KS-14510 METER
(PORTABLE VOLT-OHM-MILLIAMMETER)
DESCRIPTION AND APPLICATION

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1. GENERAL

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

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to emphasize the more significant changes. The Equipment Test List is not affected.

(1) To rate the KS-14510, L2, L3, L6, L7, L8, and L10, Leads Mfr Disc.

(2) To rate the KS-14510, L4, Carrying Case Mfr Disc.

(3) To add the KS-14510, L12, Leads.

(4) To add the KS-14510, L13, Alligator Clips.

1.03 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.

1.04 The KS-14510 meter is a multipurpose instrument intended to supersede the Western Electric Company M9B meter which has been rated Mfr Disc.

1.05 ▶The KS-14510, L1 and L5, meters are now rated Mfr Disc. They are replaced by the KS-14510, L11, meter.◀

1.06 The KS-14510, L11, meter is provided by three different manufacturers. One by Weston Instruments, Inc, is their modified Model 671; one by Simpson Electric Company is their modified Model 260; and one by Triplett Instrument Company is their modified Model 60.

2. CIRCUIT AND EQUIPMENT FEATURES

A. KS-14510, L1 or L5, Meter (Mfr Disc.)

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)	1000 ohms
3.0	3	1.2 mA	10,000 ohms
12.0	12	12.0 mA	100,000 ohms
60.0	60	120.0 mA	1 megohm
300.0	300		10 megohms
000.0	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.

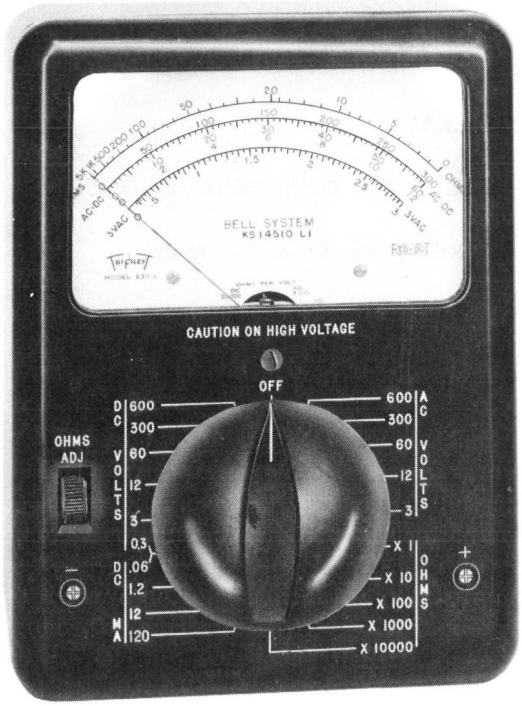


Fig. 1—KS-14510, L1 (Mfr Disc.), Meter

2.03 The accuracy of the meter is ±2.0 percent of full scale for all dc-voltage measurements and ±5.0 percent of full scale for all ac-voltage measurements. The accuracy of the resistance measurements portion is ±2.0 percent 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 ±2 percent. 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.

2.04 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 to 10,000, the values on the

ohms scale must all be multiplied by the indicated multiplier; ie, 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 3-volt range. This latter voltage is read on the bottom (red) scale.

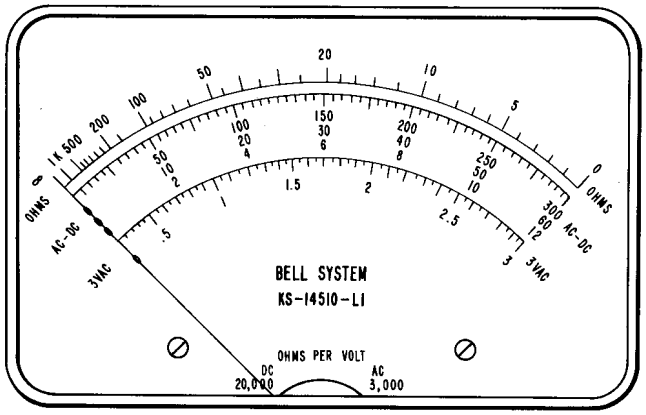


Fig. 2—Scale—KS-14510, L1

2.05 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 or where it is not in a strong electromagnetic field.

2.06 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, 4-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.

2.07 For measuring resistance, a 1-1/2 volt battery and a 30-volt battery are required. A KS-14711 battery, or its equivalent, may be used for the former. The 30-volt battery may be an Eveready 413, or equivalent. The common battery lead is fused with a 1/2-ampere fuse. A spare 1/2-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.

2.08 If 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. If 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.

2.09 The KS-14510, L1 or L5 (Mfr Disc.), includes the meter and one pair each of test leads per L2 and L3 (Mfr Disc.), as described herein. The L5 (Mfr Disc.) meter is the same as the L1, (Mfr Disc.) meter 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 ±0.5 percent 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.

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

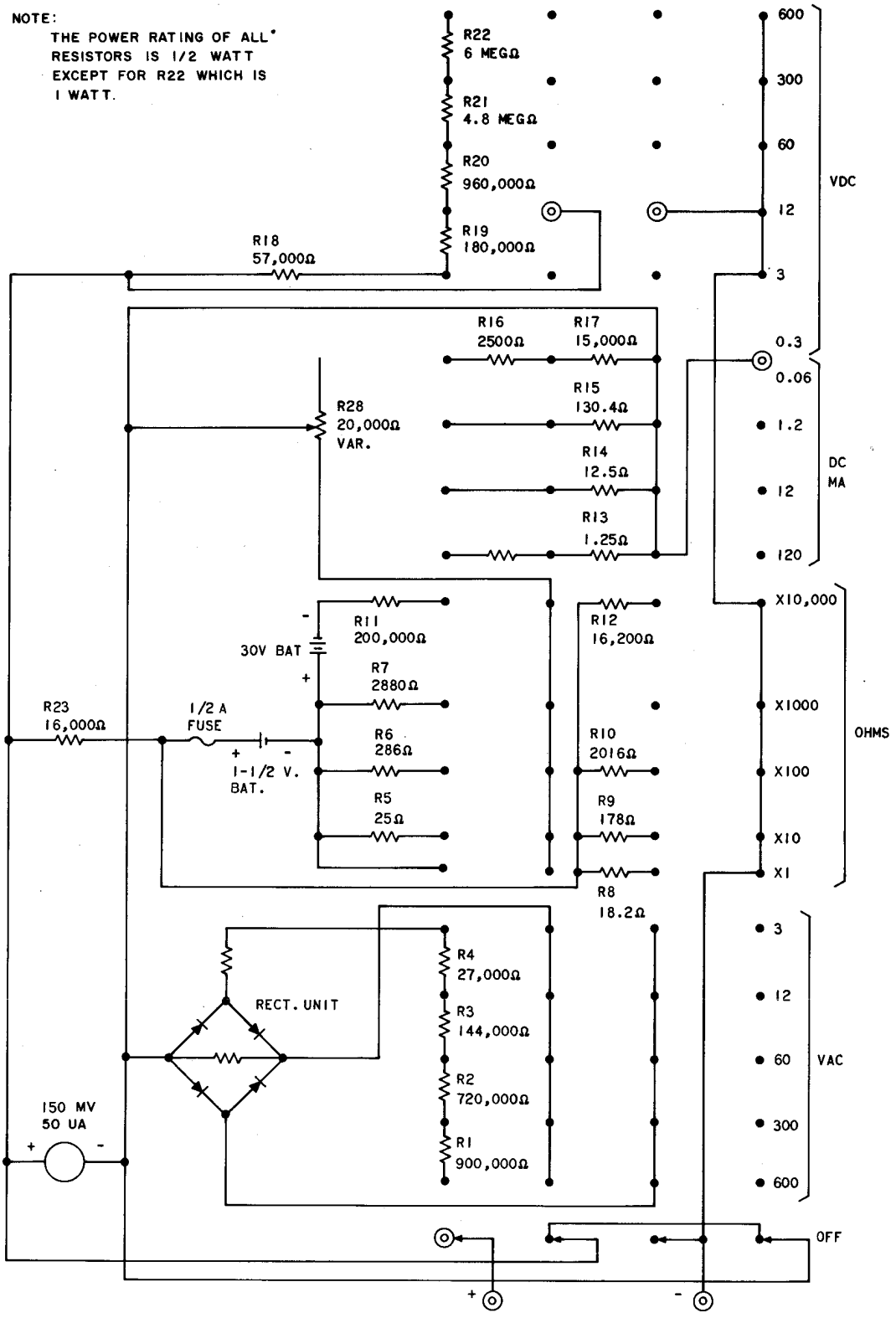


Fig. 3—KS-14510, L1 or L5 (Mfr Disc.), Meter Circuit

B. KS-14510, L11 Meter

2.11 The meter, illustrated in Fig. 4, 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)	1000 ohms
3.0	3	1.2 mA	10,000 ohms
12.0	12	12.0 mA	100,000 ohms
60.0	60	120.0 mA	1 megohm
300.0	300		10 megohms
600.0	600		

2.12 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.

2.13 The case for the VOM is color coded in Bell pastel yellow with a Bell blue range plate.

2.14 The new high impact case material, ruggedized mechanism, and internal components are highly resistant to rough handling. However, continued care in handling is recommended. Devices subject to severe shock should be checked for calibration, even if there is no physical damage.

2.15 The accuracy of the meter is ±2.0 percent of full scale for all dc-voltage measurements and ±5.0 percent of full scale for all ac-voltage measurements. When the range switch 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 ±0.5 percent 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. The accuracy of the resistance measurements portion is ±2.0 percent 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 ±2 percent. 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. 4—KS-14510, L11, Meter—Simpson Unit

2.16 There are five scales on the meter as shown in Fig. 5. 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 to 10,000, the values on the ohms scale must all be multiplied by the indicated multiplier; ie, 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 3-volt range. This latter voltage is read on the bottom (red) scale.

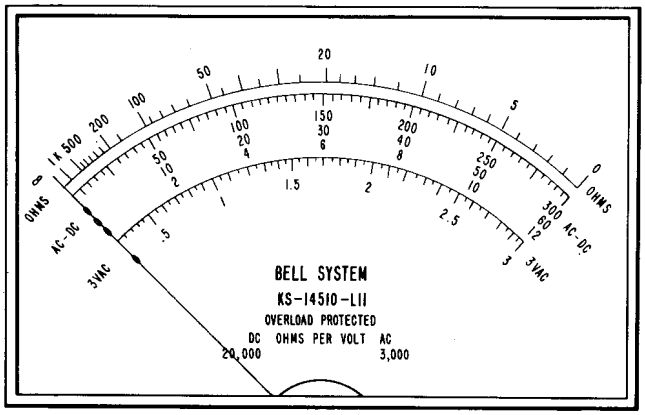


Fig. 5—Scale—KS-14510, L11

2.17 Approximately 2000 KS-14510, L11, meters manufactured by Weston Instruments, Inc, have been shipped to the field with an ohms scale reading to 2K. Future instruments will conform to Fig. 5. It should be noted that the function switch arrangement of Weston manufactured instruments is different from those of the other manufacturers.

2.18 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 or where it is not in a strong electromagnetic field.

2.19 External connections for all readings are made to two pin jacks marked "-" and "+", located to the left and right of the range switch. Semiconductor diode rectifiers are 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.

2.20 The symbol "Ω" next to "-" indicates that in the ohmmeter function, positive internal battery voltage will be applied at this terminal. The negative internal battery voltage will be applied at the "+" input terminal. For measuring resistance, a 1-1/2 volt battery, KS-14711, or equivalent, is required. In addition, 30 volts of battery voltage are required to operate the X 10,000 range. The Triplett unit requires a 30-volt battery, Eveready 413, or equivalent. The Weston and Simpson units require two 15-volt batteries, Eveready 411, or equivalent. The common battery lead is fused with a 1/2-ampere fuse. A spare 1/2-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.

2.21 If the meter pointer can no longer be adjusted to zero when using the OHMS X 1, OHMS X 10, OHMS X 100, or OHMS X 1000 ranges, the 1-1/2 volt battery should be replaced. If the pointer can no longer be adjusted to zero when using the OHMS X 10,000, the 30-volt battery, or two 15-volt batteries, 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.

2.22 The L11 of KS-14510 includes the meter, appropriate carrying case, and one pair of test leads per KS-14510, L12.

2.23 A schematic drawing of each meter circuit is shown in Fig. 6, 7, and 8.

C. Test Leads and Carrying Case

2.24 The following is a list of the test lead and carrying cases that are used with the KS-14510, L11, meter:

(a) ***KS-14510, L2 (Mfr Disc.):*** 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. Replaced by the KS-14510, L12, Fig. 9.

(b) ***KS-14510, L3 (Mfr Disc.):*** 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. Replaced by the KS-14510, L12, equipped with an L13 clip, Fig. 10.

(c) ***KS-14510, L4 (Mfr Disc.):*** This carrying case has no "KS" replacement.

(d) ***KS-14510, L6 (Mfr Disc.):*** 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 an alligator clip at one end and a connector at the other. Replaced by the KS-14510, L12 lead, equipped with an L13 clip, Fig. 11.

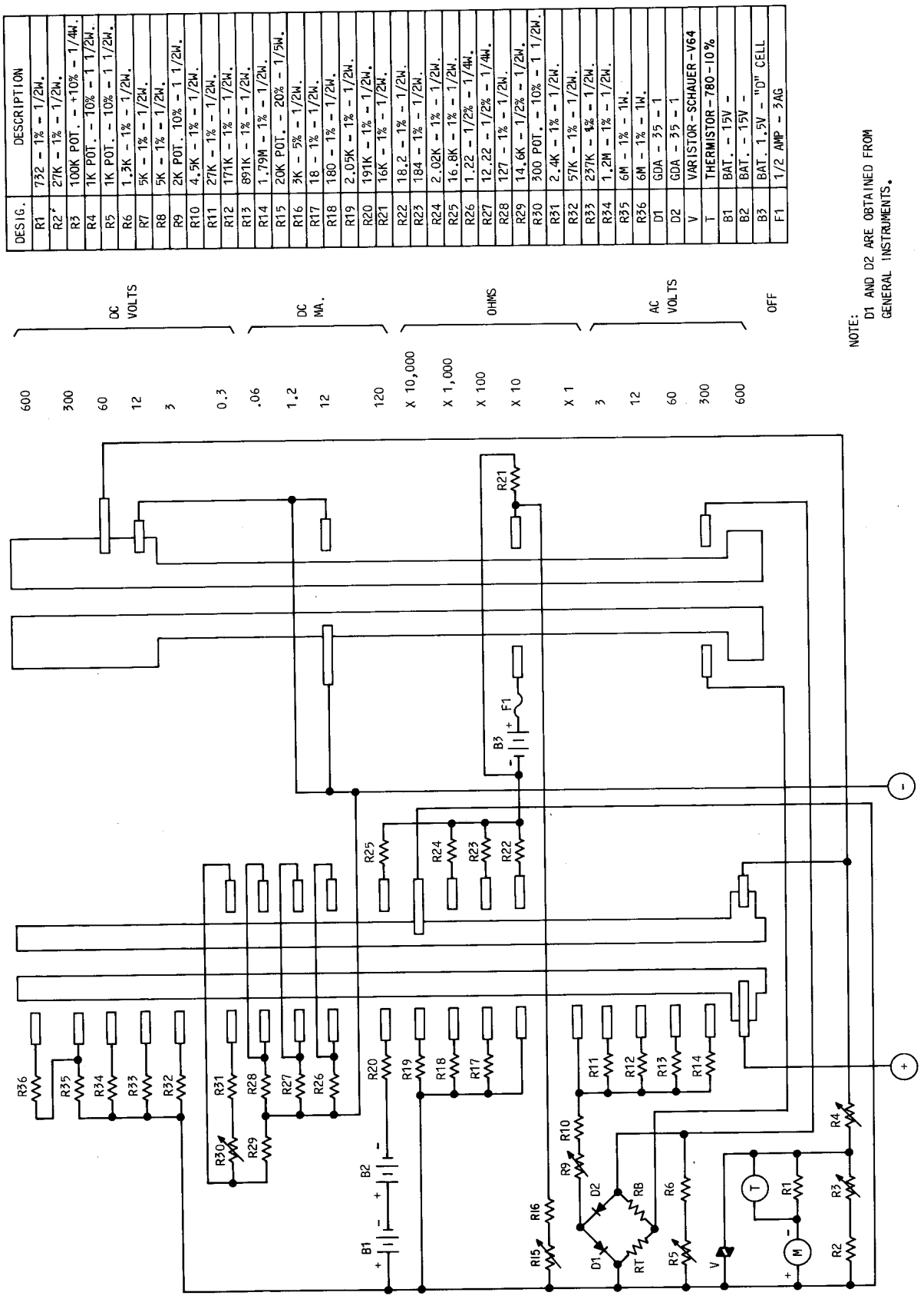
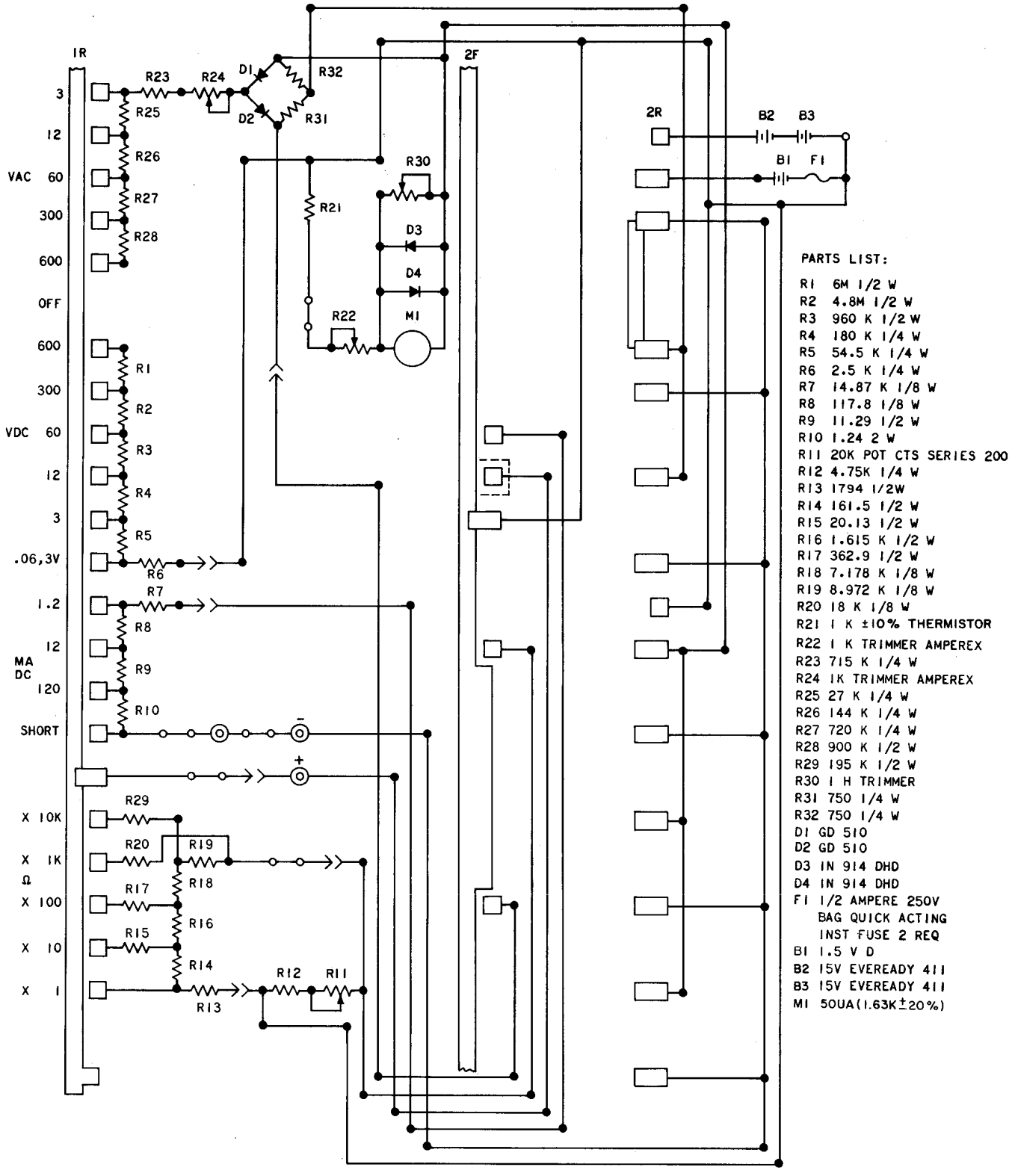


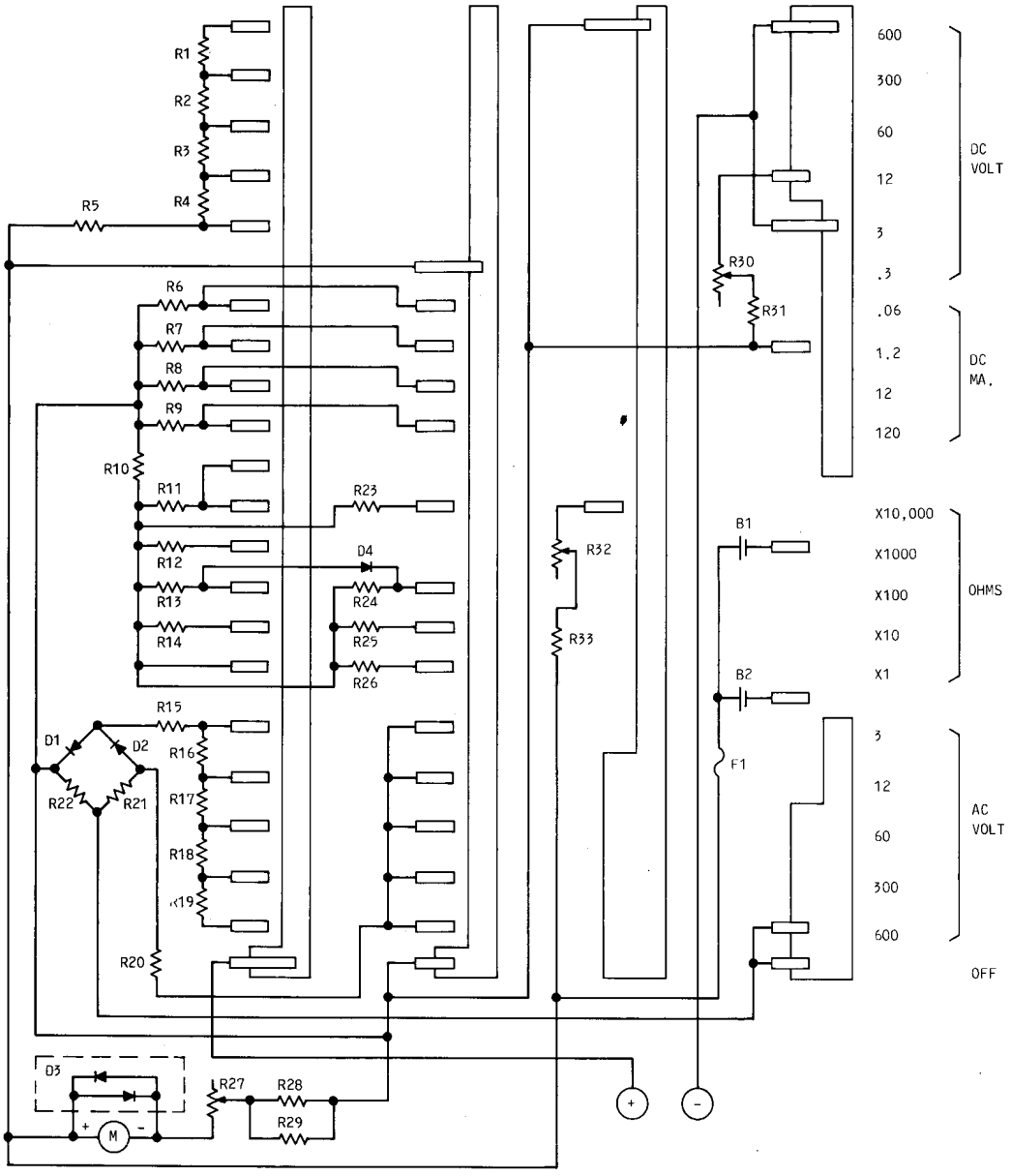
Fig. 6—Meter Circuit—Simpson Unit



PARTS LIST:

R1 6M 1/2 W
R2 4.8M 1/2 W
R3 960 K 1/2 W
R4 180 K 1/4 W
R5 54.5 K 1/4 W
R6 2.5 K 1/4 W
R7 14.87 K 1/8 W
R8 117.8 1/8 W
R9 11.29 1/2 W
R10 1.24 2 W
R11 20K POT CTS SERIES 200
R12 4.75K 1/4 W
R13 1794 1/2W
R14 161.5 1/2 W
R15 20.13 1/2 W
R16 1.615 K 1/2 W
R17 362.9 1/2 W
R18 7.178 K 1/8 W
R19 8.972 K 1/8 W
R20 18 K 1/8 W
R21 1 K ±10% THERMISTOR
R22 1 K TRIMMER AMPEREX
R23 715 K 1/4 W
R24 1K TRIMMER AMPEREX
R25 27 K 1/4 W
R26 144 K 1/4 W
R27 720 K 1/4 W
R28 900 K 1/2 W
R29 195 K 1/2 W
R30 1 H TRIMMER
R31 750 1/4 W
R32 750 1/4 W
D1 GD 510
D2 GD 510
D3 IN 914 DHD
D4 IN 914 DHD
F1 1/2 AMPERE 250V
BAG QUICK ACTING
INST FUSE 2 REQ
B1 1.5 V D
B2 15V EVEREADY 411
B3 15V EVEREADY 411
M1 50UA(1.63K±20%)

Fig. 7—Meter Circuit—Weston Unit



DESIG.	DESCRIPTION
R1	6 MEG. - 1% - 1/2 W.
R2	4.8 MEG. - 1% - 1/2 W.
R3	960K - 1% - 1/2 W.
R4	178K - 1% - 1/2 W.
R5	57K - 1% - 1/2 W.
R6	15K - 1% - 1/2 W.
R7	130.4 - 1/2% - 1/4 W.
R8	12.55 - 1% - 1/4 W.
R9	1.25 - 1/2% - 1/4 W.
R10	16K - 1% - 1/4 W.
R11	200K - 1% - 1/4 W.
R12	2.88K - 1% - 1/4 W.
R13	287 - 1% - 1/2 W.
R14	24.90 - 1% - 1/2 W.
R15	4.22K - % - 1/8 W.
R16	27 K - 1% - 1/2 W.
R17	144K - 1% - 1/2 W.
R18	720K - 1% - 1/2 W.
R19	900K - 1% - 1/2 W.
R20	16.9K - 1% - 1/4 W.
R21	4.99K - 1% - 1/4 W.
R22	4.99K - 1% - 1/4 W.
R23	16.2K - 1% - 1/2 W.
R24	2016 - 1% - 1/2 W.
R25	185 - 1% - 1/2 W.
R26	19 - 1% - 1/2 W.
R27	500 POT. - 1 1/2 W.
R28	1.4K - 1% - 1/4 W.
R29	3K - 1% - 1/4 W.
R30	500 POT. - 1 1/2 W.
R31	2370 - 1% - 1/4 W.
R32	10K POT. - 1/2 W.
R33	2.2K - 5% - 1/4 W.
D1	DIODE
D2	DIODE
D3	VARISTOR - SCHAUER - V64
D4	6.2 V. ZENER
F1	1/8 AMP. - 8 AG
B1	30 V. BAT. - NEDA. 210
B2	1.5 V. BAT. - "D" CELL

Fig. 8—Meter Circuit—Triplett Unit

(e) ***KS-14510, L7 (Mfr Disc.):*** This lead is replaced by the KS-14510, L12, black test lead, Fig. 12.

(f) ***KS-14510, L8 (Mfr Disc.):*** One pair of test leads, (one red and one black), each equipped with a test prod at one end and a connector at the other end: Replaced by the KS-14510, L12 lead, Fig. 9.

(g) ***KS-14510, L9 (Mfr Disc.), Carrying Case:*** This case has no "KS" replacement.

(h) ***KS-14510, L10 (Mfr Disc.):*** One pair of test leads, (one red and one black), each equipped with a test prod at one end and a connector at the other end. Replaced by the KS-14510, L12 lead, Fig. 9.

(i) ***KS-14510, L12, Test Leads:*** The KS-14510, L12, leads are a pair of red and black colored leads, approximately 50 inches long and equipped with recessed insulated jacks at one end and threaded test prods at the other end. In addition, these leads may be provided

Fig. 9—KS-14510, L12—Without Alligator Clips Attached

with insulated, screw-on alligator clips (KS-14510, L13) which attach to the threaded test prod end. The options are as follows:

(1) 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. (See Fig. 9.)

(2) One pair of test leads (one red and one black lead), each lead equipped with an L13 alligator clip at one end and a connector at the other end. (See Fig. 10).

(3) 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 an L13 alligator clip at one end and a connector at the other. (See Fig. 11).

(4) A black lead equipped with a test prod on one end and a connector on the other end. (See Fig. 12.)◀

Fig. 10—KS-14510, L12—With Alligator Clips Attached

(j) ▶***KS-14510, L13:*** Two insulated screw-on alligator clips (one red and one black lead), which attach to the threaded test prod end, and are used with some List 12 arrangements. (See Fig. 13).◀

(k) ▶***KS-14510, L101, L102, L103, Carrying Cases:*** The carrying case material is virgin or processed leather, vinyl or approved equivalent. It is black in color. The strap is attached to the L11 volt-ohm meter such that it can be carried in the top up position without the carrying case.

- KS-14510, L101, Carrying Case is used with the Weston Meter.
- KS-14510, L102, Carrying Case is used with the Simpson Meter.

Fig. 11—KS-14510, L12—With Alligator Clips Attached to Black Lead Only

- KS-14510, L103, Carrying Case is used with the Triplett Meter.

(k) ***KS-14708, L1:*** 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 (±2 percent) resistor at one end and a spring-type safety meter connector at the other; and the second a black, medium rubber-covered flexible "low" 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.

(l) ***KS-14709, L1:*** 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 (±1 percent) 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.

Fig. 12—KS-14510, L12—One Black Test Lead

(m) ***KS-14530:*** Meter connector.

(n) ***KS-13632, L1:*** Meter carrying strap.

2.25 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.

2.26 The test prods furnished as part of the KS-14510, L2, test leads are the conventional type of test picks with black and red insulated handles and exposed brass, nickel-plated, needle-pointed terminal pins.

2.27 The test prod furnished with KS-14510, L6 or L7, is a metallic rod surrounded by a

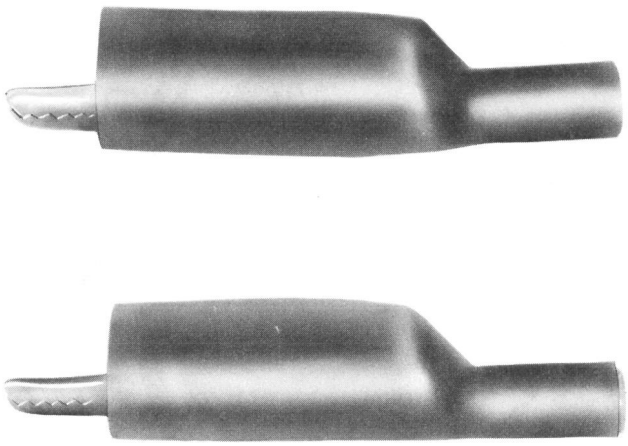


Fig. 13—KS-14510, L13—Alligator Clips

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.

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

2.29 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.

2.30 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 1 inch from the inner high-voltage parts to the outside.

2.31 The KS-14709 test leads are used for extending the 3-volt dc range of the KS-14510, L11, meter to 3000 volts.

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 any 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. When troubleshooting semiconductors, use the X 1000 range and observe the proper internal battery polarity. The positive battery terminal is indicated by "Ω."

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 L6 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.

3.06 The plastic window on the L11 meter is subject to static charge buildup. This condition can result in erroneous readings. The window should be treated periodically with an antistatic solution. The frequency of treatments depends on the local climate conditions. To test for a static charge condition, rub the window vigorously with a dry piece of cotton. If the window requires treatment, the pointer will remain deflected for a protracted period of time.

B. Preparation

3.07 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 with a small screwdriver. The adjusting screw is located immediately below the meter scale and above the range switch.

3.08 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.

3.09 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

3.10 The meter scales are illustrated in Fig. 5. A familiarity with these scales and their relation to the ranges controlled by the range switch are 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 2.16.

3.11 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

3.12 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, L6 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.

> ***Warning: 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.***

3.13 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

3.14 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.

3.15 In reading the 60-UA 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

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

TO READ	SET SWITCH TO
0-1000 ohms	Ohms × 1
0-10,000 ohms	Ohms × 10
0-100,000 ohms	Ohms × 100
0-1 megohm	Ohms × 1,000
0-10 megohms	Ohms × 10,000

3.17 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.)

3.18 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.

3.19 All meter readings should be multiplied by the multiplier on the range switch; ie, 1, 10, 100, 1000, or 10,000.

3.20 The resistance scale is nonuniform (nonlinear), 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.

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

SWITCH POSITION	CURRENT DRAIN
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

3.22 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.

3.23 A good paper or mica capacitor of less than 1 UF capacitance should read 100 megohms or more. Good paper capacitors of more than 1 UF 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 2.05 is 2 percent, and for all AC scales is 5 percent. 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 or two 15-volt batteries. These batteries should be replaced when

the meter pointer can no longer be adjusted to zero.

4.03 To replace batteries on units employing Fiberite cases (black), remove the four screws in the bottom of the meter case and lift the meter panel from the case. On units employing pastel blue- and yellow-colored cases, remove the screw that holds the battery compartment cover. In either unit, 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, buss-type, 250-volt instrument fuse. A spare 1/2-ampere fuse is mounted in clips on the inside of the meter panel. In the case of failure of all resistance scales, the fuse should be checked for continuity before replacing the battery. Check for possible damage to ohmmeter ranging resistors by measuring known resistors.

5. REPAIR

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, 6, 7, and 8. All resistors are precision wire wound or metal film resistors with a tolerance of ±1 percent. Refer to circuit drawings for wattage. 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.