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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 360-2**
**DIGITAL VOLT-OHM-MILLIAMMETER**

**SIMPSON ELECTRIC COMPANY**
853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

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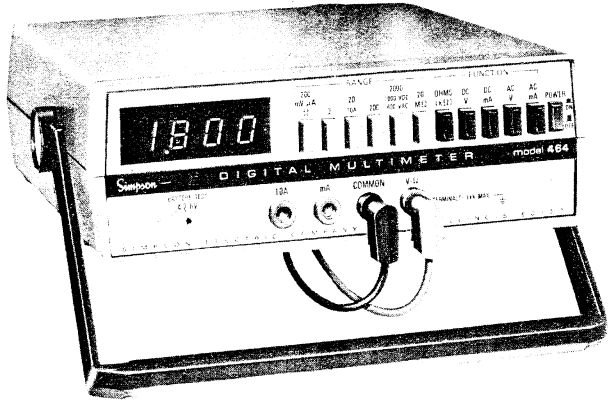


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  6 DC current ranges to 10A
  6 resistance ranges to 20MΩ
  5 AC voltage ranges to 600V
  5 DC voltage ranges to 1000V
- Choice of Battery and AC Line Operation, or AC Line Operation only.

**Order from your Electronics/Electrical Distributor**

# OPERATOR'S MANUAL

## SIMPSON 360-2 DIGITAL VOLT-OHM-MILLIAMMETER

**SIMPSON ELECTRIC COMPANY**
853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

Printed in U.S.A.
10-75 HINZ

Part No. 5-118798


**Figure 1-1. Simpson 360-2 Digital Volt-Ohm-Milliammeter**



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**WARNING**

**The Simpson 360-2 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 360-2 Digital Volt-Ohm-Milliammeter is a compact, 3-1/2 digit instrument, suitable for both field and bench use in general electronic maintenance, production, and laboratory. It features 0.25% accuracy, solid state integrated circuit electronics, AC line and self-contained battery operation, and LED display. Additional features are automatic polarity, excellent temperature and overranging characteristics, analog indication, and analog (recorder) output.

**1.1.2** The 360-2 measures DC voltage, AC voltage, DC and AC current and resistance as specified in Table 1-1. The up-down integration technique is used for the analog-to-digital conversion, because of its inherently excellent stability, accuracy, and noise immunity. The use of an MOS-LSI integrated circuit achieves high reliability, low power dissipation, and a compact design.

**1.1.3** The Simpson 360-2 is supplied with a standard AC adapter/charger for 120 VAC, 50-400 Hz operation. A 220V AC adapter/charger is available as an option. For applications requiring complete isolation from the power line, or when the AC line is not available, battery operation is provided using rechargeable, nickel-cadmium cells. The battery can operate the Instrument for 8 hours continuously. Recharging is automatic when the Instrument is in the BATT CHRG ONLY position, and with the AC adapter/charger connected. In an emergency, commercially available, "C" size (flashlight type) batteries can be used (refer to Section IV for precautions and instructions).

**1.1.4** The numerical display is a 7-segment light-emitting-diode (LED) for easy viewing and solid-state reliability. The numerals are 0.43 inch high and in a single plane for distant and wide-angle viewing. Ambient lighting effects are minimized by a filter which reduces reflections and background illumination.





**1.1.5** Two "low power" resistance measuring ranges, which feature a maximum full-scale voltage of 200 millivolts, are provided. These ranges are useful in making resistance measurements in circuits containing semiconductor devices. The low full-scale voltage allows "in circuit" resistance measurement without the "turn-on" of most semiconductor junctions.

**1.1.6** The recorder output provision makes it possible to record low level high impedance voltage sources using a non-potentiometric recorder.

**1.1.7** The analog meter provides quick and convenient indications for nulling, peaking, scanning and varying signal applications.

## 1.2 ACCESSORIES AND SUPPLIES

All supplies and accessories required for the operation of the Instrument (using line power) are furnished with the Instrument and listed in Table 7-1. Batteries are not supplied.

## 1.3 TECHNICAL DATA

Table 1-1 lists the technical specifications for the Simpson 360-2 Digital Volt-Ohm-Milliammeter.

**Table 1-1. Technical Data**

**1. DC VOLTAGE:**

| Range | Maximum Indication | Input Resistance | Overload Protected To |
|---|---|---|---|
| 200 mV | ±199.9 mV | 10 MΩ | ±350 V |
| 2 V | ±1.999 V | 10 MΩ | ±350 V |
| 20 V | ±19.99 V | 10 MΩ | ±1100 V |
| 200V | ±199.9 V | 10 MΩ | ±1100 V |
| 1000 V | ±1000 V (max. input) | 10 MΩ | ±1100 V |

| | |
|---|---|
| Accuracy: (from +15°C to +35°C) | ± (0.25% of reading + 1 digit) |
| Input Bias Current: | 7 nA maximum at reference conditions |
| Sensitivity: | 100 microvolts on 200 mV range |
| Overrange Capability: | Linear to 500 counts beyond maximum indication (except on 1000 V range, where any indication greater than 1100 is an overload) |
| Temperature Coefficient: (from 0°C to +50°C) | ± (0.025% of reading + 0.1 digit)/°C |
| Full Scale Step Response: (to within rated accuracy) | 1 second |
| Normal Mode Rejection: | 35 dB minimum at 60 Hz |
| Common Mode Rejection: | 80 dB minimum at 60 Hz with 1000 Ω unbalance<br>100 dB minimum at DC with 1000 Ω unbalance |

## 2. RESISTANCE:

| Range | Maximum Indication | Test Current | Full Scale Voltage | Overload Protected To |
|---|---|---|---|---|
| 200 Ω | 199.9 Ω | 1 mA | 200 mV | *150 V rms |
| 2 kΩ | 1.999 kΩ | 1 mA | 2 V | *150 V rms |
| 20 kΩ | 19.99 kΩ | 10 μA | 200 mV | 250 V rms |
| 200 kΩ | 199.9 kΩ | 10 μA | 2 V | 250 V rms |
| 2 MΩ | 1.999 MΩ | 1 μA | 2 V | 250 V rms |
| 20 MΩ | 19.99 MΩ | 100 nA | 2 V | 250 V rms |

*Fuse Protected

| | |
|---|---|
| Accuracy: (from +15°C to +35°C) | ± (0.5% of reading + 1 digit), except on 2MΩ and 20 MΩ ranges, which are ± (1% of reading + 2 digits) |





| | |
|---|---|
| Sensitivity: | 0.1 ohm on 200 Ω range |
| Overrange Capability: | Linear to 500 counts beyond maximum indication |
| Temperature Coefficient: (from 0°C to +50°C) | ± (0.05% of reading +0.1 digit)/°C |
| Full Scale Step Response: (to rated accuracy) | 1 second, except 10 seconds on the 20 MΩ range |

## 3. AC VOLTAGE (Average-Sensing, RMS-Calibrated Sine Wave):

| Range | Maximum Indication | Input Impedance | Overload Protected To |
|---|---|---|---|
| 200 mV | 199.9 mV | 10MΩ and 100 pf | 350 V rms |
| 2 V | 1.999 V | 10MΩ and 100 pf | 350 V rms |
| 20 V | 19.99 V | 10MΩ and 100 pf | 650 V rms |
| 200 V | 199.9 V | 10MΩ and 100 pf | 650 V rms |
| 600 V* | 600 V (Max. Input) | 10MΩ and 100 pf | 650 V rms |

*40 Hz to 1 kHz

| | |
|---|---|
| Accuracy: (from +15°C to +35°C) | ± (0.5% of reading + 1 digit), 40 Hz to 1000 Hz<br>± (1.0% of reading + 1 digit), 1000 Hz to 10 kHz<br>± (2.0% of reading + 2 digits), 10 kHz to 20 kHz, except on 200 V range, which is ± (5% of reading + 2 digits) |
| Sensitivity: | 100 microvolts on 200 mV range |
| Overrange Capability: | Linear to 500 counts beyond maximum indication (except on 600 V range, where any indication greater than 650 is an overload) |

| | |
|---|---|
| Full Scale Step Response: (to rated accuracy) | 5 seconds |
| Temperature Coefficient: (from 0°C to +50°C) | ± (0.05% of reading + 0.1 digit)/°C |

**4. DC CURRENT:**

| Range | Maximum Indication | Full Range Voltage Drop | Overload Protected To |
|---|---|---|---|
| 20 μA | ±19.99 μA | 200 mV | ±3 mA |
| 200 μA | ±199.9 μA | 200 mV | ±25 mA |
| 2 mA | ±1.999 mA | 200 mV | *± 1/2 Amp |
| 20 mA | ±19.99 mA | 200 mV | *±1/2 Amp |
| 200 mA | ±199.9 mA | 200 mV | *±1/2 Amp |
| 2 A | ±1.999 A | 200 mV | ±3 Amps |
| 10 A | ±10.00 A (max. input) | 100 mV | ±10 Amps |

*Fuse Protected

| | |
|---|---|
| Accuracy: (from +15°C to +35°C) | ± (0.5% of reading + 1 digit), except on 2A and 10 A ranges, which are ± (1.0% of reading + 1 digit) |
| Sensitivity: | 10 nanoamps on 20 μA range |
| Overrange Capability: | Linear to 500 counts beyond maximum indication (except on 10 A range, where any indication greater than 1000 is an overload) |
| Full Scale Step Response: (to rated accuracy) | 1 second |
| Temperature Coefficient: (from 0°C to +50°C) | ± (0.03% of reading + 0.1 digit)/°C |





**5. AC CURRENT (40 Hz to 10 kHz):**

| Range | Maximum Indication | Full Scale Voltage Drop | Overload Protected To |
|---|---|---|---|
| 200 μA | 199.9 μA | 200 mV | 25 mA |
| 2 mA | 1.999 mA | 200 mV | *1/2 Amp |
| 20 mA | 19.99 mA | 200 mV | *1/2 Amp |
| 200 mA | 199.9 mA | 200 mV | *1/2 Amp |
| 2 A | 1.999 A | 200 mV | 3 Amps |
| 10 A | 10.00 A (max. input) | 100 mV | 10 Amps |

*Fuse Protected

| | |
|---|---|
| Accuracy: (from + 15°C to +35°C) | ± (1.0% of reading + 1 digit), except on 2A and 10 A ranges, which are ± (2.0% of reading + 2 digits) |
| Sensitivity: | 100 nanoamps on 200 μA range |
| Overrange Capability: | Linear to 500 counts beyond maximum indication (except on 10 A range, where any indication greater than 10.00 is an overload) |
| Full Scale Step Response: (to rated accuracy) | 5 seconds |
| Temperature Coefficient: (from 0°C to +50°C) | ± (0.05% of reading +0.1 digit)/°C |

**6. *RATED CIRCUIT-TO-GROUND VOLTAGE:**

| | |
|---|---|
| (Maximum Common Mode Voltage) | 1000 volts (DC plus peak AC) maximum between any input terminal and power line (earth) ground |

*The maximum voltage, with respect to ground, which may safely and continuously be applied to the circuit of an instrument.

**7. DISPLAY:**

| | |
|---|---|
| Numerical Display: | 3-1/2 digits. 7-segment, 0.43 inch light-emitting-diode (LED) type |
| Conversion Rate: | 3 readings per second, nominal |
| Overrange Indication: | Automatic beyond 1999, with the "1" digit flashing |
| DC Polarity Selection: | Automatic, with "+" or "−" indication |
| Analog Display: | 50-0-50 $\mu$A meter |

**8. ANALOG OUTPUT:** The function of the ANALOG OUTPUT is to provide for analog monitoring by a chart recorder, or perhaps a companion analog instrument

| | |
|---|---|
| Level: | 1 volt DC with reading of 1000 |
| Output resistance: | 45 k$\Omega$ nominal |
| Accuracy: | The basic accuracy is that of the overall Instrument on the particular function and range being used, plus an additional possible error no greater than ±1% of maximum reading. |

**9. RESOLUTION:** 1 part in 2000

**10. POWER REQUIREMENT:**

| | |
|---|---|
| a. AC Operating or Battery Charging: | 120 VAC, ±10%, 50 to 400 Hz (standard)<br>220 VAC, ±10%, 50 to 400 Hz (optional) |
| b. Battery Operation: | Four nickel-cadmium "C" size rechargeable cells, GE Cat. No. GCT 1.5 SB or Eveready CH 1.8 or equivalent; each cell is rated at 1.25 V, 1.5 ampere-hour min. |





| | |
|---|---|
| c. Operation time (continuous) with fully charged battery | 8 hours nominal |
| d. Recharge time (function switch in BATT CHRG ONLY position): | 16 hours nominal |
| e. Recharge time (while Instrument is in operation): | 30 hours nominal |

**11. TEMPERATURE RANGE:**

| | |
|---|---|
| Operating: | 0°C to +50°C |
| Storage: | −40°C to +60°C |

**12. REFERENCE CONDITIONS:**

| | |
|---|---|
| Temperature: | +25°C ±1°C |
| Relative Humidity: | 30 to 60% |
| Atmospheric Pressure: | 575 to 800 mm Hg |

**13. WEIGHT:**

| | |
|---|---|
| (with battery): | 4 pounds |
| Dimensions: | 7.2" high, 5.4" wide, 2.75" deep (not including panel controls) |

# SECTION II

# INSTALLATION

## 2.1 UNPACKING AND INSPECTION

**2.1.1** Examine the shipping carton for signs of damage prior to unpacking. 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 AC adapter/charger plug into the power source yet. Check that the designation on the adapter/charger agrees with the power source to be used.**

**2.2.1** The Simpson 360-2 is designed to be operated from either the supplied AC adapter/charger or self-contained nickel-cadmium cells (not furnished with the Instrument). Refer to Table 1-1.

### 2.2.2 AC Line or Battery Charging Operation

The Simpson 360-2 can be operated with the standard AC adapter/charger (12288) for 120 VAC, 50-400 Hz, or with optional AC adapter/charger (12289) for 220 VAC, 50-400 Hz operation.

### 2.2.3 Battery Operation

a. The Simpson 360-2 is supplied without batteries. The cells required (refer to Table 1-1, item 10), usually can be purchased from a local electronic parts distributor.

b. Battery operation is automatic whenever cells are installed, the AC adapter/charger is disconnected, and the function switch is set in the DC, OHMS or AC position.

c. For battery installation and battery test refer to paragraph 6.5.

## 2.3 INSTALLATION

The Instrument may be operated in any position. It can be inclined conveniently by positioning the Adjust-A-Vue Handle.

# SECTION III

# CONTROLS, CONNECTORS AND INDICATORS

## 3.1 GENERAL

All operating and adjustment controls, connectors, and indicators are described in Table 3-1. Become familiar with each item prior to operating the Instrument for the first time.

## 3.2 FRONT AND REAR PANEL DESCRIPTION

Table 3-1 lists all front and rear panel controls, connectors and indicators (see Figure 3-1 for identification).

**Table 3-1. Front and Rear Panel Description**

**1. Function Selector Switch**

| Switch Position | Description |
|---|---|
| BATT CHRG ONLY | Connects the circuit to fully charge the battery in 16 hours nominal when the AC adapter/charger is connected to the recommended line voltage. The panel LED lights when the switch is in this position. |
| OFF | Disconnects all power from the internal circuits. |

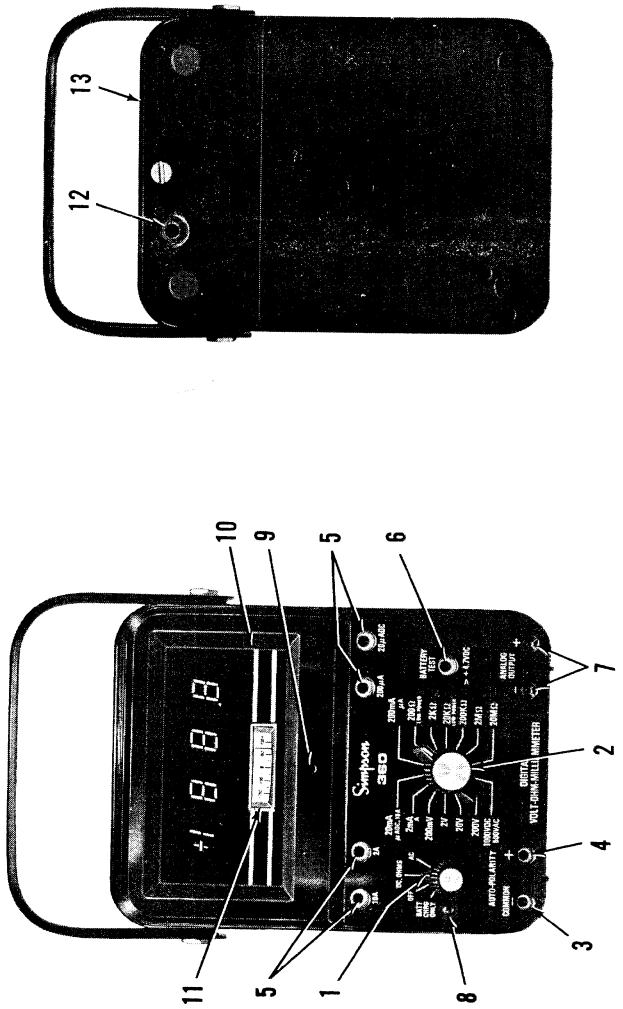



Figure 3-1. Front and Rear Panel Description





| | |
|---|---|
| DC, OHMS | Connects the appropriate jacks to the DC voltage, DC current, or resistance measuring circuits, depending on the range switch position setting. |
| AC | Connects the appropriate jacks to the AC voltage or AC current measuring circuits, depending on the range switch position setting. |

**2. Range Selector Switch**

| Switch Position | Description |
|---|---|
| 200mV, 2V, 20V, 200V and 1000VDC 600 VAC | Selects the desired range setting of DC volts (either polarity) or AC volts, depending on the function switch position setting. The input voltage is applied at the + and COMMON jacks. |
| 200Ω Low Power, 20kΩ Low Power | Selects the circuits required for the measurement of resistance from "0" to 200Ω or 20kΩ, when the function switch is set to DC, OHMS position, and the input signal leads are connected to the + and COMMON jacks. The two LOW POWER resistance ranges have a maximum full-scale voltage of approximately 200 mV. |
| 2kΩ, 200kΩ, 2MΩ, and 20MΩ | Selects the circuits required for the measurement of resistance from "0" to the corresponding range setting of kΩ or MΩ, when the function switch is set to DC, OHMS position, and the input signal leads are connected to the + and COMMON. |
| 2mA<br>A | Selects the circuits required for the measurement of AC and DC current as follows: |

| Range | Function Switch Position | Input Connection |
|---|---|---|
| 0 to ±2mA DC<br>0 to 2mA AC | DC, OHMS<br>AC | + and COMMON jacks |
| 0 to ±2A DC<br>0 to 2A AC | DC, OHMS<br>AC | 2A and COMMON jacks |

20mA, μADC, 10A — Selects the circuits required for the measurement of AC and DC current as follows:

| Range | Function Switch Position | Input Connection |
|---|---|---|
| 0 to ±20mA DC<br>0 to 20mA AC | DC, OHMS<br>AC | + and COMMON jacks |
| 0 to ±20μA DC | DC, OHMS | 20μA DC and COMMON jacks |
| 0 to ±10A DC<br>0 to 10A AC | DC, OHMS<br>AC | 10A and COMMON jacks |

200mA, μA — Selects the circuits required for the measurement of current as follows:

| Range | Function Switch Position | Input Connection |
|---|---|---|
| 0 to ±200mA DC<br>0 to 200mA AC | DC, OHMS<br>AC | + and COMMON jacks |
| 0 to ±200μA DC<br>0 to 200μA AC | DC, OHMS<br>AC | 200μA and COMMON jacks |

### 3. COMMON Jack

This jack is used to connect the "low" side of the circuit being measured to the internal circuit ground and is isolated from the AC power line ground.

### 4. + Jack

This terminal is used to connect the "high" side of the circuit being measured to all voltage, resistance, and some current measuring circuits through the range and function switches.





### 5. 20μA DC, 200μA, 2A and 10A Current Jacks

These terminals are used to connect the "high" side of the currents being measured and provide ranges of 0 to 20μA DC, 200μA AC or DC, 2A AC or DC, and 10A AC or DC depending on the position settings of the function and range switches. The "low" side is connected to the COMMON jack.

### 6. BATTERY TEST Jack

This jack connects the positive terminal of the battery (through an isolation resistor) when the internal battery is installed. For battery test, a test lead is connected between the + jack and the BATTERY TEST jack, with the function selector switch set in the DC, OHMS position and the range selector switch set in the 20V position. The numerical display must indicate greater than +4.70 volts for proper Instrument operation.

### 7. ANALOG OUTPUT, + and − Jacks

The signal from these jacks is a DC voltage which is directly proportional to the input signal, and whose value is 1 volt when the digital display indicates 1000 counts. These jacks accept test leads with insulated pin tip plugs, H. H. Smith type 491 or equivalent. See Table 1-1 for specifications.

### 8. Battery Charge Indicator

The light-emitting diode (next to the function switch) indicator illuminates when the function selector switch is set to the BATT CHRG ONLY position, with the AC adapter/charger connected. The indicator is used to indicate charging of the battery.

### 9. Zero Adjustment

The zero adjustment is a screwdriver adjusted potentiometer used to correct for a DC offset voltage at the input to the integrator/amplifier. It is adjusted to obtain a numerical indication of 000 when the input terminals are shorted together, with the function switch set on DC, OHMS and the range selector switch set on the 200mV position.

### 10. Numerical Display

The digital display uses LED's and includes a polarity (+, −) sign, a "1" digit, and three 7-segment type 0 to 9 digits and a decimal point, to indicate the polarity and the value of the signal being measured. The decimal point is properly positioned by the setting of the range selector switch. When an "overrange" condition exists, the "1" digit will flash.

### 11. Analog Display

This indicator has zero at its center. In conjunction with the position setting of the range switch, it displays in analog form the relative value of the input signal being measured. An indicator of this form can be very helpful when one is adjusting a circuit for a peak or a null.

### 12. AC Adapter/Charger Receptacle

This receptacle accepts either the 120 VAC (Cat. No. 12288) or 220 VAC (Cat. No. 12289) adapter/charger for AC operation or charging battery.

CAUTION

**Be sure AC power source used matches power requirements of the AC adapter/charger.**

### 13. Battery and Fuse Compartment Cover

Remove this cover (after disconnecting the AC adapter/charger) when installing the batteries, or when changing the OHMS and CURRENT fuses. One set of spare fuses is provided inside the compartment.

WARNING

**Do not reconnect the AC adapter/charger to the Simpson 360-2 with the Battery and Fuse Compartment removed.**



# SECTION IV

# OPERATION

## 4.1 GENERAL

WARNING

**The Simpson 360-2 is 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 do so can result in a serious or fatal accident.**

This section of the manual contains information required to operate the instrument in a safe and proper manner.

## 4.2 SAFETY PRECAUTIONS

**4.2.1** The Simpson 360-2 is designed 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 v.

**4.2.2** Do not work alone when making measurements where a shock hazard can exist. Notify another nearby person that you are 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 360-2 before making connections or disconnections. The Instrument itself is well protected against electrical overload, as noted throughout paragraph 1.3. 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 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 exist, destroy and replace the defective item(s) immediately.

**4.2.6** Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color emanating from sharp metal points in the circuit or a buzzing sound, or 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 a malfunction of some kind.

**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, circuit, or Instrument 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** Do not use test leads which differ from those originally furnished with the Instrument.

**4.2.11** Before the Instrument is used for AC operation, make sure that the power requirement of the AC adapter/charger matches with the power source to be used.

**4.2.12** Do not float any input terminal more than 1000 volts (DC plus AC peak) with respect to the power line (earth) ground.

## 4.3 PRELIMINARY NOTES AND CHECKS

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





**4.3.1** For AC line operation, insure that the power source used matches the requirements of the AC adapter/charger and insert the plug into a power outlet which conforms to the latest electrical code. The Instrument will operate with or without battery. When the Instrument is operating on the AC line with the internal battery installed, the battery is being "trickle" charged.

CAUTION

**Do not operate the Instrument with cells in the completely discharged state, which is common for all new cells as acquired from the vendor. See paragraph 6.6.**

### 4.3.2 Battery Operation

a. Disconnect the AC adapter/charger and set the function selector switch to the OFF position. Install four "C" size nickel-cadmium cells (not supplied with Instrument). Observe polarity as shown on label inside battery holder.

b. Set the range selector switch to the 20V position.

c. Set the function selector switch to the DC, OHMS position.

d. Connect a test lead between the + jack (lower left corner) and the BATTERY TEST jack. The reading must be greater than +4.7 volts for proper operation of the Instrument.

e. If the battery voltage is below +4.7 volts, or if the numerical display does not emit light, either the battery is improperly installed or recharging is required.

### 4.3.3 To recharge the battery

Refer to paragraph 6.6 for recharging procedure.

**4.3.4** For a general functional check, use this procedure:

a. Connect the black test lead to the COMMON jack and the red test lead to the + jack. Short the test leads together.

b. Turn the function selector switch to the DC, OHMS position, and the range selector switch to the 200 KΩ position. The display will indicate 00.0.

c. Open the test leads. The numerical display will indicate 99.9 with the "1" digit flashing for an overrange condition.

d. Short the test leads together. The display reading will return to 00.0.

e. If difficulty is encountered in the above steps, see Section VI, paragraph 6.9 for Zero Adjust procedure.

**4.3.5** On AC line operation, do not "float" any input terminal away from power line ground more than 1000 volts (DC plus AC peak).

## 4.4 DC VOLTAGE MEASUREMENT

**4.4.1** **Review the safety precautions listed in paragraph 4.2.**

**4.4.2** Connect input test leads to the + and COMMON terminals.

**4.4.3** Turn the function selector switch to the DC, OHMS position.

**4.4.4** Turn the range selector switch to the appropriate voltage range position as indicated in Table 4-1. If the voltage being measured is unknown, begin with the range selector switch set to the 1000 VDC position.

**4.4.5** Turn off the power to the device or circuit under test, and discharge all capacitors.

CAUTION

**Do not attempt to measure voltages on the 1000 VDC range which might be greater than 1100 volts DC.**

**4.4.6** Connect test leads to the circuit being measured.

**4.4.7** Apply power to the circuit being measured. The Instrument will automatically indicate the correct polarity. The value of the voltage being measured will be indicated on the numerical display. The analog display will indicate the relative value and can be used for nulling or peaking applications.





**4.4.8** Remove all power from the circuit being measured, discharge all capacitors, and disconnect test leads.

**Table 4-1. DC Voltage Ranges and Connections**

| Range | Range Switch Position | Function Switch Position | Input Connections | Max. Voltage | Remarks |
|---|---|---|---|---|---|
| 0 to ±200mV | 200 mV | DC, OHMS | +, COMMON jacks | ±350V | Auto-Polarity |
| 0 to ±2V | 2V | DC, OHMS | +, COMMON jacks | ±350V | |
| 0 to ±20V | 20V | DC, OHMS | +, COMMON jacks | ±1100V | |
| 0 to ±200V | 200V | DC, OHMS | +, COMMON jacks | ±1100V | |
| 0 to ±1000V | 1000V | DC, OHMS | +, COMMON jacks | ±1100V | |

## 4.5 AC VOLTAGE MEASUREMENT

**4.5.1** **Review the safety precautions listed in paragraph 4.2.**

**4.5.2** Connect input test leads to the + and COMMON terminals.

**4.5.3** Turn the function selector switch to the AC position.

**4.5.4** Turn the range selector switch to the appropriate voltage range position, as indicated in Table 4-2. If the voltage being measured is unknown, begin with the range selector switch set to the 600 VAC position.

CAUTION

**Do not attempt to measure voltages on the 600V range which might be greater than 650 volts.**

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

Table 4-2. AC Voltage Ranges and Connections

| Range | Range Switch Position | Function Switch Position | Input Connections | Max. Voltage | Frequency Range |
|---|---|---|---|---|---|
| 0 to 200mV | 200mV | AC | +, COMMON jacks | 350V rms | 40 Hz to 20 kHz |
| 0 to 2V | 2V | AC | +, COMMON jacks | 350V rms | |
| 0 to 20V | 20V | AC | +, COMMON jacks | 650V rms | |
| 0 to 200V | 200V | AC | +, COMMON jacks | 650V rms | |
| 0 to 600V | 600V | AC | +, COMMON jacks | 650V rms | 40 Hz to 1 kHz |

**4.5.6** Connect test leads to the circuit being measured.

**4.5.7** Apply power to the circuit being measured. The value of the voltage being measured will be indicated on the numerical display. The analog display can be used for nulling or peaking applications.

**4.5.8** Remove all power from the circuit being measured, discharge all capacitors, and disconnect test leads.

## 4.6 RESISTANCE MEASUREMENT

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

**4.6.2** Connect input test leads to the + and COMMON terminals.

**4.6.3** Turn the function selector switch to the DC, OHMS position.

**4.6.4** Turn the range selector switch to the appropriate resistance range position as indicated in Table 4-3.





**4.6.5** If the resistance being measured is connected into a circuit, **be certain that all power is removed from the circuit and all capacitors are discharged.** Check for alternate resistance paths other than the resistance being measured. These paths can result in a measured value which is lower than the actual value of the resistance being measured.

**4.6.6** Connect the test leads to the resistance being measured. Be careful not to contact adjacent points, even if insulated, particularly when making high resistance measurements. Some insulators can have relatively low insulation resistance, which can sufficiently shunt the resistance being measured to result in a measured value lower than the presumed and actual value.

NOTE: If the resistance being measured is polarity or voltage sensitive (for example, semiconductors), careful considerations must be given when making connections and selecting the resistance range (refer to Table 4-3).

Table 4-3. Resistance Ranges and Connections

| Range | Range Switch Position | Function Switch Position | Input Connections | Max.Full Scale Voltage | Remarks |
|---|---|---|---|---|---|
| 0 to 200Ω | 200Ω Low Power | DC, OHMS | +, COMMON jacks | 200mV | Low Power |
| 0 to 2kΩ | 2kΩ | DC, OHMS | +, COMMON jacks | 2V | |
| 0 to 20kΩ | 20kΩ Low Power | DC, OHMS | +, COMMON jacks | 200mV | Low Power |
| 0 to 200kΩ | 200kΩ | DC, OHMS | +, COMMON jacks | 2V | |
| 0 to 2MΩ | 2MΩ | DC, OHMS | +, COMMON jacks | 2V | |
| 0 to 20MΩ | 20MΩ | DC, OHMS | +, COMMON jacks | 2V | |

**4.6.7** Allow time for the display to stabilize. This is especially important when measuring a high value resistance shunted by a large value of capacitance.

**4.6.8** Disconnect test leads.

**4.6.9** If no additional immediate resistance measurements are required, rotate the range selector switch to the 1000 VDC 600 VAC position and the function selector switch to the OFF position. These settings avoid the possibility of accidentally applying voltage to the resistance circuits, and causing the internal protective fuse to open.

## 4.7 DC CURRENT MEASUREMENT

**4.7.1** **Review the safety precautions listed in paragraph 4-2.**

**4.7.2** Turn the function selector switch to the DC, OHMS position.

**4.7.3** Turn the range selector switch to the appropriate current range position as indicated in Table 4-4. If the current being measured is unknown (but less than 10 A), begin with the range selector switch set to the 20mA, μADC, 10 A position and connect the red test lead to the 10 A jack and the black test lead to the COMMON jack.

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

**4.7.5** Connect the test leads according to Table 4-4.

**4.7.6** Open the circuit in which the current is to be measured and connect the test leads in series. Insure that the Simpson 360-2 is not connected across a voltage source which can exceed the range setting of the Instrument.

**4.7.7** Apply power to the circuit being measured.

**4.7.8** The value of the current being measured is indicated on the numerical display. The analog display can be used for nulling or peaking applications.





**Table 4-4. DC Current Ranges and Connections**

| Range | Range Switch Position | Function Switch Position | Input Connections | Max. Current | Remarks |
|---|---|---|---|---|---|
| 0 to ±20μA | 20mA μADC, 10A | DC, OHMS | 20μADC, COMMON jacks | ±3 mA | Auto-Polarity |
| 0 to ±200μA | 200mA μA | DC, OHMS | 200μA, COMMON jacks | ±25 mA | |
| 0 to ±2mA | 2mA A | DC, OHMS | +, COMMON jacks | ±1/2 Amp * | |
| 0 to ±20mA | 20mA μADC, 10A | DC, OHMS | +, COMMON jacks | ±1/2 Amp * | |
| 0 to ±200mA | 200mA μA | DC, OHMS | +, COMMON jacks | ±1/2 Amp * | |
| 0 to ±2A | 2mA A | DC, OHMS | 2A,COMMON jacks | ±3 Amp | |
| 0 to ±10A | 20mA μADC, 10A | DC, OHMS | 10A,COMMON jacks | ±10 Amp | |

*Fuse Protected

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

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

**4.7.11** If no additional, immediate current measurements are required, rotate the range selector switch to the 1000 VDC 600 VAC position and the function selector switch to the OFF position. These settings avoid the possibility of accidentally applying voltage to the current circuits, which can cause damage to the Instrument.

## 4.8 AC CURRENT MEASUREMENT

**4.8.1** Review the safety precautions listed in paragraph 4.2.

**4.8.2** Turn the function selector switch to the AC position.

**4.8.3** Turn the range selector switch to the appropriate current range position as indicated in Table 4-5. If the current being measured is unknown (but less than 10A), begin with the range selector switch set to the 20mA, μADC, 10A position and connect the red test lead to the 10 A jack. Connect the black test lead to the COMMON jack.

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

**4.8.5** Open the circuit in which the current is to be measured and connect the test leads in series. Insure that the Simpson 360-2 is not connected across a voltage which can exceed the range setting of the Instrument.

**4.8.6** Connect the test leads according to Table 4-5.

**Table 4-5. AC Current Ranges and Connections**

| Range | Range Switch Position | Function Switch Position | Input Connections | Max. Current | Frequency Range |
|---|---|---|---|---|---|
| 0 to 200μA | 200mA μA | AC | 200 μA, COMMON jacks | 25 mA | 40 Hz to 10 kHz |
| 0 to 2mA | 2mA A | AC | +, COMMON jacks | 1/2 Amp * | |
| 0 to 20mA | 20mA μADC, 10A | AC | +, COMMON jacks | 1/2 Amp * | |
| 0 to 200mA | 200mA μA | AC | +, COMMON jacks | 1/2 Amp * | |
| 0 to 2A | 2mA A | AC | 2A,COMMON jacks | 3 Amps | |
| 0 to 10A | 20mA μADC, 10A | AC | 10A,COMMON jacks | 10 Amps | |

*Fuse Protected





**4.8.7** Apply power to the circuit being measured.

**4.8.8** The value of the current being measured is indicated on the numerical display. The analog display can be used for nulling or peaking applications.

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

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

**4.8.11** If no additional, immediate current measurements are required, rotate the range selector switch to the 1000 VDC 600 VAC position and the function selector switch to the OFF position. These settings avoid the possibility of accidentally applying voltage to the current circuits, which can cause damage to the Instrument.

## 4.9 OPERATION WITH RECORDERS

**4.9.1** The ANALOG OUTPUT terminals of the Simpson 360-2 may be connected to the input terminals of a graphic recorder. Operational information of the particular recorder is covered in the Operator's Manual for the recorder.

**4.9.2** The ANALOG OUTPUT terminals provide 1 volt DC (open circuit), corresponding to a digital indication of 1000, with a nominal resistance of 45 k ohms. This output is sufficient for use with general purpose, non-potentiometric recorders. Hence, it offers capabilities not otherwise possible in a low-cost package.

**4.9.3** The Simpson 360-2 provides isolation for the recorder (10 MΩ on DC volts) combined with the numerous functions of AC/DC volts, resistance and AC/DC current.

**4.9.4** The Simpson Models 603 (Cat. No. 20201), 604 (Cat. No. 12610), and 2750 (Cat. No. 22002) are excellent examples of low cost recorders which can be used with the Simpson 360-2.

**4.9.5** The Models 603 and 2750 specified in paragraph 4.9.4 are basically 0 to 50 μA DC instruments and will require a series

multiplier resistance to convert the recorder to a 2 volt or 2.5 volt instrument. Since the standard chart paper markings for the recorders are 50 divisions, a 2.5 volt range is recommended.

NOTE: On other than the 1000 VDC 600 VAC ranges, the Simpson 360-2 has measurement capability beyond an indication of 1999. It is linear to an equivalent indication of 2500.

**4.9.6** The series multiplier resistance required will be approximately 5 kΩ, minus the recorder resistance (1000 to 2000 Ω, typically). To allow for the accuracy of the recorder, the series multiplier should be made of a variable resistor of 5 kΩ. The following procedure is used for setting up either recorder.

a. Connect the Simpson 360-2 to the Model 2750 or Model 603 recorder, and a 0 to 2 VDC voltage source as shown in Figure 4-1.

b. Adjust the output of the 0 to 2 VDC voltage source for an indication of 1.950 on the 360-2.

c. Adjust the 5 kΩ variable resistance for an indication on the recorder chart paper of 39 divisions.

d. The recorder is now calibrated to the Simpson 360-2. Each division marking on the recorder chart paper equals 50 counts on the Simpson 360-2 digital display. Therefore, 39 divisions equals 1950 counts. The decimal point location and units being measured are determined by the Simpson 360-2 function and range selection.

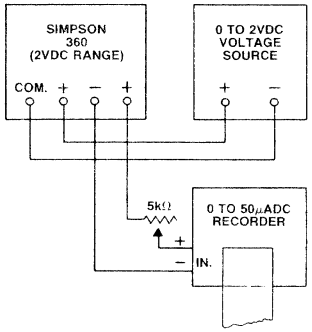



Figure 4-1. Connections For Use of The Model 603 or 2750 Recorder With The Simpson 360-2



# SECTION V

# THEORY OF OPERATION

## 5.1 OVERALL SYSTEM

The basic system diagram for the Simpson 360-2 is shown in Figure 5.1.

### 5.1.1 Signal Conditioning Section

The parameter being measured is connected to the appropriate input terminals. The corresponding Signal Conditioning circuits convert this parameter into a proportional DC voltage. The conversion is accomplished by the Attenuator, Current Shunts, Resistance Converter, AC-to-DC Converter, and associated switching.

### 5.1.2 Analog-To-Digital Converter Section

The Analog-To-Digital (A/D) Converter section changes the DC output voltage from the Signal Conditioning section to digital information. The A/D Converter also provides a proportional analog signal for both the Analog Display and Analog Output.

### 5.1.3 Display Section

Through the Segment and Anode Drivers, the digital information from the A/D converter are indicated on the 7-segment Numerical Display. The proportional analog signal is indicated by the Analog Display.

## 5.2 INPUT CIRCUITS

### 5.2.1 DC Voltage Measurements

The basic DC voltage measurement circuit is shown in Figure 5-2(A). The DC voltage being measured is connected to the + and COMMON jacks, attenuated according to the range selected and converted into digital information by the A/D converter.

**5.2.2** The A/D Converter circuit provides two basic full range sensitivities: 200 mV and 2V. This feature simplifies the attenuator design. No attenuation is required on the 200mV and 2V ranges. The same attenuator ratio is used on the 20V and 200V ranges. A separate attenuator tap is provided for the 1000 volt range.

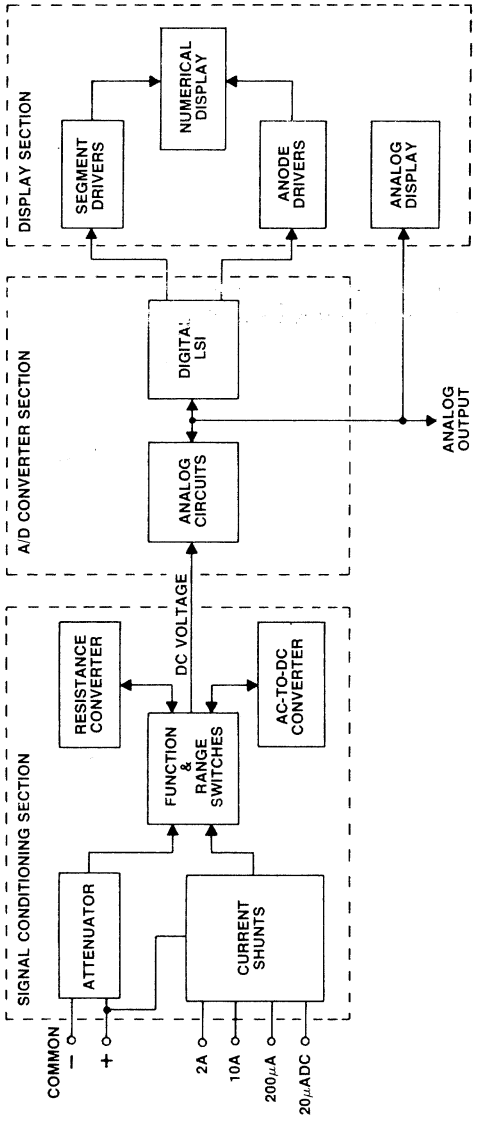



Figure 5-1. Basic System Diagram





### 5.2.3 AC Voltage Measurements

The basic AC voltage measurement circuit is shown in Figure 5-2 (b).

**5.2.4** The AC voltage being measured is connected to the + and COMMON jacks, attenuated according to the range selected, and applied to an Input Amplifier. The output of the amplifier is converted into DC by an AC to DC Converter, and the resulting DC voltage is measured by the A/D Converter.

**5.2.5** The attenuator is not used on the 200mV and 2V ranges. On the higher ranges, the attenuator is frequency-compensated to provide good accuracy over a wide frequency range.

**5.2.6** The Input Amplifier achieves a high input impedance and presents a low output impedance to the converter.

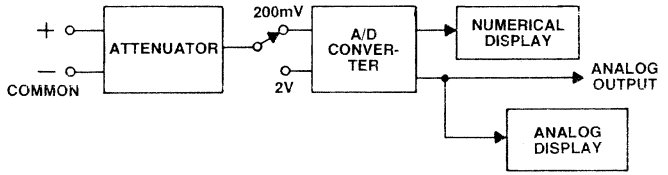
**5.2.7** The AC to DC Converter uses a half-wave operational amplifier/rectifier circuit which provides two basic full range sensitivities: 200mV and 2V. It is average-responding, but its calibration (gain) is based on the rms value of a sine wave.

**5.2.8** The output of the Operational Amplifier has two rectifying diodes and two feedback resistors, R1 and R2. These components drive a summing resistor R3. The junction of the summing resistor and feedback resistors is connected to the amplifier input to provide negative feedback. With a sinewave input signal, the positive half cycles of the output waveform go through one diode, and the negative half cycles through the other diode. The positive half cycle is filtered and the resulting DC voltage is measured by the A/D Converter.

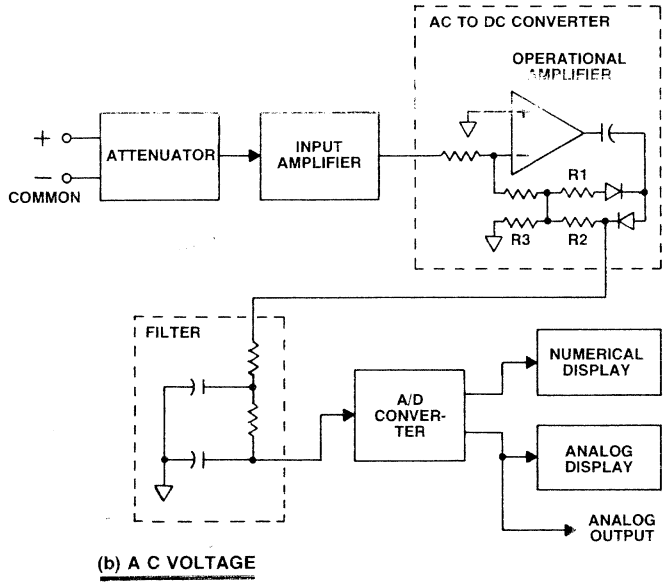
**5.2.9** The indications of the numerical display are calibrated to the rms sine wave value being measured.

### 5.2.10 AC Current Measurements

The basic AC current measurement circuit is essentially the same as the DC current measurement circuit (refer to 5.2.11), except that the voltage developed across the internal shunt resistance is measured by the AC voltage measurement circuit.




(a) D C VOLTAGE




(b) A C VOLTAGE

Figure 5-2. Basic Voltage Measurement Circuits

### 5.2.11 DC Current Measurements

The basic DC current measurement circuit is shown in Figure 5-3 (a).

**5.2.12** The current being measured is connected in series with the COMMON and appropriate jack and an internal precision shunt resistance. The value of the shunt resistance depends on the current range used and is selected so that the voltage developed across it is proportional and numerically equal to the current





through it. The A/D Converter measures this voltage, and the value indicated on the numerical display is equal to the current being measured.

**5.2.13** The full range sensitivity of the digital voltmeter circuit measurements is 200mV. Therefore, the internal resistance for each current range equals 200mV divided by the full range current. For example, if the full range current is 200 $\mu$A, then the internal resistance would be 1000 ohms.

### 5.2.14 Resistance Measurements

The basic resistance circuit is shown in Figure 5-3 (b).

**5.2.15** The resistance being measured, Rx, is connected to the + and COMMON jacks and a constant current is applied through it by the Instrument. The resulting voltage is proportional to the value of Rx. The value of the current is determined by the resistance of the range selected.

**5.2.16** The current through Rx, is controlled by an Operational Amplifier whose inputs "follow" Ex and the output is always Ex + 1 volt. The 1 volt reference for the amplifier is developed by the current from a Constant Current Source through a 6.5 k$\Omega$ feedback resistor.

**5.2.17** The Ex + 1 volt output of the amplifier maintains a constant current through Rx, regardless of the value of Rx. The magnitude of the current is determined by the resistance (precision resistors selected by the ohms range switch) in series with Rx.

**5.2.18** The A/D Converter measures the voltage developed across Rx, and the value indicated on the numerical display is equal to the resistance of Rx.

**5.2.19** When the Instrument is set for LOW POWER resistance measurements (either the 200$\Omega$ and 20 k$\Omega$ range), the full-scale voltage across Rx is set to 200 mV. This feature limits the power applied to the resistance being measured to less than 200 $\mu$W.

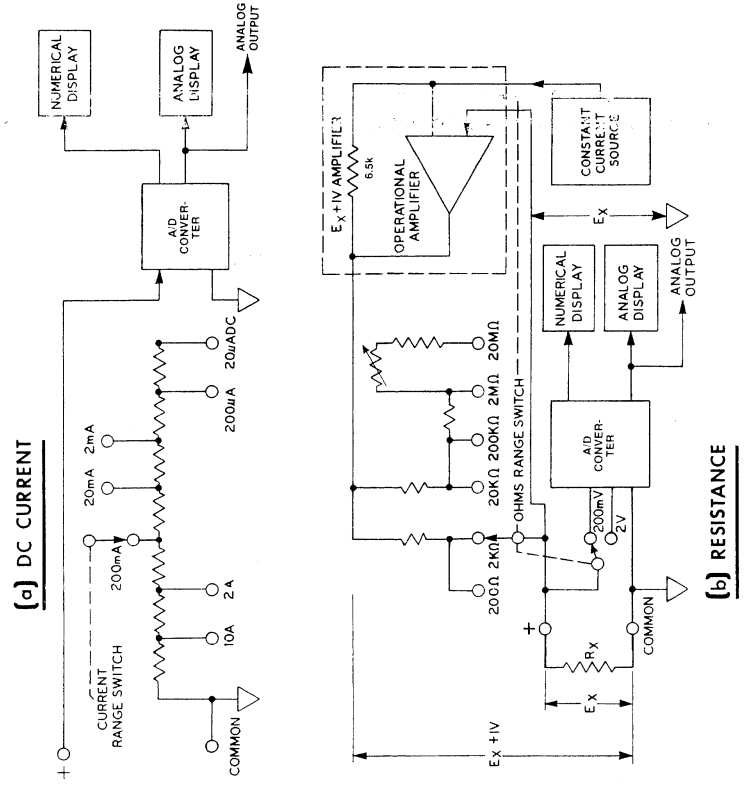



**Figure 5-3. Basic DC Current and Resistance Measurement Circuits**





## 5.3 A/D CONVERTER

**5.3.1** The basic block diagram of the A/D Converter is shown in Figure 5-4. The circuit utilizes the "Up-Down" integration technique for the analog-to-digital conversion. This technique is based on the conversion of a DC voltage into a proportional time period. The converter initially accumulated a charge proportional to the input signal on an integrator capacitor for a fixed period of time. In the second integration period, the capacitor discharges back to the "zero" voltage starting point, when the input signal is removed and a reference voltage opposite in polarity is placed at the input of the converter. The ratio of the time required to remove the integrator charge to the initial fixed time period is proportional to the amplitude of the input DC voltage.

**5.3.2** The "Up-Down" A/D Converter requires two periods of integration for each measurement. The input signal ($E_{in}$) is integrated on the "up" slope during the first period; the reference voltage is integrated on the "down" slope of the second period. The first period starts with a pulse initiated by the Sample & Reset Oscillator which generates three pulses per second as shown in (1) of the Basic Timing Diagram (Figure 5-5).

**5.3.3** The pulse resets the Decade Counters to "zero" and the trailing edge of the pulse initiates the first period $T_1$. During $T_1$, the DC voltage $E_{in}$ is sampled, and the Integrator generates a ramp whose slope is proportional to the value of the input signal. Also during $T_1$, the Master Oscillator (2) produces pulses which are counted by the Decade Counters until a total of 1,000 counts is accumulated. At this moment, period $T_1$ ends and $T_2$ begins.

**5.3.4** During $T_2$, the input signal is removed, and a reference voltage of the opposite polarity is connected to the Integrator input. The Integrator at this time produces a ramp toward the starting point with a fixed slope as shown in (6) of the timing diagram. When the Integrator output has reached the "zero" voltage starting point, the Zero Detector changes state. At this point the reference voltage is removed and the Control Logic inhibits the Master Oscillator.

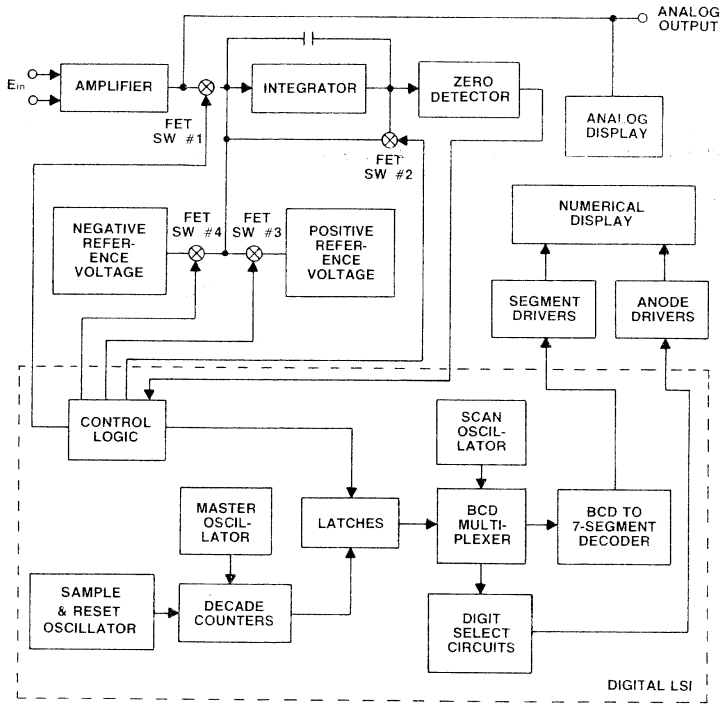



Figure 5-4. Block Diagram of A/D Converter





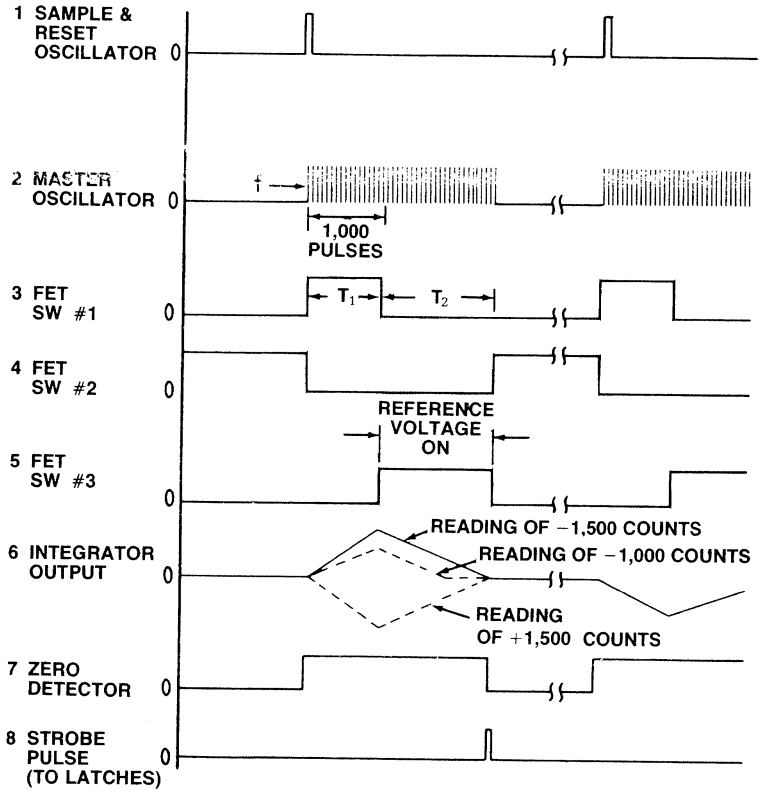



Figure 5-5. Simpson 360-2, Basic Timing Diagram

**5.3.5** The count stored in the Decade Counters is in turn transferred to the Latches via a strobe pulse (8) generated by the Control Logic. The BCD information is then multiplexed, decoded into 7-Segment information, and numerically displayed through the Segment and Anode Drivers.

**5.3.6** The other requirements of the A/D Converter such as overrange and polarity indications are accomplished by the Control Logic and Counter Circuits.

## 5.4 AC ADAPTER/CHARGER AND POWER SUPPLY

**5.4.1** The basic block diagram for the 360-2 AC Adapter/Charger and power supply circuits is shown in Figure 5-6.

**5.4.2** When the Simpson 360-2 is operated from an AC power line, the incoming AC power is applied to transformer $T_1$ of the AC Adapter/Charger. $T_1$ steps down the voltage as required by the rectifier circuit.

**5.4.3** The rectifier circuit is a full-wave center-tap circuit which converts the incoming AC into an unregulated DC voltage. This voltage is applied to a Series Type Regulator Circuit to produce +5 volts DC. The network comprising R1 and R2 provides the proper charging current for the battery.

**5.4.4** The DC-to-DC Converter changes the regulated 5 volt DC (or battery voltage) into an AC signal. This AC signal is then stepped up and rectified to provide regulated outputs of ±10 Volts DC.





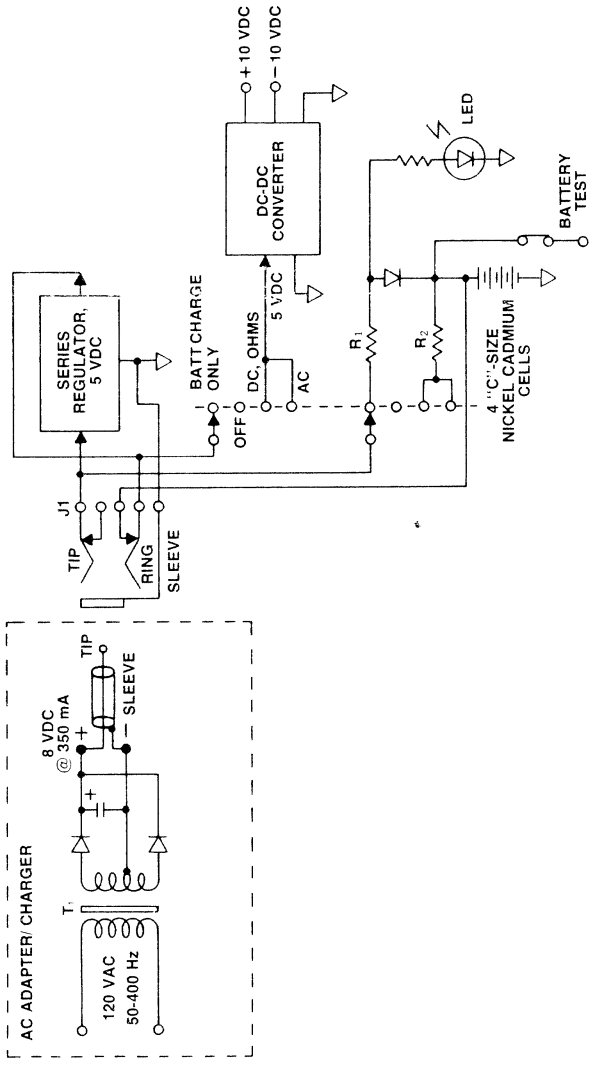



Figure 5-6. Simpson 360-2 Power Supply, Schematic

# SECTION VI

# MAINTENANCE

## 6.1 GENERAL

**WARNING**

**The Instrument can measure voltages which constitute a SHOCK HAZARD. Review what constitutes a SHOCK HAZARD as explained on page v. Internal adjustments or repairs must be performed only by qualified personnel who understand and can recognize what constitutes a SHOCK HAZARD, preferably a Simpson Authorized Service Center.**

The Simpson 360-2 is carefully designed 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 his Instrument.

## 6.2 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside back cover of the manual. Read carefully before 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 the manual. If you wish to contact the factory directly, give full details of the difficulty and include the instrument model number, serial number and date of purchase. Service data or shipping instructions will be promptly sent to you. 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.

## 6.3 SHIPPING

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





## 6.4 BATTERY AND FUSE COMPARTMENT COVER REMOVAL

**WARNING**

**Remove all power and input connections to the Instrument before removing the back cover. Do not operate the Instrument with the back cover removed.**

To install or replace battery and fuses, remove the back cover as follows:

a. Turn the function selector switch to the OFF position.

b. Disconnect the AC adapter/charger from the power source and all connections from the Instrument.

c. Loosen the single captivated screw and remove the cover.

d. Reverse the above procedure when replacing the cover.

## 6.5 BATTERY INSTALLATION

**6.5.1** Recommended cells: Four "C" size, 1.25V, 1.5 ampere-hour nickel-cadmium rechargeable (GE Cat. No. GCT 1.5 SB or Eveready CH 1.8).

**CAUTION**

**Standard carbon zinc or alkaline "C" size cells can be used in an emergency. However, the adapter/charger must be removed to prevent charging these cells in the Instrument. These cells do not have provision for pressure relief and can burst when charged. Immediately remove the cells when the emergency is over or when they are discharged, and replace with nickel-cadmium cells at your earliest convenience.**

**6.5.2** Install the cells as follows:

a. Remove back cover (refer to 6.4). Install the cells in pairs, according to the orientation designated on the battery holder label. Position the two inner cells over the pull-out strap in the

battery compartment as shown in Figure 6-2. Push downward firmly at the points A and B as shown in illustration.

NOTE: To remove the cells, pull strap upward.

b. Check that the battery contacts are clean and making good connection.

c. Replace the cover.

d. For battery recharging, refer to paragraph 6.6.

e. Test the battery according to paragraph 4.3.2.

## 6.6 BATTERY RECHARGING

a. With the function selector switch set to the OFF position, insert the AC Adapter/Charger into a power outlet which conforms to the designated power requirements and to the latest electrical code.

b. Turn the function selector switch to BATT CHRG ONLY position. The LED pilot indicator will light. The battery is being charged at full rate.

NOTE: If the battery test indicates a voltage less than 4.7 volts, leave the Instrument in BATT CHRG ONLY position for at least 15 minutes before operating.

c. Time for complete recharge of the battery is 16 hours nominal with the function switch set in the BATT CHRG ONLY position. Time for complete recharge of battery is nominally 30 hours while the selector switch is in either the DC, OHMS or AC position.

## 6.7 BATTERY CARE

**6.7.1** Avoid allowing the cells to get completely discharged. Check the battery voltage periodically using the BATTERY TEST jack (refer to paragraph 4.3.2). Charge the battery whenever its voltage is close to, or below, 4.7 volts.

**6.7.2** Do not operate the Instrument with discharged cells. Make sure to recharge all newly purchased batteries (refer to paragraph 6.6) for at least 15 minutes before operating the Instrument.





**6.7.3** Observe polarity when installing the batteries.

**6.7.4** Whenever the AC Adapter/Charger is not connected, and the Instrument is not in use, remember to turn the function switch to the OFF position.

**6.7.5** With nickel-cadmium cells installed in the 360-2, avoid storing in an area where the temperature exceeds +60°C.

## 6.8 FUSE REPLACEMENT

The current fuse and resistance fuse are mounted inside the battery and fuse compartment as shown in Figure 6-1. A spare for each fuse is provided. Use the following procedure to replace a fuse.

**WARNING**

**Remove all power and input connections to the Instrument before removing the back cover.**

**6.8.1** Remove the back cover as described in 6.4.

**6.8.2** Carefully lift the defective fuse from the holder and replace with appropriate fuse according to the following:

F1, current fuse: 1/2A, 250V, Type 8AG, Fast-Blo

F2, resistance fuse: 1/16 A, 250V, Type 8AG, Fast-Blo

**6.8.3** Replace the back cover.

## 6.9 ZERO ADJUSTMENT

**6.9.1** The Simpson 360-2 has been calibrated at the factory using precision instruments. The higher order of accuracy and stability of the Instrument eliminate the need for frequent recalibration. However, should "zero adjustment" be required after a long period of time or extreme temperature conditions, use the following procedure:

a. Connect test leads to the + and COMMON terminals.

b. Turn the function selector switch to the DC, OHMS position.

c. Turn the range selector switch to the 200mV position.

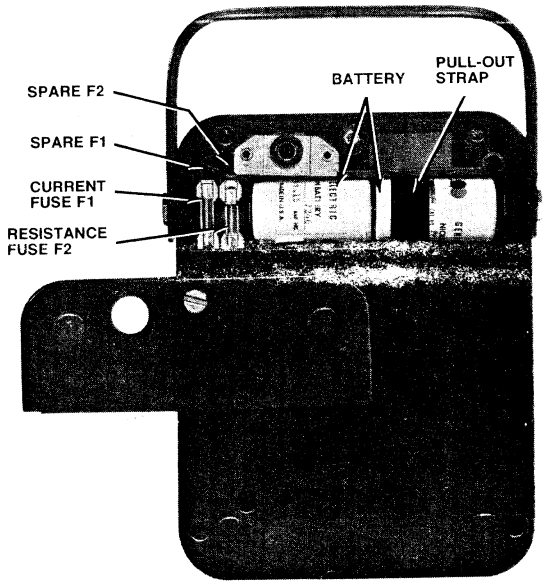



Figure 6-1. Simpson 360-2 Fuse Location

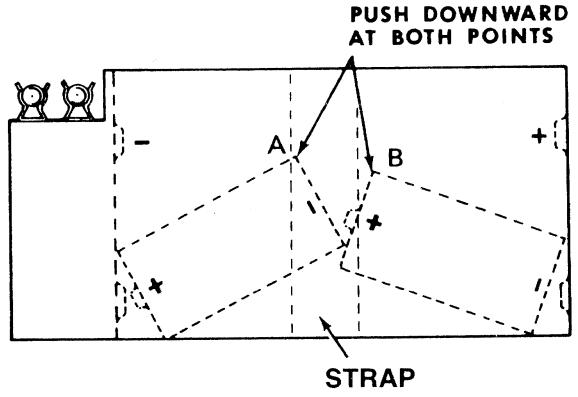



Figure 6-2. Battery Positioning For Installation





d. Short the test leads together.

e. Allow the Instrument to warm up for 15 minutes.

f. Using an insulated screwdriver, adjust the potentiometer through the hole located directly below the analog display for a numerical display of 00.0.

## 6.10 PREVENTIVE MAINTENANCE

### 6.10.1 Daily Care

a. Immediately clean all spilled materials from the Instrument and wipe dry.

**WARNING**

**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. Avoid allowing the battery to fully discharge. Check the battery voltage according to paragraph 4.3.2.

c. 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.

### 6.10.2 Monthly Care

Verify Instrument calibration by performing operational checks using known value sources. If the need for calibration is indicated, contact your nearest Simpson Authorized Service Center.

### 6.10.3 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.

### 6.10.4 Storage

When the Instrument is not in use, store it in a location free from temperature extremes, dust and corrosive fumes, and mechanical vibration or shock.

## 6.11 TROUBLESHOOTING

**6.11.1** If the Instrument does not yield satisfactory results, perform the following procedure before attempting maintenance on the Instrument:

a. Review and comply with the Preliminary Notes and Checks, listed in paragraph 4.3.

b. Check that all controls are positioned correctly for the parameter and range of value being measured and that the measurement is within the rating of the Instrument.

c. If the Instrument is battery operated, insure that the cells are charged and are installed properly (refer to 6.5).

d. If the Instrument is AC line operated, insure that power source is within the AC adapter/charger specifications, and free from excessive fluctuations and transients.

e. Insure that the environment in which the Instrument is being used is within the Instrument specifications.

f. Inspect the device being measured and the measurement test set-up to insure that proper shielding and grounding techniques have been used. If power line effects are suspected, operate the Instrument on battery. Also consider whether the Instrument is significantly affecting the circuit being measured.

**6.11.2** If the steps taken in paragraph 6.11.1 do not yield satisfactory results, refer to the troubleshooting chart (Table 6-1). All other repairs and adjustments must be directed to a Simpson Authorized Service Center.





**Table 6-1. Troubleshooting Chart**

| Symptom | Probable Causes | Cure |
|---|---|---|
| 1. No indication on numerical and analog display when Instrument is battery operated. AC operation is OK. | Cells — Discharged, defective, not installed properly, making poor contact, or missing. | Check battery voltage. Refer to para. 4.3.2. If OK contact nearest Simpson Authorized Service Center. |
| 2. LOW intensity on numerical display in battery operation. | Cells not fully charged. | Check battery voltage. Refer to para. 4.3.2. If battery checks low, remove cover and check that the cells are installed correctly and making good contact. Refer to 6.5. If they are, replace cover and charge battery overnight. Refer to para. 6.6. |
| 3. No indication on the numerical and analog displays when Instrument is AC line operated (no cells installed). | a. Low or no voltage at power source receptacle.<br>b. AC adapter/charger disconnected.<br>c. Defective AC adapter/charger. | a. Restore correct voltage at power receptacle.<br>b. Connect AC adapter/charger.<br>c. Replace AC adapter/charger. |

**Table 6-1. Troubleshooting Chart (continued)**

| Symptom | Probable Causes | Cure |
|---|---|---|
| 4. Batteries do not respond to charge. Instrument operation OK when connected to AC power. | Cells defective, not installed properly, making poor contact, or missing. | Remove cover and check that cells are installed correctly and making good contact. Refer to 6.5. If they are, check the voltages of the individual cells. Replace those which check significantly lower than nominal (1.25 volts). |
| 5. Operation normal on all functions and ranges except on 200Ω and 2kΩ resistance ranges. | Resistance fuse F2 open. | Replace fuse F2. Refer to 6.8. |
| 6. Operation normal on all functions and ranges except AC and DC current. | Current fuse F1 open. | Replace fuse F1. Refer to 6.8. |



**Table 6-1. Troubleshooting Chart (continued)**

| Symptom | Probable Causes | Cure |
|---|---|---|
| 7. Indications fluctuate and/or drift, even though indication is OK at 000 with the input terminals shorted, and at 1000 counts when using a stable and low impedance input. | Fluctuations and/or drift are being generated by the device being measured or the measurement test set up. | Use proper shielding, grounding techniques, and connections to minimize "pick-up" of unwanted signals due to ground loops, poor connections, and capacitive and/or inductive coupling. Operate Instrument on battery for complete isolation from the power line.<br><br>NOTE: If the drift and/or fluctuation is coming from the device being measured, no cure is required, the measurement is valid, and the device must be corrected. |

**Table 6-1. Troubleshooting Chart (continued)**

| Symptom | Probable Causes | Cure |
|---|---|---|
| 8. Indication is OK on battery. However, on AC operation, the reading fluctuates and/or drifts at 000, with the input shorted, and/or at 1000 counts using a stable and low impedance input. | AC power source is low or fluctuating (including transients). | Correct the power source or use Instrument on battery. |
| 9. Same as 8 above, except indication OK on AC but not on battery operation. | a. Battery voltage low.<br>b. One or more cells defective, not installed correctly. | a. Check battery condition. Refer to para. 4.3.2. If not OK charge battery, refer to para. 6.6.<br>b. Remove back cover and check that cells are installed correctly and making good contact. If OK, replace all cells temporarily with conventional carbon zinc "C" size cells for checking purposes only. If problem still exists, contact nearest Simpson Authorized Service Center. |



**Table 6-1. Troubleshooting Chart (continued)**

| Symptom | Probable Causes | Cure |
|---|---|---|
| 10. Slow response. Operation OK when using a low impedance input. | Parameter being measured has a high source impedance. | None required. |
| 11. Accuracy not within specifications when checked with a stable, higher accuracy (at least 5 times better) low impedance (voltage measurements) source. | a. Instrument is out of calibration.<br>b. Instrument not zeroed properly. | a. Contact nearest Simpson Authorized Service Center.<br>b. Perform ZERO adjustment. Refer to para. 6.9. |
| 12. Accuracy of Instrument is within specifications but measurements appear in error. | a. Instrument affects circuit being measured.<br>b. Common and/or normal mode specification is being exceeded. | a. Study circuit being measured vs. Instrument specifications. Correct indications accordingly.<br>b. Refer to cure in item 7 above. |

# SECTION VII

# ORDERING INFORMATION, SCHEMATIC DIAGRAM, AND AUTHORIZED SERVICE CENTERS

Table 7-1. Items Furnished With Instrument

| Quantity | Description | Part No. |
|---|---|---|
| 1 | AC adapter/charger, 120 VAC | Cat. No. 12288 |
| 1 | AC adapter/charger, 220V (optional) | Cat. No. 12289 |
| 1 | Test Lead Set: One black and one red insulated lead having probe tips with provision for screw-on alligator clips (one red and one black supplied) | 10-830115 |
| 1 | Operator's Manual | 5-118798 |

Table 7-2. Replacement Parts List

| Reference Symbol | Description | Part No. |
|---|---|---|
| | Alligator clip (without insulator) | 1-115963 |
| | Cover, assembly, case, battery | 10-560241 |
| | Insulator, Alligator Clip, Red | 5-112479 |
| | Insulator, Alligator Clip, Black | 5-111169 |
| | Knob, bar | 5-116237 |
| | Knob, pointer | 5-116216 |
| | Spring, coil, grounding | 5-228811 |
| C103,111 112,113, 114 | Capacitor, 15μf −10 +75%, 16V | 5-115534 |
| C104 | Capacitor, 470pf, ±5%, 250V | 5-118406 |
| C105 | Capacitor, 330pf, ±5%, 250V | 5-118749 |
| C106 | Capacitor, Trimmer 5.5 −60pf, 100V | 5-116235 |
| C107 | Capacitor, 2.2pf, ±5%, 1kV | 5-114987 |
| C108 | Capacitor, 56pf, ±20%, 1kV | 5-110934 |
| C109 | Capacitor, Elec. 220μf −10 +50%, 10V | 5-117738 |
| C110 | Capacitor, .022μf, ±20%, 100V | 5-116188 |
| C115 | Capacitor, .15μf, ±5%, 100V | 5-117279 |
| C116,123 | Capacitor, .001μf, GMV, 1kV | 5-111119 |
| C117 | Capacitor, .1μf −20 +80%, 30V | 5-113883 |
| C118 | Capacitor, 100pf, ±10%, 1kV | 5-113217 |
| C119 | Capacitor, .22μf, ±10%, 100V | 5-118750 |
| C120 | Capacitor, 330pf, ±20%, 500V | 5-112690 |
| C121 | Capacitor, .047μf, ±10%, 250V | 5-112538 |
| C122 | Capacitor, 100pf, ±5%, 500V | 5-118748 |
| C124 | Capacitor, .1μf, ±10%, 630V | 5-116189 |
| C201,202, 204,205, 210,212, 214 | Capacitor, 15μf −20 +50%, 16V | 5-115534 |
| C203 | Capacitor, .022μf, ±20%, 100V | 5-116188 |
| C206 | Capacitor, 6pf, ±5%, 300V | 5-115539 |
| C207 | Capacitor, 62pf, ±5%, 300V | 5-116187 |
| C208 | Capacitor, 2.2μf, ±10%, 16V | 5-115533 |
| C209 | Capacitor, 1.0μf, ±10%, 16V | 5-115531 |
| C211,213 | Capacitor, .1μf −20 +80%, 30V | 5-113883 |
| D101,103, 104,105, 106 | Diode, Silicon, 100PIV, 10D1 | 5-114005 |
| D107,108, 109,110, 111, 112, 113,114, 115 | Diode, Silicon, 75PIV, IN914 | 5-112004 |
| D116 | Diode, Ref. Zener, 6.4V, IN4576 | 5-116201 |
| D117 | Diode, Zener, 6.8V, IN754A | 5-116323 |
| D201,202 | Diode, Silicon, DE-113 | 5-118868 |
| D203,204 | Diode, Silicon, 75PIV, IN914 Selected | 5-117379 |
| D205,206 | Diode, Zener, 9.5V, DZ720215A | 5-116203 |
| D301 | Diode, Silicon, 75PIV, IN914 | 5-112004 |
| DS301 thru 303 | Readout, LED, 7-Segment | 5-118779 |
| DS304 | Readout, LED, ±1 | 5-118780 |
| F1 | Fuse, 1/2A, 250V, 8AG, Fast-Blo | 5-116359 |
| F2 | Fuse, 1/16A, 250V, 8AG, Fast-Blo | 5-118768 |

| | | |
|---|---|---|
| IC101 | I.C. Operational Amp. LM312H (selected) | 5-118746 |
| IC102,108 | I.C. Operational Amp. LM308N | 5-116598 |
| IC103 | I.C. Operational Amp. LM301AN | 5-118745 |
| IC104 | I.C. Dual Operational Amp. LM1458N | 5-117432 |
| IC105 | I.C. QUAD Comparator LM2901N | 5-118747 |
| IC106 | I.C. A/D Digital Custom LSI | 5-118744 |
| IC107 | I.C. Operational Amp. LM741CN | 5-115928 |
| IC201 | I.C. Operational Amp. LM709C | 5-113642 |
| Q101 | Transistor, Silicon, NPN, D40C1 | 5-118404 |
| Q102,103 | Transistor, Silicon, NPN, GET2222 | 5-115934 |
| Q104,105, 106,107 | Transistor, Field Effect, 2N5458 | 5-112747 |
| Q108 | Transistor, Silicon, NPN, 2N4274 | 5-113193 |
| Q201 | Transistor, Silicon, NPN, GET 2222 | 5-115934 |
| Q202 | Transistor, Silicon, NPN, MPS3394 | 5-112631 |
| Q203 | Transistor, Silicon, PNP, MPS3702 | 5-113864 |
| Q204 | Transistor, Silicon, PNP, 2N2907 | 5-116198 |
| Q205 | Transistor, Field Effect, 2N5458 | 5-112747 |
| Q206 | Transistor, Silicon, PNP, 2N4248 | 5-115484 |
| Q301 | Transistor, Silicon, NPN, MPS3394 | 5-112631 |
| Q302 thru 314 | Transistor, Silicon, PNP, MPS3702 | 5-113864 |
| R3 | Resistor, 9kΩ, ±1/10%, 1/4W | 5-115492 |
| R101,116 | Resistor, 100k, ±1%, 1/2W | 5-111408 |
| R102 | Resistor, 90k, ±1%, 1/4W | 5-115526 |
| R103 | Resistor, 0.894$\mu$, ±.1%, 1.25W | 5-116450 |
| R104 | Resistor, 9.0Ω, ±.1%, 3/4W | 5-115576 |
| R105 | Resistor, 900Ω, ±.25%, 1/4W | 5-116273 |
| R106 | Resistor, 90.0Ω, ±.25%, 1/4W | 5-116272 |
| R107 | Resistor, 18.0Ω, ±5%, 2W | 5-119929 |
| R108 | Resistor, 56.0Ω, ±5%, 2W | 5-116446 |
| R109,149, 150,152, 156 | Resistor, 270Ω, ±10%, 1/4W | 5-114969 |
| R110,157, 158 | Resistor, 390Ω, ±10%, 1/4W | 5-113868 |



| | | |
|---|---|---|
| R111,126 131,147, 148 | Resistor, 100kΩ, ±10%, 1/4W | 5-115514 |
| R112 | Resistor, 9.5 MΩ, ±2%, 1/8W | 5-118790 |
| R113 | Potentiometer, 1 MEG, ±20%, 1/2W | 5-118765 |
| R114 | Resistor, 2.0kΩ, ±5%, 1/4W | 5-115460 |
| R115 | Resistor, 22.0Ω, ±10%, 1/4W | 5-115509 |
| R117 | Resistor, 10MΩ, ±1%, 1/4W | 5-11 |
| R119,124 | Resistor, 100kΩ, ±1%, 1/4W | 5-115506 |
| R118 | Resistor, 22kΩ, ±10%, 1/4W | 5-113623 |
| R120,134, 135 | Resistor, 47kΩ, ±10%, 1/4W | 5-114980 |
| R121 | Resistor, 1.0kΩ, ±1/10%, 1/4W | 5-115489 |
| R122 | Resistor, 9.0kΩ, ±1/10%, 1/4W | 5-115492 |
| R123,127, 129,155 | Resistor, 270kΩ, ±5%, 1/4W | 5-118755 |
| R125 | Potentiometer, 100kΩ, ±10%, 1/2W | 5-117692 |
| R128 | Potentiometer, 50kΩ, ±20%, 1/2W | 5-118764 |
| R130 | Resistor, 100Ω, ±1%, 1/4W | 5-116164 |
| R132,133 | Resistor, 10kΩ, ±10%, 1/4W | 5-113624 |
| R136 | Resistor, 12kΩ, ±10%, 1/4W | 5-114978 |
| R137 | Resistor, 22MEG, ±5%, 1/4W | 5-118756 |
| R138 | Resistor, 1.21kΩ, ±1%, 1/4W | 5-118757 |
| R139 | Resistor, 11kΩ, ±1%, 1/4W | 5-118760 |
| R140 | Resistor, 2.0kΩ, ±1%, 1/4W | 5-115500 |
| R141 | Resistor, 9.0kΩ, ±1%, 1/4W | 5-116162 |
| R142 | Potentiometer, 500Ω, ±20%, 1/2W | 5-118763 |
| R143 | Resistor, 1.50kΩ, ±1%, 1/4W | 5-118758 |
| R144,159, 162 | Resistor, 47.5kΩ, ±1%, 1/4W | 5-118761 |
| R145 | Resistor, 42.2k, ±1%, 1/4W | 5-117504 |
| R146 | Potentiometer, 5kΩ, ±20%, 1/2W | 5-118080 |
| R151 | Resistor, 30kΩ, ±5%, 1/4W | 5-118753 |
| R153 | Resistor, 43kΩ, ±5%, 1/4W | 5-118754 |
| R154 | Resistor, 24kΩ, ±5%, 1/4W | 5-118752 |
| R156,157, 158 | Resistor, 180Ω, ±5%, 1/4W | 5-116090 |

| | | |
|---|---|---|
| R160,161 | Resistor, 20kΩ, ±1%, 1/4W | 5-116621 |
| R163 | Potentiometer, 1kΩ, ±20%, 1/2W | 5-118079 |
| R164 | Resistor, 6.73kΩ, ±1%, 1/4W | 5-118759 |
| R165 | Resistor, 100kΩ, ±10%, 1/2W | 5-113949 |
| R201 | Resistor, 51.0kΩ, ±5%, 1W | 5-114626 |
| R202,207 | Resistor, 100Ω, ±10%, 1/4W | 5-114968 |
| R203 | Resistor, 22.0kΩ, ±10%, 1/4W | 5-113623 |
| R204,205 | Resistor, 10 MEGΩ, ±5%, 1/4W | 5-116632 |
| R206 | Resistor, 6.8kΩ, ±10%, 1/4W | 5-114976 |
| R208 | Resistor, 90.0kΩ, ±0.1%, 1/4W | 5-115497 |
| R209 | Resistor, 9.96kΩ, ±0.1%, 1/4W | 5-115493 |
| R210,211 | Resistor, 100kΩ, ±10%, 1/4W | 5-115514 |
| R212 | Resistor, 1.5kΩ, ±10%, 1/4W | 5-113872 |
| R213,214, 215 | Resistor, 10.0kΩ, ±1%, 1/4W | 5-114962 |
| R216 | Resistor, 510Ω, ±1%, 1/4W | 5-115488 |
| R217 | Potentiometer, 100Ω, ±20%, 1/2W | 5-118762 |
| R218,219 | Resistor, 45.0kΩ, ±1%, 1/4W | 5-118196 |
| R220,221 | Resistor, 2.0kΩ, ±5%, 1/4W | 5-115460 |
| R222,223 | Resistor, 10.0kΩ, ±10%, 1/4W | 5-113624 |
| R301 | Resistor, 3.9kΩ, ±10%, 1/4W | 5-114974 |
| R302,303 | Resistor, 110Ω, ±5%, 1/4W | 5-118854 |
| R304,305, 306,307 | Resistor, 1kΩ, ±10%, 1/4W | 5-113871 |
| R308 | Resistor, 200Ω, ±5%, 1/4W | 5-118855 |
| R309 thru 311 | Resistor, 1kΩ, ±10%, 1/4W | 5-113871 |
| R312 | Resistor, 560Ω, ±5%, 1/4W | 5-116094 |
| R313 thru 319 | Resistor, 100Ω, ±5%, 1/4W | 5-117178 |
| Rect.1 | Diode, Bridge Rect. Woo5 | 5-115945 |
| RN1 | Resistor, Network | 5-118781 |
| T101 | Transformer DC-DC Converter | 5-118783 |



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4800 East 131st Street
Tel. (216) 587-3600

* **OHIO, CLEVELAND 44135**
** Weschler Electric Corp.
□ 4250 West 130th Street
Tel. (216) 251-4609

** **OHIO, COLUMBUS 43219**
Contronics Inc.
2629 Johnstown Road
Tel. (614) 471-6466

* **OHIO, DAYTON 45404**
** Pioneer/Dayton Div. of
□ Pioneer-Standard Electronics, Inc.
1900 Troy Street
Tel. (513) 236-9900

* **OKLAHOMA, OKLAHOMA CITY 73107**
Houston Laboratories, Inc.
536 No. Pennsylvania
Tel. (405) 235-5469

* **OKLAHOMA, TULSA 74120**
Agra Engineering Company
551 S. Quaker Avenue
Tel. (913) 584-4235

** **OREGON, PORTLAND 97217**
Westcon Inc.
1910 N. Killingsworth St.
Tel. (503) 285-6629

* **PENNSYLVANIA, PHILADELPHIA 19115**
** Sunshine Scientific Instruments Inc.
□ 1810 Grant Avenue
Tel. (215) 673-5600

* **PENNSYLVANIA, PITTSBURGH 15222**
** Cameradio Company
2801 Liberty Avenue
Tel. (412) 288-2600

* **PENNSYLVANIA, PITTSBURGH 15221**
** E.I.L. Instruments, Inc.
□ 1844 Ardmore Blvd.
Tel. (412) 731-5230

* **TENNESSEE, MEMPHIS 38116**
** Brownell-Electro Inc.
□ 3053 Tranquility Drive
Tel. (901) 332-9254

** **TENNESSEE, MEMPHIS 38104**
Instrument Repair Service
1374 Overton Park Avenue
Tel. (901) 278-0762

* **TENNESSEE, NASHVILLE 37210**
** Brownell-Electro Inc.
□ 1050 Acorn Drive
Tel. (615) 889-8230

* **TEXAS, DALLAS 75220**
** Ultra Instrument Lab., Inc.
□ 9995 Monroe
Tel. (214) 357-0297

* **TEXAS, EL PASO 79901**
** Border Electronics
1704 E. Paisano Drive
Tel. (915) 532-2524

* **TEXAS, GARLAND 75040**
** Metermaster, Inc.
2809 National Drive
Tel. (214) 271-5671

* **TEXAS, HOUSTON 77006**
** Electrical Instrument &
□ Meter Co. (EIMCO)
1424 Westheimer
Tel. (713) 526-6871 & 72

** **TEXAS, ODESSA 79760**
Meter Service & Supply Company
2127 Kermit Hwy. P.O. Box 2373
Tel. (915) 332-0565

* **VIRGINIA, ALEXANDRIA 22314**
** E.I.L. Instruments, Inc.
□ Shirley Hwy. at Edsall Rd.
Tel. (804) 354-4330

* **VIRGINIA, RICHMOND 23229**
** Instrument Technical Reps.
□ 1425 Blue Jay Lane P.O. Box 4856
Tel. (804) 288-7198

* **WASHINGTON, SEATTLE 98105**
** Eicher-Richards Company
□ 2727 N.E. Blakeley Street
Tel. (206) 523-7888

** **WASHINGTON, BELLEVUE 98009**
The Instrument Lab., Inc.
13215 S.E. 30th P.O. Box 3097
Tel. (206) 747-9410

** **WASHINGTON, SPOKANE 99202**
Industrial Instrument Supply Company
E. 2121 Riverside
Tel. (509) 534-9353

* **WISCONSIN, MILWAUKEE 53202**
** The Electro Mechano Company
□ 241 East Erie Street
Tel. (414) 272-4050


# Simpson

# UNIVERSAL ELECTRONIC COUNTER
## MODEL 7026

- For measuring frequencies, periods, ratios of two frequencies, time intervals and events.
- Large, high-visibility 0.55" planar numerical display.
- Frequencies from 5 Hz to 50 MHz in seven ranges.
- Periods from 100 $\mu$S to 0.2 sec. (sine wave).
- Multiple periods averaged from 100 nS to 0.2 sec. (sine wave).
- Ratio and multiple ratio of two frequencies.
- Time interval from 100 $\mu$sec. to 1999999 x 10 sec.
- IC construction assures high reliability, low power dissipation and compact design.
- Other standard features include: display storage selection, automatic decimal point location, variable display time, manual reset, overrange and gate time indications; 1 MEG $\Omega$ input impedance, and input overload protection.
- Interfacing with a high frequency prescaler such as the Simpson Model 7020, extends high frequency signals in excess of 500 MHz.

# Warranty

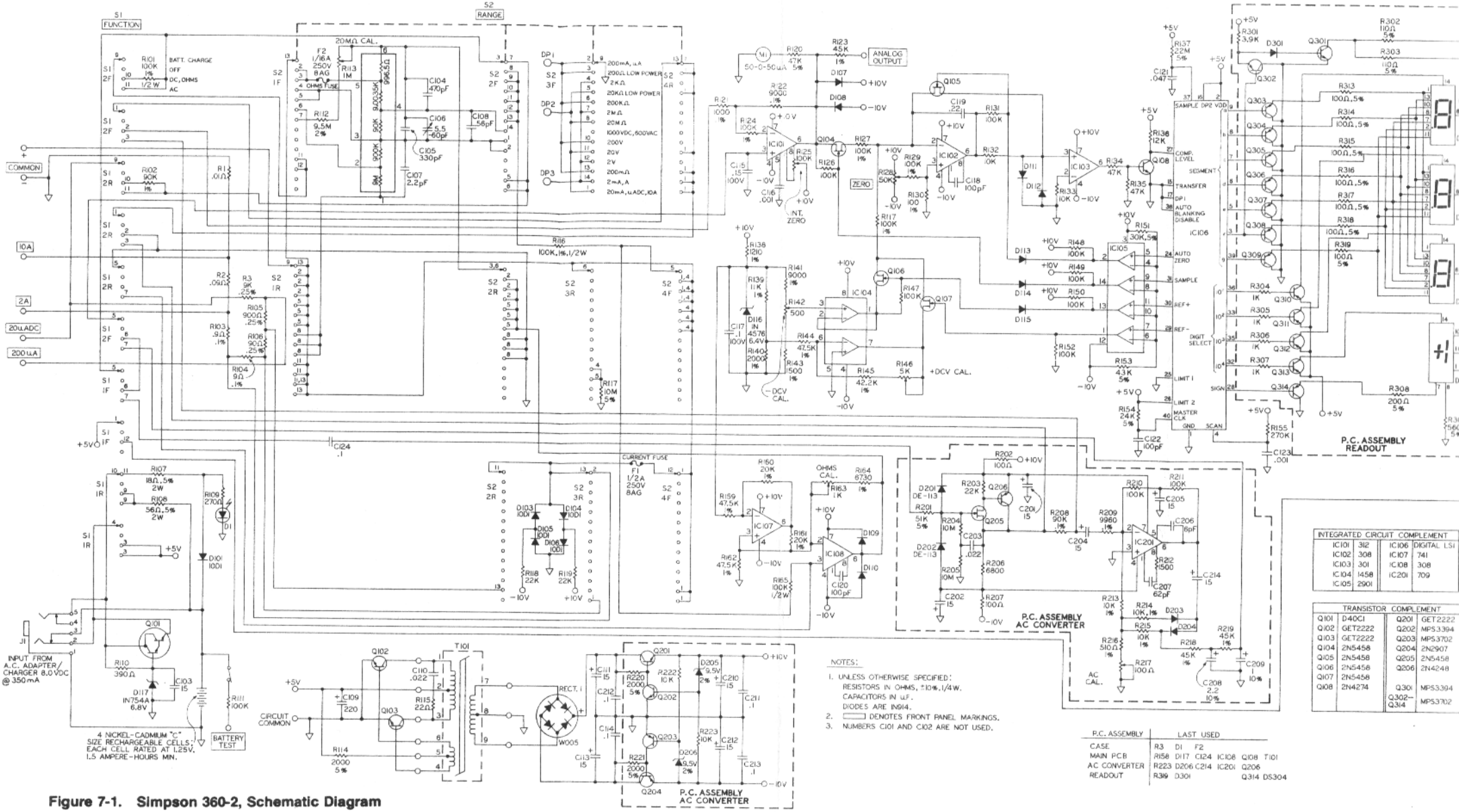
SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment 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
INSTRUMENTS THAT STAY ACCURATE

ELECTRIC COMPANY
853 Dundee Ave., Elgin, Illinois 60120 Phone: (312) 697-2260
IN CANADA: Bach-Simpson, Ltd., London, Ontario
IN ENGLAND: Bach-Simpson (U.K.) Limited, Wadebridge, Cornwall
IN INDIA: Ruttonsha-Simpson Private, Ltd., International House, Bombay-Agra Road, Vikhroli, Bombay

KATY INDUSTRIES
ELECTRICAL EQUIPMENT GROUP




NOTES:

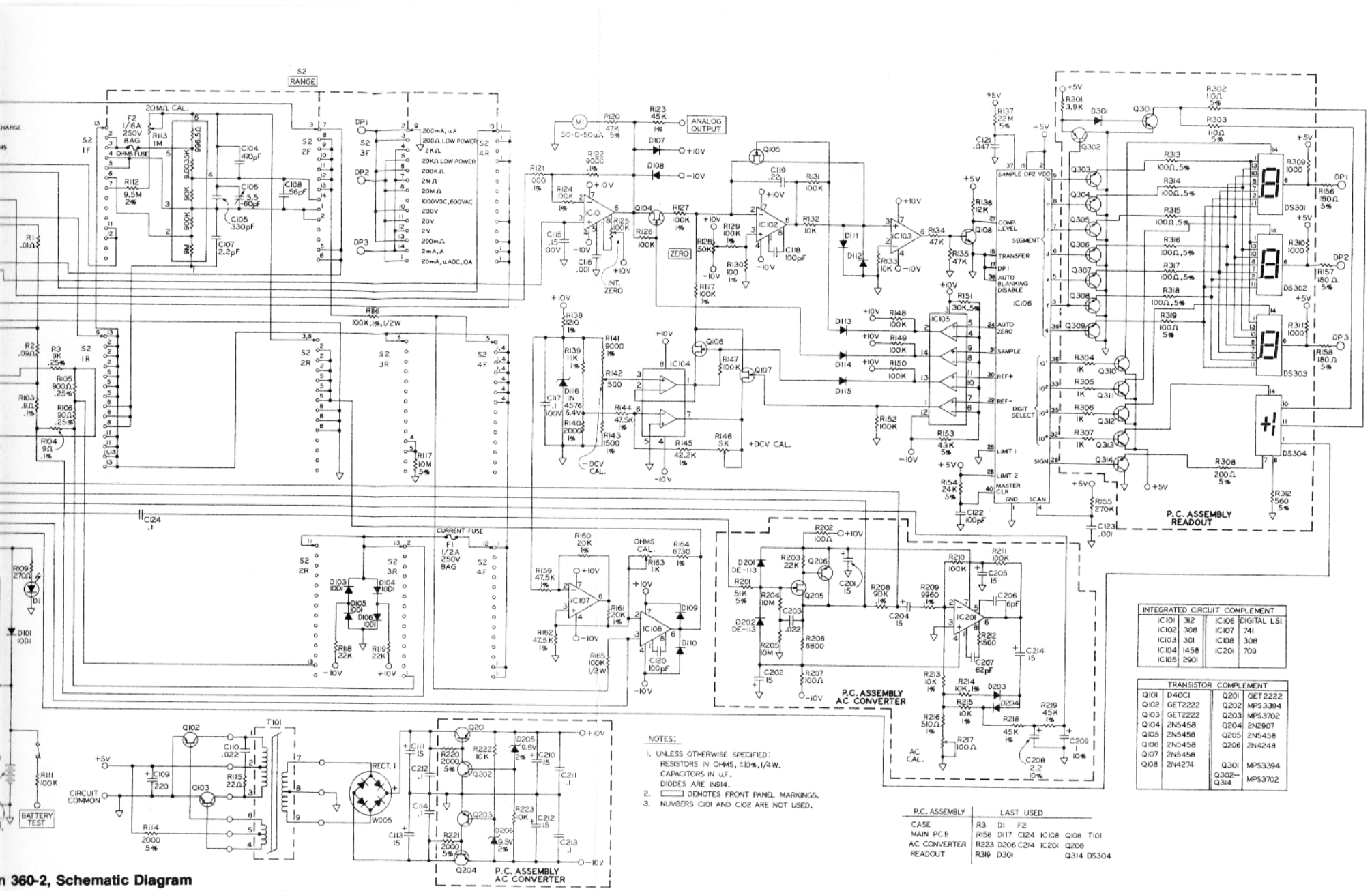
1. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS, ±10%, 1/4W. CAPACITORS IN μF. DIODES ARE IN914.
2. ▭ DENOTES FRONT PANEL MARKINGS.
3. NUMBERS C101 AND C102 ARE NOT USED.

| INTEGRATED CIRCUIT COMPLEMENT | | | |
|---|---|---|---|
| IC101 | 312 | IC106 | DIGITAL LSI |
| IC102 | 308 | IC107 | 741 |
| IC103 | 301 | IC108 | 308 |
| IC104 | 1458 | IC201 | 709 |
| IC105 | 2901 | | |

| TRANSISTOR COMPLEMENT | | | |
|---|---|---|---|
| Q101 | D40C1 | Q201 | GET2222 |
| Q102 | GET2222 | Q202 | MPS3394 |
| Q103 | GET2222 | Q203 | MPS3702 |
| Q104 | 2N5458 | Q204 | 2N2907 |
| Q105 | 2N5458 | Q205 | 2N5458 |
| Q106 | 2N5458 | Q206 | 2N4248 |
| Q107 | 2N5458 | | |
| Q108 | 2N4274 | Q301 | MPS3394 |
| | | Q302–Q314 | MPS3702 |

| P.C. ASSEMBLY | LAST USED |
|---|---|
| CASE | R3 D1 F2 |
| MAIN P.C.B | R158 D117 C124 IC108 Q108 T101 |
| AC CONVERTER | R223 D206 C214 IC201 Q206 |
| READOUT | R319 D301 Q314 DS304 |

**Figure 7-1. Simpson 360-2, Schematic Diagram**




| INTEGRATED CIRCUIT COMPLEMENT | | | |
|---|---|---|---|
| IC101 | 312 | IC106 | DIGITAL LSI |
| IC102 | 308 | IC107 | 741 |
| IC103 | 301 | IC108 | 308 |
| IC104 | 1458 | IC201 | 709 |
| IC105 | 2901 | | |

| TRANSISTOR COMPLEMENT | | | |
|---|---|---|---|
| Q101 | D40C1 | Q201 | GET2222 |
| Q102 | GET2222 | Q202 | MPS3394 |
| Q103 | GET2222 | Q203 | MPS3702 |
| Q104 | 2N5458 | Q204 | 2N2907 |
| Q105 | 2N5458 | Q205 | 2N5458 |
| Q106 | 2N5458 | Q206 | 2N4248 |
| Q107 | 2N5458 | | |
| Q108 | 2N4274 | Q301 | MPS3394 |
| | | Q302-Q314 | MPS3702 |

| P.C. ASSEMBLY | LAST USED |
|---|---|
| CASE | R3 D1 F2 |
| MAIN P.C.B | R158 D117 C124 IC108 Q108 T101 |
| AC CONVERTER | R223 D206 C214 IC201 Q206 |
| READOUT | R319 D301 Q314 DS304 |

**n 360-2, Schematic Diagram**