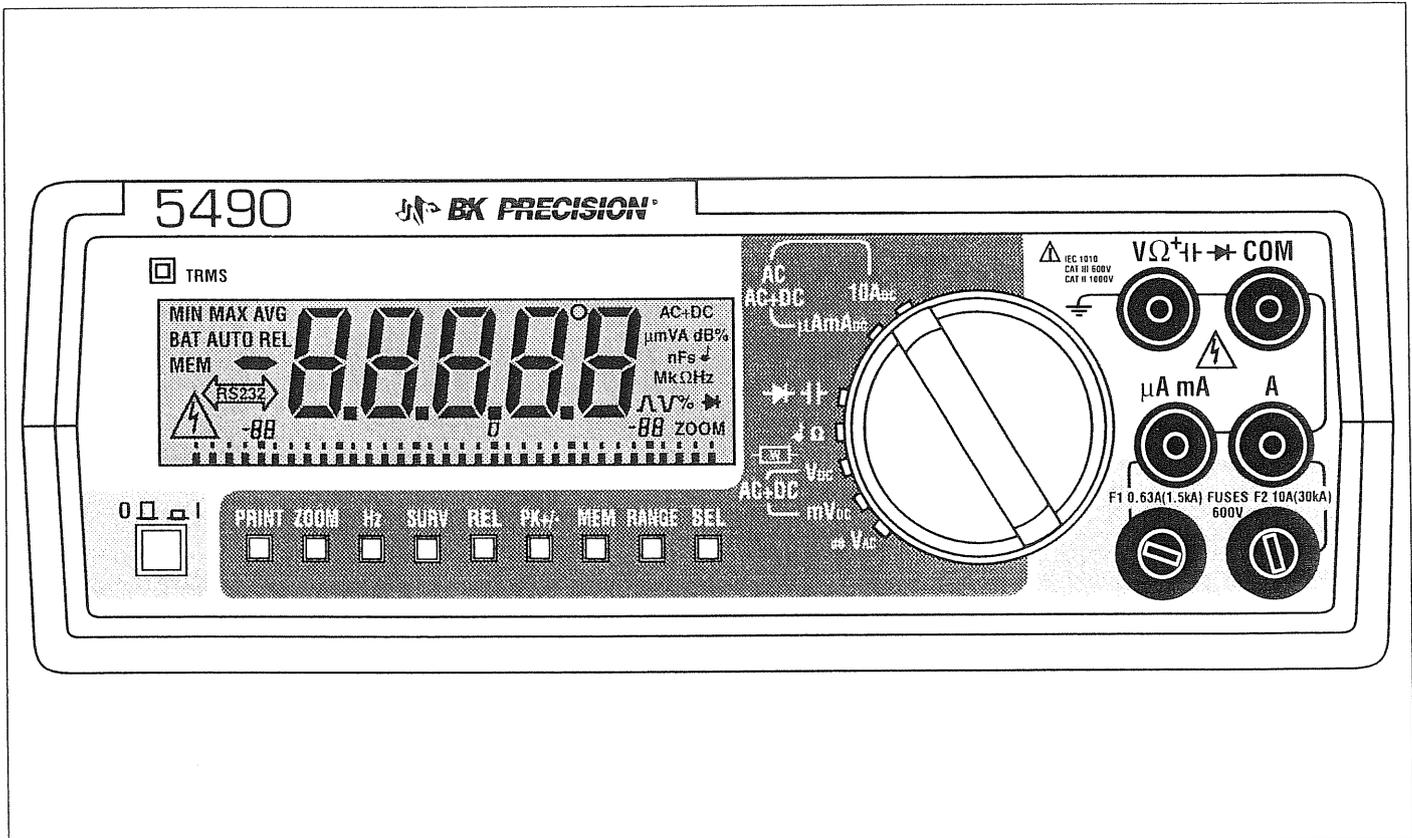


# INSTRUCTION MANUAL



## Premium Bench Type DIGITAL MULTIMETERS

Models 5460  
5470  
5490



## TEST INSTRUMENT 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 lethal current under certain conditions. Higher voltages are even more dangerous. Observe the following safety precautions:*

1. 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 V rms
OHMS	600 VDC or AC rms
μA	630 mA (fuse protected)
10 A	10 A (fuse protected)
COM	Float voltage plus measured voltage must not exceed 1000 V (dc + ac peak)

2. Never use the multimeter unless the case is closed.
3. Remove test leads before performing any service on the multimeter.
4. Use only safety type test leads like those supplied with the multimeter.
5. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
6. For voltage or current measurements in high-voltage equipment, do not touch equipment, meter, or test leads while power is applied.
7. 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.
8. Use an insulated floor material or floor mat to stand on, and an insulated work surface; make certain such surfaces are not damp or wet.
9. 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.
11. 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 Isolation Transformer, or Model 1653A or 1655A AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac equipment as "hot-chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
12. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
13. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual  
for



Models 5460  
5470  
5490

Premium Bench Type  
DIGITAL MULTIMETERS

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## FEATURES

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The **B+K Precision** Model 5490 is a highly accurate bench-type digital multimeter with a multitude of highly advanced features. It is capable of taking the following measurements:

- ac voltages with ac (or rms) capacitive coupling
- ac voltages with ac + dc (or trms) direct coupling
- dc voltages
- ac current with ac (or rms) capacitive coupling
- ac current with ac + dc (or trms) direct coupling
- dc current
- Resistance
- Continuity
- Capacitance
- Diode threshold voltage
- Frequency
- Duty cycle
- Pulse width
- Pulse count
- dBm
- Resistive power

Features of the 5490 include:

- 0.025% DCV accuracy
- 0.07% Ohms accuracy
- 100 kHz ac response
- Autoranging, bargraph, and zoom
- Capacitance to 50,000  $\mu\text{F}$
- Frequency, duty cycle, pulse width
- dB across 1  $\Omega$  to 10 k $\Omega$
- VA across 1  $\Omega$  to 10 K $\Omega$
- Min/Max/Avg

Model 5470 has the same accuracy as the 5490 for all functions except dc volts. It includes all of the measurement capabilities as the 5490 except for pulse width, event counting, and VA measurement. It also is capable of temperature measurement within 0.5°C using a platinum probe.

Model 5460 is an economy version that is capable of taking many of the same measurements as the 5470 and 5490, but at a lower accuracy. It does not include Min/Max/Avg, dB measurement, VA measurement, pulse width, or pulse count and its ac voltage response is 30 kHz.

All models include 50,000 count resolution, true rms with selectable ac or ac + dc modes, safety compliance with IEC1010, shock and vibration resistance compliance with MIL-T-28800, and a three-year warranty. Models 5490 and 5470 have built-in RS-232 capability.

All models have a carrying handle that doubles as a tilt stand.

The display features clearly legible 20 mm (0.8 inch) high figures.

Refer to the SPECIFICATION section of this manual for complete specifications for each of the models.

Refer to the ACCESSORIES section of this manual for a description of each of the standard and optional accessories for the multimeters.

## CONTROLS AND INDICATORS

Figures 1 through 4 illustrate the controls, indicators and connectors of the multimeters. Refer to the illustrations while reviewing the following descriptions of each of the controls.

### NOTE

Throughout this section of the manual, instructions include short and long presses of buttons on the multimeter. A short press means less than one second and a long press means greater than one second.

- ON/OFF Button.** Turns the unit on and off. The unit is on when the button is in the engaged position and off when in the released position.
- Display.** 50,000 count LCD display with 20 mm (0.79") high digits, automatic decimal point, minus sign and 34 segment bar graph. Indicates 5,000 counts in low resolution mode. Annunciators for all functions, units of measurement, and blown fuse. Overrange indicated by OL. Refer to Fig. 12 and the associated text for detailed description of the display.
- Function Switch.** Rotary switch, selects function for AUTO ranging modes; selects function and some ranges for current modes. Primary function selected is indicated by white labeling of the switch position. The secondary function of each position is labeled in yellow and is activated by the yellow SEL button as shown in Figures 4 through 10.
- V  $\Omega$   $\rightarrow$  Jack.** Input for DC, AC, and AC+DC Volts, capacitance, diode test, resistance, continuity, or frequency functions.
- COM Jack.** Input for common or reference test lead for all measurements.
- $\mu$ A mA Jack.** Input for DC, AC, or AC+DC currents up to 500 mA.
- A Jack.** Input for 10 A DC, AC, or DC+AC current range.
- FUSE F2.** 10A, 600 V, 50 kVA fuse.
- FUSE F1.** 0.63A, 600 V, 1.5 kA fuse.
- SEL Button (yellow).** Selects the secondary functions of the rotary **Function Switch** (3) indicated in yellow. Toggles between DC, AC, and AC+DC for current measurements; toggles between capacitance and diode testing; toggles between ohms and continuity checking; toggles between DC and AC+DC voltage measurements; or toggles between AC voltage and dB/Hz measurements.
- RANGE Button.** Manual ranging selector switch. A short press changes from the AUTO mode to MANUAL mode. Subsequent short presses advance range selection to the next higher range until the highest range is

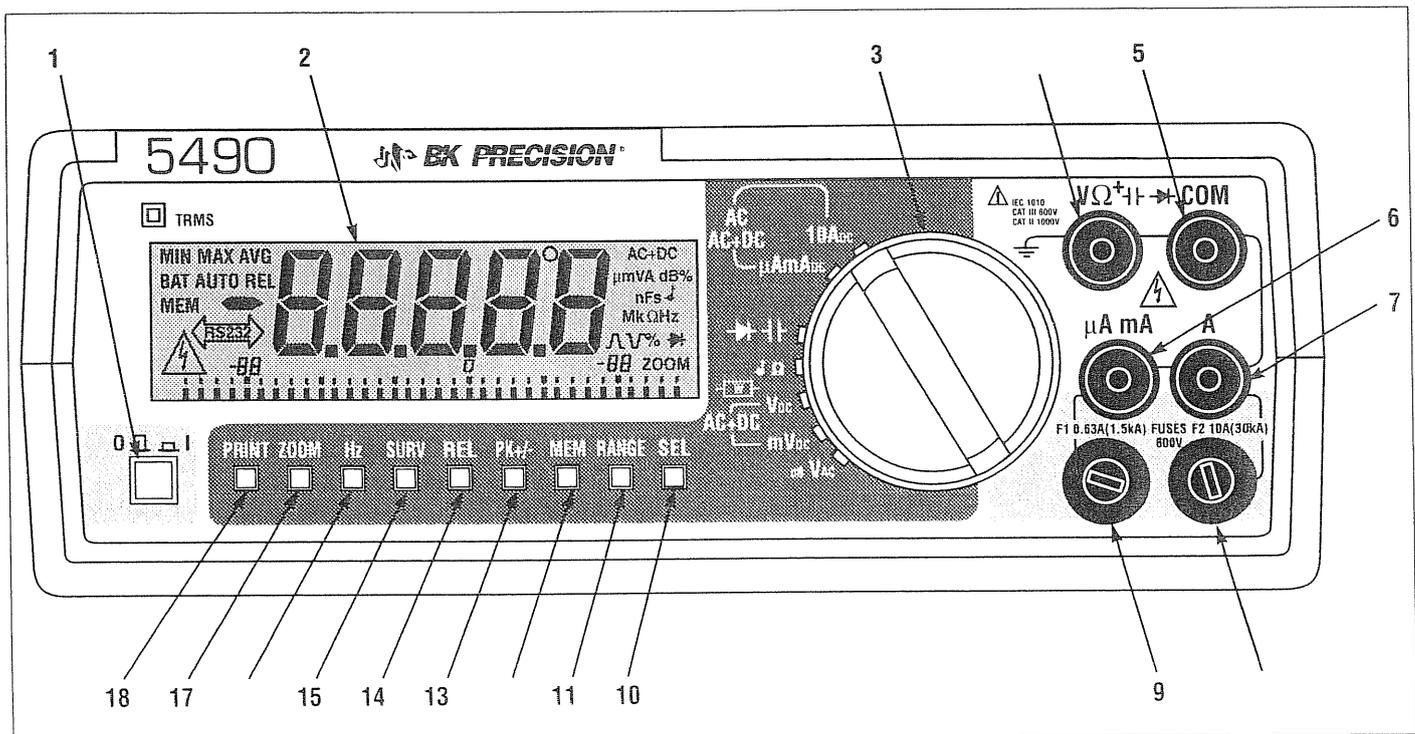


Fig. 1 Model 5490 Front Panel Controls

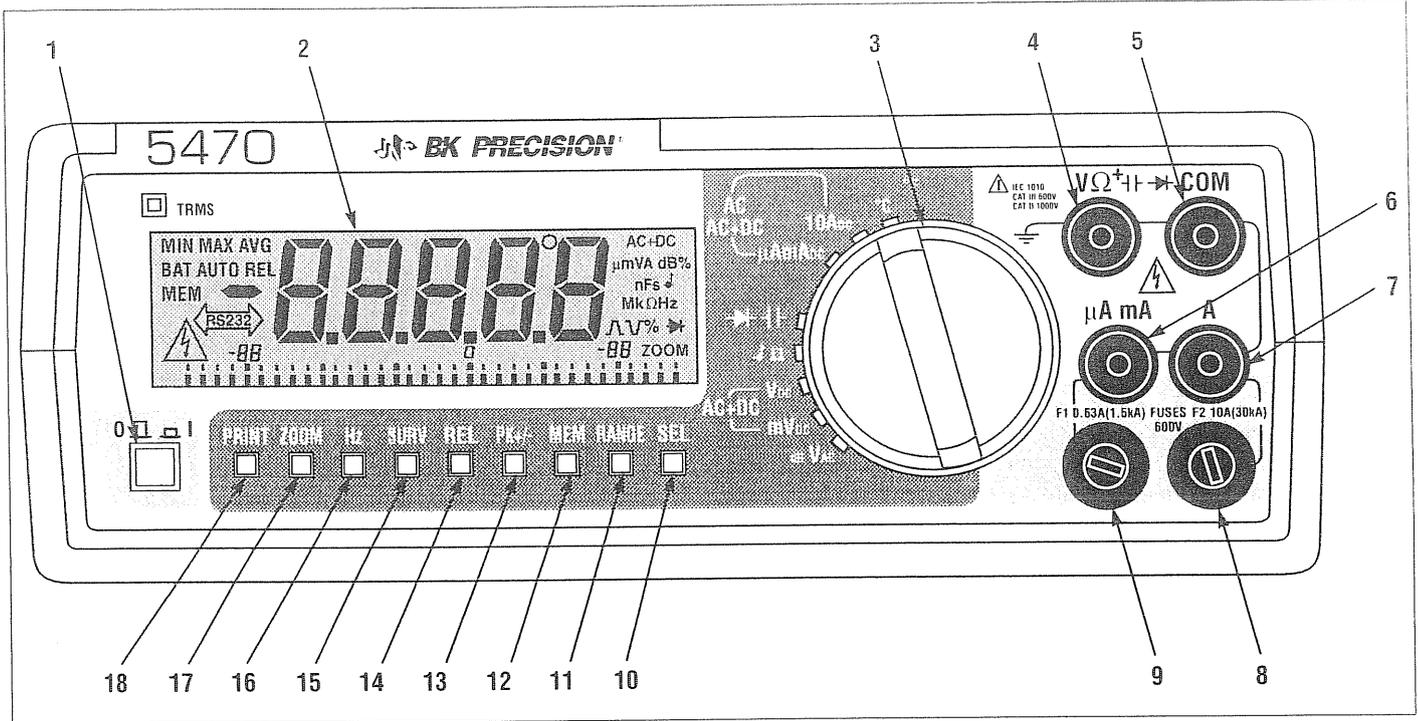


Fig. 2 Model 5470 Front Panel Controls

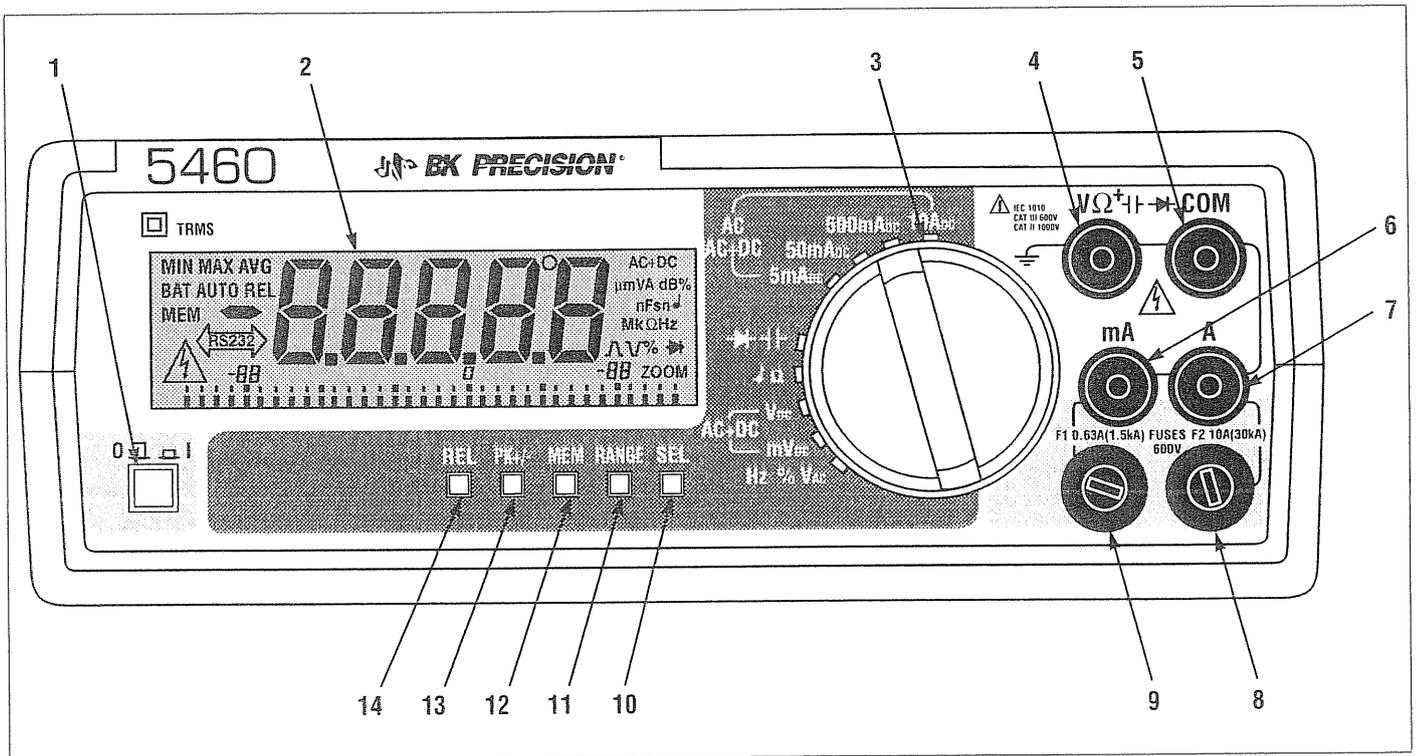


Fig. 3 Model 5460 Controls

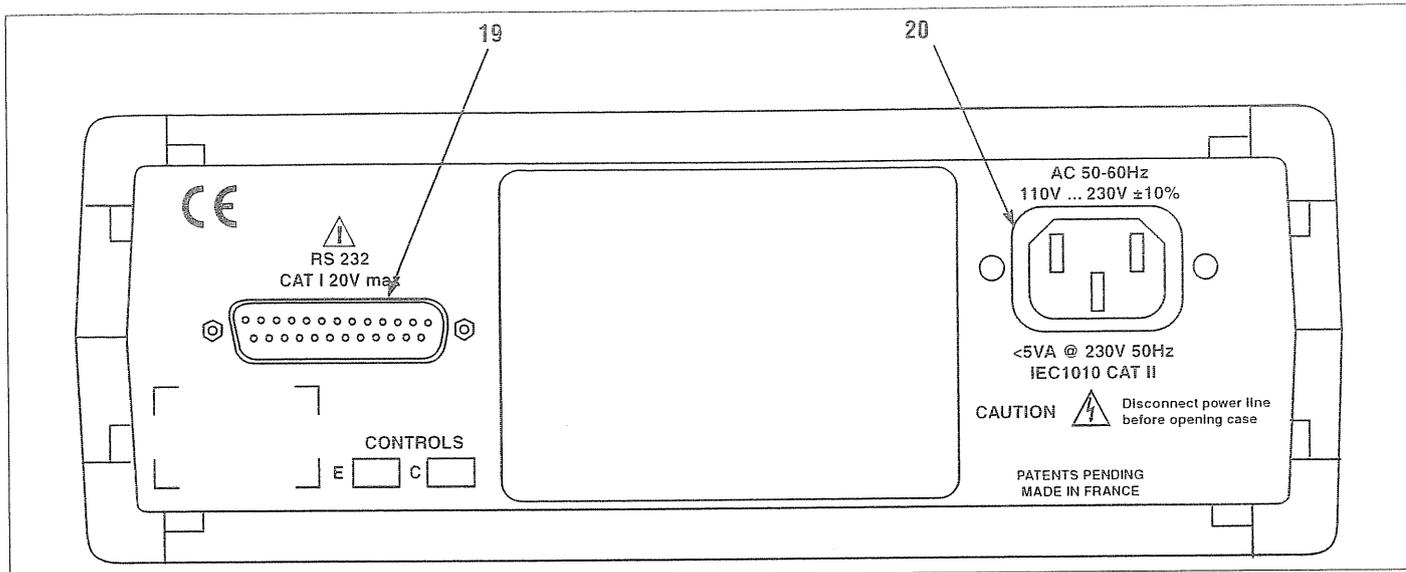


Fig. 4 Rear Panel Connectors

11. **RANGE Button.** Manual ranging selector switch. A short press changes from the AUTO mode to MANUAL mode. Subsequent short presses advance range selection to the next higher range until the highest range is reached, then advances to the lowest range. A long press at any time returns the unit back to the AUTO ranging mode.
12. **MEM Button.** Toggles the data hold feature on and off for all functions, and enables the AUTO MEM MODE. A short press freezes the current reading on the display with the MEM annunciator on. Another short press releases the display. A long press enables the AUTO MEM MODE only in the VDC, mVDC, and VAC positions of the rotary **Function Switch** (3).
13. **PK +/- Button.** Enables the fast peak hold (positive and negative) capability when the rotary **Function Switch** (3) is set to VDC, mVDC, mADC, and 10ADC functions.
14. **REL Button.** Sets initial reading as the zero reference for making relative measurements. A short press enables the mode and sets the display to zero. Another short press disables the mode and returns the unit back to its normal mode. When in the REL mode, a long press displays the reference being used. The reference value may then be adjusted using the **SEL** and **RANGE** buttons. The **SEL** button is used to select the digits and the sign, while the **RANGE** button is used to increment the selected digit. A short press returns the unit to the REL measurement mode. Another short press returns the unit back to its normal mode.
15. **SURV Button** (5470 and 5490 only). Enables the SURVEILLANCE or MIN, MAX, AVG recording mode. A long press enables or disables the recording mode. Short presses display current values of MIN, MAX or AVG measurements. The symbols flash with selected modes. The values are stored when the SURV mode is disabled or when the unit power is switched OFF. Short presses allow the MIN, MAX, AVG values to be read. A long press enables the SURV mode and clears the previous values.
16. **Hz Button** (5470 and 5490 only). Enables frequency functions when rotary **Function Switch** (3) is set to VAC, VDC, mVDC, mADC and 10ADC. Short presses engage frequency measurement, % positive duty cycle, % negative duty cycle, positive pulse count, negative pulse count, positive pulse width measurement, negative pulse width measurement, and back to original rotary **Function Switch** (3) setting. A long press at any time returns the unit back to its original rotary **Function Switch** setting.
17. **ZOOM Button** (5470 and 5490 only). Expands the scale of the 34 segment analog bargraph by a factor of five for positive measurements and a factor of 11 for bipolar measurements.
18. **PRINT Button** (5470 and 5490 only). Turns on the RS232 port and sends a measurement to the printer. A short press sends one measurement. A long press allows the user to define the rate at which the measurements are sent from 00000 sec (a single transmission) up to 9 hr, 59 min, 59 sec. The **SEL** button is used to select the digits, while the **RANGE** button is used to increment the selected digit. A short press returns the unit to the PRINT mode. Another short press returns the unit to the normal mode.
19. **RS-232 Connector** (5470 and 5490 only). Interface for **B+K Precision** Models AK-5400 Calibration Hardware and Software Kit and AK-5450 Data Acquisition Hardware and Software Kit.
20. **AC Power Connector.** Input connector for power cord.

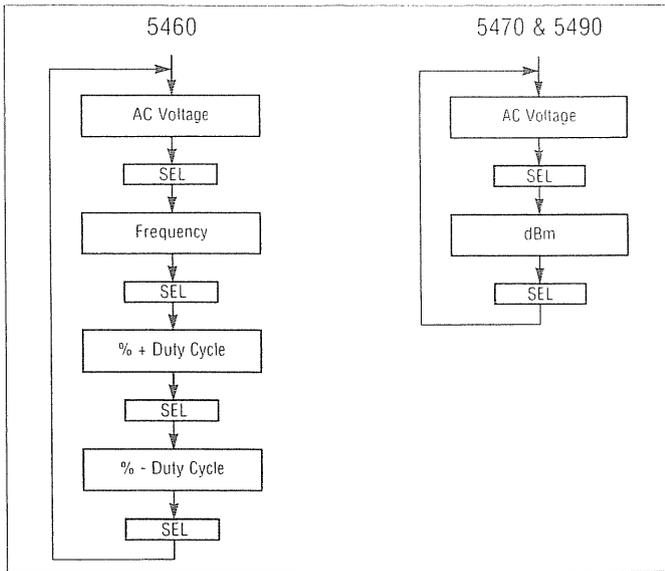


Fig. 5 VAC Position

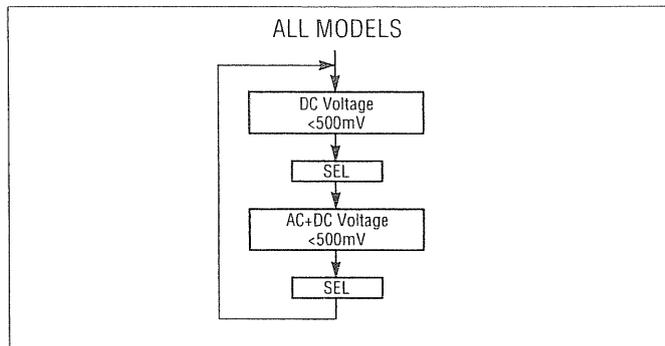


Fig. 6 mVDC Position

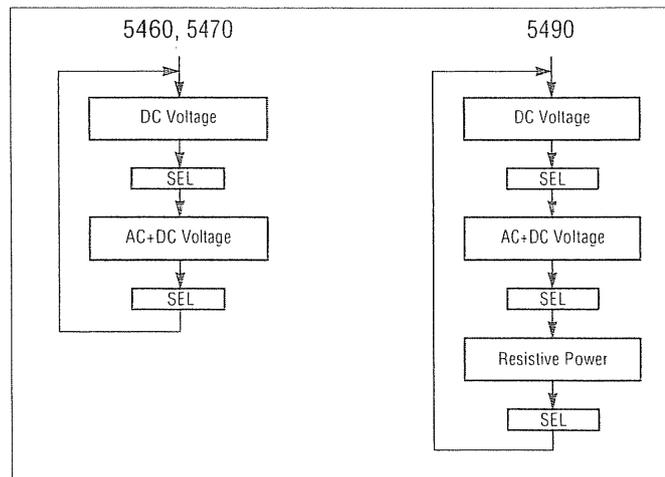


Fig. 7 VDC Position

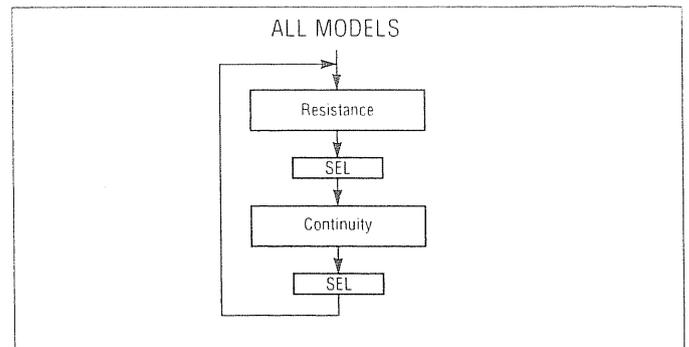


Fig. 8  $\Omega$  Position

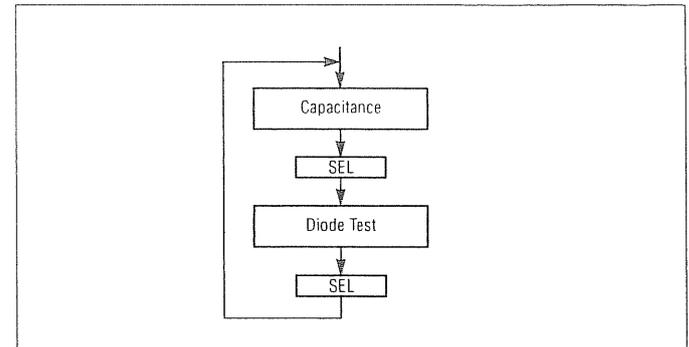


Fig. 9  $\mu\text{F}$  Position

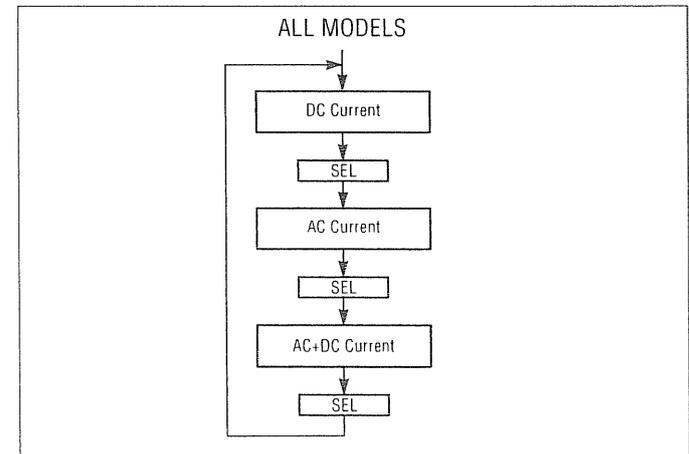


Fig. 10  $\mu\text{A}$ , mA, 10A Position

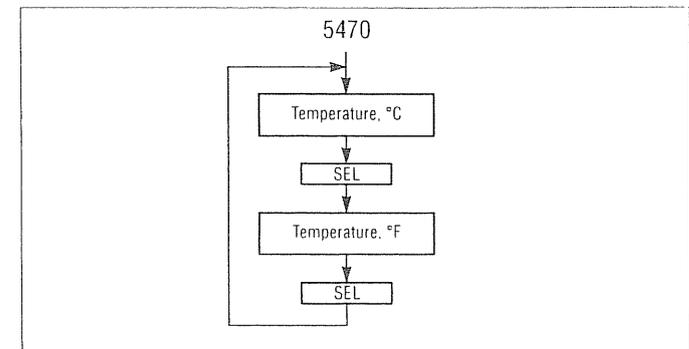


Fig. 11  $^{\circ}\text{C}$  Position

**LCD INDICATORS**

Figure 12 shows all the annunciators on the LCD display. Refer to this illustration while reviewing the following descriptions.

1. **MIN MAX AVG** illuminates when the instrument is placed in surveillance mode (long press of the **SURV** button). Each annunciator flashes when the meter displays the particular value (short press of the **SURV** button).
2. **Value display.** The 20 mm high digits display the value of the measurement being taken. A - (minus sign) signifies a negative value. Positive values are implied and a positive sign is not displayed. The ° indicator to the left of the last digit signifies temperature measurement (5470 only). The last digit displays a C for Celsius or F for Fahrenheit during temperature measurements.
3. **Unit range.** The following annunciators illuminate to signify the units of measure being displayed. They are displayed with the particular unit of measure, for example **MΩ** for Megohm and **μA** for microamp.  
**n** represents nano ( $10^{-9}$ )  
**μ** represents micro ( $10^{-6}$ )  
**m** represents milli ( $10^{-3}$ )  
**k** represents kilo ( $10^3$ )  
**M** represents Mega ( $10^6$ )
4. **AC+DC** illuminates when the instrument is set to take AC+DC voltage or current measurements. **AC** illuminates when the instrument is set to take AC voltage or current measurements.

5. **VA** illuminates when the instrument is set to take resistive power measurements (5490 only). The **A** illuminates alone when the instrument is set to take current measurements and the **V** illuminates alone for voltage measurements.
6. **dB** illuminates when the instrument is set to take dBm measurements (5470 and 5490).
7. **F** illuminates when the instrument is set to take capacitance measurements.
8. **∩** illuminates when the instrument is set to check continuity.
9. **s** illuminates when the instrument is set to take pulse width measurements.
10. **Hz** illuminates when the instrument is set to take frequency measurements.
11. **Ω** illuminates when the instrument is set to take resistance measurements.
12. **▶▶** illuminates when the instrument is set to test diodes.
13. **ZOOM** illuminates to signify that the bargraph scale has been expanded. The left and right bargraph scale indicators display the range of the bargraph.
14. **%** illuminates when the instrument is set to take duty cycle measurements (5470 and 5490).
15. **∧V** Pulses illuminates when the instrument is set to take duty cycle, pulse width, and pulse count measurements. **∧** signifies positive pulses and **V** signifies negative pulses.
16. **Right bargraph scale** displays the units for the bargraph at the right end of the scale.

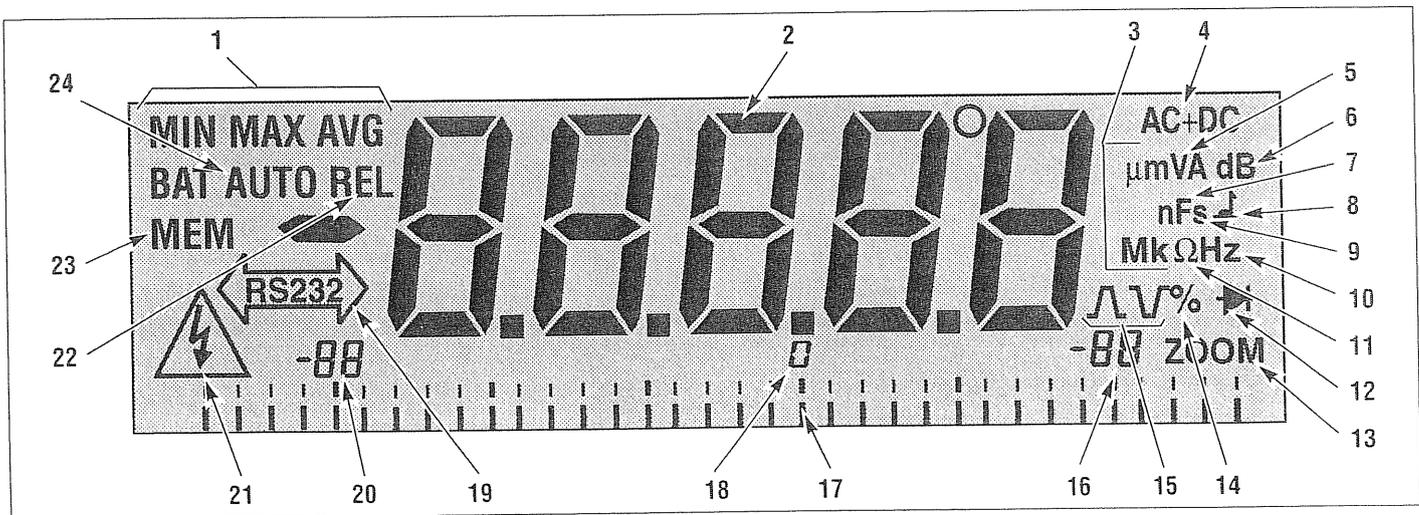


Fig. 12 LCD Display

17. **Bargraph.** The 34-segment bargraph provides an analog display of the value.
18. **Centered Zero.** Displays when the unit is set for bipolar measurement, indicating the zero position on the bargraph.
19.  illuminates when the RS232 port is active. The port is active during a print function or when the instrument is connected to a computer using the **B+K Precision** Model AK-5400 Calibration Kit or Model AK-5450 Data Acquisition Kit.
20. **Left bargraph scale** displays the units for the bargraph at the left end of the scale.
21.  (Dangerous voltage) annunciator illuminates to alert the operator that the instrument is measuring voltages greater than 24 V.
22. **REL** illuminates when the instrument is set to the relative mode (short press of the **REL** button).
23. **MEM** flashes to signify that the instrument has been placed in the autostore mode (long press of the **HOLD** button).
24. **AUTO** indicates that the instrument is in AUTO ranging mode. This is the standard mode for measurements that have more than one range.

## OPERATING INSTRUCTIONS

### WARNING

Use of test equipment may expose the operator to electric shock hazards. Observe all instructions contained in the **TEST INSTRUMENT SAFETY** section of this manual before using this instrument.

### CAUTION

The **TEST INSTRUMENT SAFETY** section of this manual lists maximum voltage and current input limits which must be observed. Failure to adhere to these limits may result in damage to the **INSTRUMENT**.

### NOTE

Throughout this section of the manual, instructions include short and long presses of buttons on the multimeter. A short press means less than one second and a long press means greater than one second.

### TILT HANDLE

The tilt handle can be placed in any of seven positions to make it convenient for carrying or viewing. To change the position of the tilt handle, refer to Figure 13, and press in on the buttons on each handle knob to release the detent. Hold the buttons in and move the handle from the detent position and release the button. Move the handle to another position. The handle snaps into position and the buttons release to lock the handle.

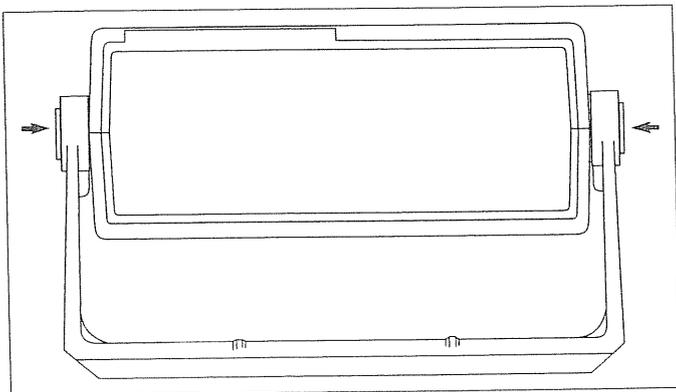


Fig. 13 Tilt Handle Operation

### ON / OFF BUTTON

Turn the unit on by depressing the **ON/OFF** button. All the LCD display segments come on for a few seconds, then only the appropriate annunciators for the selected function stay on. Turn the unit off by depressing and releasing the **ON/OFF** Button.

### PROGRAMMABLE POWERUP OPTIONS

There are several operating modes that can be selected upon powerup. Typically, these modes are infrequently changed and are stored in non-volatile memory so that the selection is retained until reprogrammed.

1. **50 Hz** or **60 Hz** rejection.

Hold down the **MEM** button and place the **ON/OFF** button in the **ON** position. The selection reverses the previous setting, is displayed for two seconds, and is stored in non-volatile memory.

2. **10MΩ / 1000MΩ** input impedance for the **mV** range. (5470 and 5490 only).

Hold down the **RANGE** button and place the **ON/OFF** button in the **ON** position. The selection reverses the previous setting, is displayed for two seconds, and is stored in non-volatile memory.

3. **5,000**-count low-resolution mode.

Hold down the **REL** button and place the **ON/OFF** button in the **ON** position. The display shows 5,000 for two seconds.

### NOTE

The low resolution mode is not stored in non-volatile memory. If the unit is turned on after an **AUTO POWER OFF** with the **SEL** button, the unit powers up in the normal 50,000 count-high-resolution mode.

## FUNCTION SELECTION

The rotary **Function Switch** selects the primary function such as **VAC**, **mVDC**, **VDC**,  $\Omega$ ,  $\pm$ . All the **Function Switch** positions are dual or multi-functional with the primary function for each position indicated by **WHITE** labeling. The secondary functions for each position are indicated with **YELLOW** labeling, and are accessed with a press of the yellow **SEL** button. For example, when the rotary Function is set to the **10A DC** position, the DC current function is selected. A press of the yellow **SEL** button puts the unit into the 10A AC (RMS) position, ready to measure AC currents with capacitive coupling. The AC annunciator illuminates on the LCD display. A second press of the **SEL** button puts the unit into the 10A AC+DC (TRMS) position, ready to measure AC currents with direct coupling. The AC+DC annunciator illuminates on the LCD display. A third press of the **SEL** button returns the unit back to the primary 10A DC function.

## RANGE SELECTION

1. The **AUTO** ranging mode is automatically selected when the unit is turned on and whenever the rotary **Function Switch** is set to a new position (does not apply to single range functions such as mVDC, 10ADC or all the current ranges of the 5460).
2. A short press of the **RANGE** button changes the instrument to the **MANUAL** ranging mode. The **AUTO** annunciator of the LCD display turns off confirming the action. A short press advances the unit to the next higher range. Subsequent short presses advances the unit until the highest range is reached, then the next short press advances the unit to the lowest range.
3. A long press of the **RANGE** button at any time returns the unit to the **AUTO** ranging mode.
4. If the quantity to be measured is unknown, start with the highest range in the **MANUAL** mode, or use the **AUTO** ranging mode.
5. When an overrange is indicated (OL and beep), switch to the next higher range or until an on-scale measurement can be taken.

## ANALOG BARGRAPH, ZOOM

The 34 segment analog bargraph feature is activated for measurements of voltage, current, resistance, frequency, and capacitance. Its update speed of 20 measurements/second 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.

The **ZOOM** feature (5470 and 5490 only) expands the scale of bargraph around the measured digital reading to greatly enhance viewing fast changes. A short press of the **ZOOM** button increases this scale. Subsequent short presses keep expanding this scale until it returns back to its original

full scale value. A long press of the **ZOOM** button at any time returns the bargraph back to full scale.

## MEM MODE (AUTOSTORE)

The **MEM** button allows the user to freeze the current display or enable the **MEM** (Autostore) mode. A short press freezes the current display. A second short press releases the display.

The Autostore mode is used to obtain a stable voltage measurement when the user cannot look at the display and the measurement point simultaneously. Autostore is accessible in the **VDC**, **mVDC**, or **VAC** positions of the **Function Switch**.

1. A long press of the **HOLD** button sets the unit to the Autostore mode. The **MEM** annunciator flashes to confirm the selection.
2. Connect the test leads to the point to be measured. A beep indicates that the measurement is stable.
3. When the leads are removed from the test point, a second beep indicates that the reading has been stored, and the value can be viewed on the LCD display.
4. A second long press of the **MEM** button returns the unit to its normal mode.

## RELATIVE MEASUREMENTS

When the **REL** button is pressed, the present reading becomes the zero reference and all subsequent readings are displayed relative to this value. A second short press disables the mode and returns the unit back to its normal mode. When in the **REL** mode, a long press displays the reference being used. The reference value may then be adjusted using the **SEL** and **RANGE** buttons. The **SEL** button is used to select the digits and the sign, while the **RANGE** button is used to increment the selected digit. A short press of the **REL** button returns the unit to the relative measurement mode. Another short press returns the unit back to its normal mode.

## PEAK HOLD MEASUREMENTS

Fast (<1 ms) positive and negative peak measurements can be made when the rotary **Function Switch** is set to **VDC**, **mVDC**, **mADC**, and **10ADC**. A short press of the **PK +/-** button puts the unit into the positive peak detection mode, and changes the unit from the **AUTO** ranging mode to the **MANUAL** ranging mode, locking the unit on the range. If the potential peak is greater than full scale of the selected range, use the **RANGE** button to set the unit to the next higher range, or until an on-scale measurement is possible. The  $\Lambda$  annunciator of the LCD display confirms the selection. If a negative peak detection is anticipated, press the **PK +/-** button a second time. The  $\nabla$  annunciator of the LCD display confirms the selection. To return the unit back to its normal mode, press the **PK +/-** button again.

## SURV or MIN / MAX / AVG MODE (5470 and 5490 only)

The surveillance mode is useful for recording the variation of the quantity (voltage, current, resistance, capacitance, etc.) being measured by the unit. Activation of the SURV mode locks the unit into its present range and deactivates the AUTO POWER OFF feature. If the unit is in the AUTO ranging mode, it changes to the MANUAL ranging mode. A long press of the SURV button enables or disables the recording mode. Short presses display current values of MIN, MAX, or AVG measurements. The annunciators flash with each selection.

The measurements are stored even when the SURV mode is disabled or the unit power is shut OFF. Short presses of the SURV button allow the MIN, MAX, or AVG values to be viewed. A long press enables the SURV mode and clears the previous values.

## VOLTAGE MEASUREMENTS (AC, DC, AC+DC)

1. To measure DC voltage, set the rotary **Function Switch** to the VDC position. If the voltage is known to be less than 500 mV, the **Function Switch** may be set to mVDC.
2. To measure AC+DC (TRMS) voltage with direct coupling, press the yellow **SEL** button with the rotary **Function Switch** in the VDC position.
3. To measure AC (RMS) voltage with capacitive coupling, set the rotary **Function Switch** to the VAC position.
4. Connect the red test lead to the  $V\Omega\text{H}\rightarrow$  jack and the black test lead to the **COM** jack.
5. Connect the test leads to points of measurement.
6. For DC measurements, a (–) sign is displayed for negative polarity; (+) positive polarity is implied and is not displayed. The V annunciator is displayed.
7. For AC measurements, the AC annunciator is displayed, and for AC+DC measurements, the AC+DC annunciator is displayed.

## CURRENT MEASUREMENTS (AC, DC, AC+DC)



*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 meter or equipment under test.*

1. To measure DC current, set the rotary **Function Switch** to the desired **mADC** or **10ADC** position.
2. For current measurements under 500 mA, connect the red test lead to the **mA** jack and the black test lead to the **COM** jack. For current measurements over 500 mA, connect the red test lead to the **A** jack and the black test lead to the **COM** jack.
3. To measure AC (RMS) current with capacitive coupling, ensure that the **Function Switch** is in the **mADC** or **10A DC** position and press the yellow **SEL** button once. The **AC** annunciator illuminates.
4. To measure AC+DC (TRMS) current with direct coupling, ensure that the **Function Switch** is in the **mADC** or **10ADC** position, and press the yellow **SEL** button a second time. The **AC+DC** annunciator illuminates.
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.

## RESISTANCE MEASUREMENTS

### WARNING

*To ensure operator safety, never connect leads to a live circuit when taking resistance measurements.*

1. To measure resistance, set the **Function Switch** to the  $\Omega$  position.
2. Connect the red test lead to the  $V\Omega\text{H}\rightarrow$  jack and the black test lead to the **COM** jack.
3. Connect the test leads to points of measurement.
4. For highest accuracy when measuring low resistance, press the **RANGE** button to set the unit to the 500 range, short the test leads together, and press the **REL** button. This zeros the meter to compensate for the resistance of the test leads.
5. For accurate measurements above 5 M $\Omega$ , use shielded test leads.

## CONTINUITY MEASUREMENTS

### WARNING

*To ensure operator safety, never connect leads to a live circuit when taking resistance measurements.*

1. To measure continuity, set the **Function Switch** to the  $\Omega$  position, and then press the yellow **SEL** button. The  $\Omega$  annunciator illuminates.
2. Connect the red test lead to the  $V\Omega$  jack and the black test lead to the **COM** jack.
3. Connect the test leads to points of measurement. The buzzer sounds when the resistance is less than approximately 20  $\Omega$ .

## DIODE TESTING

1. Set the **Function Switch** to the  $\rightarrow$  (capacitance) position, and then press the yellow **SEL** button. The  $\rightarrow$  annunciator illuminates.
2. Connect the red test lead to the  $V\Omega$  jack and the black test lead to the **COM** jack. The red lead is (+) positive polarity.
3. To check forward voltage ( $V_f$ ), connect the red lead to the anode and the black lead to the cathode. Diodes and semiconductor junctions with normal  $V_f$  of less than approximately 2 V can be checked.
4. The display indicates the forward voltage. Normal diode voltages are approximately 0.3–0.4 V for germanium diodes, 0.6–0.7 V for silicon diodes, and 1.6 V for light emitting diodes (LED). A shorted diode reads near 0 V. An open diode reads the same as with open leads.
5. Reverse the test lead connections to the diode. The reading should be the same as with open test leads. A lower reading indicates a leaky diode.

## CAPACITANCE MEASUREMENTS

### WARNING

*Discharge all capacitors before taking any measurements. Damage to the instrument and injury to the operator could occur. To ensure operator safety, never connect the leads to a live circuit.*

1. Set the **Function Switch** to the  $\rightarrow$  (capacitance) position.
2. Connect the red test lead to the  $V\Omega$  jack and the black test lead to the **COM** jack.

3. Connect the test leads to the capacitor. Observe polarity when measuring polarized capacitors. the red lead is (+) positive polarity.
4. Read the capacitance from the display. A shorted capacitor will indicate an overrange. An open capacitor will indicate near zero on all ranges.
5. For maximum accuracy, press the **RANGE** button to step to the desired range in MANUAL ranging, then press the **REL** button to zero the test lead capacitance before taking measurements. Always use the **REL** button for readings in the 50 nF range.

USEFUL CONVERSIONS		
pF	nF	$\mu$ F
1,000	1.0	0.001
10,000	10.0	0.01
100,000	100.0	0.1
1,000,000	1,000.0	1.0
	10,000.0	10.0
	100,000.0	100.0

pF = picofarads ( $10^{-12}$ )

nF = nanofarads ( $10^{-9}$ )

$\mu$ F = microfarads ( $10^{-6}$ )

## FREQUENCY MEASUREMENTS

Frequency measurement may be made when taking voltage measurements for all multimeters, and for the 5490 and 5470, while taking current measurements as well.

### NOTE

Connect the red test lead to the appropriate current input jack if the **Function Switch** is set to mADC or 10A DC on the models 5470 and 5490.

1. Connect the red test lead to the  $V\Omega$  jack and the black test lead to the **COM** jack.
2. Connect the test leads to points of measurement.
3. To measure frequency with model 5460, follow the procedure for taking voltage measurements. While the voltage measurement is displayed, press the yellow **SEL** button once. The frequency is then shown on the display.
4. To measure frequency with models 5470 and 5490, follow the procedure for taking voltage or current measurements. While the measurement is displayed, press the **Hz** button once. The frequency is then shown on the display.

## dBm MEASUREMENTS (5470 and 5490 only)

- To measure dB in the models 5470 and 5490, set the **Function Switch** to the **VAC** position, then press the **SEL** button once. The dB annunciator appears.

### NOTE

The reference impedance for dBm measurements is selectable from 1  $\Omega$  to 9999  $\Omega$ . If no selection is made, the instrument defaults to a 600  $\Omega$  selection. To change from the 600  $\Omega$  setting, use the following procedure:

- Long press the **ZOOM** button. The impedance reference is displayed.
  - Press the **SEL** button once to select the digit to set.
  - Press the **RANGE** button to increment the selected digit.
  - Press the **SEL** button again to select the next digit to set, and the **RANGE** button to increment digit.
  - When the reference impedance is set, short press the **ZOOM** button to return the unit to **VAC** mode.
- Connect the red test lead to the  $V\Omega\text{Hz}$  jack and the black test lead to the **COM** jack.
  - Connect the test leads to points of measurement.
  - Read dB measurement from the display.

## RESISTIVE POWER MEASUREMENT (5490 only)

- To measure resistive power in VA, set the **Function Switch** to the **VDC** position.
- Press the **SEL** button twice to measure power. The VA annunciator appears.

### NOTE

The reference impedance for resistive power measurements is selectable from 1  $\Omega$  to 9999  $\Omega$ . If no selection is made, the instrument defaults to a 600  $\Omega$  selection. To change from the 600  $\Omega$  setting, use the following procedure:

- Long press the **ZOOM** button. The impedance reference is displayed.
- Press the **SEL** button once to select the digit to set.
- Press the **RANGE** button to increment the selected digit.
- Press the **SEL** button again to select the next digit to set, and the **RANGE** button to increment digit.
- When the reference impedance is set, short press the **ZOOM** button to return the unit to **VAC** mode.

- Connect the red test lead to the  $V\Omega\text{Hz}$  jack and the black test lead to the **COM** jack.
- Connect the test leads to the measurement points.

## DUTY CYCLE MEASUREMENTS

Duty cycle measurements can be taken while voltage measurements are taken for all meters, and while current measurements are taken using the 5490 and 5470.

- To measure % positive duty cycle in the model 5460, set the **Function Switch** to the **VAC** position, and then press the yellow **SEL** button twice. To measure % negative duty cycle, press the yellow **SEL** button a third time. To measure % positive duty cycle in the models 5470 and 5490, set the rotary **Function Switch** to **VAC**, **VDC**, **mVDC**, **mADC**, or **10ADC**, then press the **Hz** button twice. To measure % negative duty cycle, press the **Hz** button a third time.
- To perform duty cycle measurements during current measurements (5470 and 5490 only), connect the red test lead to the appropriate current input jack and the black test lead to the **COM** jack,  
or  
to perform duty cycle measurements during voltage measurements, connect the red test lead to the  $V\Omega\text{Hz}$  jack and the black test lead to the **COM** jack.
- Connect the test leads to points of measurement.
- Read % positive or % negative duty cycle from the display. The % annunciator and either the  $\Lambda$  or  $V$  annunciators indicate the polarity.

## PULSE WIDTH MEASUREMENTS (5490 only)

Pulse width measurements can be taken while taking voltage or current measurements.

- To measure positive width, set the rotary **Function Switch** to **VAC**, **VDC**, **mVDC**, **mADC**, or **10ADC**, then short press the **Hz** button six times. To measure negative pulse width, short press the **Hz** button a seventh time.
- To perform pulse width measurements during current measurements, connect the red test lead to the appropriate current input jack and the black test lead to the **COM** jack,  
or  
to perform pulse count measurements during voltage measurements, connect the red test lead to the  $V\Omega\text{Hz}$  jack and the black test lead to the **COM** jack.
- Connect the test leads to points of measurement.
- Read positive or negative pulse width from the display. The  $\Lambda$  or  $V$  annunciators of the LCD indicate the polarity.

## PULSE COUNT MEASUREMENTS (5490 only)

Pulse count measurements can be taken while taking voltage or current measurements. This is a totalized pulse count from the time of activation until the time of reading.

1. To measure positive pulse count, set the **Function switch** to **VAC**, **VDC**, **mVDC**, **mADC**, or **10ADC**, then short press the **Hz** button four times. To measure negative pulse count. Short press the **Hz** button a fifth time.
2. To perform pulse count measurements during current measurements, connect the red test lead to the appropriate current input jack and the black test lead to the **COM** jack,

or

to perform pulse count measurements during voltage measurements, connect the red test lead to the  $\text{V}\Omega\text{Hz}$  jack and the black test lead to the **COM** jack.

3. Connect the test leads to points of measurement.
4. Read positive or negative pulse counts from the display. The  $\Lambda$  or  $\nabla$  annunciators of the LCD indicate the polarity.

## TEMPERATURE MEASUREMENT (5470 only)

1. To measure temperature in degrees Celsius, set the **Function Switch** to the  $^{\circ}\text{C}$  position. To measure temperature in degrees Fahrenheit, press the **SEL** button.
2. Connect the temperature probe assembly to the  $\text{V}\Omega\text{Hz}$  jack and the **COM** jack.
3. Connect the **B+K Precision** Model TP-5300 temperature probe to the test point.
4. Read the temperature from the display. The  $^{\circ}$  symbol illuminates and right most digit indicates C for Celsius measurement or F for Fahrenheit.

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## MAINTENANCE

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The multimeter requires no maintenance other than replacing blown fuses. The multimeter monitors the condition of the two fuses.

The display shows FUSE 1 if fuse F1 (0.63 A) is blown. The display shows FUSE 2 if fuse F2 (10 A) is blown. If both fuses are blown, the display shows FUSES.

### NOTE

Fuse F1 is tested only when the **Function Switch** is in the  $\mu\text{A}/\text{mA}$  position.

Use the following procedure to replace a blown fuse.

1. Ensure that the ON/OFF button is in the OFF (released) position, and unplug the unit from the power source.
2. Determine which fuse needs to be replaced.
3. Use a screwdriver and turn the fuseholder cap a quarter turn counterclockwise until the fuseholder cap is released.

4. Pull the fuseholder cap out of the fuseholder.
5. Replace the fuse in the fuseholder cap with one of the same type and rating.
6. Insert fuseholder cap with replacement fuse into fuseholder. Press cap in as far as it will go and turn it a quarter turn clockwise to lock.

### INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon **B+K PRECISION** for this service. We maintain a network of **B+K PRECISION** authorized service agencies for this purpose. To use this service, even if the instrument is no longer under warranty, follow the instructions given in the **WARRANTY SERVICE INSTRUCTIONS** portion of this manual. There is a nominal charge for instruments out of warranty.

# SPECIFICATIONS

## NOTES

1. Unless otherwise stated, accuracy specifications apply from 18°C to 28°C.
2. Accuracy Specifications stated as  $n\%R+nD$ , means  $\pm(n\%$  of reading  $+n$  least significant digits).
3. Accuracy Specifications stated as  $n\%FS$ , means  $\pm(n\%$  of Full Scale)

## DC VOLTAGE (Auto/Manual Ranging)

DCV accuracy from 21°C to 25°C (5490).

Ranges	Accuracy			Resolution	Input Impedance
	5490	5470	5460		
500 mV	0.025%R+2D	0.05%R+2D	0.1%R+2D	10 $\mu$ V	10 M $\Omega$ or 1 G $\Omega$ *
5 V	0.025%R+2D	0.05%R+2D	0.1%R+2D	100 $\mu$ V	11 M $\Omega$
50 V	0.025%R+2D	0.05%R+2D	0.1%R+2D	1 mV	10 M $\Omega$
500 V	0.025%R+2D	0.05%R+2D	0.2%R+2D	10 mV	10 M $\Omega$
1000 V	0.025%R+2D	0.05%R+2D	0.3%R+2D	100 mV	10 M $\Omega$

\* (10 M $\Omega$  only on 5460)

Overload Protection:  $\pm$ 1100 V DC+AC peak, beeper sounds if voltage exceeds 1000 V

Transient Protection: 6 kV for 10  $\mu$ s

Normal Mode Rejection: >60 dB, selectable 50 Hz and 60 Hz

Common Mode Rejection: >120 dB, selectable 50 Hz and 60 Hz

## AC VOLTAGE (Auto/Manual Ranging, True RMS)

Modes: AC or AC+DC, selectable

Models 5490 and 5470

Accuracy at greater than 10% of range, 50,000 counts at Full Scale:

Ranges	DC to 1 kHz	1 kHz to 4 kHz	4 kHz to 10 kHz	10 kHz to 30 kHz	30 kHz to 50 kHz	Resolution	Input Impedance
5 V	0.3%R+30D	1%R+30D	2%R+30D	2%R+30D	3%R+30D	100 $\mu$ V	11 M $\Omega$ /100 pF
50 V	0.3%R+30D	1%R+30D	2%R+30D	2%R+30D	3%R+30D	1 mV	10 M $\Omega$ /100 pF
500 V	0.3%R+30D	1%R+30D	2%R+30D	2%R+30D	3%R+30D	10 mV	10 M $\Omega$ /100 pF
750 V	0.3%R+30D	Not specified				100 mV	10 M $\Omega$ /100 pF

50 kHz to 100 kHz (5 V, 50 V, 500 V ranges):  $\pm$ 6% FS typical

Crest Factor: 6

Accuracy Factor: 0.2% for crest factor of 2 to 3  
0.5% for crest factor of 3 to 6

Overvoltage Protection:  $\pm$ 1100V DC+AC peak, beeper sounds if voltage exceeds 750 V

Transient Protection: 6 kV for 10  $\mu$ s

Common Mode Rejection: >80 dB, selectable 50 Hz or 60 Hz

## Model 5460

Accuracy at greater than 10% of range, 5,000 counts at Full Scale:

Ranges	DC to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 20 kHz	20 kHz to 30 kHz	Resolution	Input Impedance
500 mV	1%R+3D	4%R+3D	Not specified			100 $\mu$ V	10 M $\Omega$ /100 pF
5 V	1%R+3D	1%R+3D	2%R+3D	2%R+3D	3%R+3D	1 mV	11 M $\Omega$ /100 pF
50 V	1%R+3D	1%R+3D	2%R+3D	2%R+3D	3%R+3D	10 mV	10 M $\Omega$ /100 pF
500 V	1%R+3D	1%R+3D	2%R+3D	2%R+3D	3%R+3D	100 mV	10 M $\Omega$ /100 pF
750 V	1%R+3D	Not specified				1 V	10 M $\Omega$ /100 pF

Crest Factor: 3

Accuracy Factor: 1.0% for crest factor of 1.5 to 2  
4.0% for crest factor of 2 to 3.

Overvoltage Protection:  $\pm$ 1100 V DC+AC peak, beeper sounds if voltage exceeds 750 V

Transient Protection: 6 kV for 10  $\mu$ s

Common Mode Rejection: 80 dB, selectable 50 Hz or 60 Hz

## DC CURRENT (Auto/Manual Ranging)

Ranges	Accuracy		Resolution	Max Burden Voltage
	5490, 5470	5460		
500 $\mu$ A	0.2%R+5D	Not Available	10 nA	700 mV
5 mA	0.2%R+2D	0.2%R+2D	100 nA	700 mV
50 mA	0.05%R+2D	0.2%R+2D	1 $\mu$ A	700 mV
500 mA	0.2%R+2D	0.2%R+2D	10 $\mu$ A	1.5 V
10 A	0.5%R+2D	0.5%R+2D	1 mA	500 mV

Overload Protection: 630 mA, 600 V fuse for mA ranges, interrupts 1500 A  
10 A, 600 V fuse for 10 A range, interrupts 50,000 A  
Display indicates blown fuse F1, F2 or FUSES

## AC CURRENT (Auto/Manual Ranging, True RMS)

Models 5490 and 5470.

Accuracy at greater than 10% of range, 50,000 counts at Full Scale:

Ranges	DC to 1 kHz	1 kHz to 10 kHz	10 kHz to 20 kHz	20 kHz to 30 kHz	Resolution	Max Burden Voltage
500 $\mu$ A	0.75%R+50D	0.75%R+50D	1.0%R+50D	3.0%R+50D	10 nA	700 mV
5 mA	0.6%R+50D	0.6%R+50D	1.0%R+50D	2.0%R+50D	100 nA	700 mV
50 mA	0.6%R+50D	0.6%R+50D	1.0%R+50D	2.0%R+50D	1 $\mu$ A	700 mV
500 mA	0.7%R+50D	0.7%R+50D	Not specified		10 $\mu$ A	1.5 V
10 A	1% of FS	Not specified			1 mA	500 mV

Crest Factor: 6

Accuracy Factor: 0.2% for crest factor of 2 to 3  
0.5% for crest factor of 3 to 6

Overload Protection: 630 mA, 600 V fuse for mA ranges, interrupts 1500 A  
10 A, 600 V fuse for 10 A range, interrupts 50,000 A  
Display indicates blown fuse F1, F2, or FUSES

Model 5460. Accuracy at greater than 10% of range. 5,000 counts at Full Scale:

Ranges	DC to 5 kHz	Resolution	Max Burden Voltage
5 mA	1.0%R+3D	1 $\mu$ A	700 mV
50 mA	1.0%R+3D	10 $\mu$ A	700 mV
500 mA	1.0%R+3D	100 $\mu$ A	1.5 V
10 A	1% of FS	10 mA	500 mV

Crest Factor: 3  
 Accuracy Factor: 1.0% for crest factor of 1.5 to 2  
 4.0% for crest factor of 2 to 3  
 Overload Protection: 630 mA, 600 V fuse for mA ranges.  
 interrupts 1500 A  
 10 A, 600 V fuse for 10 A range.  
 interrupts 50,000 A  
 Display indicates blown fuse F1, F2, or FUSES

**RESISTANCE (AUTO/MANUAL RANGING)**

Ranges	Accuracy 5490, 5470	Accuracy 5460	Resolution	Test Current
500 $\Omega$	0.07%R+5D	0.1%R+5D	10 m $\Omega$	1 mA
5 k $\Omega$	0.07%R+2D	0.1%R+2D	100 m $\Omega$	100 $\mu$ A
50 k $\Omega$	0.07%R+2D	0.1%R+2D	1 $\Omega$	10 $\mu$ A
500 k $\Omega$	0.07%R+2D	0.1%R+2D	10 $\Omega$	1 $\mu$ A
5 M $\Omega$ *	0.3%R+2D	0.3%R+2D	100 $\Omega$	100 nA
50 M $\Omega$ *	1.0%R+2D	1.0%R+2D	1 k $\Omega$	10 nA

Max Open Circuit Voltage: 7V  
 Overload Protection: 600V DC+AC peak  
 \* Use shielded test leads above 5 M $\Omega$ .

**CONTINUITY**

Threshold: 10  $\Omega$  to 20  $\Omega$   
 Response Time: 1 ms  
 Overload Protection: 600 V DC+AC peak

**DIODE TEST**

Measures forward voltage drop of diode 0 to 1.999V  
 Test current: 1 mA  $\pm$ 20%  
 Overload Protection: 600V DC+AC peak

**CAPACITANCE (Auto/Manual Ranging)**

Accuracy, 5,000 counts at Full Scale:

Ranges	Accuracy		Resolution	Measurement Current	Max Measurement Time
	5490, 5470	5460			
50 nF	1.0%R+2D	1.0%R+2D	10 pF	100 nA	0.5 sec.
500 nF	1.0%R+2D	1.0%R+2D	100 pF	1 $\mu$ A	0.5 sec.
5 $\mu$ F	1.0%R+2D	1.0%R+2D	1 nF	10 $\mu$ A	0.5 sec.
50 $\mu$ F	1.0%R+2D	1.0%R+2D	10 nF	100 $\mu$ A	0.5 sec.
500 $\mu$ F	1.0%R+2D	1.0%R+2D	100 nF	1 mA	1.5 sec.
5000 $\mu$ F	1.0%R+2D	2.0%R+2D	1 $\mu$ F	1 mA	3 sec / mF
50 mF	1.0%R+2D	2.0%R+2D	10 $\mu$ F	1 mA	3 sec / mF

Overload Protection: 600V DC+AC peak

**FREQUENCY (Autoranging)**

Frequency Range: 0.6 Hz to 500 kHz  
 Accuracy:  $\pm$ (0.03% rdg + 1 dgt)  
 Sensitivity:

Range	500 mV (5490, 5470)	5 V to 500 V 500 $\mu$ A to 500 mA	750 V	10 A (5490, 5470)
0.6 Hz to 5 kHz	2% of FS	2% of FS	100 V	2 A
5 kHz to 50 kHz	5% of FS	5% of FS	250 V	
50 kHz to 500 kHz	Not Specified	10% of FS	Not Specified	

**PEAK HOLD**

Selection: Peak + or Peak - (surge or sag)  
 Acquisition Time: <1 ms  
 Applicable Modes: VDC, mVDC, mADC, 10ADC  
 Accuracy: For pulse >1ms, (1% reading + 50 digits)

**dB MEASUREMENT (5490 and 5470)**

Measures value relative to a reference from 1 to 9999  $\Omega$ . Factory preset for reference is 600  $\Omega$ . Refer to dBm measurement procedure to set impedance.

Accuracy in dB: 0.09 x VAC accuracy in percent  
 Resolution:  $\pm$ 0.01 dB  
 Measurement range: 10 mVAC to 750 VAC

**DUTY CYCLE**

Modes: Selectable %+, %-  
 Resolution: 0.01%  
 Minimum pulse width: 2  $\mu$ s  
 Maximum pulse period: 0.8 s  
 Minimum pulse period: 100  $\mu$ s  
 Accuracy: Same as FREQUENCY mode

**EVENT COUNTER (5490)**

Range: 0 to 99999 (totalize)  
 Minimum pulse duration: 2  $\mu$ s  
 Reset: Relative key  
 Sensitivity: 3% of range (excludes 750 V, 10 A ranges)

**PULSE WIDTH (5490)**

Modes: Selectable + or -  
 Resolution: 10  $\mu$ s  
 Minimum pulse width: 20  $\mu$ s  
 Maximum pulse period: 12.5 s  
 Accuracy:  $\pm$ (0.01% + 10  $\mu$ s)  
 Sensitivity: 3% of range (excludes 750 V, 10 A ranges)

**TEMPERATURE (5470)**

Using Model TP-5300 Platinum Temperature Probe  
 Temperature Range: -200 $^{\circ}$ C to +800 $^{\circ}$ C  
 Resolution: 0.1 $^{\circ}$ C  
 Accuracy: -125 C to +75 C: 0.5 $^{\circ}$ C  
 -150 C to +700 C: 1.0 C  
 Display:  $^{\circ}$ C or  $^{\circ}$ F, selectable

**COMPUTER INTERFACE (5470 and 5490)**

RS-232 capability built-in Requires AK-5400 or AK-5450 hardware/software kit for interconnection to computer or printer.

**GENERAL SPECIFICATIONS**

Display: 50,000 count LCD. 20-mm digit height. 34-segment analog bargraph. Annunciators for function and unit of measurement.

**GENERAL SPECIFICATIONS**

Display: 50,000 count LCD, 20-mm digit height.  
 34-segment analog bargraph.  
 Annunciators for function and unit of measurement.

Measurement Rate: 2 per second, 20 per second for bargraph.

Environmental:

Operation: 0° to 50°C  
 0 to 80% RH to 40°C  
 0 to 70% RH to 50°C

Limited Operation: -10°C to +60°C, <80% RH

Storage: -40°C to + 70°C without battery

Power Requirement: 110 to 230 Vac ±10%, 50 or 60 Hz

Dimensions (HxWxD): 11-5/8" x 10-5/8" x 3-3/4"  
 (295 mm x 270 mm x 95 mm)

Weight: 3 lb, 8 oz. (1.6 kg)

Safety: IEC1010-1 class 2, 600V cat III, 1000V cat II  
 Live circuit indication above 24 V  
 6 kV transient protection  
 600 V high energy fuses on all current ranges

Shock & Vibration: MIL-T-28800

Case Material: Flame retardant, self extinguishing

EMC: Emission EN55011, class B, susceptibility IEC801-4, level 3, radiation IEC 801-3 (10V/M) level 3

Calibration: One year, recalibration by serial interface without opening case