

KS-14510 METER

(PORTABLE VOLT-OHM-MILLIAMMETER)

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1. GENERAL

1.01 This section describes the KS-14510 meter (portable volt-ohm-milliammeter), and includes instructions for its use. It also describes the accessories available for use with the meter.

1.02 The KS-14510 meter is a small, portable meter for general maintenance use for the measurement of ac and dc voltages, dc current, and resistance. A carrying case and various test leads are available for the meter.

1.03 The KS-14510 meter is a multipurpose instrument intended to supersede the Western Electric Company M9B meter, which has been rated "Manufacture Discontinued."

2. CIRCUIT AND EQUIPMENT FEATURES

(A) KS-14510 Meter

2.01 The meter, illustrated in Fig. 1, is provided with the following ranges, available by means of a range switch:

DC Volts	AC Volts	DC Current	Resistance
0.3		0.06 ma (60 ua)	5000 ohms
3.0	3	1.2 ma	50,000 ohms
12.0	12	12.0 ma	500,000 ohms
60.0	60	120.0 ma	5 megohms
300.0	300		50 megohms
600.0	600		

2.02 The basic meter mechanism is of the permanent magnet moving coil type, having a sensitivity of 50 microamperes dc for full scale deflection. A combination of series and shunting resistors is provided to obtain the various ac, dc, and resistance ranges, resulting in an internal resistance (sensitivity) on all dc voltage ranges except the 0.3-volt range, of 20,000 ohms per volt. The latter range has a sensitivity of 16,666 ohms per volt. The sensitivity of all ac voltage ranges is 3000 ohms per volt.

2.03 The accuracy of the meter is  $\pm 2.0$  per cent of full scale for all dc voltage measurements and  $\pm 5.0$  per cent of full scale for all ac voltage measurements. The accuracy of the resistance measurements portion is  $\pm 2.0$  per cent at one half the pointer travel, or at "20" on the ohms scale. When measuring dc current, with the range switch in the 0.06 ma (60 ua) position, the resistance across the meter jack is 5000 ohms  $\pm 2$  per cent. With the range switch in the 1.2 ma, 12 ma, or 120 ma position the drop across the meter jacks is 150 millivolts, maximum.

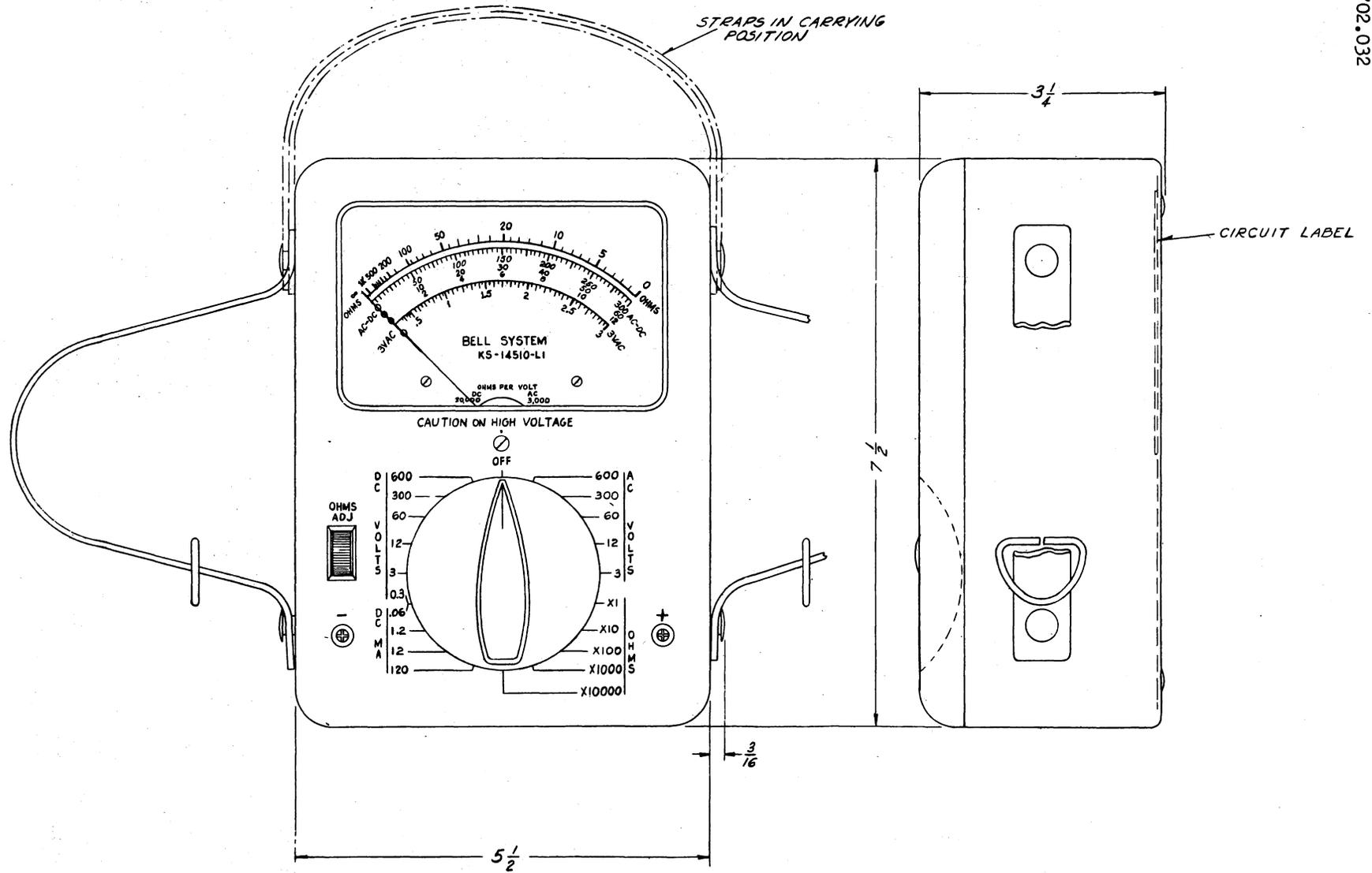


Fig. 1 - KS-14510 Meter

2.04 The list 5 meter is the same as the list 1 instrument except that, when the range switch on the former is set for 0.3-volt dc reading, the AC-DC scale is calibrated at the 0.275-volt point. This point is accurate within  $\pm 0.5$  per cent of full scale deflection when the meter is in a horizontal position, and the point is marked by a red division line extending below the AC-DC scale arc. This meter is intended for use at type 0 office or pole-mounted carrier repeater points using 130-volt heater supply.

2.05 There are five scales on the meter, as shown in Fig. 2. The top green scale is used when measuring resistance, and is marked 0 to 1K. With the switch knob turned to OHMS X 1, the ohms scale is read just as it is marked. With the switch knob turned to OHMS X 10, OHMS X 100, OHMS X 1000, or OHMS X 10,000, the values on the ohms scale must all be multiplied by the indicated multiplier, i.e., by 10, 100, 1000, or 10,000, respectively. The second or middle scale (black) is used to measure all dc voltages and currents and all ac voltages except the 0.3-volt range. This latter voltage is read on the bottom (red) scale.

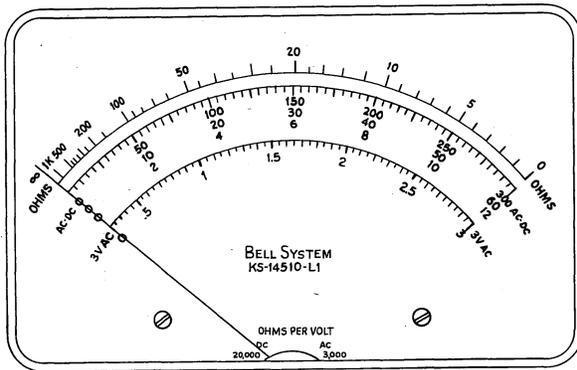


Fig. 2 - Scale

2.06 The meter is calibrated at the factory in a horizontal position, and the scale accuracies quoted herein are based on its use in this position. When used, it should be placed on a nonmagnetic surface, or bench free of magnetic influences and where it is not in a strong electromagnetic field.

2.07 External connections for all readings are made to two pin jacks marked "-" and "+", located to the left and right of the range switch. A copper oxide, four-disc, full-wave rectifier is provided for adapting the dc meter

movement for measuring ac voltages. This rectifier is automatically cut in when the range switch is moved to the "AC VOLTS" position.

2.08 For measuring resistance, a 1-1/2-volt battery and a 30-volt battery are required. A KS-6522 battery may be used for the former, but it is recommended that the new KS-14711 leak-proof battery be used instead. The 30-volt battery may be an Eveready 4L3, or equivalent. The common battery lead is fused with a one-half ampere fuse. A spare one-half ampere fuse is provided and mounted on clips inside of the meter case. Batteries are not furnished as a part of the meter, and must be ordered separately.

2.09 When the meter pointer can no longer be adjusted to zero when using the "OHMS X 1," "OHMS X 10", or "OHMS X 1000" ranges, the 1-1/2-volt battery should be replaced. When the pointer can no longer be adjusted to zero when using the "OHMS X 10,000" the 30-volt battery should be replaced. Access to the batteries or fuse may be had by removing the four screws in the bottom of the case and lifting the panel from the case.

2.10 List 1 or 5 of KS-14510 includes the meter and one pair each of test leads per lists 2 and 3, as described hereinafter. The list 5 meter is the same as the list 1 meter, except for the special calibration point on the AC-DC 3-volt scale, as described in Paragraph 2.04.

2.11 A schematic drawing of the meter circuit is shown in Fig. 3.

#### (B) Test Leads and Carrying Case

2.12 Following is a list of the test leads and carrying case available for use with the KS-14510 meter, and which may be obtained separately:

KS-14510, List 2 - One pair of test leads (one red and one black lead), each lead equipped with a test prod at one end and a connector at the other end.

KS-14510, List 3 - One pair of test leads (one red and one black lead), each lead equipped with an alligator clip at one end and a connector at the other end.

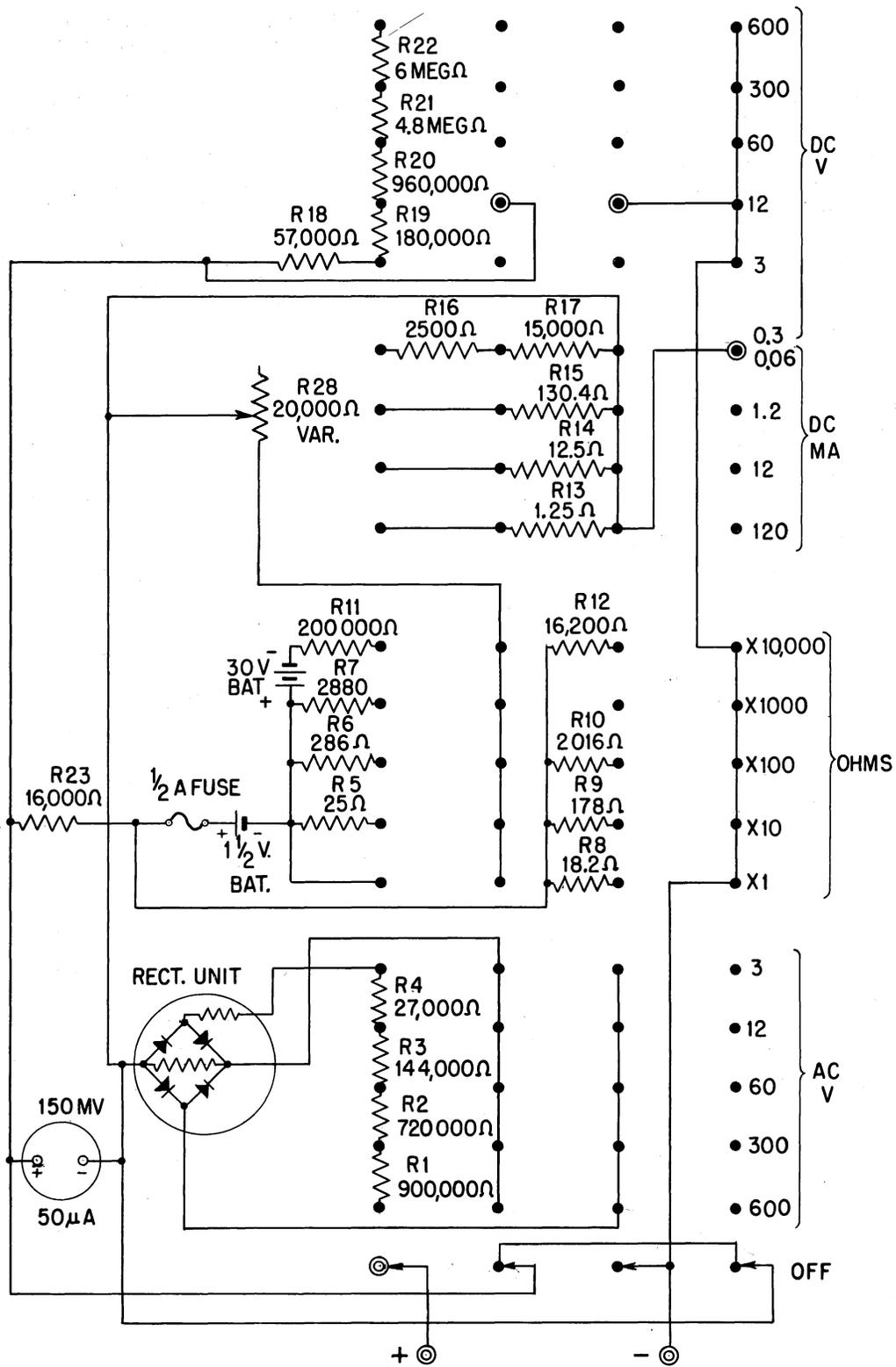


Fig. 3 - Meter Circuit

KS-14510, List 4 - Carrying case for KS-14510 meter.

KS-14510, List 6 - One pair of test leads, with a red lead equipped with a test prod at one end and a connector at the other, and a black lead equipped with a test clip at one end and a connector at the other.

KS-14510, List 7 - One test prod.

KS-14708, List 1 - One pair of 12-kilovolt test leads, one with a red hard rubber covered flexible "high" lead equipped with a high-voltage probe and self-contained 240-megohm ( $\pm 2\%$ ) resistor at one end and a spring-type safety meter connector at the other, and a second or "low" lead of black medium rubber covered flexible lead equipped at one end with a substantial test clip capable of providing a firm grip on a grounded chassis and with a KS-14530 meter connector at the other end.

KS-14709, List 1 - One pair of 3-kilovolt test leads, one with a red medium rubber covered flexible "high" lead equipped with a 3-kilovolt probe and self-contained 60-megohm ( $\pm 1\%$ ) resistor at one end, and the second a black medium rubber covered flexible "low" lead equipped with a substantial test clip at one end. The meter ends of both leads are equipped with KS-14530 meter connectors.

KS-14530 - Meter connector.

KS-13632, List 1 - Meter carrying strap.

2.13 The meter case is equipped with two recessed pin terminals and the meter ends of all test leads are equipped with fully insulated socket-type connectors. In case the leads are attached to a voltage source and become detached from the meter for any reason, the possibility of shock from handling the loose ends of the leads is virtually eliminated.

2.14 The test prod furnished with KS-14510, List 2 is the conventional type of test pick, with a black hard rubber handle and an exposed brass nickel-plated needle-pointed terminal pin.

2.15 The test prod furnished with KS-14510, List 6 or List 7 is a metallic rod surrounded by a retractable spring-loaded insulated tube and attached to an insulating handle. Under conditions of normal use, the inner point of the metallic rod is covered by the insulated tube, thereby preventing undesired contacting. The use of this test prod is recommended for all voltage-to-ground measurements or where, due to the close proximity of wires, lugs, etc, the use of such a test prod might prove advantageous.

2.16 The KS-14708 and KS-14709 test leads are provided for making high-voltage measurements on video monitors, video A scopes, stationary main radio transmitters used in Mobile Radio Systems and the like.

2.17 The KS-14708 test leads are used for extending the 3-volt dc range of the KS-14510 meter to 12,000 volts. The tip end of the high-voltage probe can be hooked over a high-voltage bus or stud by means of a cylindrical slip-on coiled spring arrangement associated with the contacting tip. If it is desired to make high-voltage contact with the plain tip, the spring can be readily removed by twisting in a direction to unwind its grip and slipping it off the tip.

2.18 The safety connector on the meter end of the 12-kilovolt probe of the KS-14708 test leads is to protect personnel against contact hazard and employs a retractable insulating guard tube. It is designed for a minimum air sparking distance of one inch from the inner high-voltage parts to the outside.

2.19 The KS-14709 test leads are used for extending the 3-volt dc range of the KS-14510 meter to 3000 volts.

2.20 The list 4 carrying case is constructed of black leather, is padded on the inside with sponge rubber, and is equipped with a carrying strap.

### 3. OPERATION

#### (A) Precautions

3.01 The KS-14510 meter is a precision instrument and, although ruggedly constructed, may be seriously damaged or burned out if improperly used.

3.02 The meter should be placed in a horizontal position when in use. It should not rest on a magnetic surface or other location where it might be subject to magnetic influence.

3.03 When making resistance measurements, the operator should make sure that the unit or circuit being measured does not include a source of either ac or dc power which might damage the meter movement or meter resistances.

3.04 When making either current or voltage measurements, the range switch should be placed in the proper position before making contact with the test probe or clips to the circuit to be measured. If there is any doubt as to the approximate value of the voltage or current to be measured, the range switch should be set to the highest value for the initial test, and decreased step by step until the proper scale range is reached.

3.05 Ordinary voltage-to-ground measurements should, in general, be made with the list 6 test leads, with the test prod connected to the "high" side of the test meter and the "low" side connected to ground or to the chassis or frame of the equipment under test by means of the test clip provided.

#### (B) Preparation

3.06 Before making voltage or current measurements, check that the pointer of the meter lines up exactly with the zero marks on the ac and dc scales. The zero position of the pointer can be adjusted by turning slightly the adjusting screw, located immediately below the meter scale and above the range switch, with a small screwdriver.

3.07 The proper test leads should be selected for the particular measurement to be made, and connections made at the meter. The proper setting of the range switch should be made before making contact with the potential or current to be measured.

3.08 When using the KS-14708 12-kilovolt test leads, the safety connector is connected to the meter by first thrusting the small open-ended insulating guard tube into the "high" connecting point recess, thereby completely closing off the inner high-voltage parts. The body of the connector is then further pressed toward the meter, in opposition to an internal spring, until the guard tube rests against the bottom of the recess and the lower end of the connector outer barrel is against the meter face. The inner metallic contacting detail is

then under pressure contact with the male meter connector and can be held in this position for use by raising the side of the meter slightly and permitting the foot of the L detail to swing under the meter to hold the spring connector in position. In order to disconnect the "high" lead, the L detail must be swung out from under the meter.

#### (C) Scales

3.09 The meter scales are illustrated in Fig. 2. A familiarity with these scales and their relation to the ranges controlled by the range switch is desirable. The 0.3- and 3.0-volt dc ranges and the 300-volt dc-ac ranges should all be read on the 0-300 scale, and the 600-volt dc-ac ranges on the 0-60 scale, using decimals as appropriate for the 0.3- and 3.0-volt ranges, and multiplying all readings by 10 for the 600-volt range. Thus a reading of 100 on the 0-300 scale would indicate 0.1 volt with the range switch on 0.3-volt range, and 1.0 volt with the switch on the 3.0-volt range. A reading of 20 on the 0-60 scale would indicate 200 volts on the 0-600-volt range. The ohms scale is read as indicated in Paragraph 2.05.

3.10 When using the KS-14709 3-kilovolt test leads, the meter switch is set for the 3-volt dc range and the results are read on the 300-volt scale as a 3000-volt scale. When using the KS-14708 12-kilovolt test leads, the meter switch is set for the 3-volt dc range and the results are read on the 12-volt scale as a 12,000-volt scale.

#### (D) Voltage Measurements

3.11 Connect the test leads to the meter, using the red lead as the positive conductor. Whenever possible, it is desirable to use the test leads equipped with alligator clips or, preferably, the KS-14510, List 6 test leads with the test prod on the positive or nongrounded lead and a clip on the negative or grounded lead. Thus, one, or both, test leads may be firmly attached to the unit to be measured.

Caution: If the approximate voltage is not known, start with the highest (600-volt) range and if the reading is less than 300 volts, change the switch to the 300-volt scale. If the reading on this scale is less than 60 volts, change the switch to the 60-volt scale. The same method should be followed on the other voltage scales.

3.12 Where polarity is difficult to determine, the meter may attempt to read backwards. In this case, simply reverse the leads at the unit being measured. The meter will not be damaged by such a reversal, if the potential applied to the meter does not exceed the scale range in use.

(E) Current Measurements

3.13 Set up the meter and test connections as for voltage readings. Do not test directly across a potential source (battery to ground) as this may burn out the meter element.

3.14 In reading the 60-microampere range, the meter may read differently than calculations may indicate. This is sometimes caused in low current circuits by a slight leakage of voltage due to moisture. Other times a slight current is generated by joining of dissimilar metals. The fingers should not be permitted to touch the metal part of the prods or clips, as body resistance can also upset some circuits.

(F) Resistance Measurements

3.15 Connect the test leads to the meter. Rotate the range switch to the appropriate range for ohms determined from the following chart.

<u>To Read</u>	<u>Set Switch to</u>
0-5000 ohms	OHMS X 1
0-50,000 ohms	OHMS X 10
0-5 megohms	OHMS X 1000
0-50 megohms	OHMS X 10,000

3.16 Short the test prods or test clips together and adjust the ADJ knob until the meter pointer reads zero on the top green (ohms) scale. (The zero for the ohms scale is at the extreme right side of the scale.)

3.17 Connect the test prods or clips across the resistor to be measured. If the resistor is wired into a circuit, one end should be disconnected before taking a reading.

3.18 All meter readings should be multiplied by the multiplier on the range switch, i.e., 1, 10, 1000, or 10,000.

3.19 The resistance scale is nonuniform (non-linear) and the meter pointer moves farther for a particular value of resistance when

over the right side of the scale than when over the left side. Therefore, greater accuracy of reading results when the scale is selected which as far as possible keeps the pointer near the middle range of its swing.

3.20 The current drains at zero reading on the ohms scale for each switch position are as follows:

<u>Switch Position</u>	<u>Current Drain</u>
X 1	75.0 ma
X 10	7.5 ma
X 100	0.75 ma
X 1000	0.075 ma
X 10,000	0.150 ma

(G) Capacitor Leakage Tests

3.21 When used to measure capacitor leakage, the meter is set up as for resistance measurements with the range switch on the X 10,000 position. When checking paper or mica capacitors the poling of the test leads at the capacitor terminals is of no significance. However, when checking electrolytic capacitors, the black (negative) test lead should be connected to the positive terminal of the capacitor, and the red (positive) test lead to the negative capacitor terminal.

3.22 A good paper or mica capacitor of less than 1mf capacitance should read 100 megohms or more. Good paper capacitors of more than 1 mf capacitance may read somewhat less than 100 megohms. Good electrolytic capacitors should read above 100,000 ohms. These are steady state readings, taken after the initial surge caused by the charging of the capacitor.

4. MAINTENANCE

(A) Meter Accuracy

4.01 No regular routine accuracy tests are required but it is recommended that both dc and ac scales be occasionally checked against meters of known accuracy. The permissible error for all dc scales, except as outlined in Paragraph 2.04, is 2 per cent and for all ac scales is 5 per cent. The ohmmeter portion of the meter may be checked by measuring various resistors of known value.

(B) Battery Replacement

4.02 The 1-1/2-volt battery is used for resistance measurements on all scales except X 10,000, which uses the 30-volt battery.

These batteries should be replaced when the meter pointer can no longer be adjusted to zero, as described in Paragraph 2.09.

4.03 To replace batteries, remove the four screws in the bottom of the meter case and lift the meter panel from the case. Lift the top spring contact above each battery, remove the old cells and replace with new units being careful to observe the correct polarity.

4.04 The common battery lead is fused with a 1/2-ampere type 8AG 250-volt instrument fuse. In case of failure of all resistance scales, this fuse should be checked for continuity before replacing the batteries.

## 5. REPAIR

### (A) General

5.01 The replacement of parts in the field, other than replacement of batteries, is not recommended since the calibration of the meter may be affected by variations in replacement parts. The instrument should be returned through the usual channels for repair and calibration. However, for use in case of an emergency, the values of all resistors are shown on the circuit drawing, Fig. 3. All resistors are "Carbofilm" (Aerovox Corp.) one-half watt type, with a tolerance of  $\pm 1$  per cent. If repairs are made in the field, the location of parts and wiring leads, or the length of wiring leads, should not be changed, as the meter calibration may be affected.