OPERATOR'S MANUAL

VOLT-OHM-MILLIAMMETER

Model 230 Series 2

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8-65-UMO—B & L

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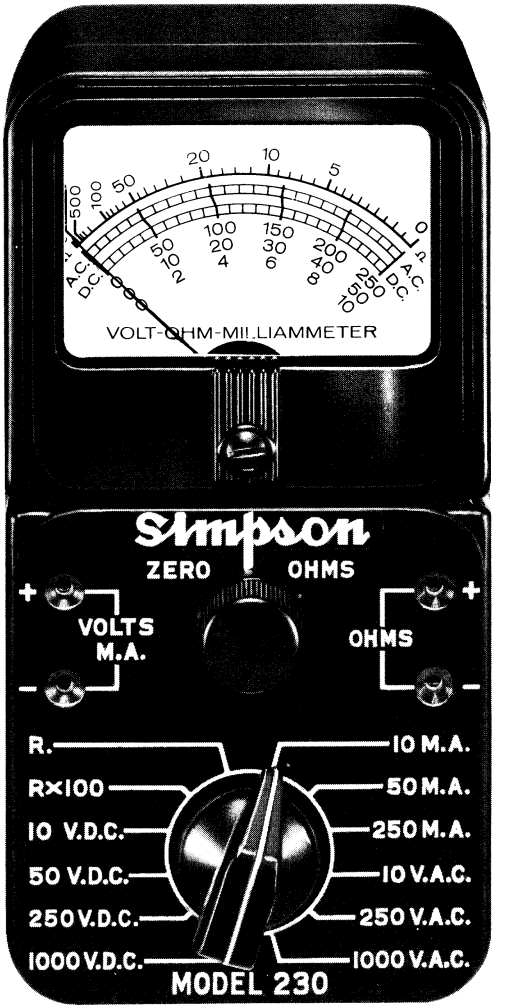

FIGURE 1. SIMPSON VOLT-OHM-MILLIAMMETER MODEL 230-2

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SECTION I
SPECIFICATIONS

D.C. Voltage		Accuracy in % of full scale
Sensitivity:	1000 ohms per volt	
4 Ranges:	0-10-50-250-1000 volts	3

A.C. Voltage		
Sensitivity:	1000 ohms per volt	
3 Ranges:	0-10-250-1000 volts	4

Direct Current		
	(150 millivolt drop, maximum)	
3 Ranges:	0-10-50-250 milliamperes	3

Resistance		Accuracy in degrees of arc
2 Ranges:	R. for 0-1000 ohms (12 ohm center)	3
	R x 100 for 0-100,000 ohms (1200 ohm center)	3

Voltage supply for Ohmmeter Circuit	
Battery, P.R. Mallory No. Mn-1500, or equivalent	1.5 volt cell

Overall Dimensions 3-1/16" x 5-7/8" x 2-5/8"

SECTION II
GENERAL DESCRIPTION

The Simpson Volt-Ohm-Milliammeter Model 230-2, shown in Figure 1, is a handy and compact combination instrument which has been designed for use in servicing radio receivers. It is also useful for many other electrical and electronic applications.

It has convenient ranges for measuring D.C. voltages, direct currents, resistances, and A.C. voltages. All the ranges and circuit arrangements available can be set easily and quickly with the range switch at the bottom of the front panel. The test leads connect into circuit jacks on the front panel, and are used to contact the source of electrical characteristics for measurements.

METER MOVEMENT

The meter movement is one of the famous Simpson INSTRUMENTS THAT STAY ACCURATE. It has a sensitivity of 400 microamperes D.C., with an internal resistance of 365 ohms. The special 2-1/2" dial is calibrated for all the measuring circuits and ranges of the Model 230-2.

TEST LEADS

The pair of test leads, one red and one black for polarity identification, are approximately four feet long. These test leads are furnished with crocodile clip terminations.

Either clip the leads to the test points in the circuit which is being measured, or hold the clip ends on the test points for momentary contacts.

INSULATED CLIPS

Flexible plastic insulators over the crocodile clips protect the operator from contacting any voltage present on the clips.

RANGE SWITCH

There are two control knobs on the front panel. The large one at the bottom is the range switch. It has twelve positions, each marked for the circuit and the range which it will set up in the instrument.

ZERO OHMS

The small knob above the range switch is the ZERO OHMS control knob. It operates a variable resistor which will compensate for aging of the internal battery when a resistance measuring circuit is used.

TEST LEAD CONNECTIONS

Two pairs of terminal jacks for the test leads are also located on the front panel. On the left side is the pair of jacks for measuring voltage or current with the Model 230.

The pair of jacks for measuring resistances is located on the right side.

INTERNAL CONSTRUCTION

The upper half of the instrument case contains the meter assembly. Inside the lower half of the instrument case is a printed circuit board containing the range switch, the battery, all resistors, and diodes which make up the circuits for the various ranges.

SECTION III

OPERATING INSTRUCTIONS

CAUTION

When measuring voltage, as a personal protection, form the habit of turning off all power to the circuit under test. Connect the test leads at the desired points in the circuit. Then turn on the power while taking readings. Turn off the power before disconnecting the test leads from the circuit.

ADJUST POINTER FOR ZERO

Before any measurements are made with your Volt-Ohm-Milliammeter Model 230, check to see that its pointer indicates zero with the instrument in its operating position. If the pointer is off zero, adjust the screw located in the phenolic case just below the center of the dial.

Use a small screwdriver to turn this screw slowly either clockwise or counterclockwise until the pointer rests over the zero mark on the dial.

D.C. VOLTAGE MEASUREMENTS

1. Set the range switch at the bottom of the front panel for the D.C. voltage range desired. These positions are marked 10 V.D.C., 50 V.D.C., 250 V.D.C., and 1000 V.D.C. **When in doubt as to the voltage present, always use the highest range as a protection to the instrument.** If the voltage reading is within a lower range, the range switch may then be set for a lower range to obtain a more accurate reading.
2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.

3. Connect the crocodile clip end of the black test lead to the negative side of the circuit to be measured, and the crocodile clip end of the red test lead to the positive side of the circuit.
4. Turn on the power in the circuit which is to be measured. If the pointer of the meter deflects to the left, the leads are reversed with respect to circuit polarity. Turn off the power, reverse the test lead connections, and then turn on the power again.
5. Read the voltage on the black arc marked D.C.

   For the 10 V.D.C., 50 V.D.C., and 250 V.D.C. ranges, read the voltage directly on the black arc.

   For the 1000 V.D.C. range, read the 0 to 10 scale on the black arc and multiply the reading by 100.
6. Turn off the power before disconnecting the test leads.

A.C. VOLTAGE MEASUREMENTS

1. Set the range switch at the bottom of the front panel for the A.C. voltage range desired. These are marked 10 V.A.C.,

250 V.A.C., and 1000 V.A.C. **When in doubt as to the voltage present, always use the highest voltage range as a protection to the instrument.**

2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.

3. Connect the crocodile clips of the test leads to the two sides of the circuit to be measured. Connect one clip to each side of the circuit. For A.C. voltage measurements, readings will be the same with either polarity of lead connections.

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

5. Read the voltage on the red arc marked A.C.

   For the 10 V.A.C. and 250 V.A.C. ranges, read the voltages directly on the red arc.

   For the 1000 V.A.C. range, read the 0 to 10 scale on the red arc and multiply the reading by 100.

6. Turn off the power before disconnecting the test leads.

D.C. RESISTANCE MEASUREMENTS

CAUTION

Before you make any resistance measurements in an electrical circuit, be sure the power is off and all capacitors have been discharged, so no voltage exists in the circuit. Otherwise you may damage the meter circuits.

1. Set the range selector switch at the bottom of the front panel for the range desired for resistance measurement. These switch positions are marked R. and Rx100.

2. Plug the black test lead into the jack marked —OHMS on the right side of the front panel. Plug the red test lead into the +OHMS jack.

3. Short the crocodile clips together. Rotate the ZERO OHMS knob until the pointer indicates 0 at the right hand end of the dial. If the pointer will not move to the 0 mark, the battery is weak and needs to be replaced. See instructions in Section IV, MAINTENANCE.

4. Separate the test leads and connect them across the resistance or the portion of a circuit which is to be measured. The

most accurate reading is obtained on the range which indicates nearer the center of the scale.

5. Read the value indicated on the black arc at the top of the dial, marked Ω. Note that this scale increases from right to left.

   For the R. range, read the resistance directly on the Ω arc. (K=1000).

   For the R x 100 range, read the indication on the Ω arc and multiply the reading by 100.

   See instructions in Section V for measuring resistances over 100,000 ohms.

DIRECT CURRENT MEASUREMENTS

CAUTION

Never connect the test leads directly across any voltage with the Model 230 set for current measurements. This would damage the instrument. Always connect the meter in series with the load.

1. Set the range switch for the current range desired. These switch positions are marked 10 M.A., 50 M.A., and 250 M.A. **When in doubt as to the current present, always use the highest current range as a protection to the instrument.**

2. Plug the black test lead into the jack marked —VOLTS M.A. on the left side of the front panel. Plug the red test lead into the jack marked +VOLTS M.A.

3. Open the circuit in which current is to be measured. Connect the Model 230 in series with the circuit. Connect the red test lead toward the positive side of the circuit and the black test lead toward the negative side.

4. Turn on the power in the circuit to be measured. If the pointer of the meter is deflected to the left, the leads are reversed with respect to circuit polarity. Turn off the power, reverse the test leads, and turn on the power again.

5. Read the current values in milliamperes on the black arc of the meter marked D.C. Use the 0 to 10 figures for the 10 M.A. range, the 0 to 50 figures for the 50 M.A. range, or the 0 to 250 figures for the 250 M.A. range.

6. Turn off the power before disconnecting the test leads.

7. Restore the circuit continuity.

SECTION IV

MAINTENANCE

CARE

This tester is very rugged and will withstand considerable use without showing any signs of damage. However, the parts are made to fit together with the precision of a fine watch, and they can be damaged by careless handling..

Be careful to prevent your Model 230 from being dropped, and from any other unnecessary shocks. If you treat your instrument with care, it will reward you with many years of trouble-free service and accurate indications of measured values.

HOW TO OPEN INSTRUMENT

The lower half of the instrument can be taken out of the case for trouble-shooting, repair, and battery replacement when it is necessary.

To open the instrument remove the four screws through the back of the case and pull the lower half of the instrument toward the bottom and out of the case. All the compo-

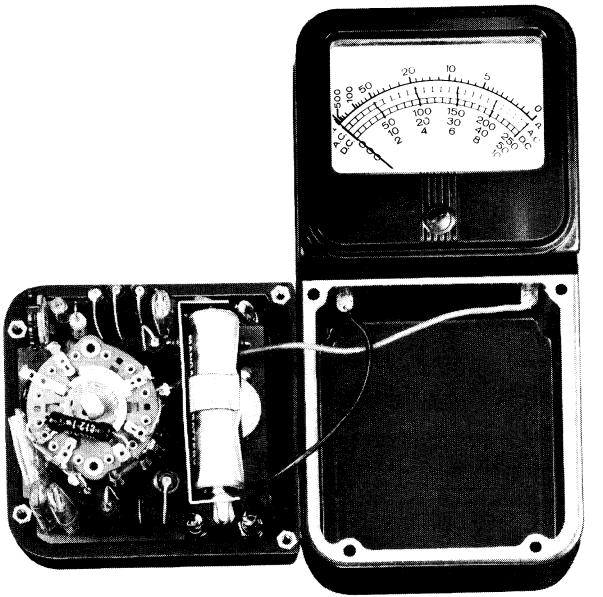

FIGURE 2. MODEL 230-2 WITH CASE OPENED TO SHOW INTERNAL COMPONENTS.

nents will come out with the front panel as shown in Figure 2. There are two wire leads which connect these circuit portions to the indicating meter; when you remove the lower portion of the instrument from the case, be careful to prevent damage to the leads.

REPAIRING THE METER

Since all repair to the meter portion of the Model 230 should be performed only by qualified repairmen with the proper tools, the top half of the instrument is sealed. Do not attempt to remove it from the case.

If any repair is necessary, return the entire Model 230 to the Repair Department at the factory, or to your nearest Authorized Simpson Repair Station.

Whenever you return an instrument to a repair station or to the factory, be sure to write a letter to explain exactly what you think is wrong with it and why. This will save both time and money for you. Also indicate in the letter what you want the repair station or factory to do, so they have the necessary authorization from you to proceed with your repairs.

BATTERY REPLACEMENT

The 1.5 volt dry cell inside the case of the Model 230-2 is used for resistance measurements. During its normal life the battery will gradually increase its internal resistance. This will result in a decrease of terminal voltage under normal load.

When the pointer can no longer be brought to 0 on the Ω (ohms) arc with the ZERO OHMS knob, open the instrument as described above, remove the old battery and slip a new 1.5 volt, size AA manganese cell into the battery holding clamp. Place the battery into the holder so that the plus (+) pole is adjacent to the insulated contact with the brown lead.

RECTIFIER REPLACEMENT

Two germanium diodes are used to rectify the A.C. voltage for measurement. Both these diodes D1 and D2 are located on the printed circuit board as shown in Figure 3.

In case of rectifier failure replace defective diode with another 1N87G. Observe correct polarity and lead locations of the diodes when assembling and soldering them into the

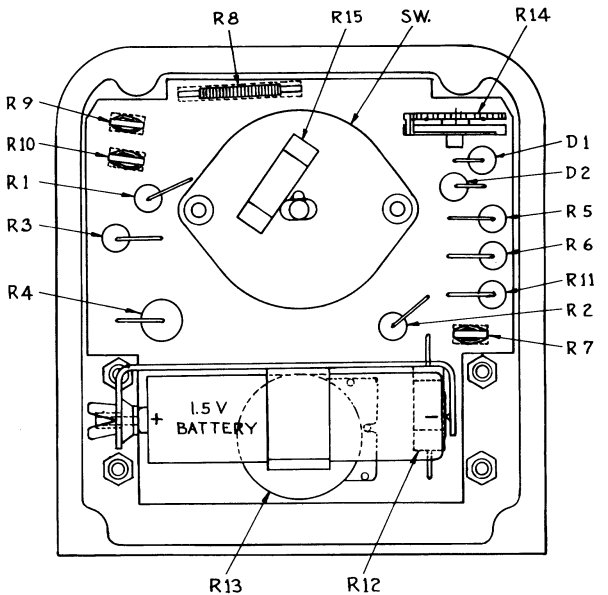

FIGURE 3. LOCATION OF PARTS ON PRINTED CIRCUIT BOARD.

printed circuit board. Both diodes are mounted in standoff position with the anode pole adjacent to the printed circuit board. After replacement of the rectifier diodes test the accuracy of the A.C. ranges.

A.C. RECALIBRATION

After repair of the tester and replacement of the rectifier diodes, A.C. recalibration may be required.

If necessary, recalibrate the circuit by adjusting variable resistor R14 located on the printed circuit board, shown in Figure 3, as follows:

1. Set the range switch at the 10 V.A.C. position.
2. Plug red test lead into the +VOLTS jack.
3. Plug black test lead into the —VOLTS jack.
4. From a standard source apply 10 V.A.C. to the red and black test leads.
5. Adjust R14 so that meter pointer indicates full scale.
6. Then check other ranges.
7. Case the tester by sliding panel assembly carefully into the case. Do not touch and disarrange the rotor knob of the calibrating potentiometer R14. Tighten four casing screws through the back of the case.

REMOVING THE PRINTED CIRCUIT BOARD

When you require access to the underside of the printer circuit board, remove the printed circuit board in the following manner.

1. Remove the knob for the ZERO OHMS control.
2. Remove the hex nut from the control bushing on the top of the front panel.
3. Lift the printed circuit board away from the front panel. The entire board, with the switch wafers in place, will come off in one piece.
4. After removal do not turn the range switch knob on the front panel or move range switch rotors on the printed circuit board until reassembled.

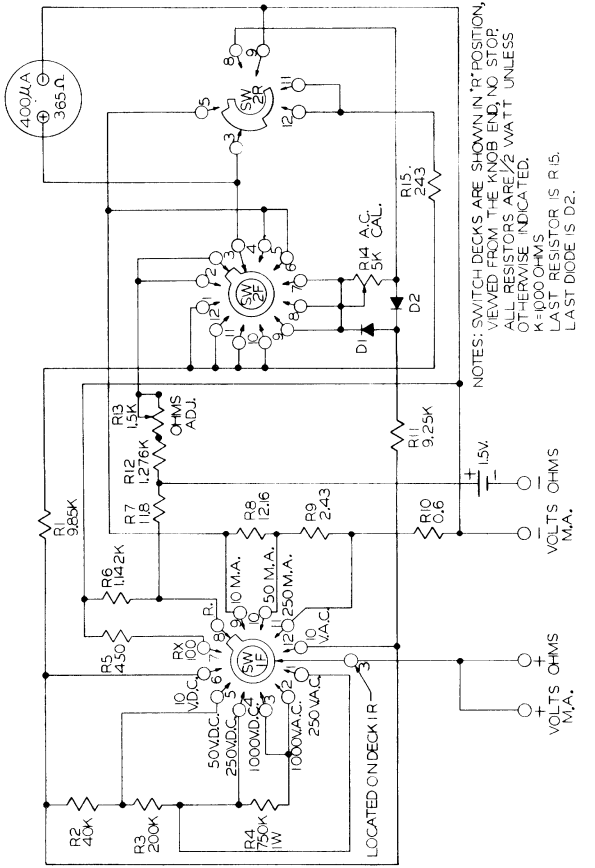

FIGURE 4. VOLT-OHM-MILLIAMMETER
MODEL 230-2, OVERALL SCHEMATIC DIAGRAM

PARTS LIST

Reference Symbol	Description	Simpson Part No.
R1	Resistor, 9.85K ohms, 1%, 1/2 watt	5-110654
R2	Resistor, 40K ohms, 1%, 1/2 watt	1-113309
R3	Resistor, 200K ohms, 1%, 1/2 watt	1-117146
R4	Resistor, 750K ohms, 1%, 1watt	5-110656
R5	Resistor, 450 ohms, 1%, 1/2 watt	1-110551
R6	Resistor, 1.142K ohms, 1%, 1/2 watt	5-110655
R7	Resistor, 11.8 ohms, 1/2% (wire-wound)	10-675270
R8	Resistor, 12.16 ohms, 1% (wire-wound)	10-675271
R9	Resistor, 2.43 ohms, 1% (wire-wound)	10-675272
R10	Resistor, 0.6 ohm, 1% (wire-wound)	10-675273
R11	Resistor, 9.25K ohms, 1%, 1/2 watt	1-119736
R12	Resistor, 1.276K ohms, 1%, 1/2 watt	1-118199

Parts List

Reference Symbol	Description	Simpson Part No.
R13	Potentiometer 1.5K ohms ±20%	5-110650
R14	Potentiometer, 5K ohms ±30%	5-110753
R15	Resistor, 243 ohms, 1%, 1/2 watt	1-119540
D1	Diode, germanium, type 1N87G	1-115970
D2	Diode, germanium, type 1N87G	1-115970
Sw	Switch, 2 sections, less frame assembly	5-110651
	Knob, for range switch, (less set screw)	3-262871
	Set screw (for knob 3-262871)	5-110242
	Knob, for Zero Ohms Adjust, set screw included	1-114949
	Test lead set (one red and one black)	0-008375
	Battery, 1.5 volt, size AA, Mallory type #Mn-1500	1-110550
	Meter Assembly, complete with case	15-302230-2

SECTION V

SPECIAL APPLICATIONS

MEASURING HIGH RESISTANCE

With the aid of a circuit such as shown in Figure 5, resistance values up to 1 megohm can be measured. Set the range switch to the R x 100 position. The range set up with this circuit will be R x 1000, so multiply the reading on the Ω (ohms) scale of the dial by 1000 (add three zeros).

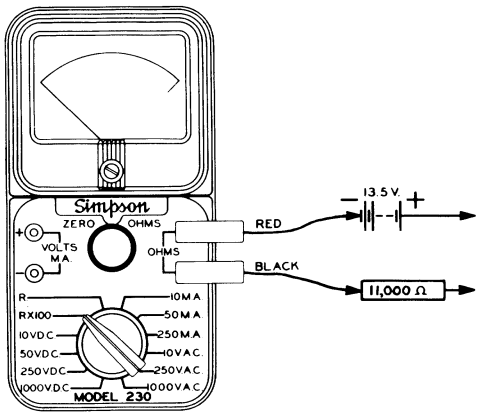

FIGURE 5. INCREASING RESISTANCE RANGES

Use any available combination of batteries to make up 13.5 volts, which is 9 cells in series. One combination would be three 4.5 volt C batteries in series. Another would be two 6 volt batteries and one 1.5 volt cell in series. Still another way to get it is to use two C batteries with five cells each, which have taps at each 1.5 volts; use the entire 7.5 volts from one battery and four cells (6 volts) from the second, all connected in series.

As long as ZERO OHMS can be set for 0 (full scale) indication on the ohms scale, any voltage deviation from the rated 13.5 volts will have negligible affect on the accuracy of the measurement.

Best accuracy will be obtained when the series resistor value is exactly 11,000 ohms, as indicated in Figure 5, but such accuracy is usually not required for resistance readings. Resistance tolerance of ± 5% will provide satisfactory indications with the ohmmeter. Resistor does not have to be a single one, but can be any combination which will produce a series equivalent resistance of 11,000 ohms.

MEASURING HIGH VOLTAGE D.C.

Occasionally there may be some voltage greater than 1000 volts D.C. which must be

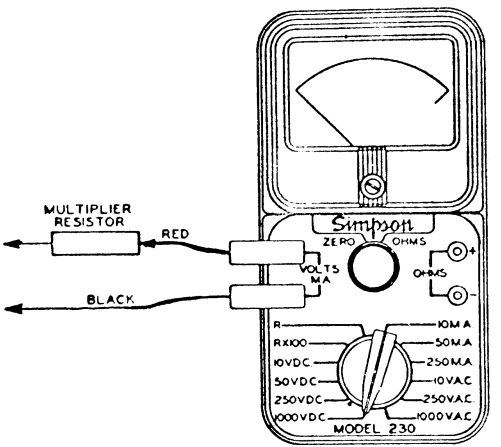

FIGURE 6. INCREASING VOLTAGE RANGES

measured. When this is true, the range of the Model 230 can be increased by adding an external series multiplier resistor as shown in Figure 6. Use the following steps.

1. Set the range switch at 1000 V.D.C. and connect the test leads in the VOLTS M.A. jacks at the left side of the instrument. Connect the red test lead in the +jack and the black test lead in the —jack.

2. Connect the crocodile clip of the red test lead to one terminal of the multiplier resistor. Use a 4 megohm, 10 watt, resistor to set up a 5000 volt D.C. range, or a 9 megohm, 20 watt, resistor to make a 10,000 volt D.C. range.

3. Use the other terminal of the multiplier resistor as the positive probe, and the black test lead as the negative probe. Connect these into the circuit where you wish to measure voltage, **while the power is off.**

CAUTION

Never touch the meter, leads, or any other parts of the measuring circuit while power is on for high voltage measurements. Connect and disconnect the leads while power is off and there is no voltage in the circuits.

4. Observe the reading on the meter as for lower D.C. voltage measurements.

5. **Turn off the power** before disconnecting the probes from the circuit.

SIMPSON WARRANTY REPAIR STATIONS AND PARTS DEPOTS

Arizona, Phoenix 85016 — Area Code 602
Metercraft Inc. — 279-6249
3308 N. 24th St.

California, San Diego 92111 — Area Code 714
Meter Master, Inc. — 278-2200
8139 Engineer Road

California, Glendale 91201 — Area Code 213
JSD Engineering Company — 849-6187
6915 San Fernando Road

California, Los Angeles 90022 — Area Code 213
Meter Master, L.A. — 685-7313
Div. of Kierulff Electronics, Inc.
5645 East Washington Blvd.

California, Mountain View 94041 — Area Code 415
Kierulff/Metermaster — 968-6292
2484 Middlefield Road

California, San Francisco 94105 — Area Code 415
Pacific Electrical Instrument Lab. — 421-7185
111 Main Street

Canada, London, Ontario — Area Code 519
Bach-Simpson Ltd. — 451-9490
1255 Brydges Street
P.O. Box 484

Colorado, Denver 80223 — Area Code 303
Meter-Master Instrument Service — 934-4601
2145 S. Kalamath Street — 934-8614

Connecticut, New Haven 06511 — Area Code 203
Kaufman Instrument Labs Inc. — 776-7201
810 Dixwell Avenue

Florida, Miami 33136 — Area Code 305
Florida Precision Instrument Corp. — 374-1731
800 N.W. 7th Avenue

Florida, Orlando 32806 — Area Code 305
Electro Tech Inc. — 423-5589
307 - 27th Street

Georgia, Atlanta 30310 — Area Code 404
Electro-Tech Inc. — 758-7205
690 Murphy Ave. S.W.

Hawaii, Honolulu 96817 — 851-457
Electronic Systems Inc. — 811-132
1622-26 Silva Street

Illinois, Chicago 60625 — Area Code 312
A & M Instrument, Incorporated — 539-4460
4801 North Ridgeway Avenue

Illinois, Chicago 60644 — Area Code 312
Pacific Indicator Company — 261-1330
5217 W. Madison Street

Illinois, Chicago 60644 — Area Code 312
Simpson Electric Company — 379-1121
5200 W. Kinzie Street

Kansas, Shawnee Mission 66205 — Area Code 913
Sturtz Instrument Co. — 236-4705
4705 Mission

Louisiana, New Orleans 70115 — Area Code 504
Industrial Instrument Works — 895-5621
3305 Tchoupitoulas Street

Maryland, Baltimore 21211 — Area Code 301
Edgerly Instrument Lab., Inc. — 243-6611
205 West 28th Street

Massachusetts, Cambridge 02138 — Area Code 617
A. S. Mancib — 864-2494
363 Walden Street

Massachusetts, Needham Heights 02194 — Area Code 617
Instruments, Incorporated — 444-9410
570 Hillside Avenue

Michigan, Detroit 48220
Ram Meter, Inc.
1100 Hilton Road Ferndale
Area Code 313
547-1000

Minnesota, Minneapolis 55411
Instrumentation Services Inc.
917 Plymouth Avenue
Area Code 612
521-8803

Missouri, St. Louis 63112
Scherrer Instruments
5449 Delmar Blvd.
Area Code 314
367-9800

New Jersey, Belleville 07109
Marshall Instruments, Inc.
236 Washington Avenue
Area Code 201
751-1190

New York, Buffalo 14216
Electrical Instrument Labs.
932 Hertel Avenue
Area Code 716
392-2726

N. Y., Great Neck, Long Island 11022
Simpson Instrument Sales & Service, Inc.
130 Gutter Mill Road
Area Code 212
683-0674
Area Code 516
482-3103

New York, Long Island City 11103
A & M Instrument Inc.
48-01 31st Avenue
Area Code 212
726-4343

New York, New York 10011
Electro-Tech Equipment Company
85 Tenth Avenue
Area Code 212
675-2400

New York, Syracuse 13215
Syracuse Instrument Lab.
4895 South Avenue Box 96
Area Code 315
492-1651

New York, Vestal 13850
Compton Industries Inc.
333 Vestal Parkway East
P.O. Box 351
Area Code 607
748-3349

North Carolina, Charlotte 28206
Electro-Tech Inc.
3107 Gullman Avenue
Area Code 704
333-0326

Ohio, Cleveland 44135
Weschler Electric Company
4250 W. 130th Street
Area Code 216
251-4609

Ohio, Cleveland 44103
Pioneer-Standard Electronics, Inc.
5403 Prospect Avenue
Area Code 216
432-0010

Ohio, Dayton 45404
SREPCO Electronics Div. of
Pioneer Standard Electronic, Inc.
314 Leo Street
Area Code 513
224-0871

Oklahoma, Tulsa 74011
Tri-State Instrument Lab.
3244 East 15th Street, Box 5057
Area Code 918
936-0489

Oregon, Portland 97217
Industrial Instrument Repair Lab.
1910 N. Killingsworth St.
Area Code 503
285-6629

Pennsylvania, Philadelphia 19115
Sunshine Scientific Instrument
1810 Grant Avenue
Area Code 215
673-5600

Texas, Dallas 75204
Ultra Instrument Lab., Inc.
3515 Swiss Avenue, Suite 117
Area Code 214
826-6395
826-6396

D.C., Washington 20001
Electronic Wholesalers, Inc.
2345 Sherman Avenue N.W.
Area Code 202
483-5200

Washington, Seattle 98119
The Instrument Lab. Inc.
934 Elliott Avenue West
Area Code 206
283-5850

Wisconsin, Milwaukee 53202
The Electro-Mechano Company
241 East Erie Street
Area Code 414
272-4050

WARRANTY

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to 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 shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective, this warranty being 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 persons 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 shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

SIMPSON ELECTRIC COMPANY

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