OPERATOR'S MANUAL

MODEL 392 VOLT-WATTMETER

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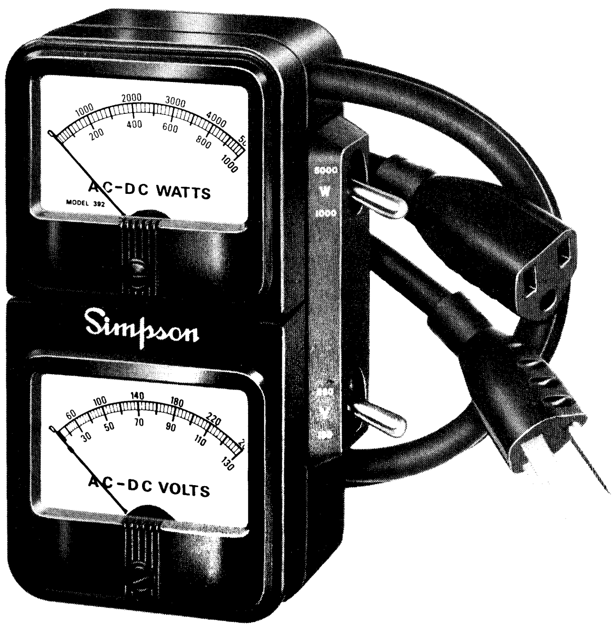

Figure 1-1. Model 392 Volt-Wattmeter

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WARNING

The Model 392 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

The Simpson Model 392 Volt-Wattmeter (hereafter referred to as the Model 392 or simply as the Instrument) is shown in Figure 1-1. This Instrument is made up of two separate indicating meters. The top half is a wattmeter and the lower half is a voltmeter. Compact and rugged, the Instrument is useful to the serviceman for localizing a problem to the distribution line or appliance. It can further be used to diagnose the problem within the appliance by the wattmeter readings. The instructions in this manual include procedures for direct wired equipment as well as plug-in appliances.

1.2 DESCRIPTION

This highly versatile instrument allows measurement of both large-current and small-current devices through the two-scale, two-switch combination.

1.2.1 Wattmeter (AC or DC)

a. The nature of the wattmeter is such that there is an automatic power factor correction for all wattage readings. This means that the wattmeter actually reads true power, whether the power source is DC or AC, and whether the load is resistive, inductive or capacitive. This feature provides a distinct advantage for measuring such effects as motor starting characteristics, in which the phase relations change very abruptly. By having an instrument that indicates true wattage the operator is able to analyze the functions of a circuit and accurately determine the operation of various devices.

b. There are two wattmeter ranges: **1000 and 5000 watts**. These two popular ranges allow the operator to select the range that fits the necessary requirement.

1.2.2 Voltmeter (AC or DC)

a. The voltmeter has a vane-type movement while the wattmeter is a dynamometer-type. However, both types operate comparatively either on DC or AC circuits. The voltmeter is designed to operate within the standard range of power frequencies (50-60 Hz) on AC.

b. The voltmeter is provided with two ranges. The 130-volt low range scale provides the high, low and normal limits for a nominal 120 VAC source. Likewise, the 260-volt high range scale provides the high, low and normal limits for a 240 VAC source. These two selected ranges provide the best coverage for appliance and equipment servicing.

1.2.3 Power Leads

a. There are two heavy power leads which are connected permanently inside the case. The longer lead is terminated with a standard male 3-prong grounded power plug which can be inserted into any ordinary 120 VAC power outlet. As soon as connection is made, the voltmeter in the lower half of the case will indicate the amount of voltage in the circuit. The voltmeter will continue to indicate as long as the power plug remains connected in the outlet.

b. The second power lead is shorter and terminates in a 3-wire female power connector. Connect the power cord of the device (to be measured for wattage) to this outlet. The line voltage that is indicated on the voltmeter will also be applied to the device (to operate it). The current that flows through the measured device, along with the line voltage determines how many watts are indicated on the wattmeter.

1.2.4 Terminal Coding

There is a polarization marking on the termination of each power cord. A dot of white lacquer on each plug and connector identifies the contact for the white lead. This lead is continuous between the two cords. If you are working with DC, and require a definite polarity because of the voltage, use the white dots to identify one continuous lead through the Instrument circuits. The other contact on each termination, unmarked, is for the other lead.

1.2.5 Range Switches

a. There are two switches on the right hand side of the Instrument. The one at the top, opposite the wattmeter, is a range switch for the wattmeter. With the switch handle in its lower position (1000 watts), the lower range is connected. When the wattage range switch is in the upper position (5000 watts), the higher range is connected.

b. The switch at the bottom on the right hand side of the Instrument, is the voltage range switch. This switch sets a range of 130 volts when it is in the down position, or of 260 volts when it is in the up position. See paragraph 4.5 for power source connection.

1.3 ACCESSORIES

A specially designed carrying case is available for the Model 392 (see Table 7-2). This case provides protection to the Instrument while in transit and during times when the Instrument is in storage.

1.4 TECHNICAL DATA

Table 1-1 lists the technical data for the Model 392.

Table 1-1. Technical Data

1. DC VOLTS:	
Ranges:	130V and 260V
Accuracy:	±5% for full scale reading
2. AC Volts:	
Ranges:	130V and 260V
Accuracy:	±3% for full scale reading
3. DC Wattage:	
Ranges:	1000W and 5000W
Accuracy:	±3% for full scale reading
4. AC Wattage:	
Ranges:	1000W and 5000W
Accuracy:	±3% for full scale reading
5. Frequency Response:	50-60 Hz or DC (no correction required).
6. Dimensions:	
Height:	5-7/8" (149.2 mm)
Width:	3" (76.2 mm)
Depth:	2-1/2" (63.5 mm)
7. Weight:	1-3/4 lb (.8 Kg)

SECTION II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Examine the shipping carton for obvious signs of damage before unpacking. If shipping carton is in good condition, then unpack and inspect the Instrument for possible damage incurred during shipment. If damage is noted, notify the carrier and supplier and do not attempt further use of the Instrument. If Instrument appears to be in good condition, read Operator's Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible.

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

2.2 POWER SOURCE REQUIREMENTS

The Model 392 has two voltmeter ranges and will operate from either a 120 or 240 volt AC or DC power line. Since it is designed for testing line operated equipment, it will operate on standard line frequencies (50-60 Hz) as well as DC. See Section IV.

2.3 INSTALLATION

The Instrument can be set horizontally or vertically. However, the unit will operate properly in any position.

SECTION III

CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

All operating controls, connectors and indicators are shown in Figure 3-1. Become thoroughly familiar with each before operating the Instrument for the first time.

3.2 DESCRIPTION

Description of controls, connectors and indicators are as follows:

NOTE: The item call-outs in Figure 3-1, correspond with the numerical order of the items listed in Table 3-1.

Table 3-1. Controls, Connectors and Indicators

1. Voltmeter Selector:	A two-position selector (toggle) switch is used to select the 130V or 260V operating voltage required to operate the equipment being tested.
2. Wattmeter Selector:	A two-position selector (toggle) switch provides two wattmeter ranges: 1000W and 5000W.
3. Voltage Indicator:	A 2½" meter with a dual scale displays the voltage present on the line, which is also applied to the equipment under test. When the voltmeter switch is in the 260V position use the upper scale. Use the lower scale for the 130V switch position.
4. Wattage Indicator:	A 2½" meter with a dual scale displays the wattage consumed by the equipment under test. Use the top scale when the wattmeter selector switch is up, and the lower scale when the switch is down.
5. Female Connector:	Provides connection for the equipment being tested.
6. Male Connector:	Provides a connection to the power source.
7. Zero Setting Screw:	See paragraph 4.3.

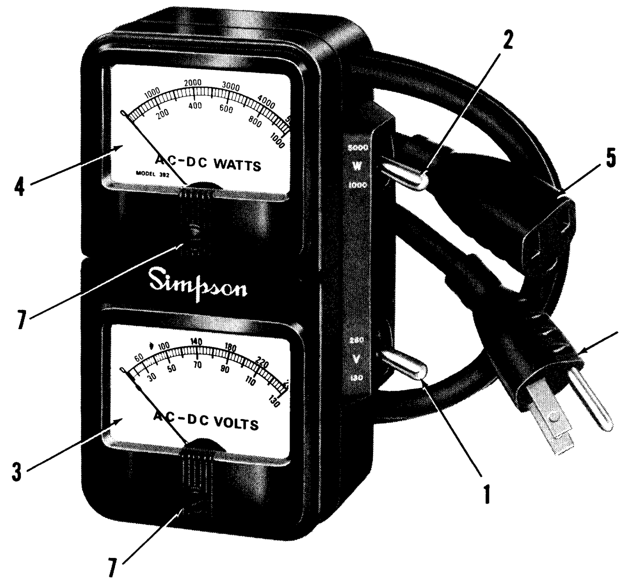


Figure 3-1. Controls, Connectors and Indicators

SECTION IV

OPERATION

WARNING

The Simpson Model 392 Volt Wattmeter is designed to prevent accidental shock to the operator when properly used. No engineering design can render safe an Instrument which is used carelessly. This manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

4.1 GENERAL

This section of the manual contains all the information related to operation of the Instrument. Special notes and instructions also have been included for added safety and convenience.

4.2 SAFETY PRECAUTIONS

4.2.1 The Model 392 is intended for use only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to the "SHOCK HAZARD" definition on page vi.

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

4.2.3 Locate all voltage sources and accessible current paths before making measurement connections. Be sure the equipment is grounded properly and that the right rating and type of equipment fuse(s) is installed. Set the Instrument to the proper range before applying power.

4.2.4 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, replace the test leads immediately.

4.2.5 Do not test equipment when 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.

4.2.6 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.

4.2.7 For maximum safety, do not touch the Instrument leads while power is applied to the circuit being measured.

4.2.8 Do not touch any object which could provide a current path to the common side of the circuit under test or power line ground. Always stand on a dry insulated surface capable of withstanding the voltage being measured.

4.2.9 When using or servicing the Model 392, ensure that it is connected to a 3-wire power line outlet that is correctly wired in accordance with the latest National Electrical Code. If not sure of the integrity of the power line outlet, or you are forced to use a 3-wire to 2-wire adapter plug, then be sure to ground the wire from the adapter to a known good earth ground.

4.3 ZERO SETTING OF METERS

a. Before using the Model 392, be sure that both meters read zero when there is no power applied and when the Instrument is in its operating position. There is a small zero setting screw in the face of each meter just below its dial (see Figure 3-1).

b. Use a small screwdriver to rotate each screw either clockwise or counterclockwise until the knife-edge pointer rests over the zero indication at the left hand side of the dial. Each of the two movements operates independently, therefore, both pointers must be set while there is no power connected to the Instrument.

4.4 SET RANGE SWITCHES

a. Set the wattmeter range switch in its up position (high range). This will help protect the Instrument from an overload. After you have observed the first reading on the wattmeter, set its range switch for the lower range if the wattage is within the lower range.

b. Set the voltmeter range switch according to the amount of line voltage expected from the power source. If you are in doubt, set this switch at 260 volts as a protection to the Instrument. Then you can change the range switch setting to 130V if you find that the line voltage is less than 130 volts.

4.5 CONNECTION TO POWER SOURCE

a. Plug the male power plug at the end of the longer power lead into a 120 VAC grounded power line outlet. A universal 3-prong plug is furnished for this

termination on the Instrument lead, and it will fit into standard type power outlets commonly available for all power line connections.

b. If your power source does not have a power outlet that will accept the 3-prong grounded plug, use a standard 3-prong adapter, making absolutely certain the wire of the adapter is connected to a good earth ground.

c. If a 240 VAC power source is to be used, adapters must be fabricated to accept the 240 VAC source. These adapters may consist of a 240 VAC plug wired to the 120 VAC three wire female connector, and a 240 VAC male connector wired to a 120 VAC three wire grounded plug. Use large enough wire in your adaptors to carry all the current for the device which shall be tested.

4.6 VOLTMETER INDICATION

As soon as the cable with the male plug is connected to a power source, the voltmeter on the lower front panel of the Instrument will register line voltage. The voltmeter will continue to indicate the voltage available from the power source as long as the plug is connected, whether you have a device connected (and operating) or not.

4.7 MEASURING WATTAGE

a. Plug the power lead, of the device that you wish to measure wattage, into the female connector at the end of the shorter power cord of the Volt-Wattmeter.

b. Turn on the power switch (if there is one) on the device.

NOTE: If the device does not have a power plug termination, temporarily connect one to it.

4.8 WATTMETER INDICATION

As soon as any current begins to flow through the device connected to the power lead of the Instrument, it will also flow through the wattmeter portion of the Volt-Wattmeter. This will cause the wattmeter to indicate how much wattage is being consumed.

4.9 STARTING SURGE INDICATION

Many electrical devices have starting currents that are greater than their normal operating currents. The pointer on the wattmeter will indicate these conditions accurately by showing a higher reading while the larger current passes through the circuit, and then a lower reading when the device has assumed its proper operating condition.

4.10 MEASURING WATTAGE IN TWO OR THREE PHASE CIRCUITS

The Model 392 is a single phase instrument. To measure either voltage or wattage (or both), in two and three phase circuits, measure each phase separately. The nominal voltage for a multi-phase circuit, is the voltage of each phase. The total wattage is found by adding the wattage read in each phase. The wattages for the different phases are usually equal, but may be different; measure each one to be sure.

4.11 INSTRUMENT OVERLOAD PREVENTION

Too much current through the current coils of the wattmeter can result in overheat and cause permanent damage if the overload is not removed quickly. The current rating for the Model 392 is 10 amperes normal, 20 amperes maximum intermittent, and 40 amperes momentarily. Do not exceed the safe operating limits for your Instrument.

Operation

4.12 CURRENT CALCULATIONS

a. The Model 392 does not indicate circuit current directly, but the wattmeter indication is an index to the amount of current. For DC circuits, watts are mathematical products found by multiplying volts times amperes. For AC circuits, this product has to be multiplied by the power factor, which is always equal to, or less than 1.

b. Volts and watts readings can be simultaneously observed on the Instrument. Therefore, calculate the approximate circuit current for each application with this related information. You can be sure of the current for DC circuits, but you can only obtain a relative idea of the current for AC circuits, which is usually satisfactory for this purpose. To use the formula:

$$I = \frac{W}{E}$$

Where I = current in amperes,
W = power in watts,
and E = volts

c. For example, suppose that your voltmeter shows 115 volts when your wattmeter shows 2700 watts. Using the formula to calculate the current, you find that you have about 23.5 amperes flowing through the circuit and through the current coils in the wattmeter.

$$I = \frac{W}{E} = \frac{2700}{115} = 23.5 \text{ amperes (approximately)}$$

d. If this measurement is in a DC circuit, this is the circuit current. If the circuit is AC, there is at least this much current and maybe more, depending on the power factor. In either case, the amount of current is enough that you will know that you cannot leave the Volt-

Wattmetter connected for any length of time without causing damage to the current coils.

4.13 SAFE WATTAGE CALCULATION

a. To be sure of maintaining a safe operating condition with your Instrument, mentally calculate the maximum safe operating wattage for each indication while line voltage is being applied to the Volt-Wattmeter, and before you connect power to any device which you are going to measure. Then you will know when you are operating within a range which is either (or is not), dangerous to the circuits in your meter. To use the formula:

$$W = E \times I$$

where W = power in watts,

E = volts

and I = current in amperes.

NOTE: The power factor has again been disregarded, so this is not a foolproof calculation for AC. However, the approximation which you get with it will serve the purpose in most cases.

b. For example, using the above formula, suppose that you plug in your power cord and find that the line voltage is 120 volts. Multiply this by each of the three current values which represent safety or danger for your circuit. They are 10, 20 and 40 amps.

c. The three results obtained will be 1200, 2400 and 4800 watts. This means that any wattage indication up to 1200 watts will probably be caused by a low enough current that you can leave the device connected in the Volt-Wattmeter circuit for any desired length of time while you observe its operation.

4.14 HOW TO USE WATTAGE CALCULATIONS

a. If the reading is between 1200 and 2400 watts, leave the device connected while you make the desired wattage measurements, but then disconnect the circuit and remove the wattmeter to let it cool (if it is hot) before you connect another device to it. If the value is between 2400 and 4800 watts, connect the wattmeter long enough to make a quick reading, and then disconnect it as soon as possible to prevent damage to the meter.

b. These calculations assumed that the line voltage was 120 volts. If you connect your Volt-Wattmeter to a power circuit and find that the voltage is only 105 volts, the three values of wattage would be 1050, 2100 and 4200. If the voltage is 125, the three wattage values are 1250, 2500 and 5000.

c. For nominal 240 volt circuits, less current is required to produce similar wattages. For instance, if the voltage is 220 volts, 2200 watts is indicated with only 10 amperes flowing through the circuit. Twenty amperes make the wattage 4400, and 5000 watts requires only about 22.7 amperes.

4.15 SUMMARY OF CALCULATIONS

CAUTION

Protect the Model 392 from being damaged by overheating of the current coils in the wattmeter.

Mentally **calculate the wattages** that indicate dangerous current through the wattmeter when you connect the Instrument and read line voltage.

4.16 ANALYZING SERVICE PROBLEMS

The Model 392 has been especially designed for analyzing service complaints on refrigerators, air conditioners, freezers, ironers, washers, electric heaters, irons, oil burner motors, fans, radios, television sets, lighting units, and a variety of other appliances and electrical devices. To test these devices follow the instructions in paragraphs 4.1 through 4.13.

4.17 LABORATORY USES

The Model 392 is also valuable for laboratory analysis of equipment operating characteristics which have, for instance, high starting current (with or without regulation) and then a lower normal operating current. The meter readings will indicate the electrical effects of mechanically loading a motor. In addition the capacity of a power source can be determined by observing the voltage at the same time as the wattage. It will show that as the load is increased more current is drawn. A power source with only a limited capacity to furnish power will decrease in terminal voltage.

4.18 EFFICIENCY CHECK OF A POWER LINE

An efficiency check of a distribution line in an electrical installation is determined in the same manner as that in paragraph 4.17.

a. Suppose that a line from the fuse box to an automatic washing machine is about 100 feet long and has #14 AWG wire for its two leads. When you plug the power lead for your Instrument into the outlet for this circuit, the voltmeter shows line voltage (for our example, suppose that it is 115 volts). Now connect the power plug for the automatic washer into the receptacle at the

end of the short lead on your Instrument and turn on the switch for the washer.

b. Watch both the wattmeter and the voltmeter as the washer goes through each of the parts of its complete cycle.

c. Whenever it goes through a part of the cycle where the motor is started or accelerated, the pointer on the wattmeter will move up the scale and then drop back after the motor has come up to speed.

d. When the wattmeter pointer moves up the scale (if the voltmeter pointer moves down) it indicates a loading effect. The distribution line wire size is too small and has decreased the efficiency of the line.

e. If the power line from the fuse box has been made up of heavier wire (as it should be), the drop in voltage during the time when the circuit requires higher currents, would be less.

4.19 POWER LINE CAPACITY CHECK

Using the same technique as in paragraph 4.18, analyze the ability of a distribution line to handle an additional appliance.

a. With your Instrument connected to the power line, turn all the devices on in this line that would normally be "on" at one time, and check your voltmeter for an indication of loading by the devices connected. If the voltage has not dropped more than 10%, add the new appliance to the same line.

b. Check the voltmeter again.

c. If the voltage has not dropped more than 10%, you can probably add the appliance to the same line. However, if there is a greater drop than 10%, it is advisable to either add a new distribution line or to re-wire the existing line with heavier wire. The 10% figure is not hard and fast, but is an approximate value that can be used as a guide until you have had a chance to adjust it through experience.

d. Always analyze the trouble symptom of an appliance, its location and type and the wattmeter indication before you begin repairs. If, for example, an electric ironer will not operate, and the wattmeter and voltmeter both show very low readings, there is no reason to tear into the circuits of the ironer; the trouble is in the power line.

e. Use your Instrument to tell you the whole story.

4.20 ANALYZING HEATING DEVICES

More and more electrical heating devices are being used in the ordinary house. While there are many more electrical devices, than listed, these are some of the devices that can be serviced with your Model 392 by using the information in the following paragraphs:

Table 4-1. Common Electrical Devices

a. Electric space heaters, with or without a fan
b. Electric Irons
c. Electric blankets and sheets
d. Automatic coffee makers
e. Electric hot water heaters
f. Electric cooking utensils and roasters
g. Bottle warmers

h. Corn poppers
i. Toasters
j. Waffle irons
k. Vaporizers

4.21 RATED WATTAGE

Normally, the wattage rating of each appliance is stamped or marked somewhere on the unit. It may be on the nameplate, or on the base or the under-side of the case. This rating assumes a nominal line voltage. When you are making a test, the voltage rating will accompany the wattage rating, because these are related. Therefore, the power line voltage must be at its rated value to read the rated wattage (of any device in good condition) on your volt-wattmeter.

4.22 WATTAGE TOLERANCES

Allow considerable tolerance when you determine whether or not a wattage rating indicates that a device is operating satisfactorily. It may vary as much as 20% above or below the rated wattage value without indicating that anything is wrong. If the wattage indicated is outside these limits and the voltage indicated on the voltmeter portion of your Instrument is within its correct range, trouble is indicated.

4.23 WATTAGE INDICATION TOO HIGH

If the wattmeter shows that the device is operating at too high a wattage, this means that there is more than the normal amount of current flowing through it. The only reason for too much current is a decrease of resistance. Look for a short or a partial short in the circuit, which could be caused by adjacent heating coils touching one another or a metalic object lodged between coils causing a short between the coils of heating wire. It could also be caused by a formation of carbon between the coils or between the wires which connect power into the circuit. Inspect the appliance to locate the short and then eliminate whatever is causing it.

4.24 WATTAGE INDICATION TOO LOW

If your wattmeter shows that the device is operating with too low a wattage, this means that there is less than the normal amount of current flowing through it. This would be caused by an increase of resistance in the circuit. Loose or corroded connections between the power wires and the internal circuits are typical of the troubles that will increase resistance. If there are two or more parallel paths through which the current can flow in the heating circuits, one or more of these parallel paths may be open. Inspect the device with these ideas in mind.

4.25 THERMOSTATICALLY CONTROLLED HEATING UNITS

Many electrical heating devices have an automatic thermostatic control that will open the circuit to the heating element or will add resistance in series with it to reduce current flow after the desired temperature is reached. Most controls are set so that current will go on again when the temperature has dropped through some definite range. There may be a wide range of temperature variation, so the element will be off for a long period of time before it turns itself on again; in others, the temperature will be held within a fraction of a degree. To hold a steady temperature,

a heating element will be turned on-and-off every few seconds after it has once reached the temperature for which it has been set.

4.26 ON-OFF TIMING INDICATIONS

Your Model 392 will register the exact timing of thermostatic functions. It will indicate quickly whether the device has a completely open circuit during its cooling period, or whether it has a decreased loading because of added series circuit resistance. By relating these indications to those that are expected of the device (see the manufacturer's instructions), you can recognize proper and improper circuit operation. Knowing what to expect of the device that is not operating properly will save you time, and increase your efficiency.

4.27 CHECKING MOTOR POWERED DEVICES

There is an apparently limitless list of devices to service that contain electric motors. Before you begin to service the equipment, use the Model 392 to analyze operation because all motors, large or small (and of any type), have one electrical characteristic in common. A heavier current is drawn when starting (shows as higher wattage), than when the motor is up to full speed. For larger motors, line voltage will probably decrease due to the load, while the motor is accelerating, and then will return to normal when the motor is up to speed because of the smaller current drain.

4.28 CENTRIFUGAL SWITCHES

Many motors have special starting circuits that use the centrifugal force present (in the rapidly rotating rotor) to operate an automatic switch to change from a high current to a low current circuit when speed has been attained. A sudden change in the wattmeter indication will occur at the same time when you hear an audible "click" in the motor; the click results from the switch operation.

4.29 SMALL MOTORS

If there is no starting circuit, such as in low powered electric fan motors, the wattage indication will decrease gradually from the higher starting value down to the lower running value.

4.30 LOADING EFFECTS

Another characteristic that is true for all motors is that the mechanical load, which the motor is forced to move, will in part determine the wattage that the motor will use. This is an excellent guide for installation and maintenance of load requirements as well as a big point to assist you in trouble-shooting.

4.31 AUTOMATIC WASHING MACHINE ADJUSTMENTS

When a washer has been installed in its operating position in the customer's home, and it has been run through its cycle to see that all the parts are working together properly, the final adjustment is the spring tension against the idler pully on the drive belt. Adjust it while the washer is operating in its spin cycle so that the wattage consumed by the washer matches the specified nameplate value. The idea behind this measurement of spring tension is that the wattage increases as the spring tension increases because the motor has to work harder to turn the parts that it is driving.

4.32 DRY BEARINGS

a. A hot or smoking motor can result from dry bearings. Don't assume that the motor has become defective, or is the cause of trouble, check it with your Instrument. A continued high wattage and low line voltage reading indicates trouble which may or may not be in the motor or in the electrical circuit. First check for lack of lubrication and apply lubrication. After the motor is lubricated check with the Model 392 to confirm the results if the bearings were dry, and also check if there is, or is not, permanent damage to the motor.

b. Similar indications will result from other mechanical loading, too tight a drive belt, gears not properly meshed, or a foreign object caught in the moving parts. The presence of trouble will be reflected in the wattmeter and voltmeter readings, which will be normal after the trouble has been eliminated.

4.33 REFRIGERATORS

The presence and type of trouble can be indicated by the wattage readings when testing an old refrigerator that has been in storage for some time and has not been used. Plug the refrigerator into the outlet of a Model 392. If the line voltage reading is satisfactory and the wattmeter indicates that the motor is completing a normal starting sequence, but the wattage levels off to a low value during operation, the motor is not working as hard as it should. Check the pressure of the refrigerator. During storage, part of the gas may have leaked out and reduced the pressure. This will account for the decrease in wattage drawn by the motor and can be identified easily and quickly with the information from your Instrument.

4.34 TROUBLE CHART

4.34.1 Summarizing the effects shown with the Model 392 for motor circuits, the indications and probable troubles are as follows:

Table 4-2. Trouble Chart

INDICATION		POSSIBLE TROUBLE	
Watts	Volts	Mechanical or Electrical	
Low	Low	Decreased Load	1 None 2 Line voltage is probably low
Low	Normal	Decreased Load	1 Increased Resistance 2 None
Low	High	Decreased Load	1 Increased Resistance 2 None 3 Line voltage is probably high
Normal	Low	None	1 Line voltage is low
Normal	Normal	None	1 None
Normal	High	None	1 Line voltage may be high
High	Low	Increased Load	1 Shorted windings 2 Defective centrifugal switch 3 Low line voltage
High	Normal	Increased Load	1 Shorted windings 2 Defective centrifugal switch
High	High	Excessive Load	1 Shorted windings 2 Defective centrifugal switch 3 The reason for the high voltage results from a high line voltage

4.34.2 In the table, the idea of low, normal and high wattage ratings are related to the rated wattage for the device. If the power source voltage is low, the wattage indication of a motor operated device may be lower or higher than the rated amount. A motor should not be operated with low voltage because the starting windings may burn out. Similarly, if the voltage is high, the wattage will be lower under ordinary conditions.

4.35 TRANSFORMER-OPERATED CIRCUITS

Loading of the secondary winding of a transformer by a circuit will be reflected in the amount of current that passes through the primary winding of the transformer. As the current is increased through the secondary circuit, primary current is also increased. The Instrument will indicate the cumulative effects of all the secondary circuits for any transformer when you use it to measure primary wattage.

4.36 HIGH WATTAGE

Wattage increases indicate that more current is drawn through one or more secondary circuits. If the line voltage is high, this could be normal depending on the increase. But if the line voltage is normal or low, a high wattage probably indicates an overloaded circuit in one or more secondary circuits of the transformer. Check each secondary circuit visually, or with another instrument if necessary, to locate and eliminate the exact reason for your trouble. Then check again for normal operation indications with your Instrument after the fault has been eliminated.

4.37 LOW WATTAGE

If the wattmeter indicates that there is less than normal wattage, the trouble is probably that one or more of the secondary circuits is open. This can be an indication of faulty equipment, or it may simply indicate that a switch or circuit breaker is open. Examine the circuits in the secondary of the transformer to determine where the fault is, and then you can eliminate it. Recheck circuit operation with your Model 392 after you have serviced a device. See that you have eliminated the original trouble and that you have restored normal operating characteristics to the circuit.

4.38 MEASURING THE WATTAGE OF EQUIPMENT WIRED DIRECTLY TO THE POWER LINE

a. Many devices with wattage ratings within the ranges of your Instrument will be wired directly to the power line without a power plug. Each of these will have a separate fuse.

b. The fuse may be located in a box on the device or on the wall near by, or it may be a special fuse in the main fuse box.

c. When you wish to measure characteristics of the device with your Model 392, connect the instrument in place of the circuit fuse as indicated in Figures 4-1 and 4-2.

WARNING

Be sure to use the white dots to identify lead polarity. The white dot leads must both be connected to the unfused side of the power line or you will place a direct short across the power source. This can damage the instrument before a main fuse blows.

d. The leads connect to the white dot contacts are common through the Instrument (see Figure 4-1). The unmarked contacts identify the lead through which the circuit current must pass to reach the current coils of the wattmeter.

4.39 TESTING PROCEDURE IN 120/240 CIRCUITS

4.39.1 The Procedure For 120-Volt Circuit

a. Disconnect the main fuse to remove power from the circuit while you make your Model 392 connections.

b. Remove the secondary fuse from the circuit of the device that is to be measured.

c. Connect an adapter (female connector with leads) to the power plug at the end of the longer lead of Model 392. Be sure you know which wire is connected to the white dot contact on the plug.

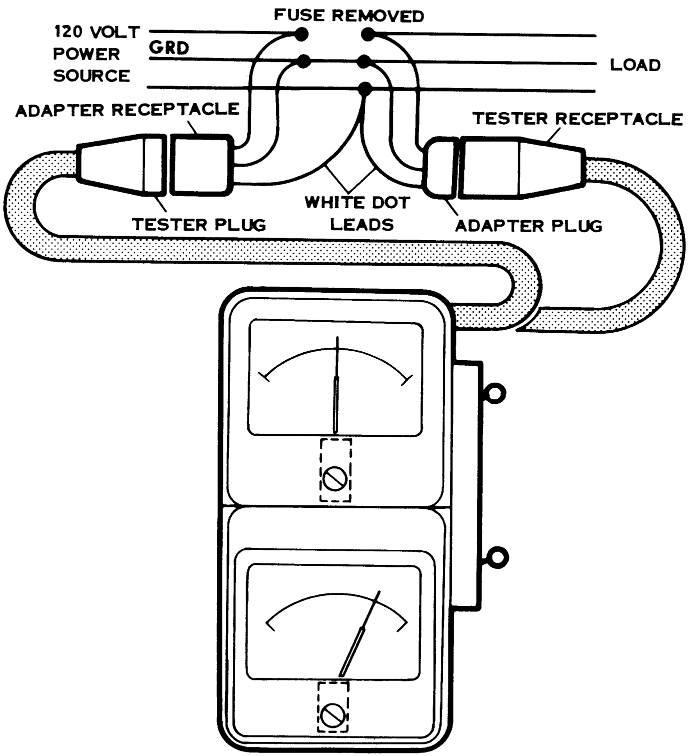


Figure 4-1. Connecting A Volt-Wattmeter In Place of a Fuse in a 120-Volt Circuit

d. Connect the adapter lead with the white dot to the common, or unfused side of the line in the fuse box. Connect the other adapter lead to the "hot" side of the line on the power side of the fuse holder (as shown in Figure 4-1). Connect the ground leads to a good earth ground.

e. Connect an adapter (male plug with leads) to the power receptacle at the end of the shorter cable of Model 392. Again, be sure you know which wire is connected to the white dot contact on the receptacle.

f. Connect the adapter wire with the white dot to the common, or unfused side of the line in the fuse box. Connect the other adapter lead to the load end of the fuse holder (as shown in Figure 4-1), and the ground lead to ground.

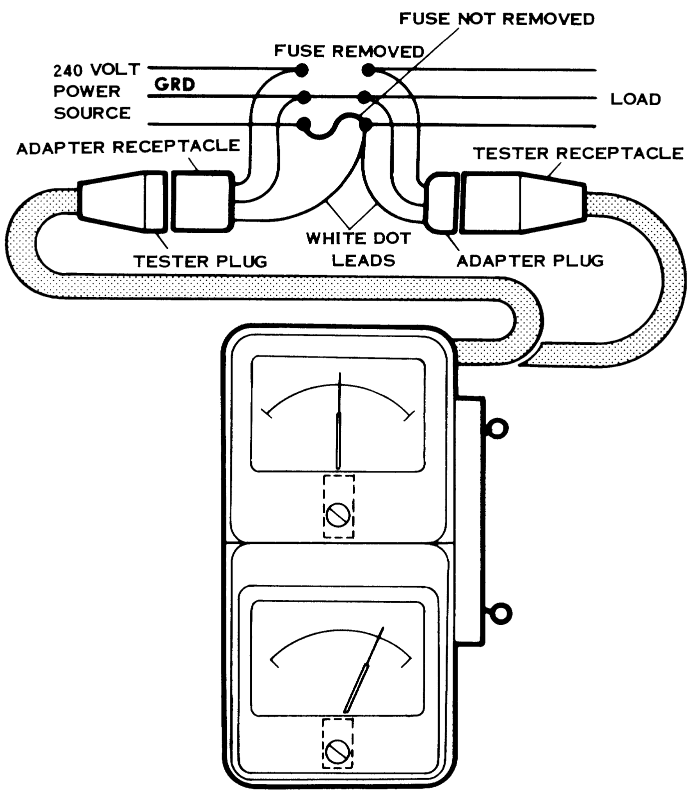
g. Connect the main power fuse to apply power to the line and perform the test.

WARNING

Do not touch the adapter connections while power is present.

h. Note the Model 392 indications.

i. Disconnect the main fuse again before the adapter and Instrument connections are removed.



NOTE: BE SURE TO OBSERVE POLARITY FOR CONNECTIONS. SEE TEXT.

Figure 4-2. Connecting A Volt-Wattmeter In Place of a Fuse in a 240-Volt Circuit

4.39.2 Test Procedure for 240-Volt Circuit

a. Figure 4-2 shows the circuit connections for measurements in a 240 volt circuit.

CAUTION

Observe lead polarity to prevent damage to the Instrument. Remove power from the circuit before connecting or disconnecting any component for measurements.

b. Use the same steps as for a 120-volt circuit. Likewise, use the side of the line from which you do not remove the fuse, in the same manner as the unfused line in 120 volt circuits.

SECTION V MAINTENANCE

5.1 GENERAL

WARNING

When connected to a power source this Instrument contains internal voltages which constitute a SHOCK HAZARD. Review what constitutes a SHOCK HAZARD as explained on page vi. Internal adjustments or repairs should be performed only by qualified personnel who understand and can recognize what constitutes a SHOCK HAZARD, preferably a Simpson Authorized Service Center.

The Model 392 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 this Instrument.

5.2 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside back cover of this 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. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument model number, and date of purchase. Service data or 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.

5.3 SHIPPING

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

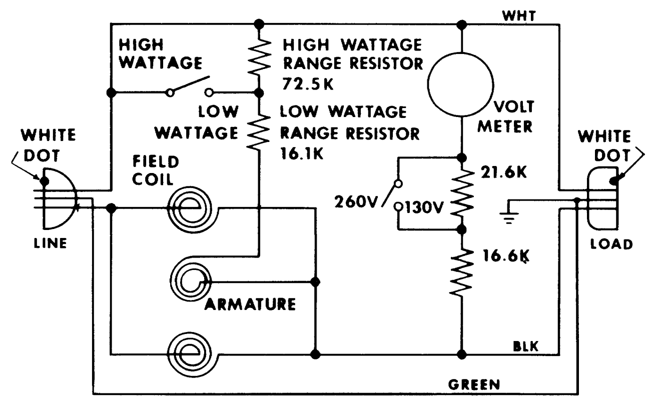


Figure 5-1. Model 392, Schematic Diagram

SECTION VI

REFERENCE INFORMATION

6.1 WATTS

A watt is the practical unit of electrical power. It is equal to 10^7 ergs per second, 1/746 horsepower or, the number of Volt-Amperes multiplied by the power factor. This product is also known by the term **true watts**, because it is a value which is directly related to the ability of a unit to perform its intended work. Your Model 392 indicates true watts.

6.2 VOLT-AMPERES

A measurement which does not include a consideration of the power factor in AC circuits is called **volt-amperes** or **apparent watts**. It is simply the product of volts times amperes. This is the same value as true watts for DC circuits and for pure resistive or resonant AC circuits. In an inductive or capacitive circuit, the volt-ampere measurement is always more than the true wattage.

6.3 POWER FACTOR

Power factor is a fractional multiplier that changes apparent power to true power when dealing with inductive or capacitive AC circuits. It is equal to the cosine of the angle of lag or lead between voltage and current in the circuit. This value is maximum (1) when there is no lead or lag, or minimum (0) when there is a difference of 90° between voltage and current. When the phase angle is between 0° and 90°, the power factor will be between 1.0 and 0, and will be equal to the cosine of the phase angle.

6.4 ELECTRICAL AND MECHANICAL EQUIVALENTS

a. The standard measurement of power in electricity is in units of watts. In mechanical measurements, the units are horsepower (hp). For convenience in relating electrical and mechanical measurements of power, use the following formulas:

   1 horsepower = 746 watts = 0.746 kilowatt

   1 kilowatt = 1000 watts = 1.34 horsepower

b. When you transfer energy from one form to another, there is always some loss. These equivalents assume 100% efficiency in the power transfer, which is an ideal condition. Actually, the wattage rating for a 1/2 horsepower motor, for example, may be anything from 373 watts (746 divided by 2) on up, depending on how efficient the circuit is in accomplishing the power transfer.

6.5 RATINGS FOR AIR-CONDITIONERS

Nominal ratings for air-conditioners are in units of tons or BTU's. You will need to measure the normal wattage for each size and each brand to know what the expected indications will be. Some sample values are as follows:

5000 BTU, 120 volt 800 watts

10000 BTU, 120 volt 1375 watts

14000 BTU, 120 volt 2700 watts

Make your own table of wattages, using known good units, and use the figures to identify high and low wattage indications for each size.

SECTION VII

ORDERING INFORMATION AND AUTHORIZED SERVICE CENTERS

7.1 GENERAL

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.

Table 7-1. Items Included With the Instrument

Description	Part No.
Model 392 Volt Wattmeter	12500
Operator's Manual	5-118338

Table 7-2. Optional Accessories

Carrying Case	03143

AUTHORIZED SERVICE CENTERS

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853 Dundee Avenue, Elgin, Illinois 60120 — Phone: (312) 697-2260

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3222 Commercial Drive
P.O. Box 406
Tel. 907/277-1497

★ **ALASKA, ANCHORAGE 99500**
R. M. ZOOK & ASSOCIATES
1710 E. 27th Avenue
Tel. 907/272-6917

★ **ALASKA, FAIRBANKS 99701**
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WESTERN ELECTRONIC SUPPLY CORP.
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INSTRUMENT LAB
150 Folsom
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85 Tenth Avenue
Tel. 212/924-6000

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Tel. 212/925-1730

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3005 Lamb Road
Tel. 614/475-6120

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1900 Troy Street
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** **TEXAS, HOUSTON 77006**
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1424 Westheimer
Tel. 713/526-6871 & 72

** **TEXAS, ODESSA 79760**
METER SERVICE & SUPPLY
2127 Kermit Highway
P.O. Box 2373
Tel. 915/332-0565

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13215 S.E. 30th
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INDUSTRIAL INSTRUMENT SUPPLY COMPANY
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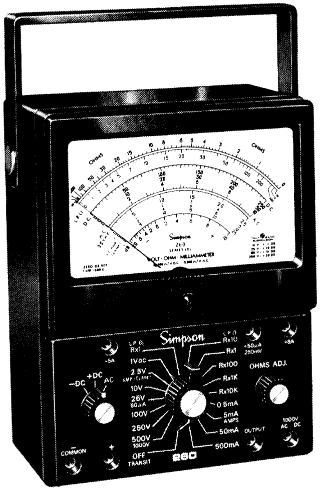

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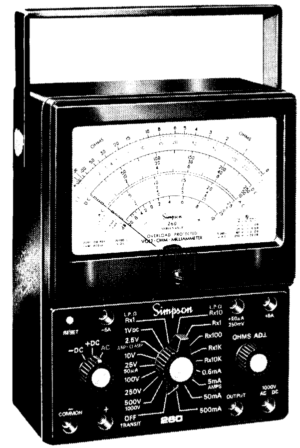

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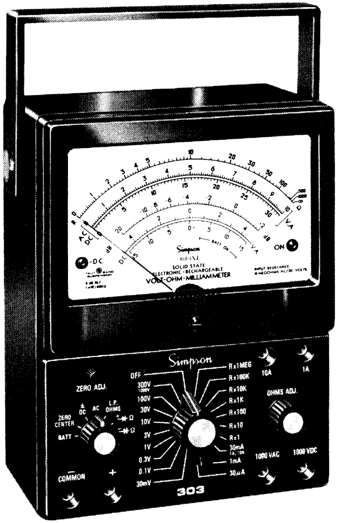

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Warranty

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
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