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Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON 604/605 SERIES 2 MULTICORDERS®

®Multicorder is a Registered Trademark of the Simpson Electric Company

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120

Area Code 312, Telephone 695-1121

In Canada, Bach-Simpson, Ltd., London, Ontario

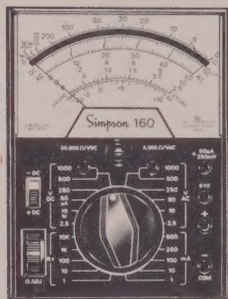
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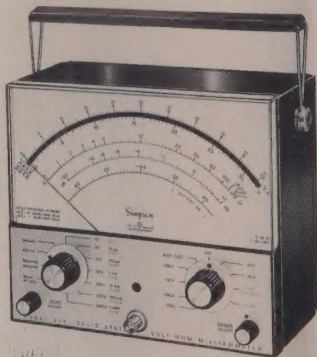
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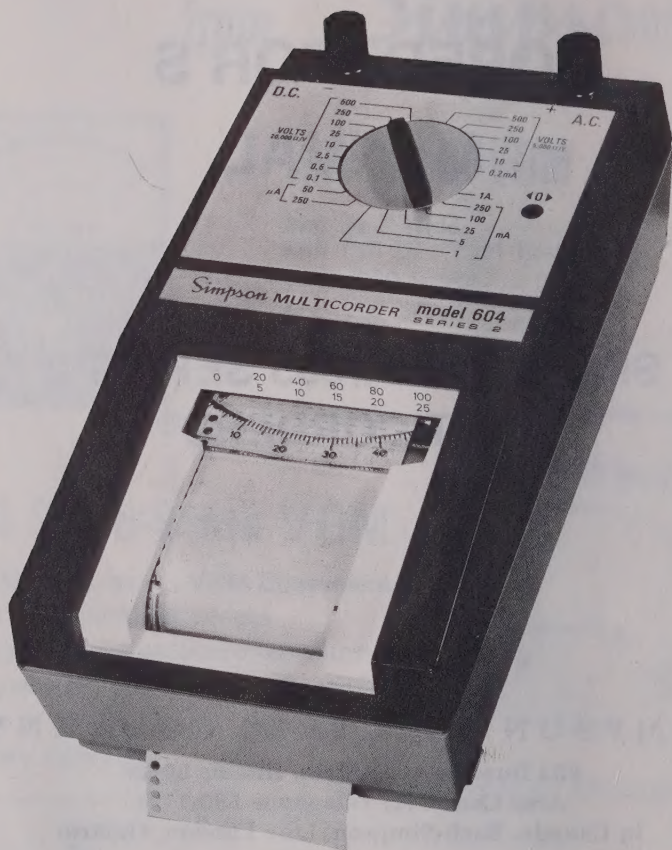


Figure 1-1. Simpson Multicorder® 604 Series 2
Volt-Amp-Milliamp-Millivolt Recorder

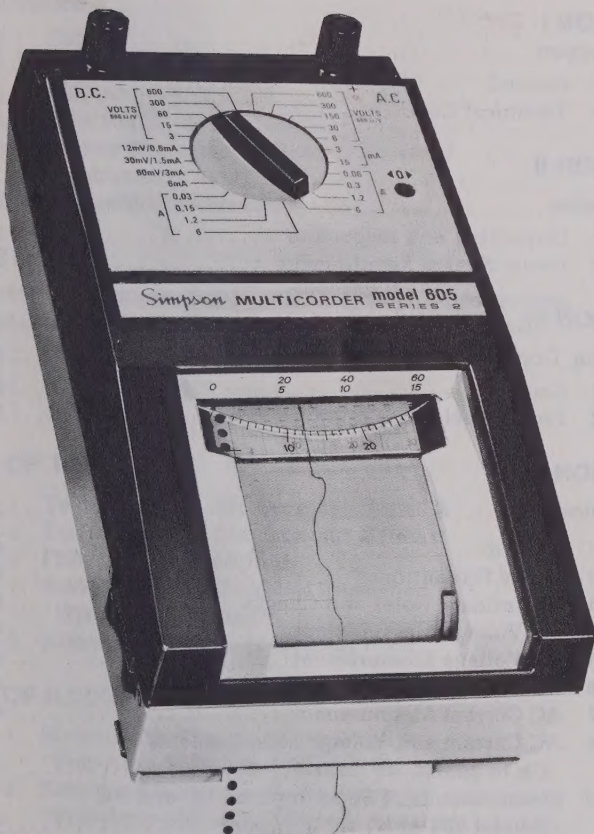


Figure 1-2. Simpson Multicorder® 605 Series 2
Volt-Amp-Milliamp-Millivolt Recorder

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WARNING

The Simpson Models 604/605 Series 2 MULTICORDERS are 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 prior to making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD (As defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, Twelfth Edition, dated June 25, 1969).

“Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:

- A. If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.
- B. If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.
- C. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.
- D. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds $75T-350T^2$ millicoulombs, where T is the time in seconds.
- E. If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 micro-microfarads”.

NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present.

SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson Models 604 and 605 Series 2 MULTICORDERS (hereinafter referred to as the Models 604 and 605 or simply as the Instrument), are accurate, compact, measuring Instruments combining the advantages of portable multi-range measuring instruments with those of recording devices. The two models are mechanically alike, but differ electrically. Model 605 Series 2 MULTICORDER uses a built-in transformer for measurement of superimposed DC and AC components by a current or voltage measurement, and also provides more ranges than the Model 604 Series 2 MULTICORDER.

1.1.2 The Models 604 and 605 Series 2 MULTICORDERS are simple and rugged in construction, with a new modern look and utilizing latest technology in circuit design. Inkless recording, by use of fast sequential impressions on pressure sensitive strip chart paper, eliminate the problems of pen and ink maintenance. The Instruments permit instant visual observation of measured values. A special device marks the range and measured value.

1.1.3 The Models 604 and 605 Series 2 MULTICORDERS feature a high-torque meter movement with a shock-resistant, taut-band suspension, moving-coil system. Electrical protection of the Instrument is provided by protective diodes and fuses to prevent high currents from damaging the indicating mechanism and the measuring circuits.

1.1.4 The Model 604 Series 2 MULTICORDER, with its range coverage of low DC currents and its high internal resistance, is particularly suited to the recording of electrical characteristics of circuits. Accurate quantitative measurements and permanent recordings of DC and AC voltages and currents can be made.

1.1.5 The Model 605 Series 2 MULTICORDER, with its built-in transformer is suited particularly well to the measurement of electrical characteristics of circuits in the power and process engineering industries. Accurate quantitative measurements and permanent recordings of DC and AC voltages and currents can be made.

1.1.6 The Models 604 and 605 Series 2 MULTICORDERS are available both as AC line-operated Instruments or as battery-powered Instruments. The battery compartment is externally accessible, and an electronic speed control circuit assures accurate chart speeds.

1.1.7 The Model 604 and 605 Series 2 MULTICORDERS are assembled by well-trained personnel using high-quality materials and modern equipment. This combination of design, materials and skillful assembly results in units which will take considerable abuse and still provide accurate indication. If kept clean and not unduly abused nor misused, nor subjected to extreme shock or vibration, these Instruments will give many years of trouble-free service.

1.2 TECHNICAL DATA

1.2.1 Table 1-1 lists the technical data for the Simpson Model 604 Series 2.

Table 1-1. Technical Data

MEASURING RANGES, Model 604 Series 2

DC — 20,000 Ω per volt

AC — 5,000 Ω per volt

<u>DC Voltage</u>		<u>DC Current</u>	
Range	Internal Resistance	Range	Voltage Drop
500 V	10 M Ω	1 amp	0.35 V
250 V	5 M Ω	250 mA	0.20 V
100 V	2 M Ω	100 mA	0.18 V
25 V	500,000 Ω	25 mA	0.17 V
10 V	200,000 Ω	5 mA	0.17 V
2.5 V	50,000 Ω	1 mA	0.16 V
0.5 V	10,000 Ω	250 μ A	0.14 V
0.1 V	2,000 Ω	50 μ A	0.10 V

<u>AC Voltage</u>		<u>AC Current</u>	
500 V	2.5 M Ω	0.2 mA	0.45 V
250 V	1.25 M Ω		
100 V	500,000 Ω		
25 V	125,000 Ω		
10 V	50,000 Ω		

1.2.2 Table 1-2 lists the technical data for the Simpson Model 605 Series 2.

Table 1-2. Technical Data

MEASURING RANGES, Model 605 Series 2

DC — 666 Ω per volt

AC — 666 Ω per volt

<u>DC Voltage</u>		<u>DC Current</u>	
Range	Internal Resistance	Range	Voltage Drop
600 V	400 k Ω	6 amp	0.27 V
300 V	200 k Ω	1.2 amp	0.10 V
60 V	40 k Ω	0.15 amp	0.05 V
15 V	10 k Ω	0.03 amp	0.05 V
3 V	2 k Ω	6 mA	0.05 V
60 mV	20 Ω	3 mA	0.06 V
30 mV	20 Ω	1.5 mA	0.03 V
12 mV	20 Ω	0.6 mA	0.012 V

<u>AC Voltage</u>		<u>AC Current</u>	
600 V	400 k Ω	6 amp	0.30 V
300 V	200 k Ω	1.2 amp	0.05 V
150 V	100 k Ω	0.3 amp	0.10 V
30 V	20 k Ω	0.06 amp	0.02 V
6 V	2 k Ω	15 mA	0.75 V
		3 mA	0.25 V

1.2.3 Extended Ranges

See paragraph 7.3 for information on available shunts and current transformers to extend the MULTICORDER ranges.

1.2.4 Temperature Measurement

The Model 605 Series 2 MULTICORDER can be used to measure temperature as explained in paragraph 7.3 and Figure 7-1.

NOTE: Unless otherwise noted, the following data applies to both models.

1.2.5 Measuring System Data

1. General—The taut-band suspension, moving-coil mechanism has a response time of less than 1.0 second. AC measurements up to 20,000 Hz are made via a full-wave rectifier.
2. Accuracy of Indication (reference conditions):
DC and AC $\pm 1.5\%$ of full scale
3. Accuracy of Recording (reference conditions):
DC and AC $\pm 2.5\%$ of full scale
4. Reference Conditions
 - a. Temperature: 23°C (73.4°F)
 - b. Frequency: Model 604, sinusoidal AC 15 Hz - 10 kHz
Model 605, sinusoidal AC 45-65 Hz
5. Accuracy-Influencing Variables
 - a. Temperature Influence in range of 0 to 50°C
DC: Maximum 1%/10°C of indication
AC: Maximum 1%/10°C of full scale
 - b. Frequency Influence
Model 604: Maximum 2.5% in range of 10 Hz to 20 kHz
Model 605: Maximum 1.5% in range of 25 Hz to 10 kHz
Maximum 2.5% in range of 10 Hz to 20 kHz
 - c. Waveform Influence
The Instruments are calibrated in effective value of a sinusoidal waveform factor of 1.11 for sinusoidal AC taken into account. Deviations from a sine wave can cause substantial errors.

Introduction

6. **Rated Circuit to Ground Voltage**
Both Instruments are rated at 650V (DC plus AC peak) between the measuring circuit and any part of the case (in battery operation) or from "common" terminal to earth ground (in line operation).
7. **Overload Protection**
 - a. Model 604: 2 amp medium acting fuse, 5 x 20 mm.
Model 605: 6 amp Slo-Blo fuse, 5 x 20 mm. (Two extra fuses provided with each Instrument.)
8. **Indicating Mechanism**
 - a. High torque, shock-resistance, taut-band suspension, moving coil system.
 - b. Response time: Less than one second.
 - c. Pointer Zero: Pointer can be shifted up to 30% up-scale if negative quantities are expected.

1.2.6 Recording System Data

1. **Chart Paper**
 - a. Paper Type: Pressure Sensitive
 - b. Paper Width: 2.56 inches (65 mm)
 - c. Recording Width: 2.31 inches (58.7 mm)
 - d. Paper Length: 50-foot roll
 - e. Time Scale: Every inch, numbered 1 thru 12
 - f. Range Imprint: Every 12 inches
2. **Chart Speeds**
 - a. 1/3/12 inches per hour standard
 - b. 30/60/90 inches per hour optional
3. **Impression Rate**
Records value of measured variable, and also the selected range
 - a. One per second
 - b. One per 2 seconds (by reversing cam)

4. Chart Paper Drive

- a. AC Line-Operated, self-contained synchronous motor, 120 VAC, 60 Hz, 3-wire grounding type line cord provided with recorder.
- b. Battery-Operated Version: Three "AA" size batteries Carbon-Zinc, NEDA No. 15F Alkaline, NEDA No. 15A
- c. Battery Life: 70 to 100 hours — Carbon-Zinc 140 to 200 hours — Alkaline

1.2.7 General

1. Dimensions: 10-5.8 x 5 x 3-3.4 inches (270 x 127 x 95 mm)
2. Weight: 5.5 lbs. (2.5 kg)
3. Power Requirement: 120 VAC, 60 Hz: consumption 2 VA (line-operated version), or three 1.5 volt batteries (battery-operated version).

Divisions: Model 604 — 50

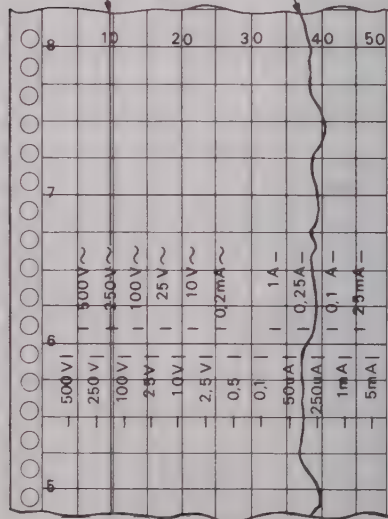


Figure 1-3. Chart Paper for Model 604

Divisions: Model 605 — 30

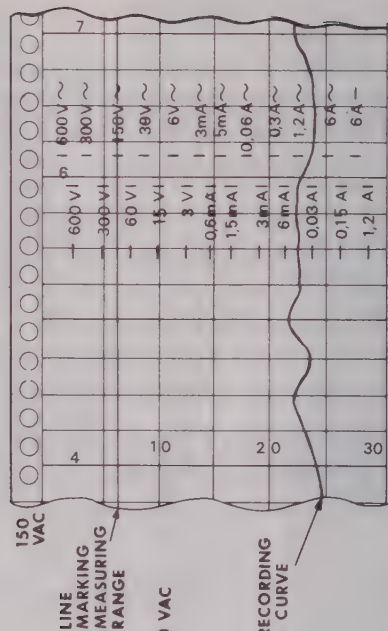


Figure 1-4. Chart Paper for Model 605

SECTION II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Prior to unpacking, examine the shipping carton for signs of damage. If there is none, then unpack and inspect the Instrument for possible damage in shipment. Check the electrical performance as soon as possible. If damage is noted, notify the carrier and supplier before using the Instrument. Also check that all items are included (Table 7-1).

2.1.2 Save the shipping carton and packing materials for future storing or shipping of the Instrument.

2.2 POWER SOURCE REQUIREMENTS

CAUTION

Do not insert power cord plug into the power source yet. Check that the designation on the rear panel agrees with the power source to be used.

2.2.1 AC Line Operation: The Simpson Models 604 and 605 Series 2 MULTICORDERS are designed for 120 V.A.C. 60 Hz operation.

WARNING

For AC line operation, be sure the grounding pin of the power plug is securely connected to an earth (power line) ground. Use a 3-wire grounded outlet which conforms to the latest electrical code.

2.2.3 **Battery Operation:** The battery-operated versions of the Simpson Model 604 and 605 Series 2 MULTICORDERS are supplied with three "AA" size 1.5V carbon-zinc batteries. Refer to paragraph 1.2.6, item 4. Replacement batteries are available at your local parts distributor.

1. Battery versions are not supplied with a line cord, and can be run only with batteries installed.
2. For battery installation, refer to paragraph 6.5

2.2.4 **Installation:** Operate these Instruments in the horizontal position only.

SECTION III

CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

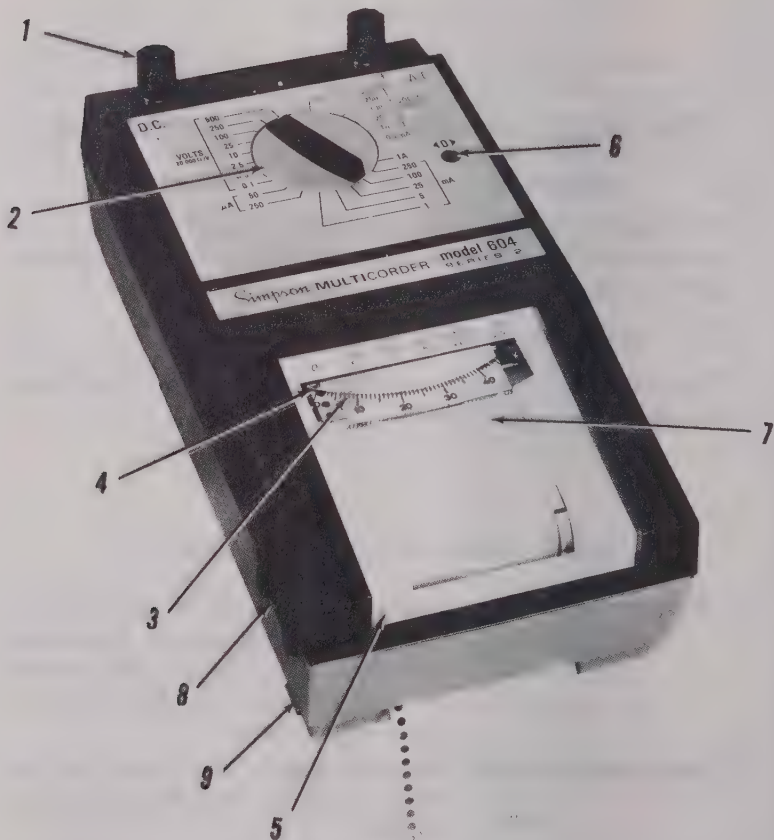
All operating and adjustment controls, connectors and indicators are described in this section. Become familiar with each item before operating the Instrument for the first time.

3.2 FRONT PANEL DESCRIPTION

Table 3-1 lists all controls, connectors and indicators. See Figures 3-1 and 3-2 for identification.

Table 3-1. Front Panel Description (see Fig. 3-1)

1. Binding Posts	Two binding posts are provided to accept the prods of the test lead set. The binding posts are marked (+) and (-). The test leads are color-coded (red and black) for easy polarity identification.
2. Range Selector Switch	Selects the desired range setting, and the proper circuits for making the correct measurement.
3. Scale	The value of the measured variable can be determined by the numbers printed on the scale and the position of the pointer.
4. Pointer	Indicates the value of the measured variable, and by means of the clamping bar, makes an impression of this value on the chart paper.
5. Plexiglass Cover	Hinged removable cover which allows access to the writing desk.



- | | |
|--------------------------|---|
| 1. Binding Posts | 6. Zero-Adjustment Screw |
| 2. Range Selector Switch | 7. Writing Desk (for making notes on chart) |
| 3. Scale | 8. Start-Stop Switch |
| 4. Pointer | 9. Case Locking Latches |
| 5. Plexiglass Cover | 10. Accessory Shunt (not shown) |

Figure 3-1. Multicorder, Closed

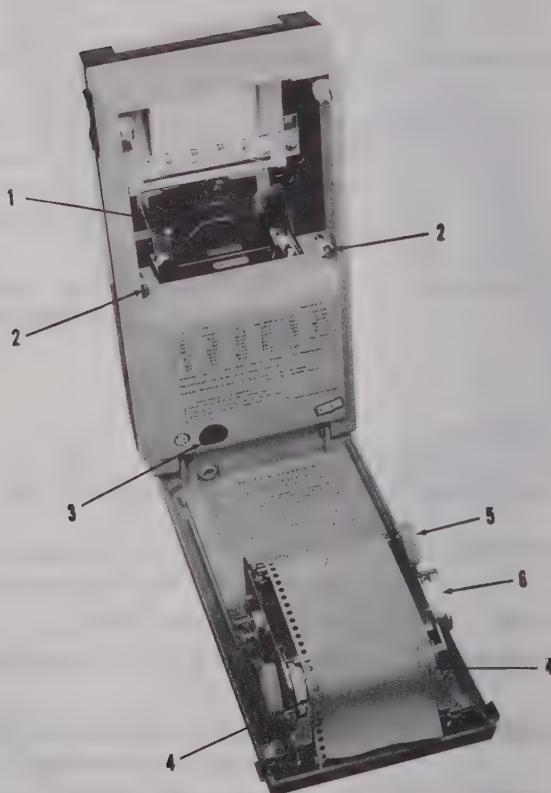
6. Zero-Adjustment Screw	This screw is used to adjust the pointer zero position, with the clamping bar out of operation, and no input across the binding posts.
7. Writing Desk	After lifting the removable plexiglass cover, the writing desk is accessible for making notes on the chart.
8. Start Stop Switch	Actuates the chart drive and clamping bar mechanism.
9. Case Locking Latches	The push-in latches lock the case to the bottom plate. The case must be opened for replenishing the chart paper and for changing chart speeds and the overload protection fuses.
10. Accessory Shunt	This is but one of the many accessories available for the MULTICORDERS. See Section VII.

Table 3-2. Open Multicorder Description (see Fig. 3-2)

1. Taut-Band Movement	High torque, taut-band, moving-coil movement which indicates measured values.
2. Spare Fuses	Two fuses of correct value.
3. Fuse Receptacle	Slotted screw-cap can be removed easily for fuse replacement.
4. Chart Guides	The chart guides keep the chart paper engaged with the driving sprocket.
5. Switch Panel (Gear Box)	Speed changes are made by moving the lever into the appropriate slot. The gear box can be replaced with one having different speeds.

6. Cam

Initiates the sequential dot chart recording mechanism. The cam can be reversed to slow the recording rate to 1 impression/2 seconds instead of 1 impression/second.



- 1. Taut Band Movement
- 2. Spare Fuses
- 3. Fuse Receptacle

- 4. Chart Guide
- 5. Switch Panel (gear box)
- 6. Cam

Figure 3-2. Multicorder, Opened

SECTION IV

OPERATION

4.1 GENERAL

WARNING

The Simpson Models 604 and 605 Series 2 are designed to prevent accidental shock 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 prior to making any measurements. Failure to follow directions can result in a serious or fatal accident.

This section of the manual contains all the information required to use and operate 604 and 605 MULTICORDERS in a safe and proper manner. Special notes and instructions also have been provided for added user safety and convenience.

4.2 SAFETY PRECAUTIONS

4.2.1 The Simpson Models 604 and 605 Series 2 are intended to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to SHOCK HAZARD definition on page vi.

4.2.2 Do not work alone when making measurements where a shock hazard can exist. Notify a nearby person that you are making, or intend to make, such measurements.

4.2.3 Remember, voltages might appear unexpectedly in defective equipment. An open bleeder resistor can result in a capacitor's retaining a dangerous charge. Remove all power and discharge all capacitors in the circuit being measured and remove all power from the Simpson 604 or 605 before making connections or dis-

connections. The Instrument input circuit is fused. However, the above precautions are wise even in the laboratory, and especially in field usage of the Instrument where many strange or unknown safety hazards might prevail.

4.2.4 Locate all voltage sources and current accessibility paths prior to making any measurement or connections.

4.2.5 For your own safety, inspect the test leads for cracks, breaks or crazes in the insulation prods and connectors before each use. If any defects are noted, destroy and replace the defective item(s) immediately.

4.2.6 Do not make measurements near a circuit where corona is present. Corona can be identified by a pale-blue color emanating from sharp metal points in the circuit, or by a buzzing sound, or by the odor of ozone. In rare instances, such as around germicidal lamps, ozone might be generated as a normal function. Ordinarily, the presence of ozone indicates presence of high voltage, and probably an electrical malfunction of some kind which can make the equipment dangerous and/or invalidate your measurements.

4.2.7 Hands, shoes, floor and workbench must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or the Instrument.

4.2.8 For maximum safety, do not touch test leads or circuit while power is applied to the circuit being measured.

4.2.9 Use extreme caution when making measurements in an rf circuit where a dangerous combination of voltages could be present, such as in a modulated rf amplifier.

4.2.10 Before the Instrument is used for AC operation, make sure that the "third wire" on the AC power cord is connected to an earth or power line ground.

4.2.11 Do not exceed the rated circuit to ground voltage rating of 650V (DC plus AC peak).

4.3 PRELIMINARY NOTES AND CHECKS

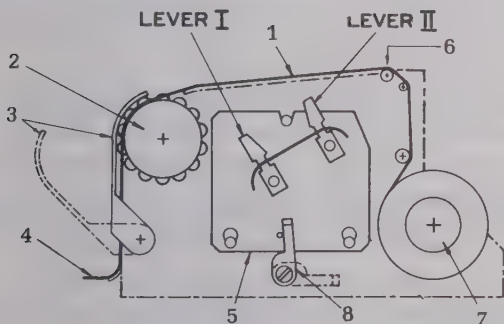
Prior to operation of the Instrument, review and perform (where applicable) the following steps and checks. These steps also can be used as a general functional check.

4.3.1 For AC line operation, insure that the power source used matches the requirements of the Instrument as marked on the rear panel and insert the plug into a 3-wire power outlet which conforms to the latest electrical code.

4.3.2 For battery-operated Instruments, install the three "AA" size 1.5 volt batteries, supplied with the Instrument. Observe polarity as marked in the battery holder.

4.3.3 Chart Paper Insertion. (Refer to Figure 4-1.)

- a. Push in the locking latches on each side of the base of the Instrument, and lift up the hinged upper portion to expose the chart drive mechanism assembly.



1. Desk (can be raised on its hinges)
2. Drive Spool with knurled wheel
3. Chart Guides (closed and pulled back)
4. Chart paper

5. Exchangeable gear unit (before removing, place lever II to position 0)
6. Recording edge
7. Feed spool
8. Locking lever

Figure 4-1. Chart Drive

- b. Press down the plastic spring holding clips on each side of the feed spool and lift out the feed spool.
- c. Install a new chart roll on the feed spool, with the perforated edge of the paper firmly placed against the flange of the feed spool.
- d. Reinsert the feed spool and pull off about 8 inches of paper from the chart roll.
- e. Pull the chart guides back and insert the chart so the pins of the drive spool smoothly engage the perforations of the chart paper.
- f. Tighten the chart paper strip by turning the knurled flange on the feed spool.
- g. Make sure that the chart paper strip extends beyond the edge of the baseplate of the Instrument.

4.3.4 Chart Paper Time Scale Adjustment

- a. Instrument Opened: Turn the knurled flange of the feed spool in the direction of chart motion until the desired time-line coincides with the recording edge (Figure 3-2).
- b. Instrument Closed: Carefully pull out the chart paper until the "►" mark on the scale coincides with that mark "►" on the chart paper which is 7/8" before the desired time-line.

4.3.5 Chart Paper Speed Selection (See Figure 4-1)

- a. Make sure that lever II is in the "M" position.
- b. Move lever I into the slot corresponding with the desired speed. Three speeds are available with each gear unit.

4.3.6 Gear Unit Exchange

(See Section I for specific chart speeds available)

- a. Engage Lever II in the slot marked "0" (Figure 4-1).
- b. Swivel the locking lever (Figure 4-1, No. 8) downward to unlock the gear unit.

- c. Push down on the gear unit to disengage the guide pins, and pull the gear unit straight out.
- d. Prior to inserting the new gear unit, place its lever II into the slot marked "0".
- e. Insert the new gear unit, line up the guide pins, and lift up to correctly position the unit.
- f. Finally, return the locking lever to its original position, and move lever II into the slot marked "M".

4.3.7 Chart Activation and Marking

- a. Bring the hinged upper portion of the Instrument down onto the base and push down until both locking latches have engaged. Do not allow the upper part to fall down by itself, as the shock might damage the Instrument.
- b. To actuate the chart drive and clamping bar mechanism, move the sliding ON-OFF switch to the position marked "N". To stop the mechanism, move the switch to the position marked "O".
- c. With the ON-OFF switch in the OFF("O") position, the recorders can be used as indicating instruments only.
- d. The clamping bar provides two marks, or lines, on the chart paper. One line will indicate the quantity of the measured value; the other line will indicate the measuring range in use. See Figures 1-3 and 1-4.

4.3.8 Pointer Zero Adjustment

- a. With the Instrument in a horizontal operating position, check that the pointer indicates zero at the left side of the scale when there is no input into the MULTICORDER and the switch is in the off "O" position.
- b. If the pointer is off zero, adjust by means of the slotted screw located on the range plate.

- c. Use a screwdriver to turn the screw slowly clockwise or counterclockwise until the pointer is exactly under the zero mark on the left side of the scale.
- d. With the indicating pointer on zero, reverse the direction of rotation of the zero adjuster, and rotate slightly to introduce mechanical freedom or play.

NOTE: Do not turn so much so that the position of the indicating pointer is disturbed.

4.4 DC VOLTAGE MEASUREMENT

WARNING

Prior to making measurements, review and comply with the SAFETY PRECAUTIONS listed in paragraph 4.2.

- 4.4.1** Review and comply with the Preliminary Notes and Checks, paragraph 4.3.
- 4.4.2** Connect input test leads to the + and COMMON terminals.
- 4.4.3** Turn the range selector switch to the appropriate voltage range position. If the voltage being measured is completely unknown, begin with the range selector switch set to the highest DC volts position.
- 4.4.4** Turn off the power to the device or circuit under test, and discharge all capacitors.
- 4.4.5** Connect test leads to the circuit being measured.
- 4.4.6** Apply power to the circuit being measured. The value of the voltage being measured will be indicated by the pointer.
- 4.4.7** Remove all power from the circuit being measured, discharge all capacitors, and disconnect test leads when finished.

4.5 AC VOLTAGE MEASUREMENT

WARNING

Prior to making measurements, review and comply with the SAFETY PRECAUTIONS listed in paragraph 4.2.

4.5.1 Review and comply with the Preliminary Notes and Checks, paragraph 4.3.

4.5.2 Connect input test leads to the + and COMMON Terminals.

4.5.3 Turn the range selector switch to the appropriate voltage range position. If the voltage being measured is completely unknown, begin with the range selector switch set to the highest VAC position.

4.5.4 Remove all power from the circuit being measured and discharge all capacitors.

4.5.5 Connect test leads to the circuit being measured.

4.5.6 Apply power to the circuit being measured. The value of the voltage being measured will be indicated by the pointer.

4.5.7 When finished, remove all power from the circuit being measured, discharge all capacitors, and disconnect test leads from circuit.

4.6 DC CURRENT MEASUREMENT

WARNING

Prior to making measurements, review and comply with the SAFETY PRECAUTIONS listed in paragraph 4.2.

4.6.1 Review and comply with the Preliminary Notes and Checks, paragraph 4.3.

4.6.2 Turn the range selector switch to the appropriate current range position. If the current being measured is completely unknown, begin with the range selector switch set to the highest range.

4.6.3 Remove all power to the circuit being measured and discharge all capacitors.

4.6.4 Open the circuit in which the current is to be measured and connect the test leads in series. Insure that the MULTICORDER is not connected to a current source which can exceed the range setting of the Instrument.

4.6.5 Apply power to the circuit being measured.

4.6.6 The value of the current being measured is indicated by the pointer.

4.6.7 Remove all power from the circuit being measured and discharge all capacitors.

4.6.8 Disconnect the test leads and reconnect the circuit which was originally opened.

4.7 AC CURRENT MEASUREMENT

WARNING

Prior to making measurements, review and comply with the SAFETY PRECAUTIONS listed in paragraph 4.2.

4.7.1 Review and comply with the Preliminary Notes and Checks, paragraph 4.3.1.

4.7.2 Turn the range selector switch to the appropriate current range position. If the current being measured is completely unknown, begin with the range selector switch set to the highest available range.

4.7.3 Remove all power from the circuit being measured and discharge all capacitors.

4.7.4 Open the circuit in which the current is to be measured and connect the test leads in series. Insure that the MULTICORDER is not connected to a current source which might exceed the range setting of the Instrument.

4.7.5 Connect the test leads, and apply power to the circuit being measured.

4.7.6 The value of the current being measured is indicated by the pointer.

4.7.7 Remove all power from the circuit being measured and discharge all capacitors.

4.7.8 Disconnect the test leads and reconnect the circuit which was originally opened.

4.8 AC CURRENT AND VOLTAGE MEASUREMENTS UP TO 20,000 Hz

4.8.1 Connect the "minus" terminal of Instrument directly to ground if possible, or the point with the lowest potential from ground. At higher frequencies, input capacitance causes a lowering of the internal resistance (R_i).

4.8.2 The input capacitance is about 40 picofarads.

4.9 MEASUREMENT OF SUPERIMPOSED DC AND AC (Model 604 Only)

4.9.1 Select a voltage range at least as large as the superimposed AC component.

4.9.2 For measuring superimposed alternating voltage, block off the DC component by means of a suitable condenser (e.g., 0.1 μ F/500V DC). Lower frequencies will make the indication frequency-dependent; the change of indication can be calculated as follows:

$$\Delta = - \frac{1.25 \times 10^{12}}{f^2 \times R_i^2 \times C^2}$$

Δ = Change in indication in per cent

f = Frequency in Hz

R_i = Internal resistance in ohms

C = Capacity in microfarads

SECTION V

THEORY OF OPERATION

5.1 OVERALL SYSTEM

5.1.1 The circuit diagrams for the Models 604 and 605 Series 2 MULTICORDERS are shown in Figures 7-2 and 7-3.

5.1.2 The parameter being measured is connected to the input leads. The desired range is selected with the range selector switch, and the corresponding circuitry converts the parameter into an input which is applied to the indicating instrument.

5.1.3 The input into the indicating instrument causes the moving-coil assembly to deflect. This deflection may be observed visually with reference to the printed scale.

5.1.4 The indicating instrument deflection also is recorded when the pointer is clamped against the pressure sensitive chart paper.

5.1.5 The chart paper is moved forward at a pre-selected speed, providing a time base for the measured parameter.

5.1.6 The chart drive is powered by either a synchronous AC motor, or a battery-powered DC motor. The DC motor speed is regulated accurately by means of an electronic speed control.

5.2 DC CURRENT MEASUREMENTS

5.2.1 The DC current input is fed thru a ring shunt (connected across the indicating instrument), causing it to deflect proportionately.

5.3 DC VOLTAGE MEASUREMENTS

5.3.1 The applied DC voltage is fed through a series of dropping resistors, and applied to the indicating instrument.

5.4 AC VOLTAGE MEASUREMENTS

5.4.1 The input voltage to be measured is dropped by series resistors to a low value, rectified, and applied to the indicating instrument.

5.5 AC CURRENT MEASUREMENTS

5.5.1 Model 604 Series 2 MULTICORDER. The one current range input is shunted in a rectifier circuit and fed to the indicating instrument.

5.5.2 Model 605 Series 2 MULTICORDER. The AC input current is fed thru a current transformer, rectified, and applied to the indicating instrument.

SECTION VI

MAINTENANCE

6.1 GENERAL

WARNING

This Instrument contains internal voltages which constitute a SHOCK HAZARD. Review what constitutes a SHOCK HAZARD as explained on page v. Also, before attempting to adjust, calibrate or repair this Instrument, review and comply with the SAFETY PRECAUTIONS outlined in paragraph 4.2. Preferably, only Simpson Authorized Service Centers or factory personnel will disassemble any part of the Instrument.

The Simpson Model 604 and 605 Series 2 MULTICORDERS are designed carefully and constructed with high-quality components. By providing reasonable care, and following the instructions in this manual, the user can expect a long, useful service life from these Instruments.

6.2 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside back cover of this manual. Read carefully prior to requesting a warranty repair. NOTE: For assistance of any kind, including help with the Instrument under warranty, contact your nearest Authorized Service Center for instructions. These centers are listed on the last pages of this manual. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument model number, serial number (inside Instrument on meter housing) and date of purchase. Service data or shipping instructions will be sent to you 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 your prior approval.

6.3 SHIPPING

6.3.1 Pack the Instrument carefully and ship it prepaid to the proper destination. Insure the shipment.

6.4 FUSE REPLACEMENT

WARNING

Remove all power and input connections to the Instrument, before opening the Instrument.

To replace a fuse, open the Instrument as follows:

- a. Slide the ON-OFF switch to the OFF position.
- b. Push in the locking latches on each side of the base of the Instrument and lift up the hinged upper portion. The fuse receptacle, and spare fuses are in the hinged upper portion (Refer to Figure 3-2).

- c. Using a screw driver, remove the fuse compartment cap, replace the fuse, and screw the cap back on to the receptacle.
- d. Bring the hinged upper portion of the Instrument down onto the base, and push down until both locking latches have engaged.

6.5 BATTERY REPLACEMENT (Battery-powered Instruments only)

6.5.1 Recommended cells: Three "AA" size, 1.5V cells, NEDA 15A. Either carbon-zinc or alkaline cells may be used. (Refer to 1.2.4.4.)

6.5.2 Install the cells as follows:

- a. Slide the ON-OFF switch to the OFF position.
- b. Carefully turn the Instrument over. Loosen the single captivated screw on the bottom of the base, and remove the battery compartment cover.
- c. Remove the old cells, and replace with fresh ones, carefully observing polarity.
- d. Be sure the battery contacts are clean and making good connection.
- e. Replace the cover, tightening the captivated screw.

6.6 PREVENTIVE MAINTENANCE

6.6.1 Daily Care:

- a. Immediately clean all spilled materials from the Instrument and wipe dry. Do not attempt to clean this Instrument with the test leads connected to a power source or when it is connected to the AC power line.
- b. Whenever possible, avoid prolonged exposure or usage in areas which are subject to: temperature and humidity extremes, vibration or mechanical shock, dust or corrosive fumes, or strong electrical or electromagnetic interferences.

6.6.2 Monthly Care:

Verify Instrument calibration by performing operational checks using known stable sources. If proper calibration equipment is not available, contact your nearest Simpson Authorized Service Center. Carefully remove from time to time any deposits of dust which fall from the chart paper onto the scale and the chopper bar. Use a soft brush.

6.6.3 Annual Care:

It is recommended that the Instrument be returned annually to a Simpson Authorized Service Center, or the factory, for a complete overall check, adjustment and calibration.

6.6.4 Storage:

When the Instrument is not in use, store it in a room free from temperature extremes, dust and corrosive fumes, and mechanical vibration or shock. If storage time is expected to exceed 30 days, remove the batteries.

6.6.5 Lubrication:

Every 1000 hours, sparingly lubricate the drive bearings with a light oil such as sewing machine oil.

6.6.6 Carrying Case:

The Instrument can be protected by a carrying case (see Section VII).

SECTION VII

ORDERING INFORMATION, SCHEMATIC DIAGRAMS, ACCESSORIES, REPLACEMENT PARTS, AND AUTHORIZED SERVICE CENTERS

7.1 GENERAL

7.1.1 Simpson Authorized Service Centers have been established throughout the United States and Canada. To obtain repair or recalibration of Simpson equipment, contact the Authorized Service Center and make arrangements with them for the service you require. A list of these Authorized Service Centers is included in the last pages of this manual.

7.2 BASIC RECORDERS

7.2.1 Model 604 Series 2 MULTICORDER, cat. number 12610 AC line operated version.

7.2.2 Model 604 Series 2 MULTICORDER, cat. number 12615 battery-powered version.

7.2.3 Model 605 Series 2 MULTICORDER, cat. number 12613 AC line operated version.

7.2.4 Model 605 Series 2 MULTICORDER, cat. number 12614 battery-powered version.

7.3 ACCESSORIES

7.3.1 Shunts are available for use with the MULTICORDERS to extend their range in a safe, convenient manner at nominal cost. When using shunts, be careful to use conductors capable of carrying the higher currents. Choose conductors having 500 circular mils cross-sectional area per ampere of current.

7.3.2 Current Transformers are available for use with the Model 605 Series 2 MULTICORDER. These can extend the range of the 605 Series 2 up to 1200 AC Amperes. Conductors must be used which are capable of carrying the currents being measured; use cross-sectional areas of 500 circular mils per ampere of current.

7.3.3 Iron-Constantan Temperature Probes are available for use with the Model 605 Series 2 MULTICORDER. Temperatures up to about 1000°F can be measured and recorded, using the millivolt ranges. The curve given is adjusted to a reference temperature of 73.4°F (23°C) since the Instrument does not have reference temperature compensation. (See Figure 7-1.) Other thermocouple types may be used in conjunction with standard reference tables.

Table 7-1. Accessories and Supplies Furnished With the Instruments

Quantity	Description	Part Number
1	Test lead set: one black and one red insulated lead with banana plug and alligator clip	07500
1	Feed Spool	G0-000243
1	Gear Unit, 1/3/12 inch per hour (Standard)	22306
3	Fuse, 2 Amp 5 x 20 mm (Model 604)	5-117011
3	Fuse, 6 Amp 5 x 20 mm (Model 605)	5-117286
2	Rolls, chart paper, 50 division (Model 604)	02612
2	Rolls, chart paper, 30 division (Model 605)	02614
1	Operator's Manual	5-117291

Table 7-2. Accessories And Replacement Parts

Description	Part Number
Fuse, 2 amp medium-acting, 5 X 20 mm, available in boxes of five (Model 604)	5-117011
Fuse, 6 amp, Slo-Blo, 5 X 20 mm, available in boxes of five (Model 605)	5-117286
Battery, "AA" size, 1.5 volt, carbon-zinc, NEDA 15A	
Chart Paper, 50 divisions, available 10 rolls per box (Model 604)	02612
Chart Paper, 30 divisions, available 10 rolls per box (Model 605)	02614
Gear Unit, 1/3/12 inches per hour (Standard)	22306
Gear Unit, 30/60/90 inches per hour (Optional)	22307
Carrying Case, Vinyl	02616
Feed Spool	G0-000243
Test Lead Set, one black and one red insulated lead, each with banana plug and alligator clip	07500
Cover, Battery Compartment	G0-00994
Shunt, 0-5/10/20 DC Amperes (100mV), Accuracy 0.5%, (Model 604 only)	06526
Shunt, 0-25 DC Amperes (100 mV), Accuracy 0.5% Model 604	06527
0-15/7.5/3 DC Amperes (60/30/12 mV) Accuracy 0.5%, Model 605	
Shunt, 0-50 DC Amperes (100 mV), Accuracy 0.5% Model 604	06528
0-30/15/6 DC Amperes (60/30/12mV) Accuracy 0.5%, Model 605	
Shunt, 0-100 DC Amperes (100 mV), Accuracy 0.5% Model 604	06531
0-60/30/12 DC Amperes (60/30/12mV) Accuracy 0.5%, Model 605	

Shunt, 0-600/300/120 DC Amperes, (60/30/12mV) Accuracy 0.5%, Model 605 only	06529
Terminal lugs for 06529 shunt, 2 required for external leads	06532
Current Transformer, 0-600/120/30/6 AC Amperes (2000:1 turns ratio) 0.3/0.06A/15/3mA AC ±3% Accuracy at 45-65 Hz, Model 605 only	02461
Current Transformer, 0-600/150/30 AC Amperes (10000:1 turns ratio) 60/15/3mA AC ±1% Accuracy at 45-65 Hz, Model 605 only	02462
Current Transformer, 0-1200/300/60/15/3 AC Amperes (1000:1 turns ratio) 1.2/0.3/0.06A/15/3mA AC ±1% Accuracy at 45-65 Hz, Model 605 only	02463
Temperature Probe, I/C surface type, Model 605 only	22923
Temperature Probe I/C immersion type, Model 605 only	22924

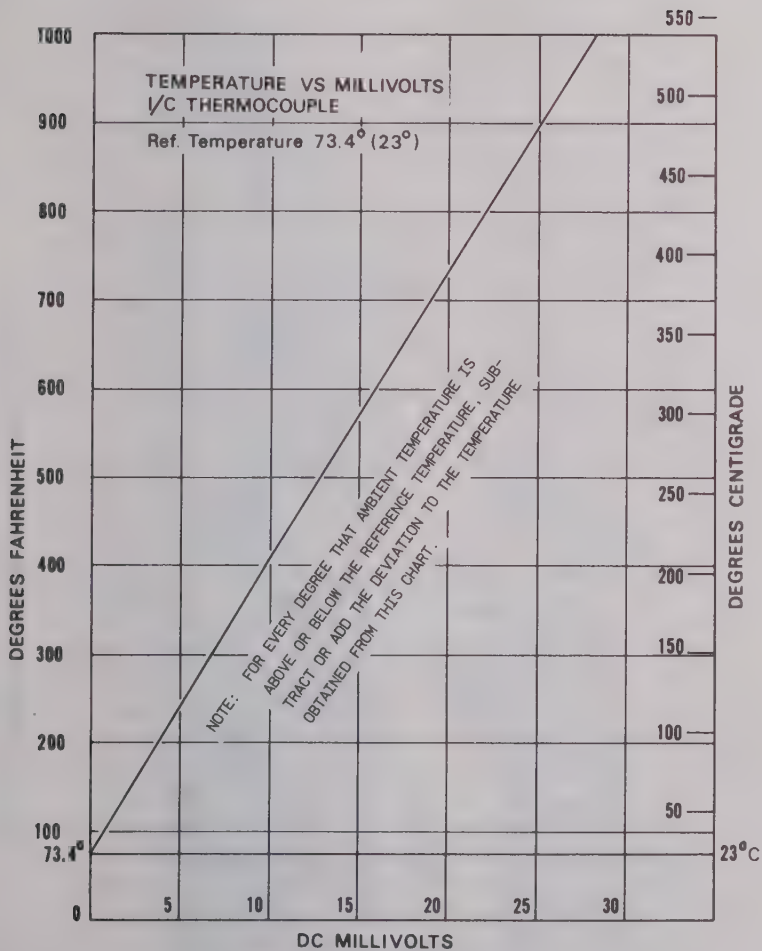


Figure 7-1. Temperature VS Millivolts, I/C Thermocouple

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853 Dundee Avenue, Elgin, Illinois 60120 — Phone: (312) 695-1121

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Simpson R-L-C BRIDGE model 2785



- **FAST—EASY-TO-USE**

No critical adjustments. Meter "null" indications are smooth and precise.

- **MEASURES CAPACITANCE, INDUCTANCE, RESISTANCE, "D" AND "Q"**

All with one compact battery operated unit less than 9" high. Switch selection of functions is made with a front panel control.

- **BUILT-IN 1 kHz OSCILLATOR**

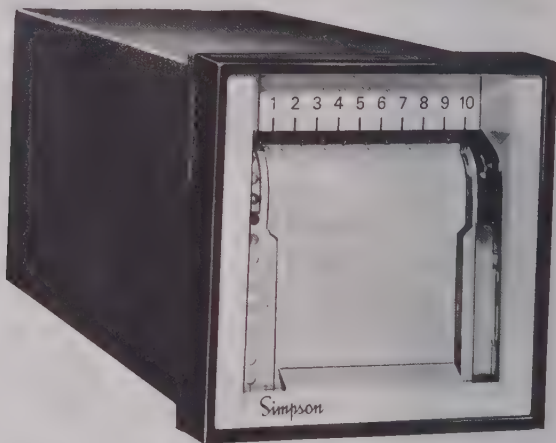
Makes measurements at the accepted standard frequency of 1,000 Hertz. Provision for external oscillator to allow measurements at other frequencies.

- **ACCURATE**

The 2785 is accurate to within $\pm 1\%$ on most Resistance and Capacitance ranges, to within $\pm 1.5\%$ on most Inductance ranges.

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Simpson MINIATURE STRIP CHART RECORDER



Model 2755 SERIES 10-CHANNEL EVENT RECORDER

Durable, rugged electromechanical instruments for inkless, continuous recording the on/off status (rather than magnitude) of ten separate sources. Inkless, pressure sensitive chart paper continuously passes the ten recording pens. It is possible to determine from the chart, the actual time an event occurred, the duration of time the event lasted and the sequence of

events recorded on several channels. Up to 32 days' recording can be made at the 20 mm-per-hour chart speed. Quick selection of two built-in chart speeds, 20/120 mm-per-hour is provided by slide switch. Interchangeable gearboxes permit speeds to 600/3600 mm-per-hour.

Optional hi-speed motor available for chart speeds up to 10,000 mm-per-hour.

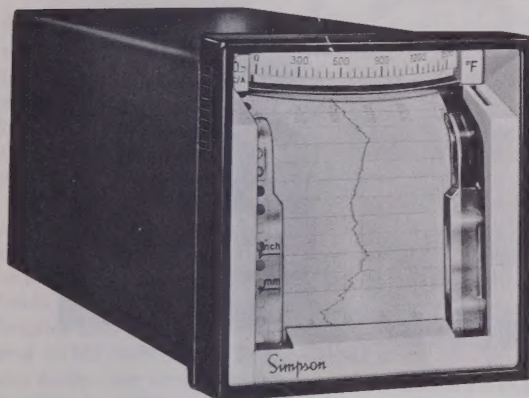
Voltage	Power per Solenoid	Cat. No.
10 channels, 6 Volts DC	1.2 watts	22203
10 channels, 12 Volts DC	1.2 watts	22202
10 channels, 24 Volts DC	1.2 watts	22201
10 channels, 115 Volts AC, 60 Hz	2.2 VA	22200
10 channels, 24 Volts AC, 60 Hz	2.2 VA	22204

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OR CONTACT THE
FACTORY**

Supplied complete with two rolls of chart paper, panel mounting bracket, 60" three-wire line cord and operator's manual.

Simpson

MINIATURE STRIP CHART RECORDERS



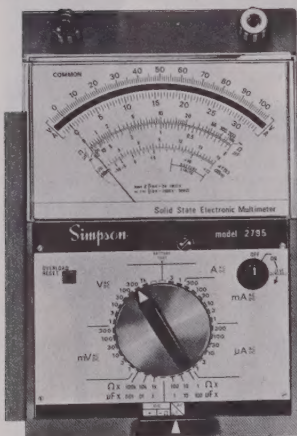
Model 2760 SERIES SINGLE RANGE TEMPERATURE RECORDER

These rugged units record for over a month unattended. Inkless, pressure sensitive paper. Switch selected chart speeds 20/120 mm-per-hr. Taut Band movement is temperature compensated. Accuracy is $\pm 1.5\%$ F.S.

RANGES	SENSOR	CAT. NO.	PRICE
-60°C to 0°C	Pt-100 Resis. Bulb	23100	\$170.00
0 to +60°C	Pt-100 Resis. Bulb	23102	170.00
0 to +100°F	Pt-100 Resis. Bulb	23114	170.00
0 to +100°C	Pt-100 Resis. Bulb	23103	170.00
0 to +500°F	1/C Thermocouple	23008	180.00
0 to +800°F	1/C Thermocouple	23009	180.00
0 to +1500°F	C/A Thermocouple	23010	180.00
0 to +2500°F	C/A Thermocouple	23011	180.00

New SOLID-STATE FET-INPUT MULTIMETER

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SIMPSON
of course



**Model
2795**
PORTABLE,
LABORATORY
ACCURACY
**SOLID-STATE
ELECTRONIC
MULTIMETER**

- 68 Switch Selectable Functions:
 - 13 AC and DC Voltage Ranges (as low as 1 MV, full scale)
 - 14 AC and DC Current Ranges (as low as 1 μ A, full scale)
 - 6 low power (IC compatible) Resistance Ranges
 - 6 completely self-contained Capacitance Ranges
- **Plus 12 Output Ranges**
- Circuit Breaker Overload Protection
- High FET-Input Impedance
- $\pm 1\%$ Accuracy for AC and DC
- Negligible Voltage Drop
- Simple, Straight-Forward Operation
- Size: 8.07" High, 5.04" Wide, 3.94" Deep. Only 3.3 lbs.

2795 MULTIMETER supplied complete with batteries, test leads and operator's manual. Complete accessories available.

WRITE FOR BULLETIN L-1010. . . OR CONTACT
YOUR SIMPSON INSTRUMENTATION PRODUCTS
DISTRIBUTOR FOR OFF-THE-SHELF DELIVERY

Simpson
INSTRUMENTATION

SIMPSON ELECTRIC COMPANY

853 Dundas Ave., Elgin, Illinois 60120

Phone: (312) 695-1121

IN CANADA: Bach-Simpson, Ltd., London, Ontario

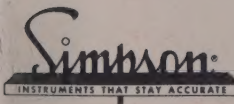
IN ENGLAND: Bach-Simpson (U.K.) Limited, Wadebridge, Cornwall

IN INDIA: Ruttonshah-Simpson Private, Ltd., International House, Bombay-Agra Road, Vikhroli, Bombay

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.



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Quality is the indispensable component
of every Simpson instrument