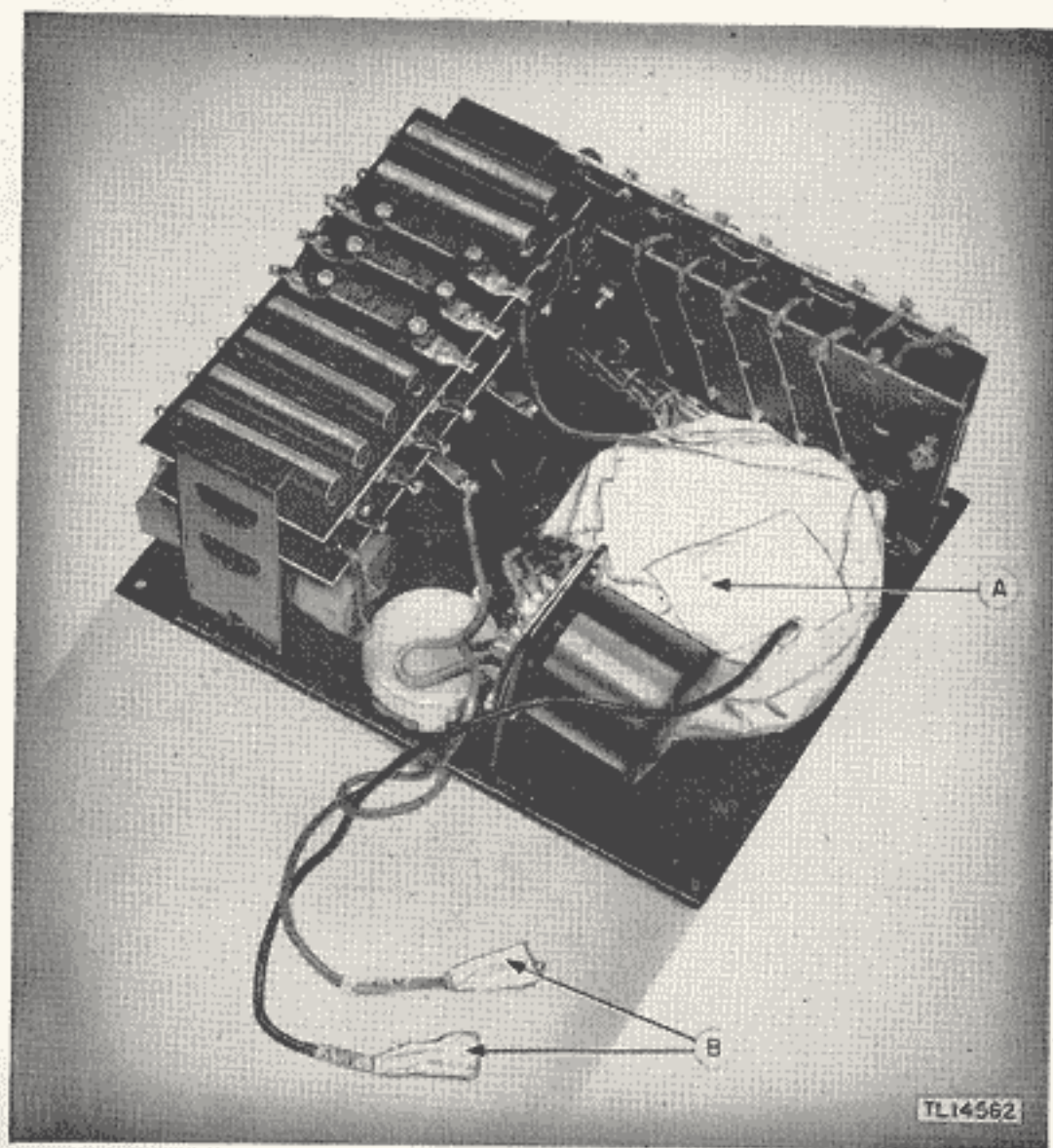


Figure 7. Volt ohmmeter I-166, bottom view, masking.

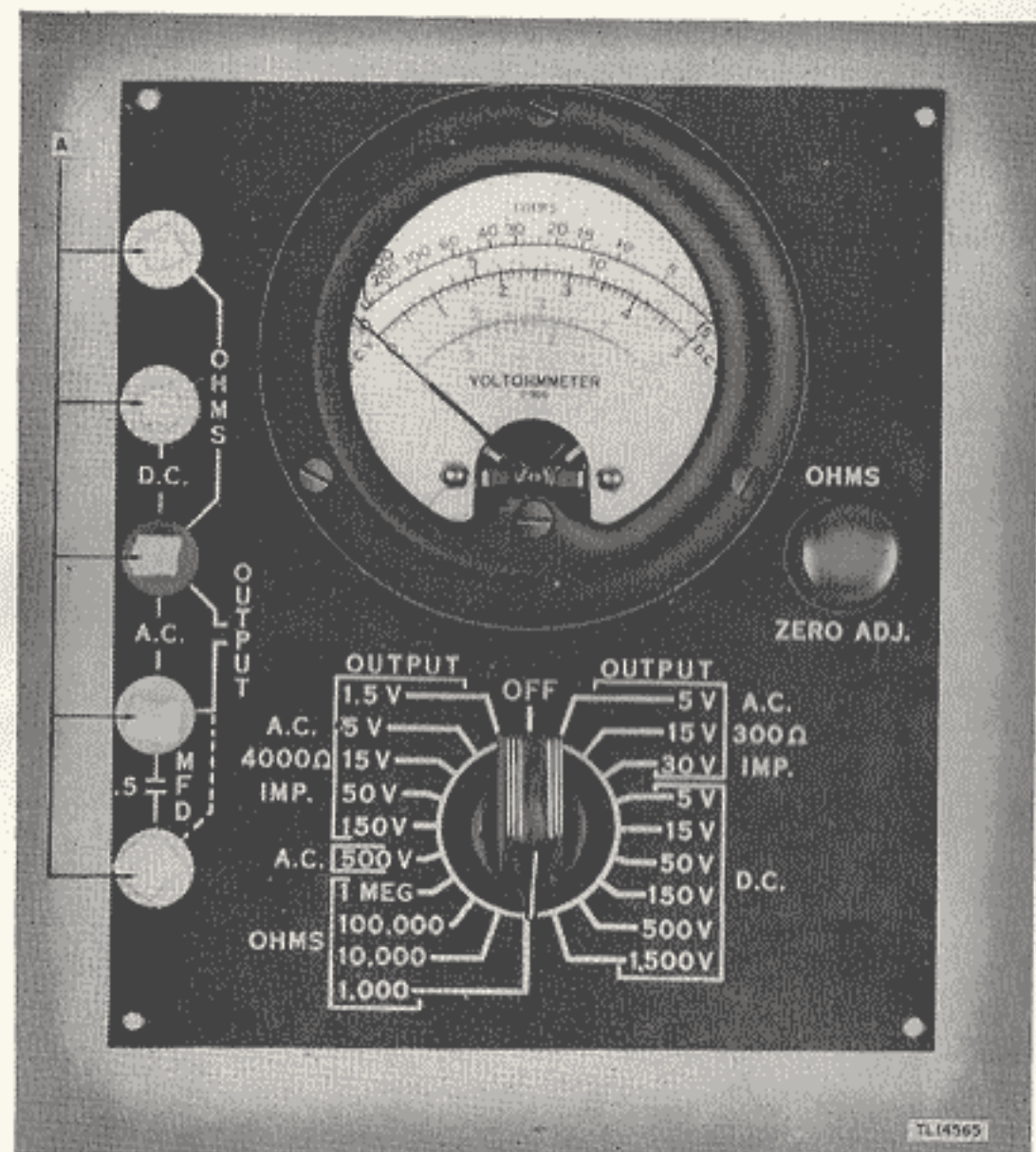


Figure 8. Volt ohmmeter I-166, top view, masking.