Warranty

SIMPSON ELECTRIC COMPANY's warranty covering instrument and other articles of equipment manufactured shall be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which, [illegible] after delivery of such instrument or other article of equipment to the original purchaser, shall be returned to the factory or one of its authorized service agencies, transportation charges prepaid, and which shall examination to be in its satisfaction to have been thus defective. This warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any instrument or other article of equipment which has been repaired or altered outside the SIMPSON's factory or authorized service agencies, in any way so as, in the judgment of the factory, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident, nor which has been connected or used otherwise than in accordance with instructions furnished by the manufacturer.

SIMPSON ELECTRIC COMPANY
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OPERATOR'S MANUAL

Courtesy of :
Simpson260.com

SIMPSON 165/165U
VOLT-OHM-MILLIAMMETER

Simpson®
INSTRUMENTS THAT STAY ACCURATE

Printed in U.S.A.
Effective Date: 4/82
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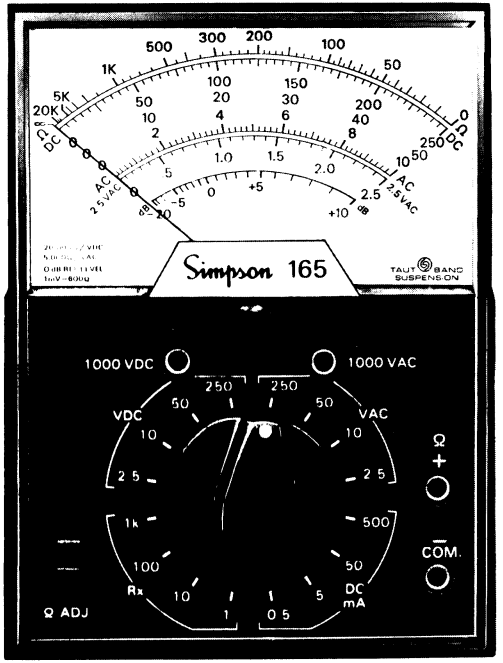

Figure 1-1. 165/165U Volt-Ohm-Milliammeter

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LIST OF ILLUSTRATIONS

NOTE: This Operator's Manual contains information essential to the operation of this Instrument. Therefore, it should be kept in a convenient place and used for reference as required.

SAFETY SYMBOLS

This marking, adjacent to another marking, terminal, or operating device, indicates that the Operator must refer to an explanation in the operating instructions to avoid damage to the equipment and/or to avoid personal injury.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the Instrument.

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

> **NOTE:** The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229 Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC leakage current, connect a 1500 ohm non inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

SECTION I
INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson 165/165U Volt-Ohm-Milliammeter (hereafter referred to as the 165 or the Instrument) is a compact, easy-to-operate instrument which may be used for measuring electrical characteristics of circuits and circuit components. It features a taut-band movement suspension with diode overload protection to provide long, trouble-free service. The 100 degree dial arc and knife edge pointer provide excellent readability.

1.1.2 A one-knob Function/Range selector simplifies operation of the Instrument. The internal batteries used to furnish the power required for resistance measurements and the fuse used to protect the ohms ranges are readily obtainable. Replacement is accomplished quite easily.

1.1.3 Most of the component parts are mounted on a printed circuit board conforming to the latest engineering developments. This ensures uniformity of performance, reduces maintenance and extends the useful life of the Instrument.

1.2 SUPPLIES AND ACCESSORIES

1.2.1 All supplies and accessories are furnished with each Instrument and listed in Table 1-2. (Available replacement parts are listed in Table 7-1.)

1.3 SAFETY CONSIDERATIONS

1.3.1 This Operator's Manual contains cautions and warnings alerting the user to hazardous operating and service conditions. This information is flagged by CAUTION or WARNING headings throughout this publication, where applicable, and is defined at the front of the manual under SAFETY SYMBOLS. To ensure the safety of operating and servicing personnel and to retain the operating conditions of the instrument, these instructions must be adhered to.

1.4 TECHNICAL DATA

1.4.1 Table 1-1 lists the technical data for the 165.

Table 1-1. Technical Data

1. DC Volts:

Ranges:	2.5, 10, 50, 250; and 1000 V on separate jacks
Sensitivity:	20,000 ohms per volt
Rated Accuracy:	Within ±3% of full scale, all ranges

2. AC Volts:

Ranges:	2.5, 10, 50, 250; and 1000 V on separate jacks
Sensitivity:	5,000 ohms per volt
Rated Accuracy:	Within ±4% of full scale, all ranges
Indication:	Full-wave average-responding; calibrated in rms for sinusodial waveforms
*Frequency Response:	Rated accuracy to 100,000 Hz on all ranges through 50 V; to 20 kHz on 250 V range; to 1 kHz on 1000 V range

3. Direct Current:

Ranges:	.5, 5, 50, 500 mA
Rated Accuracy:	Within 3% full scale, all ranges
**Rated Circuit-To-Ground Voltage:	1000 V AC/DC max.

**See typical Response Curves, Figure 1-2.*

***Per ANSI C39.5 April 1974: "The maximum voltage with respect to ground, which may safely and continuously be applied to the circuit of any instrument."*

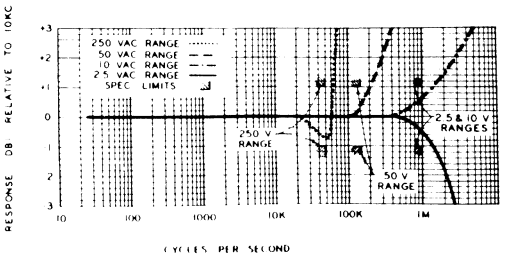

Figure 1-2. Typic[illegible] Frequency Response Curve

4. DC Resistance:

Ranges:	R x 1	20 k ohms (200 ohm center)
	R x 10	200 k ohms (2000 ohm center)
	R x 100	2 megohms (20,000 ohm center)
	R x 1 k	20 megohms (200,000 ohm center)
Accuracy:		3° arc
Max. Voltage or Current Delivered:		
	R x 1:	7.5 mA short circuit 1.5 V open circuit
	R x 10:	.75 mA short circuit 1.5 V open circuit

	R x 100:	0.075 mA short circuit 1.5 V open circuit
	R x 1 k:	.75 microamp short circuit 15 V open circuit

5. dB Ranges:

−20 dB to +10 dB on 2.5 VAC range

−8 dB to +22 dB on 10 VAC range

+6 dB to +36 dB on 50 VAC range

+20 dB to +50 dB on 250 VAC range

Zero dB referenced to 1 milliwatt at 600 ohms (0.775 volt)

6. Movement: Taut-Band 100° arc, 50 μA full scale

7. Dial Arcs: One arc for ohms, one arc for DC, two arcs for AC, one arc for dB

8. Scale Length: 3.0 inches

9.	**Operating Position:**	Horizontal or vertical; rubber feet prevent slipping on moderate slopes
10.	**Batteries:**	1.5 V AA penlight cell and No. 504 15 V battery; simple removal via back of Instrument
11.	**Fuse:**	1/8 A, 250 V, 3AG Type "normal blo"
12.	**Movement & Indicator Protection:**	Varistor across movement terminals
13.	**Test Leads:**	Custom molded elbow terminals; 3 ft. flexible plastic leads with probe tips
14.	**Operating Temperature Ranges:**	75°F for rated accuracy; less than 4% additional error over the range of +25°F to +130°F
15.	**Size:**	4 9/16" x 3 5/16" x 1-3/4"
16.	**Weight:**	Approximately 12 ounces complete
17.	**Construction:**	Combination high impact plastic and phenolic; P.C. board
18.	**Color:**	Black case with white lettering; white scale with black & red lettering

Table 1-2. Items Supplied with This Instrument

Description	Number
Probe tip test leads	02055
Operator's manual	6-112660
Carrying case 165U (Only)	02935

Table 1-3. Additional Accessories

Description	Catalog Number
Vinyl carrying case	02935
Leatherette carrying case	02225
Molded hard case	02929
Simpson 150-2 AC Amp-Clamp adapter	00541
Adapter pins for Amp-Clamp	02056
Alligator clip leads	01927

SECTION II
INSTALLATION

2.1 GENERAL

2.1.1 This section contains instructions for the installation and shipping of the 165. Included are unpacking and inspection procedures, warranty, shipping and installation.

2.2 UNPACKING AND INSPECTION

2.2.1 Examine the shipping carton for signs of damage prior to unpacking. Then unpack and inspect the Instrument for possible damage in shipment. If damage is noted, notify the carrier and supplier before using the Instrument. Also, check that all furnished items and accessories are included (Table 1-2).

2.2.2 Save all shipping materials for future use.

2.3 WARRANTY

2.3.1 The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair.

> **NOTE:** For assistance of any kind, including help with the Instrument under warranty, contact the nearest Authorized Service Center for instructions (listed on the last pages of this manual). If it is necessary to contact the factory directly, give full details of the difficulty and include the Instrument model number and date of purchase. Service data or shipping instructions will be mailed promptly. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

2.4 SHIPPING

2.4.1 Pack the Instrument carefully and ship it prepaid and insured to the proper destination.

2.5 INSTALLATION

2.5.1 The Instrument may be operated in a horizontal or vertical position. It can also be set at an angle by positioning a stand (not supplied) under the Instrument.

SECTION III
CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

3.1.1 All operating and adjustment controls, connectors and indicators are described in this section along with a list (Table 3-1) describing their function. Become familiar with each item prior to operating the Instrument.

3.2 PANEL DESCRIPTION

3.2.1 Table 3-1 lists all Controls, Connectors and Indicators.

Table 3-1. Controls, Connectors and Indicators

1. Function and Range Switch: This control is located in the lower center of the panel. This switch combines the operations of selecting the desired range and function. The switch may be turned in either direction to any of its 16 positions.

2. Zero Ohms Adjust Control: This control is located at the lower left on the front panel and is used to obtain a "O" indication on the ohms scale when the test leads are shorted together. During operation, the zero indication is checked each time the ohmmeter is to be used. This permits compensation for aging internal batteries, and allows them to be used for a longer period of time.

3. Input Jacks: There are four input jacks: Two of these are on the right side of the panel and two directly below the zero adjustment screw. The two jacks on the right are identified COM – and + Ω. The COM – and + Ω

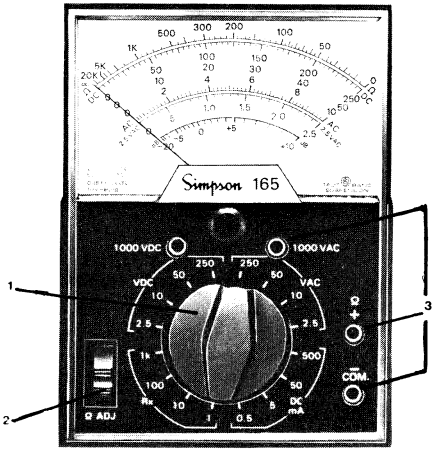

Figure 3-1. Front Panel Description

jacks are used for all ranges and functions with the exception of the 1000 VDC and 1000 VAC ranges. The two jacks on the Instrument are identified 1000 VDC and 1000 VAC and are used to extend the 250 VDC and the 250 VAC ranges.

SECTION IV
OPERATION

WARNING

Before proceeding with the operation of the 165, review the SHOCK HAZARD definition printed at the front of this manual.

4.1 SAFETY PRECAUTIONS

4.1.1 Instruments of this type are intended for use only in low-power, consumer product type applications, such as TV or radio. Their use is not recommended in high-power circuits, such as power plants, substations or high power transmitter circuits, where the likelihood of corona, together with sufficient energy to sustain flash-over arcs, is a serious hazard.

4.1.2 The small size of this Instrument might tempt the user to hold it in his hand while making measurements. Avoid this practice when working in circuits that might contain a shock hazard.

4.1.3 Inspect the test leads, probes, connectors and insulating boots for damage or deterioration before each use. If any defects are found, replace the leads immediately with leads designed for this Instrument. Do not use test leads inferior to those furnished with the Instrument.

4.1.4 Never disconnect the COMMON lead from an active circuit while the other lead is connected to an energized circuit. The COMMON lead becomes unexpectedly "hot" in such a case and can be a shock hazard to the user. Develop safe habits by always turning off power to the measured circuit and discharging any capacitors before handling the test leads.

4.1.5 Become familiar with the circuit to be measured and locate any shock hazards before attempting measurements. Keep in mind that high voltages might appear where not expected in a faulty circuit.

4.1.6 Electrical measurements in the presence of humidity or moisture are particularly hazardous. Hands, shoes, floor and workbench must be dry.

4.1.7 Avoid making measurements in circuits where composite voltages can exceed the Instrument's safe limits. When measuring DC voltages, the Instrument will not respond to (and thereby not indicate) the presence of AC components.

4.1.8 Be alert for the presence of corona in the measured circuit. Its presence indicates high voltage; and unexpected or unknown paths might lead to a flash-over. A buzzing sound, odor of ozone and a pale blue emanation are indications of its presence.

4.1.9 Do not work alone when making measurements where a shock hazard can exist. Notify a nearby person of your intentions.

4.2 MECHANICAL ZERO ADJUSTMENT

4.2.1 Before making any measurements, check to see that the pointer indicates zero when the Instrument is in the operating position. If the pointer is off zero, make the required correction by turning the screw located directly below the "Simpson 165" legend.

4.3 MEASURING DC VOLTAGES, 2.5 THROUGH 250 VOLT RANGES:

a. Connect the black test lead into the COM – jack and the red test lead into the + jack.

b. Set the range switch for the DC voltage range desired. When in doubt as to which range to use, always start with the highest voltage range as a protection to the Instrument.

c. Turn on power in the circuit to be measured.

d. Touch the black test prod to the negative side of the circuit and the red prod to the positive side.

> **NOTE:** If the pointer moves to the left of zero, circuit polarity is reverse of that anticipated. Transpose the test prods for proper indication.

e. Read the voltage on the black arc marked DC which is second from the top of the dial. If the voltage is within a lower range, the switch may be set for a lower range to obtain a more accurate reading.

2.5 VDC range:	Use the 0-250 scale and divide the value by 100.
10 and 50 VDC ranges:	Read the corresponding scale directly.
250 VDC range:	Use the 0-250 scale and read the value directly.

4.4 MEASURING DC VOLTAGES, 1000 VOLT RANGE ONLY:

WARNING

Use extreme care when working in high voltage circuits. Even though the Instrument and its test leads are well insulated for the measuring ranges available, avoid touching the Instrument and test leads except for the prod handles. Keep fingers behind the prod barrier rings.

a. Set the range switch to the 250 VDC position.

b. Connect the black test lead to the COM – jack and the red test lead to the 1000 VDC jack.

c. Turn on power in the circuit to be measured.

d. Connect the black test lead to the negative (–) side of the circuit and the red test lead to the positive (+) side.

e. If the pointer deflects to the left side of zero, refer to Paragraph 4.3, step d.

f. Read the voltage, using the 0-10 scale on the black arc marked DC and multiply the reading by 100.

4.5 MEASURING AC VOLTAGES 2.5 THROUGH 250 VOLT RANGES:

4.5.1 The 165 rectifier circuit responds to the full wave rectified average value of the AC voltage being applied. The Instrument dial, however, is calibrated in terms of rms voltage, which will be correct for all sinusodial waveforms.

> **NOTE:** Since the 165 will respond to DC voltage when set on any AC volt range, an external blocking capacitor must be employed where measurements of AC superimposed on DC are encountered.

a. Connect the black test lead to the COM – jack and the red test leads to the + jack.

b. Set the range switch for the VAC range desired. When in doubt as to which range to use, always start with the highest voltage range as a protection to the Instrument.

c. Turn on power in the circuit to be tested.

d. Touch the test prods to the circuit points between which voltage is to be measured (either polarity).

e. Read the voltage on the red arc marked AC as follows:

0-2.5 VAC range:	Read the value directly on the special arc marked 2.5 VAC.
10 VAC and 50 VAC ranges:	Read the red arc marked AC, and use the corresponding black numbers immediately above the arc.
250 VAC range:	Read the red arc marked AC and use the 0-250 figures directly.

4.6 MEASURING AC VOLTAGES, 1000 VOLT RANGE ONLY:

WARNING

Use extreme care when working in high voltage circuits. Even though the Instrument and its test leads are well insulated for the measuring ranges available, avoid touching the Instrument and test leads except for the prod handles. Keep fingers behind the prod barrier rings.

a. Set the range switch at 250 VAC position.

b. Connect the black test lead in the COM jack, and the red test lead in the 1000 VAC jack.

c. Turn on power in the circuit being measured.

d. Touch the test prods to the circuit points between which voltage is to be measured (either polarity).

e. Read the voltage on the red arc marked AC using the 0-10 figures and multiply the reading by 100.

4.7 MEASURING DECIBELS

4.7.1 For some applications, power loss or gain measurements in terms of dB are required. The dB is defined as:

$$dB = 10 \log \frac{Power_1}{Power_2} \text{ or } 20 \log \frac{E_1}{E_2} \text{ when } R_1 = R_2$$

The 165 is calibrated with 0 dB referenced to 1 milliwatt at 600 Ω, i.e., dB reading corresponds to:

$$20 \log E \frac{\text{(reading)}}{0.775 \text{ V (measured across 600 } \Omega)}$$

The decibel scale at the bottom of the dial is numbered from −20 through 0 to +10. To measure decibels, proceed according to instructions for AC voltages, and read the dB arc. The dB scale is calibrated for direct reading on the 2.5 V range. Scale factors for other ranges and dB reference at 0.006 watts into 500 ohms are given in the table below.

dB Scale Factor (add to reading)

	0 dB Reference	
Range	**1 mW @ 600**	**6 mW @ 500**
2.5 V	direct	−7
10 V	+12	+5
50 V	+26	+19
250 V	+40	+33

4.8 MEASURING RESISTANCES

4.8.1 When DC resistances are measured, the internal batteries of the 165 furnish power for the measuring circuit. Correction for battery deterioration over long periods of time is provided by means of the Zero Adjust control which is part of the ohmmeter circuit.

a. Set the range switch at the desired resistance range position.

b. Connect the black test lead to the COM – jack, and the red test lead to the + Ω jack.

c. Connect the contact ends of the test leads together.

d. Observe the Instrument indication. Look for a reading of "0" on the OHMS arc, which is at the top of the dial.

e. If the pointer does not read "0", rotate the ZERO OHMS knob at the lower left on the front panel until it does. If the pointer cannot be adjusted to zero, one or both batteries may be exhausted or their connections corroded. The 1.5 V battery powers the R x 1, R x 10 and R x 100 ranges and the 15 V battery powers the R x 1 k range. Refer to Section VI for battery replacement instructions.

f. If the pointer does not move when adjusting for zero in any of the resistance ranges, the fuse may need to be replaced. See Section VI for fuse replacement instructions.

CAUTION

To make in-circuit measurements of resistance, make certain the circuit has been de-energized and capacitors, if any, have been discharged.

g. Connect the test leads across the resistance which is to be measured. If there is a "forward" and "backward" resistance, such as with diodes, observe polarity in the lead connections to control each direction of test.

h. Read the indication on the OHMS arc at the top of the dial. Note that the arc reads from right to left for increasing values.

i. Multiply the reading by the multiplier factor indicated at the switch position; the result is the resistance value in ohms. "K" on the dial and panel stands for "times one thousand."

NOTE: The resistance of nonlinear components will measure as different values on different ranges of the 165. For example, a diode could measure 80 ohms on the R x 1 range, and 300 ohms on the R x 10 range. This is normal and is the result of the diode characteristic. The difference in readings does not indicate faulty operation of the ohmmeter circuit.

4.9 DIRECT CURRENT MEASUREMENT

WARNING

- **Never exceed the Instrument's rated circuit-to-ground voltage (1000 V max: Table 1-1, 2-A).**
- **In all current measurements, turn power off in the circuit to be measured and discharge all capacitors, if any, in DC circuits before touching the circuit.**
- **Avoid disconnecting a test lead or changing the Instrument's range setting while the circuit is energized.**
- **Whenever possible, connect the current measuring 165 in series with the grounded or nearest-to-ground side of the circuit to minimize the circuit-to-ground voltage.**

4.10 MEASURING DIRECT CURRENT: 0-0.5 THROUGH 0-500 MILLIAMPERE RANGES:

a. Connect the black test lead to the COM – jack, and the red test lead to the + jack.

b. Set the range switch to the mA direct current range desired. When in doubt as to which range to use, always start with the highest ranges as a protection to the Instrument.

c. When the circuit power is turned **off**, open the circuit at the point where current is to be measured. Connect the Instrument in series with the circuit, observing proper polarities.

d. Apply power to the circuit being measured. If the pointer deflects to the left of zero, the polarity is reversed. Turn off the power. Transpose the test prods and then re-apply the power.

e. Read the current on the black scale marked DC, which is second from the top of the dial.

mA Range	Use Scale	Reading
0.5	0-50	Divide by 100
5	0-50	Divide by 10
50	0-50	Read direct
500	0-50	Multiply reading by 10

f. Turn off power to the circuit. Remove the test leads and restore circuit continuity.

SECTION V
THEORY OF OPERATION

5.1 GENERAL

5.1.1 The taut-band indicating instrument used in the 165 responds linearly to direct current and requires less than 50 microamperes to cause full-scale deflection. The indicating instrument and its associated calibration network, R1 and R2, are adjusted accurately to an equivalent circuit resistance of 5000 ohms. The resulting basic metering circuit, after calibration, requires precisely 50 microamps at 0.25 volts for full-scale deflection. The varistor, D1 shown in the schematic diagram (Figure 7-1), provides an effective shorting path for metering signals appreciably in excess of full scale. The network can bypass excessive currents as high as several hundred milliamperes continuously, thereby affording considerable protection to the indicating instrument.

5.2 DC VOLTMETER CIRCUIT

5.2.1 The basic circuit configuration employed for DC voltage measurements is shown in simplified form in Figure 5-1. The metering circuit (M) in this diagram includes the calibrating network as described above. The precision voltage ranging resistors, R14, R15, R16, R17 and R28, provide the necessary voltage drop to yield full-scale deflection for each corresponding range as shown in Figure 5-1. Note that the 1000 V ranges utilize separate jacks.

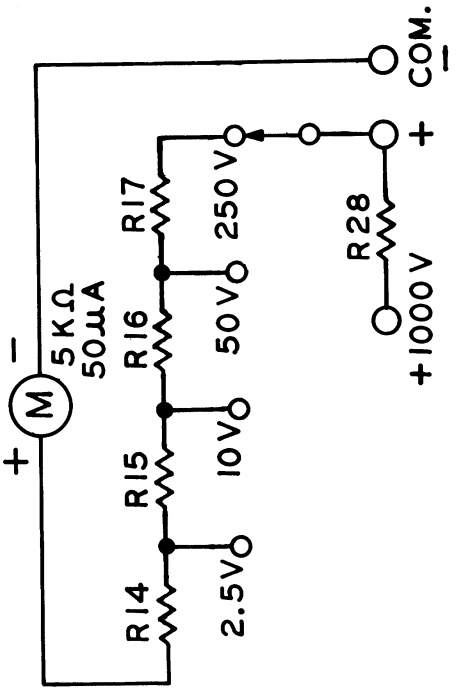

Figure 5-1. Simplified Circuit-DC Volts

5.3 DC MILLIAMMETER CIRCUIT

5.3.1 The basic circuit configuration utilized for direct current measurements is shown in simplified form in Figure 5-2. Resistors R5, R6, R7 and R8 in the arrangement shown form a shunt. The values of these resistances can be computed as:

$$RSH \quad \frac{RM \times IM}{ISH}$$

where RSH is defined as the total value of the shunt between the input terminals.

5.4 AC VOLTMETER CIRCUIT

5.4.1 The simplified circuit for the AC voltage ranges of the 165 is given in Figure 5-3. The modified full-wave bridge comprising D2, D3, R26 and R27 provides direct current to the metering circuit (M) proportional to the average rectified value of the AC voltage being measured. With the range switch set at 2.5 volts and calibration resistors R3 and R4 properly adjusted, an effective input resistance of 12,500 ohms is attained. This corresponds to a sensitivity of:

$$\frac{12{,}500\ \Omega}{2.5\ V} = 5{,}000\ \Omega/V$$

Values of the range resistors R18, R19, R20 and R29 are calculated on the basis of this sensitivity.

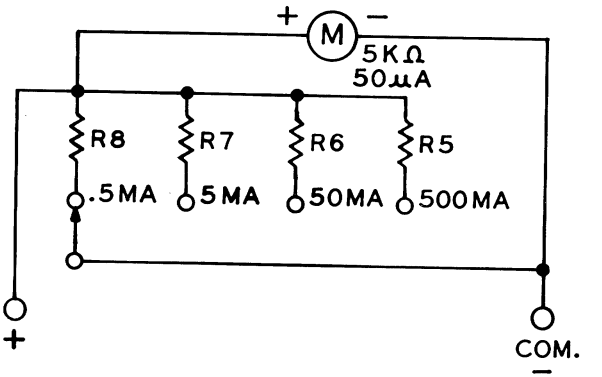

Figure 5-2. Simplified Circuit-DC mA

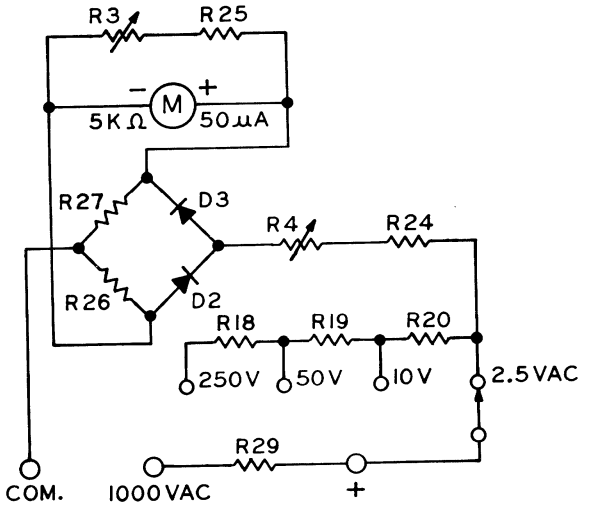

Figure 5-3. Simplified Circuit-AC Volts

5.5 OHMMETER CIRCUIT

5.5.1 A simplified circuit for the 165 ohmmeter ranges is given in Figure 5-4. Note for the R x 1 ohms measurements, the equivalent meter resistance is approximately 200 ohms. A 1.5 volt battery supplies the power for measurements on the R x 1, R x 10 and R x 100 ranges.

5.5.2 For the R x 1 k range, a 15 volt battery is employed to obtain the required full-scale meter current. The Ohms Adjust resistor (R12) is adjusted manually by the operator to allow full-scale deflection (zero ohms) with the test leads shorted. A slight readjustment of R12 might be required when switching from the lower ohms scales to the higher because of the difference in condition of the two batteries.

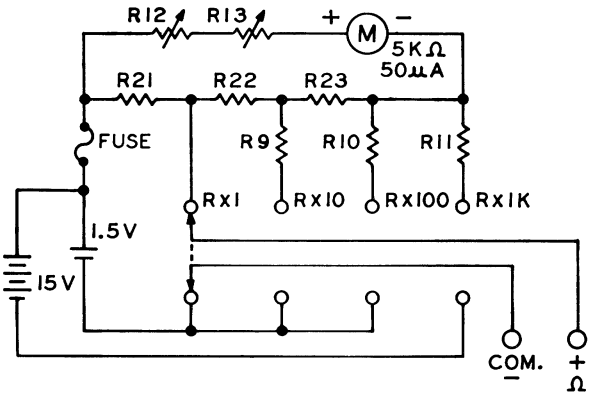

Figure 5-4. Simplified Circuit—DC Ohms

SECTION VI
OPERATOR MAINTENANCE

6.1 REMOVAL FROM THE CASE

6.1.1 The Instrument has been designed to provide easy access for all necessary adjustments and replacement of parts. It is only necessary to remove one screw from the back of the Instrument (center of the case) to gain access to the battery and fuse compartments.

6.1.2 After removing this screw, the front panel, including the indicating instrument, printed circuit board, fuse and batteries, can then be removed as a unit. Press lightly againt the threaded brass insert, using a pencil or similar device, to facilitate separation of the Instrument from its case.

6.2 BATTERY REPLACEMENT

NOTE: When the Ohms Adjust control cannot be adjusted for zero ohms (with shorted test leads), it is generally an indication that a battery has reached the end of its useful life. Consequently the defective battery must be replaced. Failure to do so promptly can result in damage to the 165 due to chemical leakage from the battery.

6.2.1 After removal of the case, loosen and remove the screw securing the battery contact plate to the panel assembly. The contact plate is marked showing location and polarity of the two batteries used in the Instrument. When installing new batteries, note battery placement and polarity as indicated on contact plate.

6.2.2 Line up notch in contact plate with round boss on panel assembly and press contact plate down. While holding contact plate down, insert screw back into its hole and thread into nut located in panel assembly. Continue to thread screw until contact plate is firmly secured to panel assembly.

6.3 FUSE REPLACEMENT

6.3.1 After removal of the case, loosen and remove the screw securing the battery and fuse contact plate to the panel assembly. The contact plate is marked showing location of the fuse.

CAUTION

To ensure maximum protection to the Instrument, do not replace the fuse with one of different type, voltage rating, current rating or with a "slo-blo" type.

6.3.2 Replace the fuse with a 3AG type, 1/8 A, 250 V, normal time lag fuse (refer to Table 7-1).

6.3.3 Replace the contact plate in accordance with 6.2.2.

6.4 TEST LEAD INSPECTION

6.4.1 Periodic inspection of the test leads is recommended to detect cuts, burns or other damage that could reduce the insulation strength of the leads. New leads may be purchased from the nearest Authorized Service Center.

WARNING

The following servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION VII
SERVICING INSTRUCTIONS

7.1 REPLACEMENT PARTS AND SCHEMATIC DIAGRAM

7.1.1 This section contains information for ordering replacement parts. Table 7-1 lists parts in alphanumeric order of their reference designators and indicates the description. (Refer to Table 1-2 for Items and Accessories Furnished with This Instrument.)

7.1.2 To obtain replacement parts, address order to the nearest Authorized Service Center (listed on the last pages of this manual). Refer to paragraph 2.3.1 for ordering instructions.

NOTE: If it is necessary to replace components, do not apply heat directly to the circuit board. Cut leads close to component body and solder new component to the leads. Refer to an Authorized Service Center or the Simpson Electric Company for recalibraton or servicing of the printed circuit board.

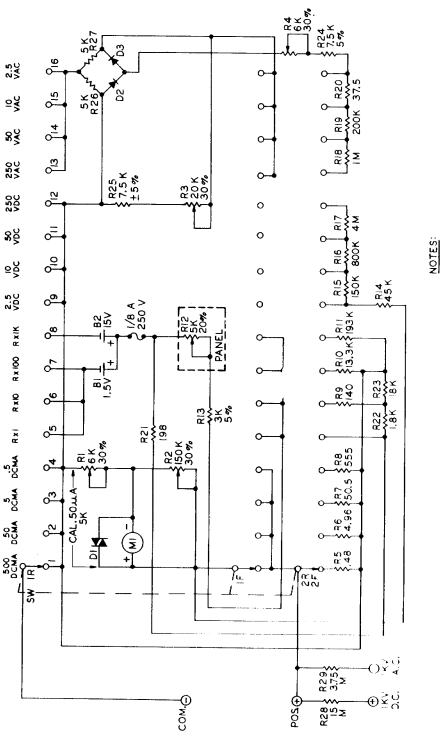

Figure 7-1. Schematic Diagram

Table 7-1. Replacement Parts

Symbol	Description	Part No.
R1, R4	Potentiometer 6 kΩ	5-110716
R2	Potentiometer 150 kΩ	5-111672
R3	Potentiometer 20 kΩ	5-116850
R5	Resistor .48 Ω	6-112665
R6	Resistor 4.96 Ω	6-112669
R7	Resistor 50.5 Ω	6-112682
R8	Resistor 555 Ω	6-112662
R9	Resistor 140 Ω	6-112672
R10	Resistor 13.3 kΩ	6-112670
R11	Resistor 193 kΩ	5-114350
R12	Potentiometer 5 kΩ	6-112146
R13	Resistor 3 kΩ	5-118682
R14	Resistor 45 kΩ	1-114192
R15	Resistor 150 kΩ	1-113366
R16	Resistor 800 kΩ	1-113363
R17	Resistor 4 megΩ	1-113362
R18	Resistor 1 megΩ	1-113392
R19	Resistor 200 kΩ	1-113365
R20	Resistor 37.5 kΩ	1-113393
R21	Resistor 198 Ω	6-112664

Table 7-1. Replacement Parts

Symbol	Description	Part No.
R22	Resistor 1.8 kΩ	6-112668
R23	Resistor 18 kΩ	6-112671
R24, R25	Resistor 7.5 kΩ	5-111320
R26, R27	Resistor 5 kΩ	1-113425
R28	Resistor 15 megΩ	1-115763
R29	Resistor 3.75 megΩ	1-115765
D1	Diode, Varistor	1-110670
D2, D3	Diode, Germanium, IN 100	1-115970
	Molded Case Assembly — 165U	10-864872
	Molded Case Assembly — 165	10-864906
	Case Mounting Screw, Nylon	5-111655
	Range Knob	3-260548
	Meter Cover Assembly	10-560318
	Rubber Feet, Case	5-111660
B2	Battery, 15 V NEDA #220	
	Eveready type 504 (or equivalent)	1-115329
B1	Battery, 1.5 V size AA NEDA 15F	
	Eveready 915 (or equivalent)	1-111802
	Battery and Fuse Contact	3-812885
	Fuse, 1/8 A, 250 volt, 3AG type	1-116104
	Test Leads, 1 set	02055
	Carrying Case	02935

NOTES

FOR THE RECORD

Date Purchased_____

Purchased From:_____

Identification Number:_____

Date	Type of Service	Serviced By

NOTES

FOR THE RECORD

Date Purchased_____

Purchased From:_____

Identification Number:_____

Date	Type of Service	Serviced By