46-Range Digital Multimeter
## with PC Interface

22-812

Auto-Ranging with Manual-Ranging Override — automatically selects a range when you measure voltage, current, resistance, capacitance, and frequency. You can also manually set the range when measuring values you know are within a certain range.

Computer Interface with Supplied Software — you can connect the meter to your computer and use the supplied software to log and graph measurements.

Logic Function — you can use the meter to test HI and LO logic levels.

Multiple Displays — the supplied software displays the information you see on your meter's display onto your computer's monitor, updating it 4 times per second.

Automatic Data Logging — the software works with your meter and computer to select the correct sampling rate for your application, then capture and store data. The software logs the time for each reading, helping you keep track of each sample. You can also save logged data in your hard drive for future reference.
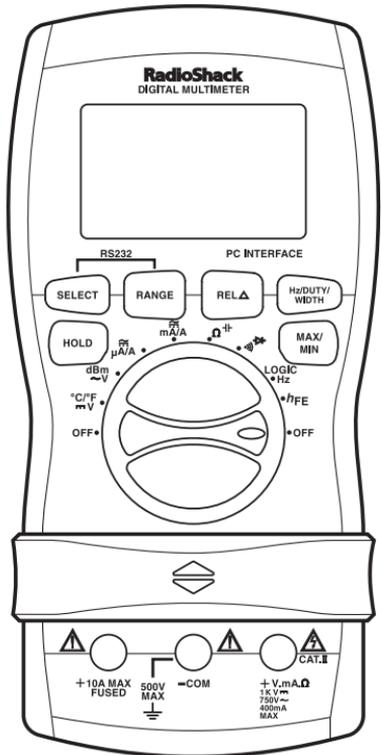
❗ IMPORTANT ❗

If an icon appears at the end of a paragraph, go to the box on that page with the corresponding icon for pertinent information.

⚠ — **Warning**   ❗ — **Important**   💥 — **Caution**   ☼ — **Hint**   ✒ — **Note**

OWNER'S MANUAL
Please read before using this equipment.

RadioShack®
www.radioshack.com℠

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Your RadioShack 46-Range Digital Multimeter is a portable, compact, auto-ranging, digital multimeter. It is ideally suited for field, lab, shop, and home applications. The multimeter provides precise measurements and is built to provide the highest possible reliability. The meter measures voltage up to 1000V DC and 750V AC, DC and AC current up to 10A, resistance up to 40MΩ, capacitance from 0.5nF to 40μF, and frequency from 10Hz to 4MHz. Its 3$\frac{3}{4}$-digit digital display can display up to 4,000 units. **!** ✐

SYSTEM REQUIREMENTS

You can use your meter either with or without a computer. Before connecting the meter to your computer, be sure it is an IBM**®** PC with a Pentium 133 MHz processor or compatible, running Windows 95, Windows 98, Windows ME, Windows 2000, or Windows XP, with all of the following: ✐

- VGA or SVGA video adapter
- at least 32 MB RAM
- Microsoft-compatible mouse

You cannot use the meter with Microsoft Windows 3.1.

Your multimeter requires one 9V battery (not supplied).

A WORD ABOUT SAFETY

We have taken every precaution in designing this meter to ensure that it is as safe as we can make it. But safe operation depends on you, the operator. We recommend that you follow these simple safety rules:

- Never apply voltages to the meter that exceed the limits given in the specifications. Never

apply more than 1000V DC or 750V RMS AC between the input jacks and ground.

- Use extreme caution when working with voltages above 100V. Always disconnect power from the circuit you are measuring before you connect test leads to high-voltage points.

- Never connect the test leads to a voltage source when you set the meter's function selector to ⦿/⊹, Ω/⊦, **LOGIC/Hz**, ⏚ /**μA/A**, or ⏚ / **mA/A**.

- Always discharge any capacitors of the circuit under test before you attach test leads.

- Always turn off power and disconnect the test leads from the circuit you are testing before you replace the meter's battery or fuse.

- Never operate the meter unless its back cover and battery cover are in place and fully closed.

- This equipment is rated for installation category II (maximum 3600VA).

- Because many AC/DC sets have a potentially hot chassis, be sure the top of your workbench and the floor underneath it are made of non-conductive materials.

This meter is fully calibrated and tested. Under normal use, no further adjustment should be necessary except as noted in this Owner's Manual. If the meter requires repair, do not try to adjust it yourself. Take it to your local RadioShack store. ⚠

A Word About Safety

⚠ **WARNING** ⚠

- Use extreme caution in the use of this device. improper use of this device can result in injury or death. Follow all safeguards suggested in this owner's manual, in addition to normal safety precautions, in dealing with electrical circuits. Do not use this device if you are unfamiliar with electrical circuits and testing procedures.

- Never try to probe with both test leads at the same time or hold both test leads in one hand.

(continued)

⚠ **WARNING** ⚠

(continued)

• Use extreme care while using the meter to measure current and voltage in commercial electrical panels. Unlike a home AC outlet, a commercial electrical panel has tremendous current surge potential. This is especially true for three-phase industrial electrical panels. A small spark from one of these panels can cause a plasma explosion and fire that can severely burn you. Do not hold the meter while using it.

• Always wear protective leather gloves, a face shield, and fireproof arm and upper body protection while using the meter to measure current and voltage in commercial electrical panels.

• If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

• To reduce the risk of fire or shock hazard, do not expose this product to rain or moisture.

• For indoor use only.

SPECIAL PANEL MARKINGS

For your safety, we have added special markings to the meter's panel to remind you of the measurement limitations.

1 K V ⎓ **750V ∼** **400mA MAX**	The maximum voltage that this meter can measure is 1000V DC or 750V AC. The maximum current that this terminal can measure is 400mA DC and AC.
⚡	**Caution**: Be extremely careful when making high-voltage measurements; DO NOT TOUCH TERMINALS OR PROBE ENDS.
⚠	**Caution**: Risk of electric shock! Refer to the complete operating instructions.
▫	The meter is protected by double insulation.
CAT II	This equipment is rated for INSTALLATION CATEGORY II (3600VA max.).
500V MAX ⏚	To avoid electrical shock or instrument damage, do not connect the common input terminal (– **COM** jack) to any source that exceeds 500 volts with respect to earth/ground.
+10A MAX FUSED	The maximum current you can measure at this jack is 10 amps DC/AC. This jack is fuse-protected.
WARNING: Shock Hazard if guard not installed.	The sliding guard on the front of the meter protects against electrical shock. Do not remove the guard.

SPECIFICATIONS

Accuracies at 73.4°F (23°C) ±5°, <75% RH

DC VOLTS (Maximum Measurement: 1000V)

400mV .... ± 0.3% of Reading,
± 4 in Last Digit

4V to 40V .... ± 0.3% of Reading,
± 3 in Last Digit

400V .... ± 0.5% of Reading,
± 3 in Last Digit

1000V .... ± 0.5% of Reading,
± 4 in Last Digit

AC VOLTS (Maximum Measurement: 750Vrms at 50/60 Hz, Average Responds, RMS Calibrated, AC Coupled)

400mV .... ± 0.5% of Reading,
± 4 in Last Digit

4V to 40V .... ± 0.5% of Reading,
± 3 in Last Digit

400V .... ± 0.6% of Reading,
± 3 in Last Digit

750V .... ± 0.8% of Reading,
± 4 in Last Digit

dBm ACCURACY (–31.8dBm to +59.7dBm at 50/60 Hz sine wave) .... ± 0.3dBm,
± 2 in Last Digit

DC CURRENT (Maximum Measurement: 10A)

400µA .... ± 0.8% of Reading,
± 5 in Last Digit

4mA .... ± 0.6% of Reading,
± 3 in Last Digit

40mA .... ± 0.8% of Reading,
± 5 in Last Digit

400mA .... ± 0.6% of Reading,
± 3 in Last Digit

4A .... ± 0.8% of Reading,
± 5 in Last Digit

10A .... ± 1.0% of Reading,
± 5 in Last Digit

AC CURRENT (Average Responds, RMS Calibrated, 10A Maximum, DC Coupled)

400μA .... ± 1.0% of Reading,
± 5 in Last Digit

4mA .... ± 0.8% of Reading,
± 3 in Last Digit

40mA .... ± 1.0% of Reading,
± 5 in Last Digit

400mA .... ± 0.8% of Reading,
± 3 in Last Digit

4A .... ± 1.0% of Reading,
± 5 in Last Digit

10A .... ± 1.2% of Reading,
± 5 in Last Digit

RESISTANCE

400Ω .... ± 0.4% of Reading,
± 5 in Last Digit

4kΩ – 40kΩ– 400kΩ .... ± 0.3% of Reading,
± 3 in Last Digit

4.0MΩ .... ± 0.6% of Reading,
± 3 in Last Digit

40MΩ .... ± 1.5% of Reading,
± 5 in Last Digit

CAPACITANCE

4nF .... ± 3.0% of Reading,
± 40 in Last Digits

40nF .... ± 3.0% of Reading,
± 10 in Last Digits

400nF – 4μF – 40μF .... ± 2.0% of Reading,
± 4 in Last Digit ☑

PULSE WIDTHS (Frequency Range: 10Hz to 100kHz)

1μS to 90mS (at +5/–0V square wave):

.... ± 5% of Reading,
±2 in Last Digit

K-TEMPERATURE MODE

This is a special voltage mode, to be used with an optional thermocouple module that can be attached to the meter. This mode automatically converts the 1mV per °C or °F voltage into a readout that appears as a temperature. In these modes, the unit can show up to ± 999°C or °F.

☑ **NOTE** ☑
Accuracy with film capacitor or better, specified from 9.5% of full scale to full scale except 4.0nF range from 0.5nF to full scale.

The accuracy of these modes is determined by the external device and the accuracy of the DC volt mode. The temperature range of the newer 1mV per degree C probes are generally between –50°C and 1000°C.

FREQUENCY

Accuracy

400Hz – 4k–40k–400kHz–4MHz:

.... ± 0.1% of Reading, ± 4 in Last Digit

Sensitivity

The function selector set to **LOGIC/Hz** (10Hz – 4MHz)

400Hz–4k–40kHz .... 50 mVrms

400kHz .... 100 mVrms

4MHz .... 250 mVrms

For AC voltage frequency, the function selector set to °**C/°F / ⎓ V** (maximum measuring frequency 1 kHz for signal above 40V)

10Hz to 1 kHz .... 70 mVrms

1kHz to 10 kHz .... 400 mVrms

For AC voltage frequency, the function selector set to **dBm ~ V** (maximum measuring frequency 1 kHz for signal above 40V)

10 Hz to 200 Hz .... 300 mVrms

200 Hz to 1 kHz .... 0.4 Vrms

1 kHz to 10 kHz .... 4 Vrms

For AC current frequency

400μA/4mA .... 10 Hz to 30 kHz: 250μArms

40mA/400mA .... 10 Hz to 30 kHz: 25mArms

4A/10A .... 10 Hz to 10 kHz: 2.5Arms

DUTY CYCLE (Frequency Range: 10 Hz to 100 kHz)

10% – 90% (at +5V/-0V Square wave)
                    ± 2 digits/kHz, ± 2 in last digit ✓

DIODE MODE

Open Circuit Voltage .... < 2.8Vdc

Test Current .... 1 mA Typical

✗ **NOTE** ✗

Duty cycle accuracy depends on input signal frequency.

LOGIC MODE

Min. High-Level Voltage: .... 2.0V ± 0.2V

Max. Low-Level Voltage: .... 1.0V ± 0.2V

CONTINUITY BEEPER

Continuity (short) .... ≤ 50 ± 30 Ohms

Open .... > 50 ± 30 Ohms

Open Circuit .... < 2.8 Volts

Short Circuit Current .... < 2.0 mA

Beeper Volume (at 5cm) .... 65dB Min (audio scale)

GENERAL

Maximum Common Mode Voltage .. 500VDC or RMS AC

Battery Life at 30 minutes
use per day .... About 200 days, Alkaline

Sleep Mode Timing .... 30 ± 10 Minutes

Range Up Detect Value .... Overflow (>4000 Counts)

Range Down Detect Value .... 380 Counts

Low Battery Indication .... 6.3V ± 0.3 V

Sleep Mode Current .... 10 µA Normal, 20µA Max.

Input Impedance .... DCV/ACV: 10Mohm

Power Source .... One 9V battery (not supplied)

Operating Temperature .... 41°F to 104°F
(5°C to + 40°C)

Storage Temperature .... – 4°F to 140°F
(– 20°C to + 60°C)

Humidity .... Maximum Relative Humidity 80% for
temperatures up to 87°F (31°C), decreasing linearity
to 50% relative humidity at 104°F (40°C)

Dimensions (HWD) .... $7 \times 3^7/_{16} \times 1^{11}/_{16}$ Inches
(178 mm $\times$ 88 mm $\times$ 43 mm)

Weight .... Approx 10.44 oz (296 g)

Accessories .... Fuse F500mA/250V
Fuse F12A/250V
2 shrouded test leads red/black
Rubber boot, RS-232C cable, CD-ROM

Specifications are typical; individual units might vary.
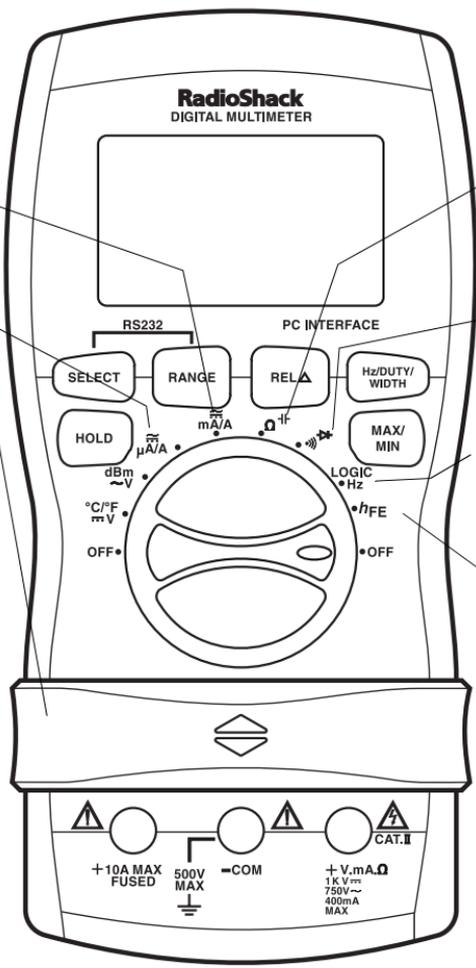Specifications are subject to change and improvement
without notice.

A QUICK LOOK AT YOUR METER

⏚ **/ mA/A** — measures current.

⏚ **/ μA/A** — measures current.

Guard

WARNING: THE GUARD PROTECTS AGAINST ELECTRIC SHOCK. DO NOT REMOVE IT.

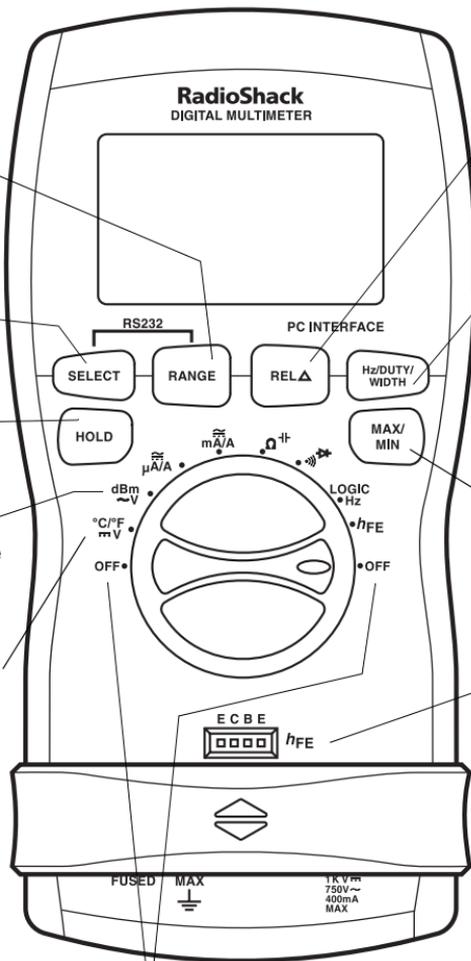**Ω/⊣⊦** — measures ohms and capacitance.

•))/⊣⊳⊦ — checks continuity and diodes.

LOGIC/Hz — measures frequency and logic.

***h*FE** — lets you measure the gain of small-signal, bipolar transistors.

RadioShack
DIGITAL MULTIMETER

RS232   PC INTERFACE

SELECT   RANGE   REL△   Hz/DUTY/ WIDTH

HOLD   mA/A   Ω ⊣⊦   •))   MAX/ MIN

μA/A

dBm
~V   LOGIC
•Hz

°C/°F
~V   •*h*FE

OFF•   •OFF

CAT.Ⅱ

+10A MAX FUSED   500V MAX   −COM   +V.mA.Ω
1 K V
750V~
400mA
MAX

RANGE — selects auto or manual ranging.

SELECT — selects options.

HOLD — holds a measurement value.

dBm / ~ V — selects AC voltage measurement in dBm or volts.

°C/°F / ⎓ V — displays temperature and measures DC volts.

REL△ — lets you work with relative measurements.

Hz/DUTY/WIDTH — measures frequency, duty cycle, and pulse width.

MAX/MIN — lets you store maximum and minimum readings.

***h*FE Socket** — lets you insert a transistor so you can check its gain.

RadioShack
DIGITAL MULTIMETER

RS232   PC INTERFACE

SELECT   RANGE   REL△   Hz/DUTY/WIDTH

HOLD   MAX/MIN

mA̅/A   Ω ⊩
μA̅/A   ))) ⊮
dBm
~V   LOGIC
°C/°F   Hz
⎓V   *h*FE
OFF•   •OFF

E C B E
▭▭▭▭ *h*FE

⇕

FUSED   MAX
⏚

1 K V ⎓
750V ~
400mA
MAX

OFF — turns the meter off.

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PREPARATION

INSTALLING A BATTERY

Your meter requires one 9-volt battery (not supplied) for power. For the best performance and longest life, we recommend a RadioShack alkaline battery. ⚠ 💥

1. If the rubber boot is attached to the meter, simply pull it off to remove it (see "Using the Rubber Boot" on Page 12).

2. If the meter is on, rotate the function selector to **OFF** to turn it off. Then disconnect the test leads if they are connected.

3. Use a Phillips screwdriver to loosen the battery cover's screw, then lift off the battery cover.

4. Snap a fresh 9V battery onto the terminals of the battery clip in the battery compartment.

5. Replace the battery cover and secure it with the screw.

When ⊐ appears on the left side of the display or the meter stops operating properly, replace the battery. ⚠ 💥

CONNECTING THE TEST LEADS

The black and red test leads supplied with your meter are rated for 1000 volts. Use only test leads of the same rating with the meter. You can order replacement leads from your local RadioShack store. ⚠

If necessary, slide up the guard on the front of the meter. Plug the black test lead's right-angled end into **–COM** (common) on the front of the meter, then plug the red test lead's right-angled end into **+ V.mA.Ω**. If you want to measure current higher than

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⚠ WARNING ⚠

Installing a Battery

- To avoid electrical shock, disconnect all of the meter's test leads from any equipment before you install or replace the meter's battery.

- Do not use your meter until the battery is properly installed and the battery cover is in place and secured.

- Dispose of an old battery promptly and properly. Do not burn or bury it.

Connecting the Test Leads

- ALTHOUGH THE TEST LEADS ARE RATED FOR 1000 VOLTS, THE MAXIMUM RATING OF THIS METER IS 1000 VOLTS DC/750 VOLTS RMS AC. DO NOT TRY TO MEASURE VOLTAGE GREATER THAN 1000 VOLTS DC/ 750 VOLTS RMS AC.

💥 CAUTION 💥

- Use only a fresh battery of the required size and recommended type.

- If you do not plan to use the meter for a month or more, remove the battery. Batteries can leak chemicals that can destroy electronic parts.

400mA, plug the red test lead's right-angled end into **+10A MAX** instead of **+ V.mA.Ω**. ☑

USING THE STAND

The stand on the back of the meter lets you place it upright on a flat surface for easier viewing. To use the stand, simply fold it out.

USING THE RUBBER BOOT

The rubber boot supplied with the meter helps protect the meter from damage. The keyhole on the back of the rubber boot lets you hang the meter on a wall.

Simply slide the meter onto the boot, or pull down on the bottom of the boot to remove it from the meter. Use the clips on the back of the rubber boot to store the test leads while you are not using them.

USING THE METER

For the most accurate reading, the temperature should be between 65° and 83°F (18° and 28°C), with a maximum of 75% relative humidity. ✿

TURNING THE METER ON/OFF/ TESTING THE DISPLAY

To turn on the meter, rotate the function selector to any function except **OFF**. To turn off the meter, rotate the function selector to **OFF**. ☑

To test the meter's display, turn off the meter, then hold down **HOLD** while turning on the meter. The meter turns on and all segments on the display appear. Release **HOLD** to turn off the test.

BEFORE YOU START

Follow these steps to familiarize yourself with the meter's operation before you use it for the first time. ⚠ 🏭

1. Rotate the function selector to select one of the following functions, then repeatedly press **SELECT** to select the function you want.

Position	Description
°C/°F / ⎓ **V**	Displays temperature (°C or °F). Measures DC voltage.
dBm / ~ V	Measures AC voltage in dBm. Measures AC voltage in volts.
⎓ **/ µA/A**	Measures current, DC 0.4/4 mA and AC 0.4/4 mA Measures current, DC 4/10 A and AC 4/10 A
⎓ **/ mA/A**	Measures current, DC 40/400 mA and AC 40/400 mA Measures current, DC 4/10 A and AC 4/10 A
Ω /⊣⊢	Measures ohms. Measures capacitance.
•))/⊸⊢	Checks continuity. Checks diodes.
LOGIC/Hz	Measures logic (HI/LO). Measures frequency.
h$_{FE}$	Measures the gain of small-signal bipolar transistors (using the h_{FE} jack on the front of the meter).

For example, to measure a diode, rotate the function selector to •))/⊸⊢, then press **SELECT**. ⊸⊢ appears.

2. Your meter automatically enters the auto range mode when you turn on the meter. In the auto range mode, **AUTO** appears and the meter automatically selects the next higher or lower range (if available) when the measurement causes the display to overflow (the meter tries

🏭 **CAUTION** 🏭

Be sure to select the correct function before you touch the test leads to the circuit or component to be tested.

Using the Meter

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to display 4001 or more units) or underflow (the meter tries to display 379 or fewer units).

3. To select manual range mode, press **RANGE**. **AUTO** disappears. Then repeatedly press **RANGE** until the range you want appears. The decimal point shifts each time you press **RANGE**.

4. Hold down **RANGE** for about 2 seconds. The meter exits manual range mode and returns to its auto range mode.

5. To select the temperature range you want to display (°C or °F), rotate the function selector to **°C/°F / ⎓ V**, press **SELECT** once, then repeatedly press **RANGE** until **C** or **F** appears.

6. Set the meter to the different measurement ranges. The unit of measure that appears on the display shows the currently set range. For example, **mV** appears in the 400 mV range. Note the position of the decimal. If **0.000 V** appears, the meter is set to measure less than 4 volts. If **0000V** appears, the meter is set to measure up to 1000 volts.

Read the range in volts, ohms, capacitance, or amps as indicated by the position of the decimal point.

Range	Display
400 mV	ddd.d mV
4 V	d.ddd V
40 V	dd.dd V
400 V	ddd.d V
1000 V DC/750 V AC	dddd V
400 μA	ddd.d μA
4 mA	d.ddd mA
40 mA	dd.dd mA

Range	Display
400 mA	ddd.d mA
4 A	d.ddd A
10 A	dd.dd A
400 Ω	ddd.d Ω
4 kΩ	d.ddd kΩ
40 kΩ	dd.dd kΩ
400 kΩ	ddd.d kΩ
4 MΩ	d.ddd MΩ
40 MΩ	dd.dd MΩ
4 nF	d.ddd nF
40 nF	dd.dd nF
400 nF	ddd.d nF
4 μF	d.ddd μF
40 μF	dd.dd μF

7. Connect the test leads to the circuit you want to measure. To measure different circuits, see "Making Measurements" on Page 18. ✐ 🎇

HOLDING A MEASUREMENT

Press **HOLD** to hold all indications on the display. **Hold** appears and the meter holds the measured value on the display even if you remove the probes from the circuit.

To cancel hold, press **HOLD** again or set the selector to another setting or press **SELECT**. **Hold** disappears.

USING RELATIVE MEASUREMENT

You can set the meter so it does not show an unwanted value that might appear as a result of internal or other factors. For example, the meter always shows a small value when you set the selector to Ω/⊣⊢ to measure capacitance, even when you have not connected the test leads to a component. (This happens because the meter

✐ **NOTE** ✐

The display might show a phantom reading in some DC and AC voltage ranges when the test leads are not connected to a circuit. This is normal. The high input sensitivity produces a "wandering" effect. When you connect the test leads to a circuit, the measurement appears.

🎇 **CAUTION** 🎇

If **0 F** (overflow) appears, the measured value exceeds the range for the selected setting. This is normal when you measure resistance or a diode, or do not have the leads connected to a component. If you are measuring voltage or current when **0 F** appears, immediately disconnect both probes from the circuit, then touch the probes together or choose another range.

- If the value you
  measured in Step 2 is
  greater than the value
  you measured in Step 4,
  the meter shows a
  negative value. This is
  not a malfunction.

- **O F** appears if you
  measure values outside
  the meter's currently set
  range. If **O F** appears,
  immediately disconnect
  both probes from the
  circuit, then touch the
  probes together or
  choose another range.

- The meter displays val-
  ues greater than 4000
  counts as long as the
  range used is not an
  overflow range. (A count
  is the smallest unit the
  meter can measure). For
  ex-ample, if you store
  –3.500 volts as a
  reference, then measure
  +3.500 volts, the meter
  displays 7.000 volts.

- You cannot set **O F** as a
  reference value.

measures its own internal capacitance, which is
normal). If you set the meter in relative mode with
the small value as reference, it does not display this
value when you measure a component.

You can also set the meter to a baseline reference
value. For example, if you are measuring a power
source that is supposed to be exactly 5 volts AC or
DC, you can set the meter to a baseline reference
value of 5 volts. Then, the meter displays the
amount of voltage above or below 5 volts that the
power source actually emits.

1. Set the meter to any function except **°C/°F**,
   dBm, ●), ➔⊢, **LOGIC**, or **hFE**.

2. Measure the zero offset (disconnect test leads
   for capacitance, or touch the test leads to-
   gether for other functions) if you want to re-
   move the zero offset from a reading, or connect
   the test leads to the component whose mea-
   surement you want to use as a reference value.

3. While measuring the zero offset or with the test
   leads connected to a component, hold down
   REL△. **Rel △** appears. The meter is set to
   manual range mode.

4. Use the meter to make a measurement. ✒

To reset a relative measurement, press **REL△** again
or set the function selector to another setting.

AUTOMATIC POWER OFF

Your meter conserves power by automatically
turning off about 30 minutes after the last time you
changed a setting (even if you are making
measurements), unless **RS232** appears on the
display (see "Configuring/Using the Meter and
Software" on Page 29) or you disable the automatic
power off feature (see "Using Power Lock" on
Page 17).

To turn the meter back on after it automatically turns off, press any button.

USING POWER LOCK

To set the meter so it does not turn off automatically, set the function selector to **OFF** to turn it off. Hold down **HOLD** and **SELECT** at the same time, then turn on the meter. PLoc appears until you release **HOLD** and **SELECT**. The meter sets itself to its normal test mode and does not automatically turn itself off. ⬡

To reset the meter so it automatically turns itself off, turn off the meter then turn it back on. The meter automatically turns itself off after about 30 minutes.

USING MONITOR

You can use the meter to monitor maximum and minimum readings in a circuit, saving both readings for you to check.

As the meter monitors, it displays the minimum or maximum value it measured and stores those values. If the meter measures a value higher than the stored maximum value or lower than the stored minimum value, it updates the value it stored with the new value. The meter automatically sets itself to manual mode when you use it to monitor.

1. Set the meter to any function except **°C/°F**, **dBm**, ◆, ⊣⊦, **LOGIC**, or **hFE**.

2. Connect the test leads to the circuit you want to measure. To measure different circuits, see "Making Measurements" on Page 18.

3. Press **RANGE**. AUTO disappears. Then repeatedly press **RANGE** until the range you want appears.

4. Press **MAX/MIN** until max appears on the left side of the display (to set the meter to record the maximum and minimum values). Then

⬡ **NOTE** ⬡

The meter automatically sets itself to its power lock mode while you use it to monitor (see "Using Monitor").

NOTE

When the meter is set to its voltage or current function and the input is out of the setting's range, **O F** appears on the display and **Max** or **Min** flashes on the left side of the display.

⚠ WARNING ⚠

- Never clamp a test lead to a hot wire (usually red, black, or blue in AC wiring circuits). If one lead is clamped to a hot wire and you touch the meter's other probe. you could receive an electric shock.

- The maximum input limit for DC voltage measurement is 1000 V DC. To avoid electrical shock and damage to the meter, never try to measure a DC voltage above 1000 volts.

repeatedly press **MAX/MIN** to read the currently selected maximum value (if **Max** appears) or the currently selected minimum value (if **Min** appears).

5. To pause monitoring, press **HOLD**. **Hold** appears. To continue monitoring, press **HOLD** again. **Hold** disappears.

To exit the monitor mode, press **MAX/MIN** for more than 2 seconds. **Max** or **Min** disappears.

MAKING MEASUREMENTS

MEASURING DC VOLTAGE

1. Set the function selector to **°C/°F / ⎓ V**. ⚠

2. If necessary, press **SELECT** to select DC voltage measurement.

3. If the meter is set to automatic range control, the meter automatically moves to the range that gives the best reading.

4. To set manual range control, press **RANGE**. **AUTO** disappears. Repeatedly press **RANGE** to change the range.

5. Touch the probes to the circuit you want to test.

   In the 400 V and 400mV ranges, the decimal point appears in the same position (one place to the left). To distinguish between the two ranges, **mV** appears in the 400mV range and **V** appears in the 400 V range.

   When the meter is set to the 400mV range, **O F** continues to appear even if you remove an over-range input signal. This is not a malfunction. To clear the display, simply touch the test leads together or connect them to a circuit. **O F** disappears.

DISPLAYING TEMPERATURE

You can use an optional thermocouple module to measure temperature with your meter. The thermocouple module you use must output 1mV per measured °C or °F. The meter can display temperatures up to 999°C or 999° F.

1. Set the function selector to **°C/°F / ⎓ V**.

2. Unplug both test leads from the meter, plug the thermocouple's common plug into **–COM** (common) on the front of the meter, then plug the thermocouple's +V plug into **+ V.mA.Ω**

3. Press **SELECT** once to select temperature measurement.

4. To select the temperature range you want to display (°C or °F), repeatedly press **RANGE** until **C** or **F** appears.

5. Touch the thermocouple's sensor head to the object you want to test. ⚠

MEASURING AC VOLTAGE

1. Set the function selector to **dBm / ~ V**. ⚠

2. Repeatedly press **SELECT** to select the measurement unit you want to use (dBm or volts). ☑

   In dBm mode, relative measurement and monitor modes are disabled.

   In the 400 V and 400mV ranges, the decimal point appears in the same position (one place to the left). To distinguish between the two ranges, **mV** appears in the 400mV range and **V** appears in the 400 V range.

3. *If the meter is set to automatic range control*, the meter automatically moves to the range that gives the best reading.

⚠ **WARNING** ⚠

Displaying Temperature

The thermocouple module has not been evaluated by Underwriters Laboratories. Do not use the thermocouple to measure objects when the voltage is above 30 V RMS and 42.4 V peak or 60V DC.

Measuring AC Voltage

- Never clamp a test lead to a hot wire (usually red, black, or blue in AC wiring circuits). If one lead is clamped to a hot wire and you touch the meter's other probe, you could receive an electric shock.

- The maximum input limit for AC voltage measurement is 750 V AC (RMS). To avoid electrical shock and damage to the meter, never try to measure an AC voltage above 750 volts RMS.

☑ **NOTE** ☑

0 dBm is equal to the consumption power on a 600-ohm resistor with 0.775V voltage drop.

⚠ WARNING ⚠

Measuring AC Voltage Riding on a DC Source Bias

To avoid injury or damage to your meter, never try to measure an AC voltage that is riding on a DC source bias where the peak AC voltage exceeds 1000 V with respect to earth ground.

Measuring Three-Phase AC Voltage

This voltage exceeds the meter's rating. Therefore, you should not connect the meter to this circuit or to any equipment connected to the circuit. Doing so could present a dangerous shock hazard to you, and could also damage the meter.

Measuring DC/AC Current

Do not apply voltage directly across terminals. You must connect the meter in series with the circuit.

☠ CAUTION ☠

Measuring DC/AC Current

• Never connect the test leads across a voltage source. Doing so can damage the meter or the circuit under test. The maximum input limit for AC/DC current measurement is 10A.

(continued)

To set manual range control, press **RANGE** then change the range (if necessary) by repeatedly pressing **RANGE**.

4. Touch the probes to the circuit you want to test.

MEASURING AC VOLTAGE RIDING ON A DC SOURCE BIAS

To measure AC voltage superimposed on a DC voltage source bias while ignoring the DC voltage, follow the steps for measuring AC voltage under "Measuring AC Voltage" on Page 19. ⚠

MEASURING THREE-PHASE AC VOLTAGE

Your multimeter is designed primarily to measure household AC voltages. If you want to measure 3-phase, line-to-line voltage, please note the following:

• Because of the dangers inherent in measuring three-phase circuit, we strongly recommend you do not use this meter for such applications.

• The actual voltage can be greater than the circuit's rated line-to-ground voltage.

Most 3-phase power circuits are rated by their line-to-line voltage. This voltage is higher than the line (or phase) to ground voltage. To determine if a line-to-line 3-phase voltage exceeds the rating of this meter, multiply the rated line-to-ground voltage by 1.732 (the square root of 3). For example, if the rated line-to-ground voltage is 640 volts, the line-to-line voltage is $640 \times 1.732 = 1108$ V AC. ⚠

MEASURING DC/AC CURRENT

To measure AC or DC current, you must break the circuit and connect the test leads to two circuit connection points. The connection must be in series with the circuit under test. ⚠ ☠

1. Rotate the function selector to ⏚ / **µA/A** for 0.4/4mA and 4/10A ranges or ⏚ / **mA/A** for 40/400mA and 4/10A ranges.

2. Press **SELECT** once to set the meter to measure AC current (∼ appears). Otherwise, repeatedly press **SELECT** to set the meter to measure DC current (∼ disappears).

3. Remove the power from the circuit under test and discharge all capacitors.

4. Plug the black test lead into **–COM** and the red test lead into the appropriate jack.

5. Connect the meter's test leads in series with the circuit.

6. Apply power and read the current value. If the measurement is less than 400mA and the red test lead is connected to **+10A MAX**, remove power from the circuit.

   If your measurement exceeds the selected range, **0 F** appears until the measured voltage or current is reduced to a value below the selected range.

7. Move the red test lead to **+ V.mA.Ω**

8. Rotate the function selector to ⎓ **/ µA/A** or ⎓ **/ mA/A** depending on the value you measured in Step 6.

9. Reapply power to the circuit.

If you are measuring DC current and the current's polarity is negative, **–** appears before the value.

MEASURING RESISTANCE

The resistance measuring circuit in your meter compares the voltage gained through a known resistance (internal) with the voltage developed across an unknown resistance. ⚠ ☄

1. Remove all power from the circuit under test and discharge all capacitors.

☄ **CAUTION** ☄

Measuring DC/AC Current
(continued)

• If you do not know the amount of current in the circuit you are measuring, always connect the red test lead to **+10A MAX**.

Measuring Resistance
Your meter has a circuit to protect the resistance range from over-voltage. However, to avoid accidentally exceeding the protection circuit's rating and to ensure a correct measurement, never connect the test leads to a source of voltage while the function selector is set to Ω/⊣⊢.

⚠ **WARNING** ⚠

Be sure the circuit under test has all power removed and any associated capacitors are fully discharged before you make a resistance measurement.

Measuring Resistance

- With no resistance connected across the test leads (meaning resistance is infinite), **O F** appears when you set the meter to measure resistance. This is normal.

- If you are measuring resistance of about 1MΩ or more, the display might take a few seconds to stabilize. This is normal.

2. Rotate the function selector to **Ω/┤├**.

3. If necessary, press **SELECT** until **Ω, KΩ**, or **MΩ** appears to set the meter to measure resistance. ☑

4. Touch the test leads across the resistor you want to measure, or remove one of the leads of the component you want to measure from its circuit and touch the test leads across the resistor. If the meter is set to automatic range control, it automatically moves to the proper range.

If you set the meter to use manual range, repeatedly press **RANGE** to set manual-range control and change the range (if necessary). ☑

As with the voltage range, use the measuring units that appear on the display to determine the current resistance range. If only **Ω** appears, the values of the measurements are in ohms. If **K** and **Ω** appear, the meter is measuring kilohms (1 kilohm = 1000Ω). If **m** and **Ω** appear, the meter is measuring megohms (1 megohm = 1,000,000 Ω).

If you want to accurately measure a very small resistance, you can view the resistance of the meter's test leads, then subtract that resistance from the measured value. To measure the resistance of the test leads, simply touch the ends of the leads together. The meter selects the 400Ω scale and displays the resistance of the test leads. You can also use the meter's relative function to do this (see "Using Relative Measurement" on Page 15).

MEASURING CAPACITANCE

The capacitance measuring circuit in your meter charges a connected capacitor to a specific voltage level, then discharges the capacitor to a lower voltage. The meter measures the amount of time takes to discharge the capacitor. ✹

Capacitance measurement accuracy depends on the measurement method and differs with different types of capacitors. The meter's measurement is for reference only.

1. Remove all power from the circuit under test and discharge all capacitors.

2. Rotate the function selector to Ω/Ⱶ.

3. Set the meter to measure capacitance by pressing **SELECT**. **nF** or **μF** appears. Then repeatedly press **RANGE** if necessary to manually select the range you want.

4. Attach the red test lead to the positive side of the capacitor and attach the black test lead to the negative side of the capacitor. Or, remove one of the leads of the capacitor you want to measure from its circuit and connect the test leads to the capacitor's matching (positive or negative) terminals. The measured value appears. ▯

CHECKING CONTINUITY

You can use the meter to check for shorted or open electrical circuits. ✹

1. Remove all power from the circuit under test and discharge all capacitors.

2. Rotate the function selector to •))/-Ᵽ.

3. To select the continuity function, press **SELECT** until •)) appears at the top of the display.

Making Measurements

✹ CAUTION ✹

Measuring Capacitance
Do not connect the test leads to a source of voltage with the function selector set to Ω/Ⱶ. This could damage the meter or the circuit being tested.

Checking Continuity
Do not connect the test leads to a source of voltage with the selector set to •))/-Ᵽ. This could damage the meter or circuit being tested.

▯ NOTE ▯

• The voltage applied across electrolytic capacitors affects their measured values. That is, a measurement taken with a low voltage will be lower than one taken with a voltage near the capacitor's voltage rating. Since this meter cannot use high voltage to set the electrolyte, it cannot measure the absolute value of capacitance.

• Low-value capacitors might match or be close to the meter's actual input capacitance. To measure low capacitance values, use the meter's relative feature to adjust the meter for *(continued)*

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4. Touch the test leads across the circuit you want to measure. **Shrt** appears and the buzzer sounds if the circuit resistance is less than about 50 ohms (meaning the circuit is continuous or shorted). **Open** appears and the meter's buzzer does not sound if the circuit resistance is greater than about 50 ohms (meaning the circuit is not continuous).

CHECKING DIODES

This procedure lets you check diodes, transistors, and other semiconductors for opens, shorts, and normal operation. It also lets you determine the forward voltage and polarity for diodes. (This is handy when you need to match a diode.) You can also check LEDs using this procedure. ☢ �

You can also use the meter's *h*FE feature to quickly measure the gain of small-signal, bipolar transistors. See "Measuring *h*FE" on Page 27 for more information.

1. Remove all power from the circuit under test and discharge all capacitors.

2. Rotate the function selector to ·》/-▷⊦.

3. To select the diode function, press **SELECT** once. -▷⊦appears on the display.

4. Connect the test leads to the device you want to check, or remove one of the leads of the component you want to measure from its circuit and connect the test leads to the component. Note the first reading.

5. Reverse the test leads and note the second reading.

If one reading shows a value and the other is overrange (**0 F** appears) the device is good. If **0 F** appears during both readings, the device is open. If both values are very small or zero, the device is shorted.

☝ NOTE ☝

(continued)

its own capacitance (see "Using Relative Measurement" on Page 15).

Checking Diodes

- When you test a silicon-type semiconductor, the values might vary depending on the temperature.

- The values that appear during a diode check show the actual forward voltage (2.0V max). If the voltage exceeds 2.0V, **0 F** appears. The meter cannot check this diode.

☢ CAUTION ☢

Do not connect the test leads to a source of voltage with the function selector set to ·》/-▷⊦. This could damage the meter or the circuit being tested.

CHECKING DIODE POLARITY

Many diodes have a stripe or mark on one side. The marked side of the diode indicates the diode's cathode or negative (–) side. The other side is the anode or positive (+) side.

If a diode is not marked, you can use your meter to check the diode's polarity. As you follow the steps under "Checking Diodes" on Page 24, connect the red test lead to one side, connect the black test lead to the other side, then measure and note the voltage. Then reverse the test leads and measure and note the second reading. The side of the diode where the meter shows a higher voltage using the red test lead is the anode (+) side. The side of the diode where the meter shows **OF** using the red test lead is the cathode (–) side.

MEASURING LOGIC

1. Rotate the function selector to **LOGIC/Hz**. ⚡

2. To select the logic function, press **SELECT** once. **LO** appears.

3. Connect the test leads to the device you want to check. **LO** appears if the logic is low (the voltage is lower than 1.0V). **Hi** appears if the logic is high (the voltage is higher than 2.0V) The actual voltage appears if the logic is between 1 and 2 V.

MEASURING FREQUENCY/ DUTY CYCLE/PULSE WIDTH

The meter can measure frequency from 10 Hz to 4 MHz and duty cycle and pulse width with a signal frequency from 10 Hz to 100 kHz. The amplitude of a signal is not larger than 10V peak.

1. Rotate the function selector to **LOGIC/Hz**.

2. To select the frequency function, press **SELECT** until **Hz**, **KHz**, or **MHz** appears.

⚡ CAUTION ⚡

Measuring Logic
Do not apply more than 5 VDC between terminals. This could damage the meter or the circuit being tested.

Otherwise, to select the duty cycle or pulse width function, repeatedly press **Hz/DUTY/WIDTH** until ‰ appears (to select duty cycle) or until **µS** or **mS** appears (to select pulse width)

3. If you are measuring frequency, press **RANGE** if necessary to select manual range then repeatedly press **RANGE** until the range you want appears.

4. Connect the black test probe to a ground reference for the signal, and connect the red test probe to the signal source.

MEASURING AC VOLTAGE FREQUENCY

The meter can measure the frequency of an AC voltage, with or without a DC source bias. ⚠ ⅄

1. If you are measuring AC voltage with a DC source bias, set the function selector to **dBm / ~ V**. Otherwise, set the function selector to **°C/°F / ⎓ V**.

2. To select the frequency function, repeatedly press **Hz/DUTY/WIDTH** until **Hz**, **kHz**, or **MHz** appears.

3. If necessary, press **RANGE** to select manual range, then repeatedly press **RANGE** until the desired range appears.

4. To select the duty cycle or pulse width function, repeatedly press **Hz/DUTY/WIDTH** until ‰ appears (to select duty cycle) or until **µS** or **mS** appears (to select pulse width).

5. If ‰, **µS**, or **mS** appears and you want to select the frequency function again, repeatedly press **Hz/DUTY/WIDTH** until **Hz**, **kHz**, or **MHz** appears.

6. Connect the test leads to the device you want to check.

⚠ **WARNING** ⚠

To avoid electrical shock and damage to the meter, never try to measure a frequency of more than 1 kHz between AC 40 volts RMS and 750 volts RMS.

⅄ **NOTE** ⅄

- If the function selector is set to **dBm / ~ V** and you want to set the meter for maximum sensitivity when measuring a new signal, press **SELECT** to select the ACV function then press **Hz/DUTY/WIDTH** to select the frequency function.

- To change back to ACV measurement, press **SELECT** once then repeatedly press **SELECT** to select the ACV display mode (dBm or volts).

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MEASURING AC CURRENT FREQUENCY

1. Rotate the function selector to ⏛ **/ μA/A** for 0.4/4mA and 4/10A ranges or ⏛ **/ mA/A** for 40/400mA and 4/10A ranges. ☐

2. To select the frequency function, press **Hz/DUTY/WIDTH** once.

3. If necessary, press **RANGE** to select the manual range, then repeatedly press **RANGE** until the desired range appears.

4. To select the duty cycle or pulse width function, repeatedly press **Hz/DUTY/WIDTH** until **%** appears (to select duty cycle) or until **μS** or **mS** appears (to select pulse width).

5. If **%**, **μS**, or **mS** appears and you want to select the frequency function again, repeatedly press **Hz/DUTY/WIDTH** until **Hz**, **kHz**, or **MHz** appears.

6. Connect the test leads to the device you want to check in series.

MEASURING hFE

You can use the meter to measure the DC gain of small-signal, bipolar transistors in the hFE range of 1000. ☒

1. Set the function selector to **hFE**.

2. Unplug both test leads from the meter, then slide down the guard on the front of the meter.

3. Insert the transistor you want to check into the hFE socket on the front of the meter, matching the pinout of the transistor with the labels on the socket. The transistor's value appears.

☐ NOTE ☐

- If the meter is set to measure current, it cannot measure the frequency of a signal with DC bias.

- Press **SELECT** twice to set the meter back to the AC A measurement function.

☒ CAUTION ☒

To avoid damaging the meter, do not try to check a transistor if you do not know its type and pinout.

USING THE METER WITH A COMPUTER

You can connect your meter to a computer, letting you conveniently monitor and record and log data over a long period of time. You can even use your meter to display oscilloscope information on your computer! For example, you can record changes in temperature in a refrigerator or voltage changes in a circuit over a long period of time.

Use the supplied RS-232 cable to connect the meter to your computer and the supplied software to display information recorded by the meter on your computer.

INSTALLING THE METER'S SOFTWARE/ HARDWARE

To use your meter with your computer, you must install the supplied Meter View software on your computer, then connect the meter to the computer.

The Meter View software includes installation files and a Help Guide. This guide provides more detailed information about the Meter View software's features. You can read the guide while Meter View is running, or print a copy directly to your printer. To read the guide, click **Start**, **Programs**, **Meter View**, then select **Help**.

Follow these steps to install the Meter View software on your computer. ☑

1. Turn on your computer and start the installed Windows operating system (Windows 95, Windows 98, Windows ME, Windows 2000, or Windows XP).

2. Insert the software CD into your CD-ROM drive. The CD starts automatically.

☑ **NOTE** ☑

- If the CD does not start automatically, make sure the CD-ROM drive's door is completely shut. If the CD still does not start, the auto run option on your computer might be turned off. If this happens, click *My Computer*. The window shows the available drives on your computer. Then double-click the icon for your CD-ROM drive and double-click **setup.exe**. The CD starts.

- The supplied cable fits only one way. Do not force it.

3. After you finish installing the software, restart your computer.

4. Connect one end of the supplied RS-232 cable to the jack on top of the meter, then connect the other end to your computer's serial port.

CONFIGURING/USING THE METER AND SOFTWARE

You must configure your meter to work with the Meter View software and the software to work with your meter.

1. Make sure the meter is connected to your computer (see "Installing the Meter's Software/Hardware" on Page 28).

2. On your computer, click **Start**, **Programs**, then **Meter View.** The Meter View software starts.

3. On your meter, rotate the function selector to any function except **OFF**. Then hold down **SELECT** and **RANGE** together. `RS232` appears on the meter's display.

4. On your computer, select the COM port where you connected the meter by pulling down **Option** then **COM Port** then clicking **COM1**, **COM2**, **COM3**, or **COM4**.

5. On your computer, set up the meter to work with your computer by clicking the 🖥 icon or pulling down **Run** then clicking **Start.** Data is transmitted from your meter to your computer. The display you see on the meter also appears on your computer. ✓

6. Follow the steps listed in the Meter View software's Help Guide to configure and use the software with the meter.

✓ **NOTE** ✓

• If you select the wrong COM port, an error message appears. Repeat Step 4 to select the correct COM port.The supplied cable fits only one way. Do not force it.

• The Meter View software stops communicating with the meter if the connection between the meter and the computer fails. If this happens, check the connection between the meter and the computer and make sure `RS232` still appears on the meter's display. Then repeat Step 5 in this section.

CARE AND MAINTENANCE

Keep the meter dry; if it gets wet, wipe it dry immediately. Use and store the meter only in normal temperature environments. Handle the meter carefully; do not drop it.

CLEANING

To keep the meter looking new, occasionally wipe it with a cloth slightly dampened with water. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the meter. ⚠

REPLACING THE FUSES

If the meter does not work, you might need to replace one or both of the fuses with the spare fuses we have included with your meter. The spare fuses are inserted in a plastic holder inside the meter's cabinet near the RS-232 connector on top of the meter.

The meter contains a 500mA, 250V ceramic fuse (Littelfuse 314.500) and a 12A, 250V ceramic fuse (Littelfuse 314012). 💥

If the meter is on, rotate the function selector to **OFF** to turn it off. Then disconnect the test leads if they are connected.

1. Use a Phillips screwdriver to loosen the battery cover's screw, then lift off the battery cover.

2. Remove the battery.

3. Use a Phillips screwdriver to loosen the screws from the back cover and gently pull apart the case. ⚠

4. To remove the fuse, gently pull the red ribbon holding it. The fuse pops out.

5. If the fuse is blown, discard it and save the ribbon. Then remove the spare fuse from the

plastic holder and insert it into the fuse holder through the loop of the attached ribbon.

6. Replace the back cover and secure it with the screws.

7. Reinstall the battery (see "Installing a Battery" on Page 11), then replace the battery cover and secure it with the screw.