

BK PRECISION

TEST BENCH™

**INSTRUCTION
MANUAL**

**BK PRECISION
MODEL 388-HD**



BK PRECISION®

6470 West Cortland Street
Chicago, Illinois 60635

480-610-9-001B

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FEATURES


- Complete Handheld Test Bench.
- 11 Functions, 41 Ranges.
- Five dc voltage ranges: 200 mV to 1000 V.
- Five ac voltage ranges: 200 mV to 750 V.
- Six dc current ranges: 200 μ A to 20 A.
- Six ac current ranges: 200 μ A to 20 A.
- Seven resistance ranges: 200 Ω to 2000 M Ω .
- Five capacitance ranges: 1 pF to 10 nF.
- Three frequency ranges: 2 kHz to 200 kHz.
- hFE transistor test function; measures dc gain (hFE) of NPN and PNP transistors.
- Logic probe function; indicates logic high or logic low for TTL circuitry.
- Diode test function; measures forward voltage drop.
- Audible continuity buzzer.
- Extra large, easy to read 3-1/2 digit display with annunciators for polarity, decimal, logic, frequency, ac/dc, capacitance, and low battery.
- Basic accuracy: $\pm 0.5\%$ (DCV).
- Resolution of 100 μ V, 0.1 μ A, 0.1 Ω , 1 pF, 1 Hz.
- Slanted display for easy viewing.
- Shock resistant case withstands 4-foot drop.
- Auto polarity, auto zero.
- Overrange indication on all ranges.
- Overload protection.
- High energy fuse.
- Safety type test leads.
- Tilt stand. Also converts for use as a hanger strap.

MAINTENANCE

WARNING

Remove test leads before changing battery or fuse or performing any servicing. Never operate the TEST BENCH unless the battery compartment cover is closed.

BATTERY REPLACEMENT

A low battery is indicated when the  symbol in the lower left 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. Open the battery compartment and replace the dead battery with a fresh 9 volt "transistor" battery. Use alkaline batteries for longer life. To prolong battery life, set **Function/Range/Power** switch to the **OFF** position when not making measurements.

FUSE REPLACEMENT

If no current measurements are possible, check for blown overload protection fuse F1. This fuse is located in the battery compartment. Replace only with original type 2 A, 250 V, 5 x 20 mm fast acting fuse (B & K-Precision part number 194-012-9-001).

The unit also includes a high energy fuse to protect against accidental connections to high energy sources (power lines, etc.). The high energy fuse is located inside the meter near the input terminals. Replace only with original type 4 A high energy fuse (B & K-Precision part number 194-008-9-001). Under normal operation, this device should not require replacement for the life of the instrument. If you suspect a blown fuse, always check F1 first.

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 lead receptacles and fuseholder, and keep these areas free from dirt and corrosion.

WARRANTY

LIMITED ONE-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 one year 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**, Factory 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.

SPECIFICATIONS

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

DC VOLTAGE Manual ranging.

Range	Resolution	Accuracy	Overvoltage Protection
200 mV	100 µV	± (0.5% rdg + 1 dgt)	500 VDC 350 VAC rms
2 V	1 mV		1200 VDC 850 VAC rms
20 V	10 mV		
200 V	100 mV		
1000 V	1 V		

Input Impedance 10 MΩ
Full Range Response Time (to rated accuracy) ... 3 sec. max.
Normal Mode Rejection Greater than 30 dB (50/60 Hz)
Common Mode Rejection Greater than 100 dB (50/60 Hz)

AC VOLTAGE Manual ranging. Average responding, rms reading.

Range	Resolution	Accuracy	Overvoltage Protection
200 mV	100 µV	± (1.25% + 4 dgt) 40 Hz to 1 kHz	500 VDC 350 VAC rms
2 V	1 mV		1200 VDC 850 VAC rms
20 V	10 mV		
200 V	100 mV		
750 V	1 V	± (1.25% + 4 dgt) 40 to 400 Hz	

Input Impedance 10 MΩ/less than 100 pF
Full Range Response Time 8 sec. max.

DC CURRENT Manual ranging.

Range	Resolution	Accuracy	Burden Voltage
200 µA	0.1 µA	± (1.0% + 1 dgt)	600 mV max.
2 mA	1 µA		
20 mA	10 µA		
200 mA	100 µA	± (2.0% rdg + 3 dgt)	900 mV max.
2 A	1 mA		
20 A	10 mA		

Overload Protection 2 A (250 V) fast blow fuse and 4 A (600 V) high-energy fuse. 20 A not fused.
20 A Range Maximum Current 10 A continuous, 20 A for 30 sec. max.
Full Range Response Time (to rated accuracy) ... 3 sec. max.

AC CURRENT Manual ranging. Average responding, rms reading.

Range	Resolution	Accuracy	Burden Voltage
200 µA	0.1 µA	± (1.5% rdg + 3 dgt) 40 Hz to 1 kHz	600 mV rms max.
2 mA	1 µA		
20 mA	10 µA		
200 mA	100 µA	± (2.5% rdg + 3 dgt) 40 to 400 Hz	900 mV rms max.
2 A	1 mA		
20 A	10 mA		

Overload Protection 2 A (250 V) fast blow fuse and 4 A (600 V) high-energy fuse. 20 A not fused.
20 A Range Maximum Current 10 A continuous, 20 A for 30 sec. max.
Full Range Response Time (to rated accuracy) ... 8 sec. max.

RESISTANCE Manual ranging.

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
200 Ω	0.1 Ω	± (0.75% + 4 dgt)	2.5 mA	3.2 V
2 kΩ	1 Ω	± (0.75% + 1 dgt)	250 µA	0.6 V
20 kΩ	10 Ω		50 µA	
200 kΩ	100 Ω		5 µA	
2 MΩ	1 kΩ	± (1.5% + 5 dgt)	500 nA	3.2 V
20 MΩ	10 kΩ		50 nA	
2000 MΩ	1 MΩ	± (5% rdg + 10 dgt)	350 nA	

Overload Protection 500 V DC or AC rms
Full Range Response Time (to rated accuracy) 5 sec. max.
200 Ω to 2 MΩ Ranges 15 sec. max.
20 MΩ Range 25 sec. max.
2000 MΩ Range

CAPACITANCE Manual ranging.

Range	Resolution	Accuracy	Test Frequency
2 nF	1 pF	± (2.0% rdg + 4 dgt)	300 Hz
20 nF	10 pF		
200 nF	100 pF		
2 µF	1 nF		
20 µF	10 nF		

FREQUENCY COUNTER Manual ranging.

Range	Resolution	Accuracy 5 V rms Max	Sensitivity	Min Input Freq.
2 kHz	1 Hz	± (1.0% rdg + 3 dgt)	200 mV	20 Hz
20 kHz	10 Hz			200 Hz
200 kHz	100 Hz			2 kHz

Overvoltage Protection: 250 V DC or AC rms

DIODE CHECK

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
	1 mV	± (1.5% rdg + 5 dgt)	1.5 mA	3.2 V

Overvoltage Protection: 500 V DC or AC rms

CONTINUITY TEST

Range	Resolution	Description	Max Test Current	Max Open Circuit Voltage
	1 Ω	Buzzer sounds below approx. 200 Ω.	1.5 mA	3.2 V

LOGIC

LCD Displays Number "1" when selected

Test Voltage 5 V DC
Logic Threshold
Logic 1 (high) displayed, 2.4 V ± 0.3 V
Logic 0 (low) displayed, 0.8 V ± 0.3 V

Input Impedance 1 MΩ
Input Overvoltage Protection 500 V DC or AC rms

TRANSISTOR hFE (DC GAIN) MEASUREMENT

Base Current 10 µA
Vce 2.8 V
Gain Measurement Range 0-1000

GENERAL SPECIFICATIONS

Display: 3-1/2 digit liquid crystal display (LCD) with a maximum reading of 1999. Large 0.7" digits.

Polarity: Automatic (-) negative polarity indication.

Overrange Indication: "1" or "-1".

Functional Annunciator: AC~, DC~, Cx, kHz, and Logic on LCD display.

Low Battery Indication: " " is displayed when battery drops below minimum operating voltage.

Sampling Rate: 2.5 measurements per second, nominal.

Operating Temperature: 0°C to +50°C, 0 to 70% relative humidity.

Storage Temperature: -20°C to +60°C, 0 to 80% relative humidity with battery removed.

Temperature Coefficient: 0.15 x (specified accuracy)/°C (<18°C or >28°C).

Power: Single standard 9V battery, NEDA 1604.

Battery Life: 150 hours typical (alkaline).

Dimensions (H x W x D): 1-3/8 x 3-9/16 x 7-1/2" (35 x 90 x 190 mm), 1-3/4" (45 mm) maximum height at tilted window.

Weight: 370 g including battery.

Accessories: Test leads (pair), spare fuse (2 A), battery, instruction manual.

SPECIFICATIONS

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

DC VOLTAGE Manual ranging.

Range	Resolution	Accuracy	Overvoltage Protection
200 mV	100 μ V	\pm (0.5% rdg + 1 dgt)	500 VDC 350 VAC rms
2 V	1 mV		1200 VDC 850 VAC rms
20 V	10 mV		
200 V	100 mV		
1000 V	1 V		

Input Impedance 10 M Ω
 Full Range Response Time (to rated accuracy) ... 3 sec. max.
 Normal Mode Rejection Greater than 30 dB (50/60 Hz)
 Common Mode Rejection Greater than 100 dB (50/60 Hz)

AC VOLTAGE Manual ranging. Average responding, rms reading.

Range	Resolution	Accuracy	Overvoltage Protection
200 mV	100 μ V	\pm (1.25% + 4 dgt) 40 Hz to 1 kHz	500 VDC 350 VAC rms
2 V	1 mV		1200 VDC 850 VAC rms
20 V	10 mV		
200 V	100 mV		
750 V	1 V	\pm (1.25% + 4 dgt) 40 to 400 Hz	

Input Impedance 10 M Ω /less than 100 pF
 Full Range Response Time 8 sec. max.

DC CURRENT Manual ranging.

Range	Resolution	Accuracy	Burden Voltage
200 μ A	0.1 μ A	\pm (1.0% + 1 dgt)	600 mV max.
2 mA	1 μ A		
20 mA	10 μ A		
200 mA	100 μ A	\pm (2.0% rdg + 3 dgt)	900 mV max.
2 A	1 mA		
20 A	10 mA		

Overload Protection 2 A (250 V) fast blow fuse and 4 A (600 V) high-energy fuse. 20 A not fused.
 20 A Range Maximum Current 10 A continuous, 20 A for 30 sec. max.
 Full Range Response Time (to rated accuracy) ... 3 sec. max.

AC CURRENT Manual ranging. Average responding, rms reading.

Range	Resolution	Accuracy	Burden Voltage
200 μ A	0.1 μ A	\pm (1.5% rdg + 3 dgt) 40 Hz to 1 kHz	600 mV rms max.
2 mA	1 μ A		
20 mA	10 μ A		
200 mA	100 μ A	\pm (2.5% rdg + 3 dgt) 40 to 400 Hz	900 mV rms max.
2 A	1 mA		
20 A	10 mA		

Overload Protection 2 A (250 V) fast blow fuse and 4 A (600 V) high-energy fuse. 20 A not fused.
 20 A Range Maximum Current 10 A continuous, 20 A for 30 sec. max.
 Full Range Response Time (to rated accuracy) ... 8 sec. max.

RESISTANCE Manual ranging.

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
200 Ω	0.1 Ω	\pm (0.75% + 4 dgt)	2.5 mA	3.2 V
2 k Ω	1 Ω	\pm (0.75% + 1 dgt)	250 μ A	0.6 V
20 k Ω	10 Ω		50 μ A	
200 k Ω	100 Ω		5 μ A	
2 M Ω	1 k Ω		500 nA	
20 M Ω	10 k Ω	\pm (1.5% + 5 dgt)	50 nA	
2000 M Ω	1 M Ω	\pm (5% rdg + 10 dgt)	350 nA	3.2 V

Overload Protection 500 V DC or AC rms
 Full Range Response Time (to rated accuracy)
 200 Ω to 2 M Ω Ranges 5 sec. max.
 20 M Ω Range 15 sec. max.
 2000 M Ω Range 25 sec. max.

CAPACITANCE Manual ranging.


Range	Resolution	Accuracy	Test Frequency
2 nF	1 pF	\pm (2.0% rdg + 4 dgt)	300 Hz
20 nF	10 pF		
200 nF	100 pF		
2 μ F	1 nF		
20 μ F	10 nF		

FREQUENCY COUNTER Manual ranging.

Range	Resolution	Accuracy 5 V rms Max	Sensitivity	Min Input Freq.
2 kHz	1 Hz	\pm (1.0% rdg + 3dgt)	200 mV	20 Hz
20 kHz	10 Hz			200 Hz
200 kHz	100 Hz			2 kHz


Overvoltage Protection: 250 V DC or AC rms

DIODE CHECK

Range	Resolution	Accuracy	Max Test Current	Max Open Circuit Voltage
	1 mV	\pm (1.5% rdg + 5 dgt)	1.5 mA	3.2 V

Overvoltage Protection: 500 V DC or AC rms

CONTINUITY TEST

Range	Resolution	Description	Max Test Current	Max Open Circuit Voltage
	1 Ω	Buzzer sounds below approx. 200 Ω .	1.5 mA	3.2 V

LOGIC

LCD Displays Number "1" when selected

Test Voltage 5 V DC
 Logic Threshold
 Logic 1 (high) displayed, 2.4 V \pm 0.3 V
 Logic 0 (low) displayed, 0.8 V \pm 0.3 V

Input Impedance 1 M Ω
 Input Overvoltage Protection 500 V DC or AC rms

TRANSISTOR hFE (DC GAIN) MEASUREMENT


Base Current 10 μ A
 Vce 2.8 V
 Gain Measurement Range 0-1000


GENERAL SPECIFICATIONS

Display: 3-1/2 digit liquid crystal display (LCD) with a maximum reading of 1999. Large 0.7" digits.

Polarity: Automatic (-) negative polarity indication.

Overrange Indication: "1" or "-1".

Functional Annunciator: AC~, DC~, Cx, kHz, and Logic  on LCD display.

Low Battery Indication: "  " is displayed when battery drops below minimum operating voltage.

Sampling Rate: 2.5 measurements per second, nominal.

Operating Temperature: 0°C to +50°C, 0 to 70% relative humidity.

Storage Temperature: -20°C to +60°C, 0 to 80% relative humidity with battery removed.

Temperature Coefficient: 0.15 x (specified accuracy)/°C (<18°C or >28°C).

Power: Single standard 9V battery, NEDA 1604.

Battery Life: 150 hours typical (alkaline).

Dimensions (H x W x D): 1-3/8 x 3-9/16 x 7-1/2" (35 x 90 x 190 mm), 1-3/4" (45 mm) maximum height at tilted window.

Weight: 370 g including battery.

Accessories: Test leads (pair), spare fuse (2 A), battery, instruction manual.

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 safety precautions.

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

DC VOLTS	1000 V (dc + ac peak)
AC VOLTS	750 Vrms
OHMS	500 V (dc + ac peak)
A	2 A (fuse protected)
20 A	10 A continuous, 20 A for 30 seconds max
COM	Do not float more than 500 volts from earth ground
- Never use the TEST BENCH unless the battery compartment is closed.
- Remove test leads before replacing batteries or fuses, and before performing any servicing on the instrument.
- Use only the safety type test leads supplied with the instrument.
- 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.
- Never apply an external signal to the Cx or hFE input jacks. Damage to the meter will result.
- If possible, familiarize yourself with the equipment before 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.



See instruction manual for further precautionary information.



High voltage terminal; up to 1000 V may be present if connected to high voltage.

COM

Common input terminal.



Diode test.

500 V

MAX

1000 VDC

750 VAC

Connect to earth ground or point not more than 500 volts from earth ground.

Maximum input rating of V-Ω-Hz terminal with respect to earth ground.



Continuity test.



Logic high.



Logic low.

hFE

Transistor gain test.

OPTIONAL ACCESSORIES

- Carrying Case Model LC-29
- Clamp-on AC current probe Model CP-1
- 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
- Replacement test leads Model FP-30
- Temperature probe, semiconductor type Model TP-28
- Temperature probe, Type K thermocouple Model TP-30

OPERATING INSTRUCTIONS

RANGE SELECTION

- If the quantity to be measured is unknown, start with the highest range.
- When an overrange is indicated (most significant digit "1" on and all other digits blank) switch to the next highest range.

VOLTAGE MEASUREMENTS

- The annunciators in the upper right corner of the display indicate whether the ac or dc voltage function is selected.
 - To measure ac voltage, set the AC/DC switch to the AC position.
 - To measure dc voltage, set the AC/DC switch to the DC position.
- Set the Function/Range switch to the desired voltage range.
- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack.
- Connect the test leads to the points of measurement.
- For dc, a (-) sign is displayed for negative polarity; (+) positive polarity is implied.

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. The 20 A range has no fuse protection and may severely damage the meter or equipment under test or cause personal injury.

- The annunciators in the upper right corner of the display indicate whether the ac or dc current function is selected.
 - To measure ac current, set the AC/DC switch to the AC position.
 - To measure dc current, set the AC/DC switch to the DC position.
- For current measurements less than 2 A, connect the red test lead to the A jack and the black test lead to the COM jack.
- For current measurements of 2 A or greater, connect the red test lead to the 20 A jack and the black test lead to the COM jack. For current measurements greater than 2 A, high current test leads are recommended.

NOTE

Maximum continuous input current is 10 A. For current measurements higher than 10 A, the current should not be connected to the inputs for longer than 30 seconds.

- 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.
- Apply power and read the value from the display.

RESISTANCE MEASUREMENTS

- Set the Function/Range switch to the desired resistance range.
- Remove power from the equipment under test.
- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack. The red lead is (+) polarity.
- Connect the test leads to the points of measurement and read the value from the display.

CAPACITANCE MEASUREMENTS

CAUTION

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

- Set the Function/Range switch to the desired Cx (capacitance) range.
- Insert the capacitor leads directly into the slotted Cx test jacks. Observe polarity when measuring polarized capacitors. Insert one lead into the (+) jack and the other lead into the (-) jack.
- Read the capacitance directly from the display. A shorted capacitor will indicate an overrange. An open capacitor will indicate near zero on all ranges.

USEFUL CONVERSIONS

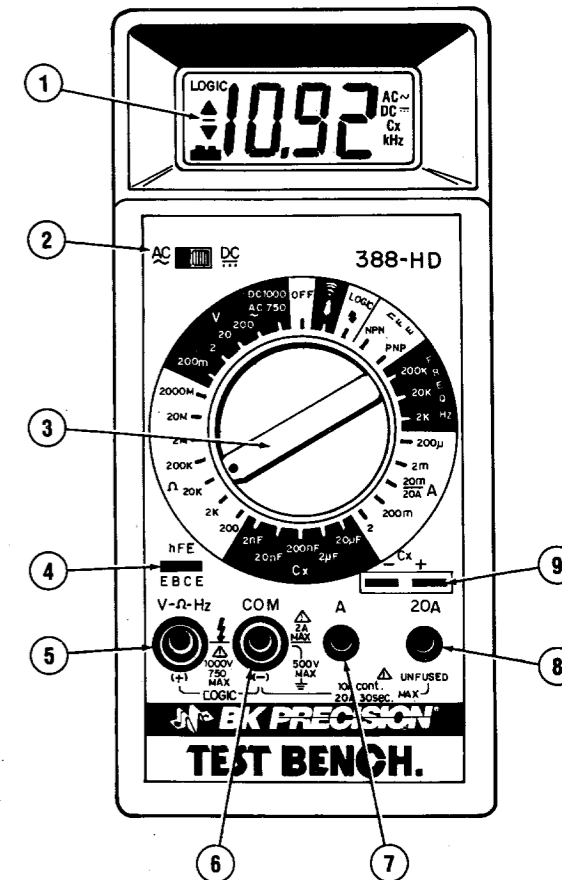
pF	nF	μF
1,000	1.0	0.001
10,000	10.0	0.01
100,000	100.0	0.1
1,000,000	1000.0	1.0
	10,000.0	10.0
	100,000.0	100.0
	1,000,000.0	1000.0

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

FREQUENCY MEASUREMENTS

- Set the Function/Range switch to the desired FREQ range.

- Display.** 3-1/2 digit display (1999 maximum) with automatic decimal point, polarity indication, high-low logic indicators, and low battery indicator. Indicates measured value and whether dc or ac is selected (for current and voltage readings). Also indicates when LOGIC, Cx (capacitance), or kHz (frequency) functions are selected. Overrange is indicated by displaying most significant digit "1" and all other digits blank.
- AC/DC Switch.** Selects ac or dc voltage and current ranges. When switch is set to DC position, all voltage and current ranges are for dc measurements. When switch is set to AC position, all voltage and current ranges are for ac measurements.
- Function/Range/Power Switch.** Selects function and range; ac or dc V (1000 DCV/750 ACV, 200 V, 20 V, 2 V, or 200 mV), Ω (2000 MΩ, 20 MΩ, 2 MΩ, 200 kΩ, 20 kΩ, 2 kΩ, or 200 Ω), Cx (2 nF, 20 nF, 200 nF, 2 μF, or 20 μF), ac or dc A (2 A, 200 mA, 20 mA/20 A, 2 mA, or 200 μA), Hz (2 kHz, 20 kHz, or 200 kHz), hFE (PNP or NPN), LOGIC, and \rightarrow/\leftarrow (diode test/continuity). When knob is pointing straight up, TEST BENCH power is off.
- hFE Jacks.** Input for direct insertion of NPN and PNP transistor leads. Emitter, collector, and base sockets are labeled.
- V-Ω-Hz Jack.** Input for voltage, resistance, frequency, hFE, Logic, and continuity/diode test functions.
- COM Jack.** Input for common or reference test lead for measurements except Cx (capacitance) and hFE (transistor gain). Connect to earth ground or reference point not more than 500 V (dc + ac peak) from earth ground.
- A Jack.** Input for dc or ac current up to 2 A.
- 20 A Jack.** Input for dc or ac current measurements on the 20 A range (currents greater than 10 A not to be connected to TEST BENCH for longer than 30 seconds). For measurements greater than 2 A, high current test leads are recommended.
- Cx Socket.** Input for capacitance measurements. Inputs are polarized for measuring polarized capacitors.



- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack.
- Connect the test leads to the point of measurement and read the frequency from the display.

TRANSISTOR GAIN MEASUREMENTS

CAUTION

Never apply an external voltage to the hFE sockets. Damage to the meter may result.

- Set the Function/Range switch to the desired hFE (dc transistor gain) range (PNP for npn type transistors and NPN for npn type transistors).
- Plug the transistor directly into the hFE socket. The sockets are labeled E, B, and C for emitter, base, and collector.
- Read the transistor hFE (dc gain) directly from the display.

LOGIC MEASUREMENTS

- Set the Function/Range switch to the LOGIC position.
- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack.
- Connect the black test lead to the circuit ground (common).
- Connect the red test lead to the test point.
- A ▲ on the display indicates TTL logic high and a ▼ indicates a TTL logic low.

CONTINUITY MEASUREMENTS

- Set the Function/Range switch to the \rightarrow/\leftarrow position.
- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack.
- Touch the test leads to the desired test point.
- The buzzer will sound when resistance is less than approximately 200 Ω.

DIODE TEST

- Set the Function/Range switch to the \rightarrow/\leftarrow position.
- Connect the red test lead to the V-Ω-Hz jack and the black test lead to the COM jack.
- To check forward voltage (V_f), connect the red test lead to the anode and the black test lead to the cathode of the diode. Diodes and semiconductor junctions with normal V_f of less than approximately 3.000 V can be checked.
- The display indicates the forward voltage. Normal diode voltages are approximately 0.300 V for germanium diodes, 0.700 V for silicon diodes, and 1.600 V for light emitting diodes (LED's). An overrange indicates an open diode. A shorted diode reads near 0 V.
- To check reverse voltage, reverse the test lead connections to the diode. The reading should be the same as with open test leads (an overrange indication). Lower readings indicate a leaky diode.