

- 3-3/4 Digits
- Analog Bargraph
- Multimeter
- Capacitance Meter
- Frequency Counter
- Temperature Meter
- Diode Tester
- Continuity Tester

INSTRUCTION MANUAL MODEL 390

TEST BENCH®
Hand-held Multifunction Instrument
This Manual Effective with
Serial No. 252-00001



BK PRECISION®
6470 W. Cortland Street
Chicago, IL 60635

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Printed in Taiwan

480-720-9-001B

- 3-3/4 digit LCD display with functional annunciators.
- Analog Bar graph
- Basic accuracy: DCV ± 0.1%.
- Resolution of 100 μV, 1 μA, 0.1 Ω, 1 pF.
- Autoranging.
- Auto power off prolongs battery life.
- Five dc voltage ranges: 400 mV to 1000 V.
- Five ac voltage ranges: 400 mV to 750 V.
- Four dc current ranges: 4 mA to 20 A.
- Four ac current ranges: 4 mA to 20 A.
- Six resistance ranges: 400 Ω to 40 MΩ.
- Five capacitance ranges 4 nF to 40 μF.
- Five frequency ranges 100 Hz to 500 kHz.
- Temperature measurements °F, °C.
- Diode test function: measures forward voltage drop.
- Audible continuity tester.
- Audible warning buzzer if probe inserted into wrong jack.
- Data hold function freezes value on display.
- Max/Min reading recorder.
- Relative mode measurements
- Auto polarity, auto zero.
- Overrange indication on all ranges.
- Fused mA range.
- Fused 20 A range.
- Safety type test leads.
- Shock resistant case in holster withstands 10-foot drop.

Specifications apply from +18°C to +28°C at relative humidity up to 75% unless otherwise noted.

DC VOLTS Auto/Manual ranging.

Range	Resolution	Accuracy	Overvoltage Protection	Input Impedance
400 mV	100 μV	± (0.1% rdg + 2 dgt)	1100 VDC or peak AC	1000 MΩ
4V	1 mV			11 MΩ
40 V	10 mV			10 MΩ
400 V	100 mV			
1000 V	1 V			

AC VOLTS Auto/Manual ranging. Average sensing, RMS Indicating

Range	Resolution	Accuracy (50 Hz to 500 Hz)	Accuracy (500 Hz to 1 kHz)	Overvoltage Protection
400 mV	100 μV	± (0.8% rdg + 5 dgt)*	Unspecified	1100 VDC or peak AC
4 V	1 mV	± (0.8% rdg + 3 dgt)	± (1.5% rdg + 5 dgt)	
40 V	10 mV		± (1.2% rdg + 5 dgt)	
400 V	100 mV		± (1.5% rdg + 5 dgt)	
750 V	1 V			

Input Impedance Same as DCV/less than 100 pF

*Frequency response for 400 mV range is 50-100 Hz

DC CURRENT Manual ranging.

Range	Resolution	Accuracy	Burden Voltage
4 mA	1 μA	± (0.8% rdg + 2 dgt)	500 mV max.
40 mA	10 μA		900 mV max.
400 mA	100 μA		
20 A	10 mA	± (1.2% rdg + 4 dgt)	500 mV max.

Overload Protection 0.5 A (600 V) fast blow ceramic fuse on mA input
20 A (600 V) fast blow ceramic fuse on 20 A input.

20 A Range Maximum Current 10 A continuous
20 A for 30 sec. max.

AC CURRENT Manual ranging. Average sensing, RMS Indicating.

Range	Resolution	Accuracy (50 Hz to 1 kHz)	Burden Voltage
4 mA	1 μA	± (1.2% rdg + 4 dgt)	500 mV rms max.
40 mA	10 μA		900 mV max.
400 mA	100 μA		
20 A	10 mA	± (1.5% rdg + 5 dgt)	500 mV rms max.

Overload Protection 0.5 A (600 V) fast blow ceramic fuse on mA input
20 A (600 V) fast blow ceramic fuse on 20 A input.

20 A Range Maximum Current 10 A continuous
20 A for 30 sec. max.

SPECIFICATIONS

RESISTANCE Auto/Manual ranging.

Range	Resolution	Accuracy	Max Open Circuit Voltage
400 Ω	0.1 Ω	± (0.5% rdg + 4 dgt)	0.4 V
4 kΩ	1 Ω	± (0.4% rdg + 2 dgt)	
40 kΩ	10 Ω		
400 kΩ	100 Ω		
4 MΩ	1 kΩ	± (0.7% rdg + 4 dgt)	
40 MΩ	10 kΩ	± (1.5% rdg + 4 dgt)	

Overload Protection 500 VDC or peak AC

FREQUENCY COUNTER Auto ranging.

Range	Resolution	Accuracy	Sensitivity (sine wave)
100 Hz	0.01 Hz	± (0.2% rdg + 10 dgt)	40 mV
1 kHz	0.1 Hz	± (0.1% rdg + 6 dgt)	
10 kHz	1 Hz		
100 kHz	10 Hz		400 mV
500 kHz	100 Hz	± (0.2% rdg + 20 dgt)	

Overvoltage Protection 500 V DC or peak AC

TEMPERATURE Auto/Manual Ranging

Range	Resolution	Accuracy
-50°C to 400°C	0.1°C	± (0.8% rdg + 2°C)
400°C to 1300°C	1°C	± (1.0% rdg + 2°C)
-58°F to 400°F	0.1°F	± (0.8% rdg + 4°F)
400°F to 2372°F	1°F	± (1.0% rdg + 4°F)

Overload Protection 60 VDC or 24 VAC rms

SAFETY

WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a fatal current under certain conditions. Higher voltages are even more dangerous. Observe the following precautions.

- Do not exceed the following input ratings. Personal injury or damage to the instrument may result.

DC VOLTS	1100 V (dc or peak ac)
AC VOLTS	1100 V (dc or peak ac)
OHMS	500 V (dc or peak ac)
mA	500 mA (fuse protected)
20 A	20 A (fuse protected)
COM	Do not float more than 500 volts from earth ground.
LOGIC	500 V (dc or peak ac)
- Remove test leads before replacing batteries or fuses, and before performing any servicing on the multimeter.
- Use only the safety type test leads supplied with the multimeter.
- Turn off equipment while making test connections in high voltage circuits. Discharge high-voltage capacitors after removing power.
- For voltage or current measurements in high voltage equipment, do not touch equipment, meter or test leads while power is applied.
- If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
- Use an insulated floor material or floor mat to stand on, and an insulated work bench surface; make certain such surfaces are not damp or wet.



- Keep "one hand in the pocket" while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
- When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
- Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result. To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B+K Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
- When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
- Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardiopulmonary resuscitation) first aid is highly recommended.

WARNING

Remove test leads before changing battery or fuse or performing any servicing.

BATTERY REPLACEMENT

A low battery is indicated when the  symbol in the upper right hand corner is on. The low battery indication first appears when the battery is about 90% depleted. The meter may be operated a few more hours but the battery should be replaced soon thereafter.

- Remove rubber holster.
- Remove two screws from back of unit securing the tilt stand.
- Remove tilt stand.
- Remove two screws securing case back, then carefully lift back off to gain access to battery. Remove and save the battery insulator.
- Replace the dead battery with a fresh 9 volt "transistor" battery. Replace the battery insulator. Use alkaline batteries such as the NEDA 1604 or equivalent for longer life. To prolong battery life set the **Function/Range** switch to the OFF position when not making measurements.
- Reinstall back cover, tilt stand and holster.

FUSE REPLACEMENT

If no current measurements are possible, check for a blown overload protection fuse. Two fuses are used: F1 for the mA input and F2 for the 20 A input. A quick check for a blown 20A fuse can be performed by inserting the probe into the 20A jack and setting the function switch to any other position except 20A or OFF. If no warning tone is heard the fuse is probably blown. This procedure can be used for the mA jack fuse by inserting the probe in the mA jack and setting the function switch to any position other than the OFF or one of the mA positions. Replace F1 only with the original type 0.5 A, 600 V, fast blow ceramic fuse (**B+K Precision** Part No. 194-045-9-001). Replace F2 only with the original type 20 A, 600 V, fast blow ceramic fuse (**B+K Precision** Part No. 194-043-9-001).

TEST LEADS

Use only safety type leads, like those supplied. Periodically examine the test leads to ensure that the conductors are not intermittent or broken. Also make sure that good contact pressure exists at the test receptacles and fuseholder, and keep these areas free from dirt and corrosion.

DIODE CHECK

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
4.0 V	1 mV	± (1.0% rdg + 1.0 dgt)	0.6 mA	3.2 VDC

Overload Protection 500 V DC or peak AC

CONTINUITY TEST

Range	Response Time	Description	Open Circuit Voltage
400 Ω	Approx. 100 ms	Buzzer sounds below approx. 40 W	0.4 VDC

Overload Protection 500 V DC or peak AC

CAPACITANCE Auto/Manual Ranging

Range	Resolution	Accuracy*
4 nF	1 pF	± (2.0% rdg + 20 dgt)
40 nF	10 pF	
400 nF	100 pF	± (2.0% rdg + 4 dgt)
4 μF	1 nF	
40 μF	10 nF	± (2.0% rdg + 4 dgt at <20 μF)
		± (5.0% rdg + 4 dgt at >20 μF)

Overload Protection 500 V DC or peak AC

*Accuracy using relative mode to zero meter.

GENERAL SPECIFICATIONS

Display: 3-3/4 digit liquid crystal display (LCD) with a maximum reading of 3999, 9999 for frequency.

Analog Bar Graph: 42 segments with measurements 20 times per second.

Polarity: Automatic (-) negative polarity indication.

Overrange Indication: "4" flashing.

Low Battery Indication:  displayed.

Sampling rate: 2 measurements per second, nominal, 1 time per second for capacitance and frequency measurements.

Temperature.

Full Operation 0 to +50°C <70% R.H.

Storage -20°C to 60°C at <80% R.H.

Power: 9V (NEDA 1604).

Battery life: 500 hours typical (alkaline).

Auto Power off: Meter automatically shuts down after approx. 30 minutes of inactivity.

Dimensions (H x W x D): 1.5" x 3.4" x 7.5" (37 mm x 87 mm x 189 mm). with Holster 2" x 3.8" x 7.9" (52 mm x 96 mm x 200 mm)

Weight: 12.4 oz. (352 g) including battery. with Holster 17.3 oz. (490 g)

Supplied Accessories: Test leads (pair), temperature probe, battery, instruction manual, protective holster.

WARRANTY

LIMITED THREE-YEAR WARRANTY

MAXTEC INTERNATIONAL CORPORATION warrants to the original purchaser that its **B+K Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from the date of purchase.

MAXTEC will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B+K Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to MAXTEC, **B+K Precision**, 6470 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

MAXTEC shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B+K Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B+K Precision Service Department**, 6470 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

B+K Precision Test Instruments warrants products sold only in the U.S.A. and its overseas territories. In other countries, each distributor warrants the **B+K Precision** products which it sells.

TILT STAND AND HANGER

The tilt stand and hanger are located on the back of the case. The tilt stand, Figure 1, can be used to position the unit at approximately a 45 degree angle of the bench top. The hanger clip can be used to support the meter on top of a panel as shown in Figure 2 or to suspend the meter from a wire, strap or screw as shown in Figure 3.

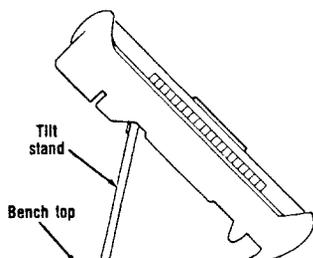


Figure 1.

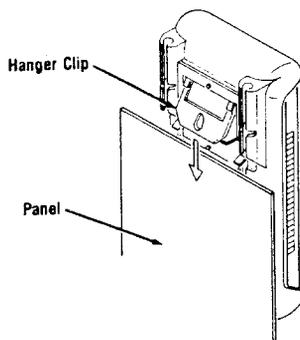


Figure 2.

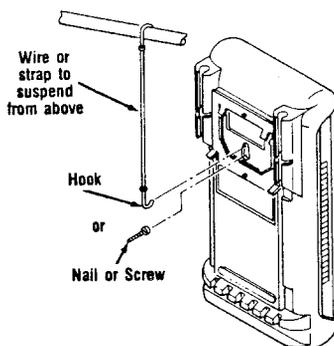


Figure 3.

PROBE HOLDER

The holster used to protect the meter and store test leads can also be used to hold the test lead in an ideal position for one-handed troubleshooting as shown in Figure 4.

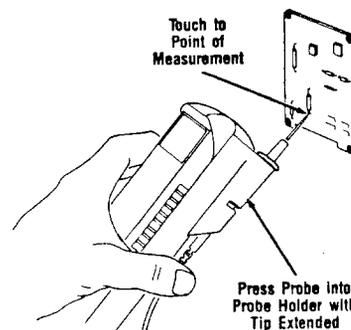


Figure 4.

CURRENT MEASUREMENTS

WARNING

For current measurements, the meter must be connected in series with the load. If incorrectly connected in parallel with the load, the meter presents a very low impedance (almost a short), which may blow the fuse or damage the equipment under test.

NOTE

A warning tone will be heard if the test lead is connected to mA input jack while the knob is not set to mA range. A warning tone will also be heard if the test lead is connected to 20 A input jack while the knob is not set to 20 A range.

1. To measure dc current, set the function switch to the desired A $\overline{\text{---}}$ range.
2. To measure ac current, set the function switch to the desired A-range.
3. For current measurements under 400 mA, connect the red test lead to the mA jack and the black test lead to the COM jack.
4. For current measurements above 400 mA, connect the red test lead to the 20 A jack and the black test lead to the COM jack (set the Function/Range switch to the 20A position). For current measurements greater than 3 A, high current test leads are recommended.
5. Remove power from the circuit under test and open the normal circuit path where the measurement is to be taken. Connect the meter in series with the circuit.
6. Apply power and read the value from the display.

MAX/MIN HOLD MODE

1. MAX/MIN mode will store and display the maximum or minimum values measured by the meter.

2. Select the desired function (MAX/MIN is not operational in "Hz" function).
3. Connect the meter to the point to be measured.
4. To observe the minimum value recorded, momentarily depress the MAX/MIN button. The "MIN" annunciator will be displayed along with the minimum recorded reading. The meter will record and hold any new minimum that occurs during the measurement.
5. To observe the maximum value recorded, momentarily depress the MAX/MIN button again. The "MAX" annunciator will be displayed along with the maximum recorded reading. The meter will record and hold any new maximum that occurs during the measurement.

DATA HOLD

Data hold can be used when making voltage, current, or frequency measurements. When switched to the ON position the display will freeze. The test leads can then be disconnected without affecting the data display.

RESET

Clears all stored reading and resets the meter.

STORE AND RECALL

Memory can be used to store any single reading. When MEM is pressed the memory annunciator comes on, the present reading is stored in memory and can be recalled at any time by pressing READ.

RELATIVE

When the REL Δ button is pressed the present reading become the zero reading and all subsequent readings are displayed relative to this value. This function is cleared by pressing the RESET button which returns the meter to normal operation.

LEAD STORAGE

The holster provides a means of storing the test leads when not in use. Refer to Figure 5 and proceed as follows:

1. Press the probe end of the test leads into the storage slots with the end of the probes pointing toward the top of the unit.
2. Press the leads into the lead slots to prevent the leads from unwrapping.
3. Wrap both test leads together in the storage channel near the bottom of the holster leaving about a foot of test lead.
4. Turn the unit over, then plug the end of the test leads into the COM and Cx \rightarrow Ω Hz connectors on the front of the unit.

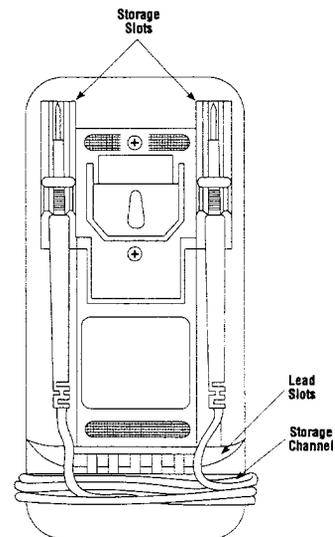


Figure 5.

SYMBOLS

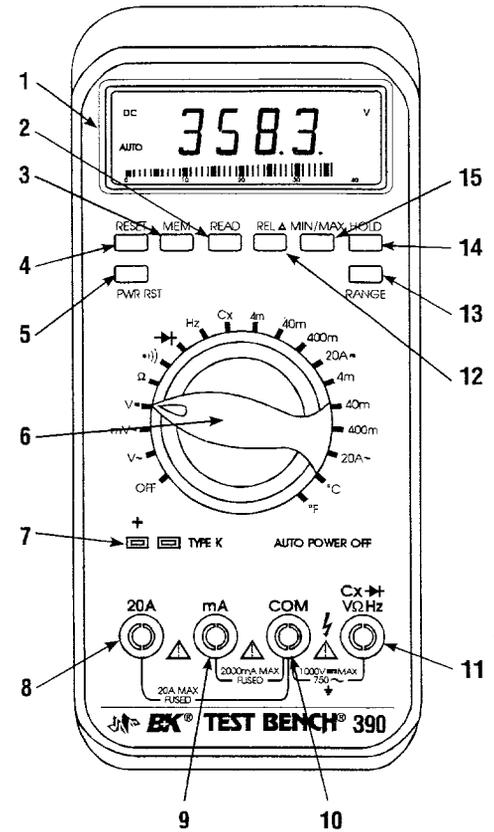
-  See instruction manual for further precautionary information.
-  High voltage terminal; up to 1000 volts may be present if connected to high voltage.
- COM Common input terminal.
-  Diode test.
-  Connect to earth ground or point not more than 500 volts from earth ground.
- 1100 V MAX Maximum input rating of V-Ω terminal with respect to COM input terminal.
-  Continuity test.
-  ACV.
-  DCV.
-  ACA.
-  DCA.

OPTIONAL ACCESSORIES

- Sheathed Temperature Probe for Immersion and General Purpose Model TP-1
- Sheathed Temperature Probe for Air and Gas Model TP-2
- Replacement Test Leads Model TL-1
- Deluxe Test Leads Model TL-2
- Accessory Tips for Deluxe Test Leads Model TL-3
- High Current Test Leads Model FP-10
- Demodulator Probe Model PR-23
- High Voltage Probe (40 kVDC) Model PR-28
- High Voltage Probe (6 kVDC) Model HV-6

CONTROLS AND INDICATORS

1. **Display.** 3-3/4 digit (3999 maximum) with automatic decimal point, analog bar graph, low battery and full annunciators for function and unit of measurement.
2. **READ.** Latches the HOLD mode and displays reading stored in memory.
3. **MEM.** Stores present reading in memory.
4. **RESET.** Resets all meter functions.
5. **PWR RST.** Restores power after auto power shutoff.
6. **Function/Range Switch.** Selects function for autoranging modes and function and range for manual ranging modes: ~V, ~mV, ~V, Ω, ~)) (continuity), ~)~ (diode test), Hz, Cx, ~ 4mA, 40 mA, 400 mA, 20 A, ~4 mA, 40 mA, 400 mA and 20 A °C, °F.
7. **Type K Receptacle.** Input for type K thermocouple probe.
8. **20 A Jack.** Input for up to 20 A dc or ac current range. For measurements greater than 3 A high current test leads are recommended.
9. **mA Jack.** Input for dc or ac current up to 400 mA.
10. **COM Jack.** Input for common or reference test lead for all measurements. Connect to earth ground or reference point not more than 500 V MAX (dc + ac peak) from earth ground.
11. **Cx ~)~ VΩHz.** Input for dc and ac voltage, resistance, frequency, continuity, capacitance or diode test.
12. **REL Δ Switch.** Sets present reading as the zero reference.
13. **RANGE Switch.** Select manual ranging mode or changes ranges.
14. **HOLD Switch.** Activates data hold feature.
15. **MIN/MAX switch.** Activates maximum and minimum record feature.



OPERATING INSTRUCTIONS

RANGE SELECTION

1. Autoranging mode is automatically selected when unit is tuned on.
2. To change ranges manually, momentarily depress RANGE button. "MANU" annunciator on display indicates that the meter is in the manual ranging mode. Press again to advance to next higher range.
3. To return to autoranging mode, depress and hold RANGE button for one second or longer.
4. If quantity to be measured is unknown start with highest range, or use autoranging mode.
5. When an overrange is indicated (4 flashes and a beep signal) switch to the next highest range.

CAUTION

Do not switch between ranges while connected to high voltage.

AUTO POWER OFF

1. The meter will automatically shut off if the Function/Range switch position is not changed within 30 minutes.
2. To restore operation, press PWR RST button.

NOTE ON ANALOG BARGRAPH

The analog bargraph feature is activated for measurements of voltage, current, resistance, frequency, and capacitance. Its update speed of 20 measurements/sec is 10 times that of the digital display. This makes it suitable for measuring coarse adjustments of these parameters, or indicating the direction of change of a varying quantity.

VOLTAGE MEASUREMENTS

1. To measure dc voltage, set function switch to V~.
2. To measure ac voltage, set function switch to V~ or mV~.

3. Connect red test lead to Cx ~)~ VΩ Hz jack and black test lead to COM jack.
4. Connect test leads to points of measurement.
5. For dc, a (-) sign is displayed for negative polarity; (+) positive polarity is implied.

RESISTANCE MEASUREMENTS

1. Set the function switch to Ω.
2. Remove power from equipment under test.
3. Connect red test lead to Cx ~)~ VΩ Hz jack and the black test lead to the COM jack. Red lead is (+) polarity.
4. Connect test leads to the points of measurement.

CONTINUITY MEASUREMENTS

1. Set the function switch to ~)) position.
2. Perform "Resistance Measurements" procedure, steps 2 thru 4. Buzzer sounds when resistance is less than about 40 Ω.

FREQUENCY MEASUREMENTS

1. Set the Function/Range switch to Hz for frequency measurement.
2. Connect the red test lead to the Cx ~)~ VΩ Hz jack and the black test lead to the COM jack.
3. Connect the test leads to the point of measurement and read the frequency from the display.

DIODE TEST

1. Set function switch to ~)~ position.
2. Connect red test lead to the Cx ~)~ VΩ Hz jack and black test lead to COM jack. Red lead is (+) polarity.
3. To check forward voltage (V_f), connect the red test lead to anode and black test lead to the cathode of the diode. Diodes and semiconductor junctions with normal V_f of less than approximately 3.0 V can be checked.
4. Display indicates the forward voltage. Normal diode voltages are approximately 0.4 V for germanium diodes, 0.7 V for silicon diodes, and 1.6 V for light emitting diodes (LED). An overrange indicates an open diode. A shorted diode reads near 0 V.
5. Reverse test lead connections to diode. Reading should be the same as with open test leads (an overrange indication). Lower readings indicate a leaky diode.

CAPACITANCE MEASUREMENTS

CAUTION

Never apply an external voltage when in the Cx position. Damage to the meter may result. Always short capacitor leads together before connecting to meter.

1. Set the Function/Range switch to Cx (capacitance).
2. Connect the COM and the Cx ~)~ VΩ Hz leads to the capacitor. Observe polarity when measuring polarized capacitors.
3. Read the capacitance directly from the display. A shorted capacitor will indicate an overrange. An open capacitor will indicate near zero on all ranges.
4. For maximum accuracy, step to the desired range in manual ranging, then press the REL Δ button to zero out test lead capacitance before the measurement.

USEFUL CONVERSIONS

pF	nF	μF
1,000	1.0	0.001
10,000	10.0	0.01
100,000	100.0	0.1
1,000,000	1000.0	1.0
	10,000.0	10.0
	100,000.0	100.0

pF = picofarads (10⁻¹²), nF = nanofarads (10⁻⁹), μF = microfarads (10⁻⁶)

TEMPERATURE MEASUREMENTS

1. Set function switch to desired temperature range: °C or °F.
2. Connect a Type K thermocouple probe to the temperature input jack. Jack on meter accepts a standard Type K thermocouple plug.
3. Take temperature measurement using the thermocouple probe and read the temperature from the display.