



eM870M Insulation Multimeter

User Manual

ennoLogic eM870M Insulation Multimeter

Made in China

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1. Precautionary Safety Measures

1.1 Important Note: Limited Liability

Cascadia Innovations is the exclusive distributor of all ennoLogic® products. Except as explicitly stated, Cascadia Innovations is not liable for direct, indirect, incidental, or other types of damages arising out of, or resulting from the use of this product. By using the eM870M you agree to hold ennoLogic® and Cascadia Innovations harmless for any and all consequences of the use of this product or application of data from the use of this instrument.

1.2 Meter Safety Standards

The insulation multimeter eM870M was designed and manufactured according to the safety requirements specified in the IEC61010-1 standard for electronic test instruments and hand-held digital multimeters. Its design and manufacturing comply with Measurement Category 1000V CAT III of IEC 61010-1 and Pollution Degree 2.

The meter conforms to the following European Union directives: 89/336/EEC (Electromagnetic Compatibility EMC), 73/23/EEC (Low Voltage Directive LVD) and 93/68/EEC (CE Mark).

Precautionary Safety Measures



1.3 Warnings

- Before first use of the meter please check if the housing shows any cracks or if any plastic parts are missing, and check whether the test leads are damaged or have any exposed metal. The meter must be used only if there are no problems or damage affecting insulation.
- Please read the operating instructions and safety measures sections in this manual carefully. Using the meter outside the methods specified in this manual may cause damage to the meter or other equipment.
- Do not use the meter or test leads if they appear to be damaged.
- Do not operate the meter around explosive gas, steam, vapor or dust.
- Caution when working with voltages above 60V DC or 30V AC rms, there is the possibility of a shock hazard. Avoid direct body contact with ground during measurement, or with any metal object that may be at ground potential. The body should be kept insulated from ground with dry insulating shoes, insulating pads or insulating clothes.
- When performing measurements with a test probe make sure you grab the probe behind the protective plastic ridge designed to protect your fingers from making accidental contact with the probe tip or circuit.

Precautionary Safety Measures

- Do not attempt to measure voltages above 1000V AC or 1000V DC, the meter may get damaged and/or the operator's safety may be threatened if the maximum limit for voltage measurements is exceeded.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.
- Before installing or replacing the battery, disconnect test leads and/or any connectors from any circuit under test, turn the meter off and remove test leads from the input terminals.
- Use AAA batteries and make sure to insert them with the proper polarity.
- When measuring voltage or current be certain that the test leads are connected to the correct input terminals.
- Any adjustments, maintenance or repair work on the meter should only be performed by qualified personnel.
- If any faults or abnormalities are observed, take the instrument out of service and ensure that it cannot be used until it has been checked out.
- If the meter is not going to be used for an extended period of time, take out the batteries and do not store the meter in high temperature or high humidity environments.

2. Instrument Description

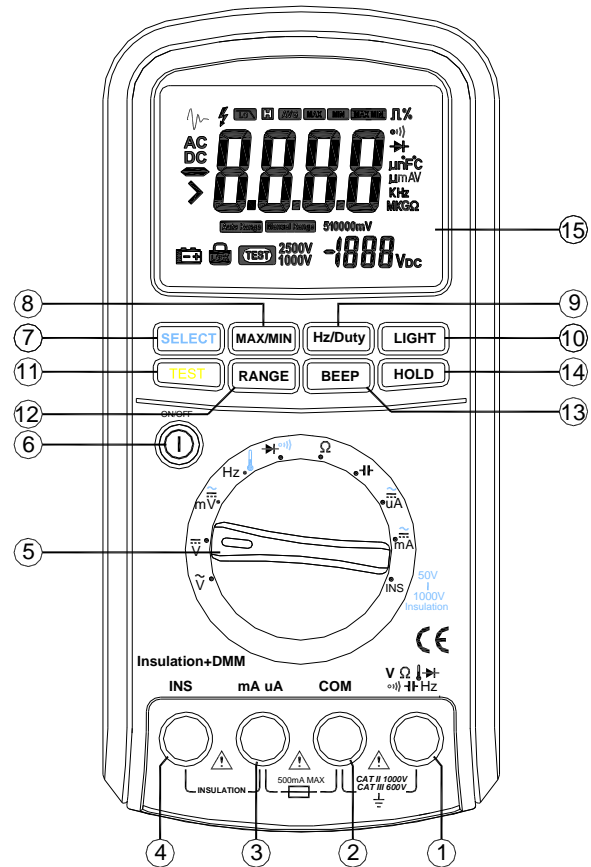
2.1 Features Overview

- 5000 counts digital display
- AC Voltage and DC Voltage measurements up to 1000V
- DC measurement accuracy as low as 0.1%
- High resolution: resistance 0.1 Ω , voltage 10 μ V
- Digital frequency and sinusoidal frequency measurement, as well as duty cycle
- Capacitance measurements, range 0.1nF to 1000 μ F
- AC True RMS measurements
- Maximum and minimum values
- Insulation resistance measurement, range: 50K Ω to 2G Ω
- Automatic shutdown or continuous-ON mode
- Backlight
- Overload protection
- Secondary plastic shell with insulating performance of 1000V CAT III

2.2 Main User Elements

The front panel is shown in Figure 2-1,
 and its user elements are described below:

Figure 2-1



Instrument Description

- (1)  Terminal

Connection terminal for the red (positive) test lead for all measurement functions except for current measurement and insulation resistance measurement. Hereinafter referred to as **V** terminal.

- (2) COM Terminal

Connection terminal for the black (common reference) test lead for all measurements except for insulation resistance measurement.

- (3) mA/μA Terminal

Connection terminal for the red (positive) test lead during mA or μA current measurements. It is also the connection terminal for the black test lead for insulation resistance measurements.

- (4) INS Terminal

Connection terminal for the red test lead during insulation resistance measurements.

- (5) Rotary Switch

Used for selecting measurement functions including AC voltage, DC voltage, millivolt, frequency/temperature, diode/continuity, resistance, capacitance, microamp current, milliamp current, and insulation resistance.

(6) POWER Switch

Press this switch to turn the meter on and off.

(7) SELECT Key

- When the rotary switch is set to position mV, μ A, or mA, press the SELECT key to select either DC or AC mode.
- When the rotary switch is set to position Hz / Temperature, press the SELECT key to select either frequency / duty cycle mode or temperature mode.
- When the rotary switch is set to position Diode / Continuity, press the SELECT key to select either diode or continuity mode.
- For all other measurement functions, pressing this key has no effect.
- To disable the auto power off feature, press and hold the SELECT key while turning the on with the Power switch.

(8) MAX/MIN Key

This key is for measuring maximum, minimum and average values.

1. Press once to enter MAX/MIN/AVG mode.
2. Press again, and the LCD will display the Minimum Value.
3. Press a third time and the LCD will display the Maximum Value.

Instrument Description

4. Press a fourth time and the LCD will display the Average Value.
5. To return to normal measurement mode, press and hold this button for two seconds.

(9) Hz/Duty Key

- When the rotary switch is set to position Hz / Temperature, pressing the HZ/DUTY key will switch between frequency and duty cycle measurement mode.
- When any of the AC voltage or AC current measurement functions are selected, pressing the Hz/DUTY key will turn on the frequency measurement mode. In this mode, the meter will measure and display the frequency of the signal instead of its voltage or current. Press this key again to exit frequency measurement mode.

(10) LIGHT key

Pressing this key briefly will turn on the backlight of the LCD display, and pressing it again will turn it off. The backlight will also turn off automatically after ten seconds.

(11) TEST key

During insulation resistance measurement, press the TEST key to start measuring, and press it again to stop measuring.

(12) RANGE key

- When the temperature measurement function is selected, press the RANGE key to select Celsius or Fahrenheit.

- For V_{\sim} , $V_{\overline{\sim}}$, mV, Ω , $\overline{\text{H}}$, μA and mA measurements, the RANGE key is used to manually select ranges:
 1. Press RANGE to enter the manual ranging mode.
 2. Press RANGE to step through the ranges available for the selected function.
 3. Press and hold RANGE for 2 seconds to return to auto-ranging.
- When measuring digital frequencies or testing diodes, pressing the RANGE key will have no effect.
- When performing insulation resistance measurement, use the RANGE key to manually select a test voltage range. There is no auto-range mode available when measuring insulation resistance.

(13) BEEP Key

When measuring continuity, press the BEEP key to select whether the meter beeps or not when a short is detected.

(14) HOLD Key

Pressing the HOLD key causes the meter to stop updating the display and freezes the current reading. Pressing it again will resume normal measurement mode.

(15) LCD Display

Displays the measurement readings and various modes (described in detail in the following section.)

2.3 LCD Display

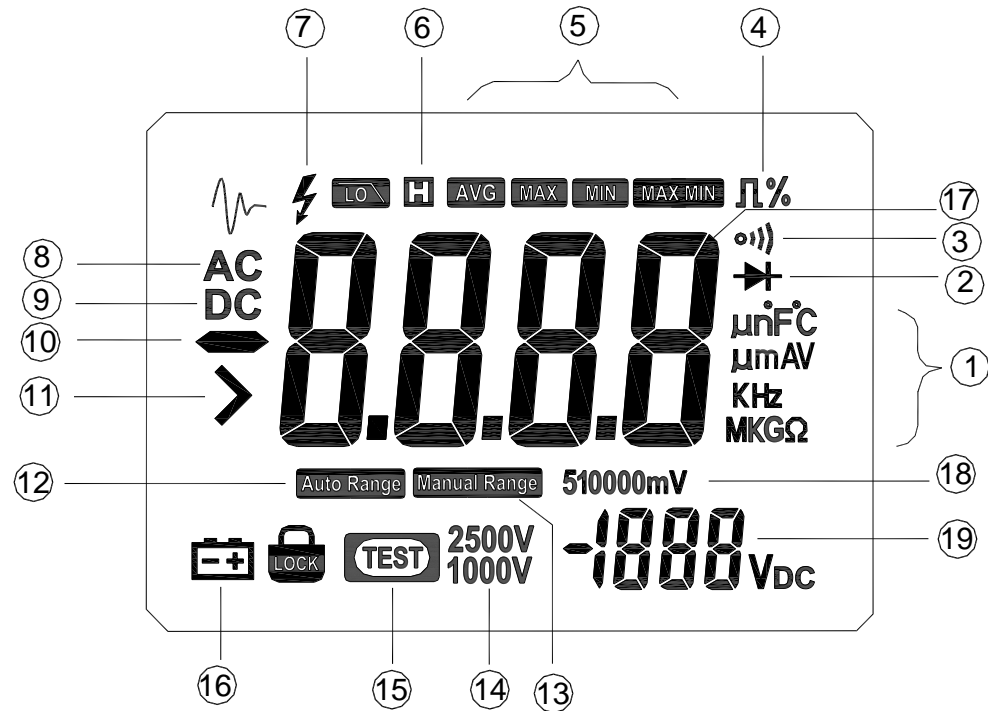










Figure 2—2

Instrument Description

The LCD screen is shown in Figure 2-2 above, and the meanings of the symbols are explained in Table 1 below:

Number of Order	Symbol	Functions
1	$\mu\text{n}^{\circ}\text{F}^{\circ}\text{C}$	Indicates the measurement unit being either $^{\circ}\text{F}$ or $^{\circ}\text{C}$ for temperature, or μF or nF for capacitance
	μmAV	Indicates the measurement unit being either μA or mA for current, or μV and mV for voltage
	KHz	Indicates the measurement unit being either kHz or Hz for frequency
	MKG Ω	Indicates the measurement unit being M Ω , k Ω , G Ω or Ω for resistance
2		The meter is in Diode Test mode.
3		The meter is in Continuity Test mode.
4	$\text{II}\%$	The meter is measuring duty cycle.
5	AVG MAX MIN MAX MIN	The display shows the average value (AVG), maximum value (MAX), minimum value (MIN) or current value (MAX MIN) while in MAX/MIN/AVG mode.
6		The meter is in Data Hold mode.
7		Warning – High Voltage!
8	AC	Indicator for AC voltage or current
9	DC	Indicator for DC voltage or current

Instrument Description

Table 1 (continued)		
10		Indicates negative readings
11		Indicates overload condition when measuring insulation resistance
12	AUTO RANGE	The meter is in Auto range mode in which the meter automatically selects the range with the best resolution.
13	MANUAL RANGE	The meter is in Manual Range mode in which the user manually selects the appropriate measurement range.
14	2500V 1000V	Indicates the applied test voltage when performing insulation resistance measurements (either 50V, 100V, 250V, 500V, or 1000V)
15	TEST	Indicates that an insulation resistance test is now being performed.
16		Low battery indicator
17		Measurement value display area
18	51000	Range indicator when selecting ranges manually such as 5, 50, 500, 1000, 5000, etc.
19	-1888VDC	Real-time display of the applied test voltage when performing insulation resistance measurements

3. Function Descriptions

3.1 General Functions

3.1.1 TRUE RMS Measurement

All AC measurement values are true RMS (true root-mean-square) values. This distinguishes this meter from other meters that only measure average AC values.

3.1.2 Manual ranging and auto range mode

The Meter has both manual ranging and auto range options. It defaults to auto range mode when turned on.

- In auto range mode, the meter selects the best range for the input detected. This allows you to switch test points without having to reset the range.
- In manual ranging mode, you override auto range and lock the meter into a specific range.
- The meter defaults to auto range mode in measurement functions that have more than one range. When the meter is in auto range mode, the symbol “AUTO RANGE” is displayed.
- When the LCD display shows “OL”, it indicates that the measured value exceeds the meter’s maximum range.

Function Descriptions

To enter and exit manual ranging mode:

1. Press the RANGE key. The meter enters manual ranging mode. The LCD symbol “AUTO RANGE” changes to “MANUAL RANGE”. Each press of the RANGE key increments the range, and the display shows the maximum value for the selected range next to the symbol “MANUAL RANGE”. When the highest range is reached, the Meter wraps back to the lowest range.
2. To exit manual ranging mode, press and hold down the RANGE key for two seconds. The Meter returns to the auto range mode and “AUTO RANGE” is displayed.

3.1.3 Maximum, Minimum and Average Value Measurements

Press the MAX/MIN key to enter the maximum/minimum/average value mode. The meter will continuously track and update the maximum, minimum, or average values based on which of the three modes is selected.


After entering this mode, the instantaneous value continues to be displayed. Press the MAX/MIN key again, and the LCD will display the Minimum Value since this mode was entered. Press it a third time and the LCD will display the Maximum Value. Press it a fourth time and the LCD will display the Average Value. Press it one more time to return to displaying the instantaneous value. Press and hold the MAX/MIN key for two seconds and the meter will return to the normal measurement mode. After exiting the MAX/MIN/AVG value mode the recorded maximum, minimum and average values will disappear.

3.1.4 Automatic Shutdown

The Meter enters "Sleep mode" and blanks the display if the Meter is on but not used for 15 minutes. The meter will not automatically shut down while in insulation resistance measurement mode. If you want the meter to operate continuously without automatically turning off, press and hold the SELECT key when pressing the POWER switch to turn the unit on.

NOTE: The meter will still consume a small amount of energy after its automatic shutdown, so it is recommended to turn off the POWER switch if the meter remains idle for a long time, otherwise it will drain the batteries.

3.1.5 Low Battery Voltage Detection

When the meter detects that its battery voltage drops below 6.8V, the LCD will display the  symbol to indicate that the AAA batteries of the meter should be replaced.

3.1.6 Backlight

Press the **LIGHT** key to turn on the backlight of the LCD display. After ten seconds the backlight will automatically turn off. It is also possible to turn it off before that time by pressing the **LIGHT** key again. With the backlight on, the meter's power consumption will be three times higher. Using the backlight sparingly will extend battery life.


3.1.7 Data Hold

Press the **HOLD** key to freeze the currently displayed measurement value. Press it again to resume normal measurement mode.

Function Descriptions

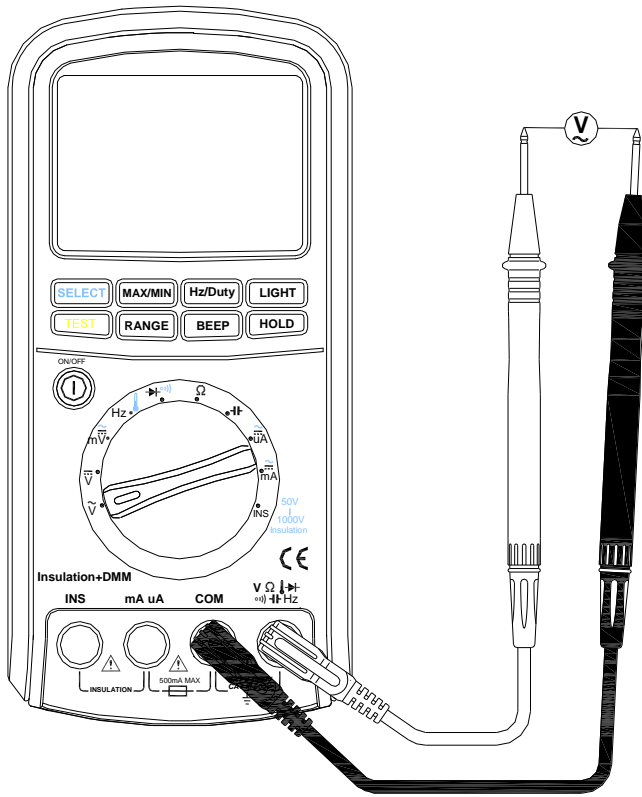
3.2 Measurement Functions

3.2.1 AC Voltage Measurement

To measure AC voltages, set up the meter as shown in Figure 3-1: 

1. Turn on the power switch and set the rotary switch to position **V**.
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. Connect the test leads/probes to the circuit being measured.
4. Read the displayed voltage value. If the meter displays OL, it indicates that the measured voltage exceeds the meter's range (1000V in auto range mode) and the test probes should be disconnected from the measured circuit immediately.
5. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the RANGE key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range. If OL is displayed with the meter set to its maximum voltage range, disconnect the test probes from the measured circuit immediately, since the voltage exceeds 1000V (the maximum AC voltage the meter can measure).

Note: It is normal for the displayed value to be unstable and fluctuate if the test leads are not connected to a circuit.



AC Voltage Measurement

Warning
Do not attempt to
measure voltages
above 1000V!

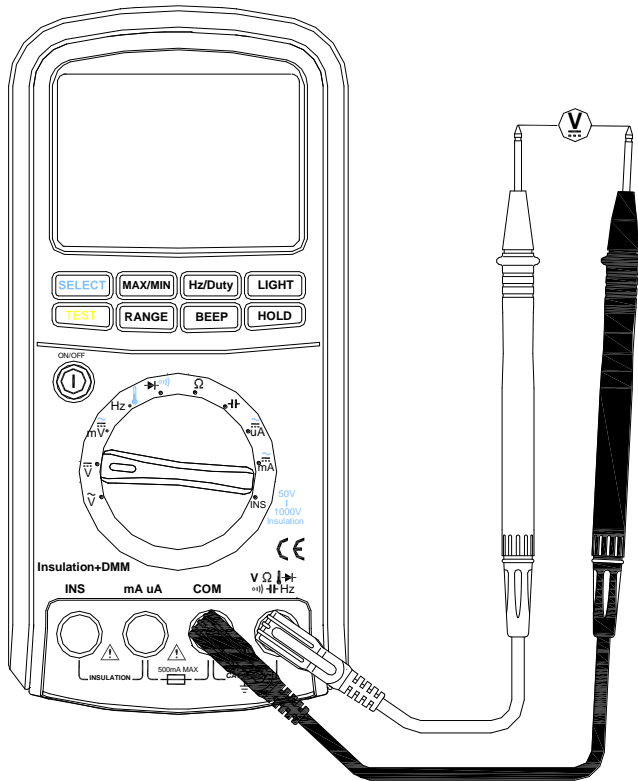
Function Descriptions

3.2.2 DC Voltage Measurement

To measure DC voltages, set up the meter as shown in Figure 3-2:

1. Turn on the power switch and set the rotary-table switch to position $\overline{\text{V}}$.
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. Connect the test leads/probes to the circuit being measured.
4. Read the displayed voltage value. The polarity of the red test lead connection will be shown on the LCD display. If the meter displays OL, it indicates that the measured voltage exceeds the meter's range (1000V in auto range mode) and the test probes should be disconnected from the measured circuit immediately.
5. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the RANGE key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range. If OL is displayed with the meter set to its maximum voltage range, disconnect the test probes from the measured circuit immediately, since the voltage exceeds 1000V (the maximum DC voltage the meter can measure).

Note: It is normal for the displayed value to be unstable and fluctuate if the test leads are not connected to a circuit.




DC Voltage Measurement

⚠ Warning
Do not attempt to
measure voltages
above 1000V!

Function Descriptions

3.2.3 DC mV/AC mV Measurement

To measure small DC and AC voltages up to 500mV, set up the meter as shown in Figure 3-3:

1. Turn on the power switch and set the rotary switch to position .
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. Press the **SELECT** key to select **DC mV** or **AC mV** measurement mode.
4. Connect the test leads/probes to the circuit being measured.
5. Read the displayed voltage value. The polarity of the red test lead connection will be indicated when making a DC Volt measurement. If the meter displays OL, it indicates that the measured voltage exceeds the meter's range in this mode and the test probes should be disconnected from the measured circuit immediately.
6. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the RANGE key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range. If OL is displayed with the meter set to its maximum voltage range, disconnect the test probes from the measured circuit immediately, since the voltage exceeds the maximum voltage the meter can measure in this mode.

Note: It is normal for the displayed value to be unstable and fluctuate if the test leads are not connected to a circuit.

DC mV / AC mV Measurement

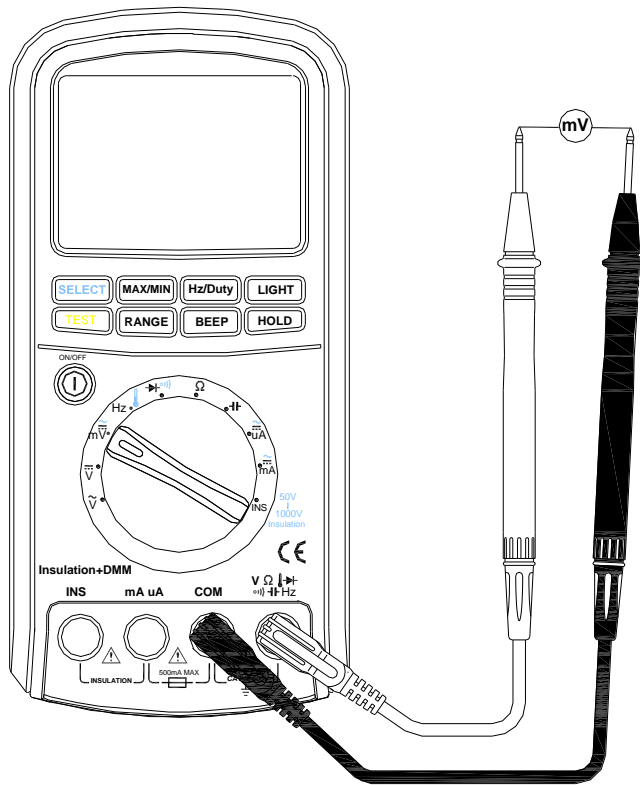



Figure 3-3

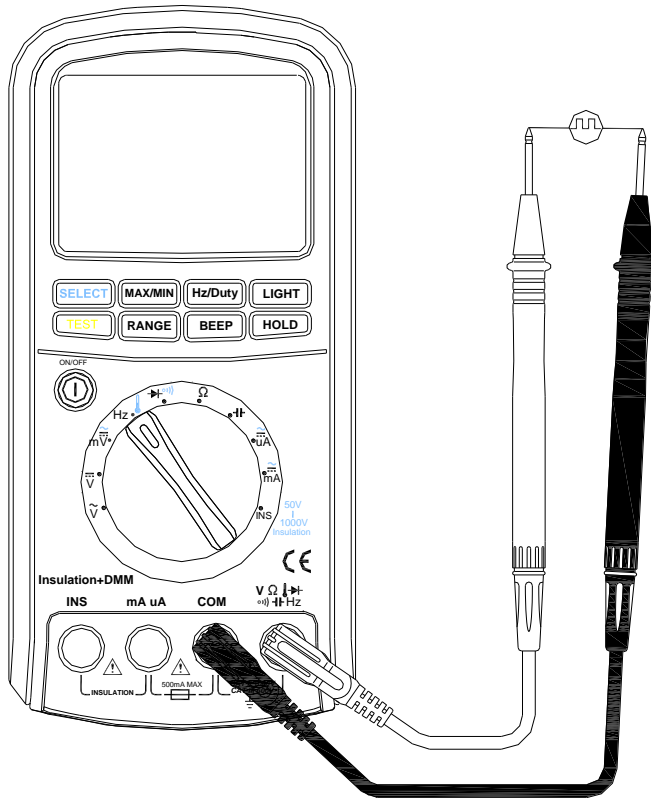
Function Descriptions

3.2.4 Frequency & Duty Cycle of Digital Signals and Temperature Measurements

To measure the frequency or duty cycle of a digital signal, set up the meter as shown in Figure 3-4. Please note that the peak to peak voltage of the digital signal must be between 2.5V and 5V, its frequency in the range of 5Hz ~ 2MHz, and its duty cycle between 5% and 95%. Duty cycle refers to (pulse width of high cycle / total period of rectangular waveform signal) x 100%.

The same rotary switch position and connection terminals are used to measure temperatures with the enclosed thermocouple probe.

1. Turn on the power switch and set the rotary switch to position **Hz**. 
2. When performing frequency and duty cycle measurements of digital signals, insert the test leads into the **VΩHz** and **COM** terminals respectively. When performing temperature measurements, connect the positive/red plug of the thermocouple to the **V** terminal and the negative/black plug to the **COM** terminal.
3. Press the **Hz/Duty** key to select frequency (Hz) or duty cycle ($\Pi\%$ measurement mode).
4. For frequency and duty cycle measurements: connect the test leads/probes to the circuit being measured. Read the displayed value. If the frequency of the measured signal is lower or higher than the meter's measurement range, the display will show zero. If the amplitude of the signal is too low or the low level is larger than 1 Volt, the display will also show zero. Note that the meter will always auto range for frequency and duty cycle measurements. Pressing the **RANGE** key has no effect.
5. For temperature measurements: press the **SELECT** key to select temperature measurement mode. If the meter's input **V** and **COM** terminals are not connected to a thermocouple, the 'OPEN' symbol will be displayed. Connect the positive/red plug of the thermocouple to the **V** terminal and the negative/black plug to the **COM** terminal, and read the displayed temperature value. Press the **RANGE** key to select Celsius or Fahrenheit. If the measured temperature is higher than the meter's measurement range, it will display the internal temperature of the instrument and the 'OL' symbol.






Frequency & Duty Cycle of Digital Signals and Temperature Measurements

Figure 3-4

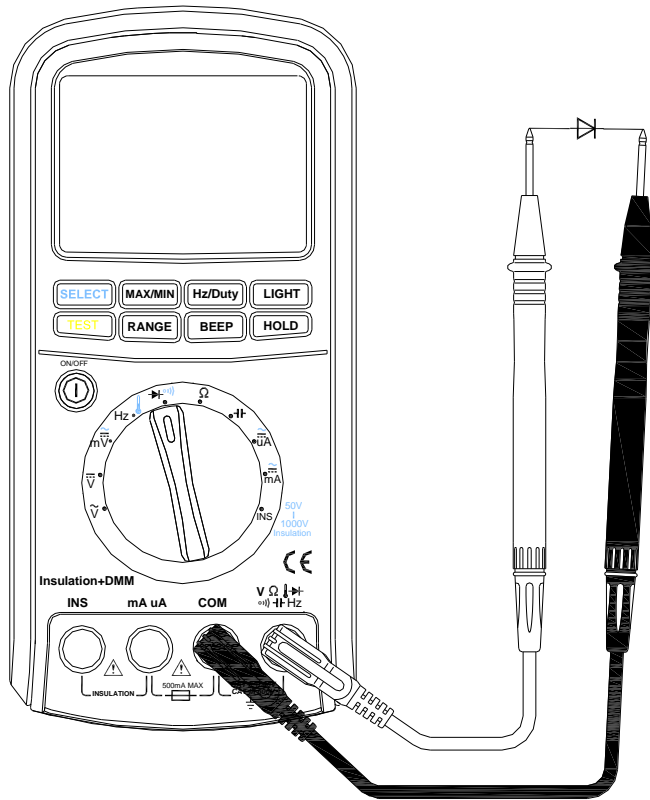
Function Descriptions

3.2.5 Diode and Continuity Tests

To test a diode outside of a circuit, or test for continuity, set up the meter as shown in Figure 3-5:

1. Turn on the power switch and set the rotary switch to position .
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. Press the **SELECT** key to select diode () or continuity () test mode.
4. For diode tests, connect the red probe to the anode of the diode and the black probe to its cathode. The display will show the forward voltage drop (range 0 ~ 2.5V). Next, connect the black probe to the anode of the diode and the red probe to its cathode. “OL” appearing on the display will indicate normal diode function. If the display doesn’t show OL, the diode has a high reverse leakage current.
5. For continuity tests, a resistance between test leads of less than 25Ω is indicated by continuous beeping, assuming the beeper was not disabled by pressing the **BEEP** key. Continuity tests are commonly used to check for opens and shorts of a circuit.

Note: If you are performing diode or continuity tests on a circuit board, it is necessary to turn off the power to the circuit board before measuring. A component tested in-circuit may have other components connected to it in parallel, resulting in different values than if tested outside the circuit or having at least one of its probed leads isolated.



Diode and Continuity Tests

Figure 3-5

Function Descriptions

3.2.6 Resistance Measurement

To measure resistance, set up the meter as shown in Figure 3-6:

1. Turn on the power switch and set the rotary switch to position Ω .
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. Connect the test leads/probes to the two ends of a resistor and read the displayed resistance value. If the display shows OL, it indicates that the resistor is larger than $50M\Omega$ (resistance measurement range is $0.1\Omega \sim 50M\Omega$).
4. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the RANGE key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range.

Note: If you are performing resistance measurements on a circuit board, it is necessary to turn off the power to the circuit board before measuring. A resistor tested in-circuit may have other components connected to it in parallel, resulting in different values than if tested outside the circuit or having at least one of its probed leads isolated. Disconnecting power will also prevent damage to the meter, or false readings that will occur if the resistor is carrying a current induced by a source other than the meter itself.

Resistance Measurement

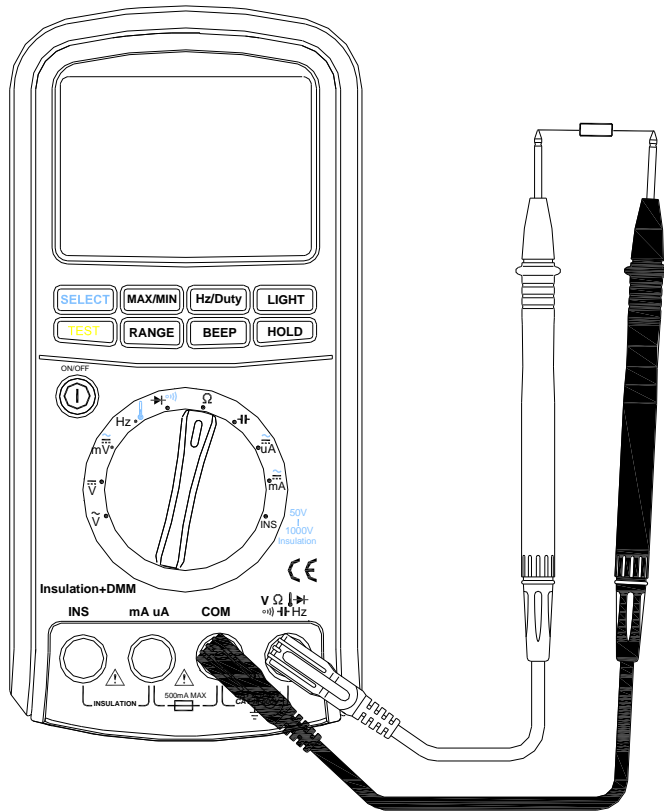



Figure 3-6

Function Descriptions

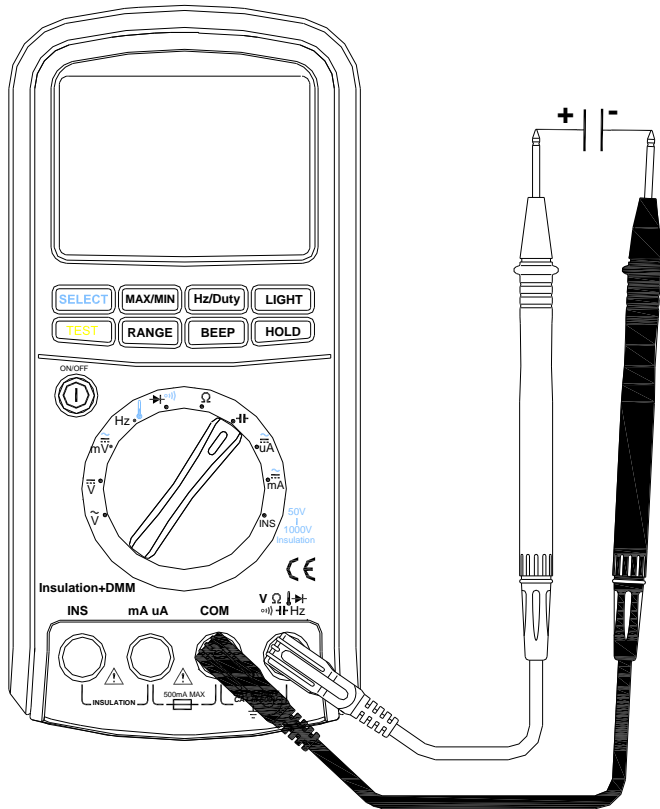
3.2.7 Capacitance Measurement

To measure capacitance, set up the meter as shown in Figure 3-7:

1. Turn on the power switch and set the rotary switch to position .
2. Connect the red and black test leads to the **V** and **COM** terminals respectively.
3. To avoid electric shock and/or damage to the instrument, disconnect power and discharge the capacitor to be measured before measuring capacitance by shorting its two leads briefly. Use the DC voltage function to confirm that the capacitor is discharged.
4. If the measured capacitor is polarized, make sure to connect the red probe to the positive lead of the capacitor and the black probe to its negative lead. If the capacitor is not polarized, simply connect the two probes to the capacitor leads.
5. Read the displayed capacitance value. The capacitance measurement range is 0.1nF ~ 1000μF. If the capacitance value is >1000μF, the meter will display OL, and if it's < 0.1nF, it will display zero.
6. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the **RANGE** key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range. If the largest range has already been selected, OL means the measured capacitance value is > 1300μF.

Notes: In order to ensure measurement accuracy when measuring large capacitors between **500μF and 1000μF**, the meter will take a long time to charge/discharge the capacitor under test. The result is a relatively slow refresh rate of the displayed value.

Do not perform capacitance measurements on components that are part of a circuit board. Other components of the circuit connected to the component under test may lead to large errors.



Capacitance Measurement



Warning

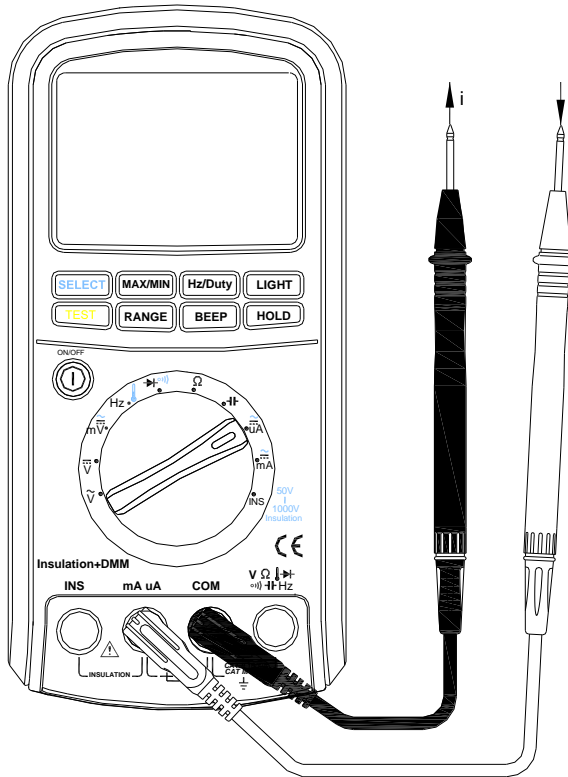
To avoid electrical shock and/or damage to the instrument, disconnect the circuit power and discharge all high-voltage capacitors before measuring capacitance. Use the DC voltage function to confirm that the capacitor is discharged.

Function Descriptions

3.2.8 DC and AC μ A Current Measurement

To measure small DC and AC currents up to 5000 μ A, set up the meter as shown in Figure 3-8:

1. Turn on the power switch and set the rotary switch to position $\cdot \overset{\sim}{\mu}A$.
2. Connect the red and black test leads to the **mA/ μ A** and **COM** terminals respectively.
3. Press the **SELECT** key to select **DC μ A** or **AC μ A** measurement mode.
4. Turn off power to the measured circuit and discharge all high voltage capacitors.
5. Disconnect (break) the circuit path to be tested.
6. Connect or touch the black probe to the negative side of the break and connect or touch the red probe to the positive side of the break. (Reversing the leads will give a negative reading, but will not damage the meter.)
7. Turn on power to the circuit; then read the display. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the **RANGE** key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range.
8. Turn off power to the circuit and discharge all high voltage capacitors. Remove the meter and restore the circuit to normal operation.



DC μA

AC μA


Measurement

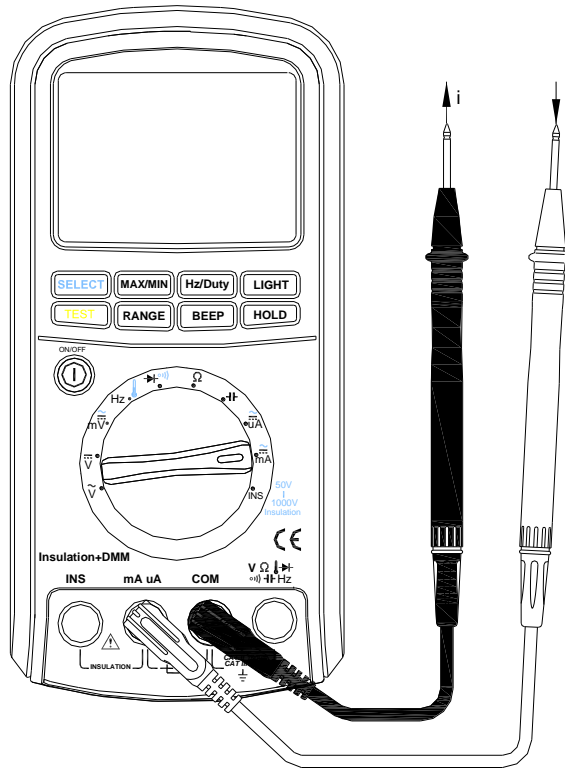
Figure 3-8

Function Descriptions

3.2.9 DC and AC mA Current Measurement

To measure DC and AC currents in the mA range of 0.01mA ~ 500mA, set up the meter as shown in Figure 3-9:

1. Turn on the power switch and set the rotary switch to position .
2. Connect the red and black test leads to the **mA/μA** and **COM** terminals respectively.
3. Press the **SELECT** key to select **DC mA** or **AC mA** measurement mode.
4. Turn off power to the measured circuit and discharge all high voltage capacitors.
5. Disconnect (break) the circuit path to be tested.
6. Connect or touch the black probe to the negative side of the break and connect or touch the red probe to the positive side of the break. (Reversing the leads will give a negative reading, but will not damage the meter.)
7. Turn on power to the circuit; then read the display. By pressing the **RANGE** key, it is possible to select a desired range manually. The display will show what range is currently active, keep pressing the **RANGE** key to cycle through the available ranges. If the meter displays OL while in manual range mode, it is necessary to select a larger range.
8. Turn off power to the circuit and discharge all high voltage capacitors. Remove the meter and restore the circuit to normal operation.



DC mA

AC mA

Measurement

Figure 3-9

Function Descriptions

3.2.10 Insulation Resistance Measurement

To measure insulation resistance, set up the meter as shown in Figure 3-10:

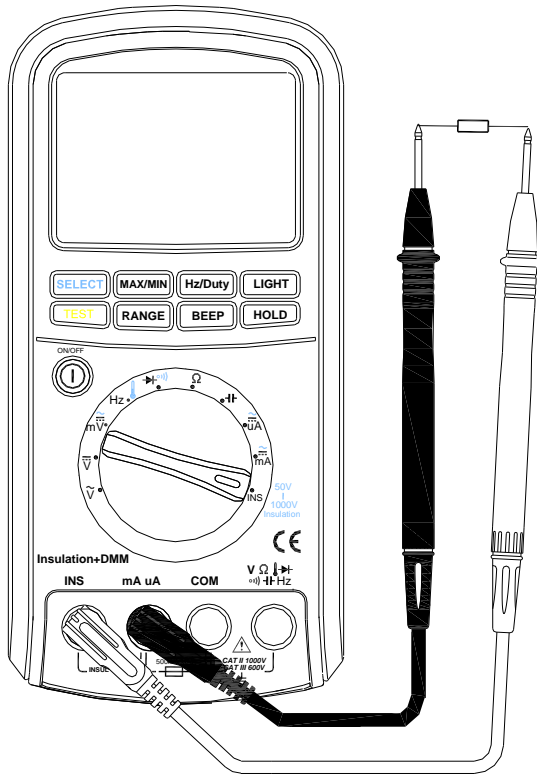
1. Turn on the power switch and set the rotary switch to position **INS**.
2. Connect the red and black test leads to the **INS** and **mA/μA** terminals respectively. (**NOT** to the COM terminal!)
3. Connect the red probe and the black probe to the two ends of the measured insulator. Press the RANGE key to select a suitable test voltage range (50V, 100V, 250V, 500V, or 1000V). The measurement range for insulation resistance corresponds to the available test voltage ranges as follows: 50V---10kΩ~50MΩ, 100V---10kΩ~100MΩ, 250V---100kΩ~250MΩ, 500V---100kΩ~500MΩ, 1000V---100kΩ~2GΩ). Note: There is no auto ranging when performing insulation resistance measurements.



Warning: After pressing the TEST key, the meter will generate a high voltage of up to 1000V! Do not touch the leads or probes when the test is active to avoid the risk of shock!

4. Press the **TEST** key to start measuring. The meter will apply a test voltage to the insulator up to the selected range to determine the insulation resistance. If the measured insulation resistance is lower than the meter's measurement range, the meter will stop measuring automatically and display "UL" (Under Limit). Otherwise the meter will display the result of the test (the insulation resistance). Press the **TEST** key again to stop measuring.

Notes: When using this function, the meter generates a high voltage up to 1000V. Please be careful to avoid the risk of shock. Also note that the automatic shutdown feature is disabled when performing insulation resistance measurements.



Insulation Resistance

Measurement



Warning

When using this function, the meter generates a high voltage of up to 1000V! Do not touch the leads or probes when the test is active to avoid the risk of shock!

Figure 3-10

Function Descriptions

3.2.11 Frequency Measurement of Sinusoidal Signals

To measure the frequency of sinusoidal signals, set up the meter as shown in Figures 3-1, 3-3, 3-8 or 3-9. The measurement range is 5Hz~200KHz:

1. When measuring AC voltages or AC currents, it is possible to measure and display the frequency of the signal by pressing the **Hz/Duty** key. However, the signal must meet certain requirements regarding amplitude depending on the selected measurement range. See Table 3-1 for detailed specifications.
2. If the rotary switch is set to position ACV, after pressing the **Hz/Duty** key the display will show the meter's currently selected voltage range. It is also possible to change the range by pressing the **RANGE** key.
3. Press the **Hz/Duty** key again to exit frequency measurement mode.

Table 3-1

Range	Sensitivity Threshold (RMS sine wave)
500mV	100mV
5V	0.4V
50V	4V
500V	40V
1000V	400V
5000μA	1mA
500mA	100mA

4. Technical Specifications

4.1 General Specifications

- Maximum voltage between terminals and earth ground: 1000V AC rms or 1000V DC.
- Measurement Category 1000V CAT III of IEC 61010-1 and Pollution Degree 2.
- 5000 counts digital display, automatic and manual range.
- Basic sampling rate 2.5 times per second. 51 segment analog bar.
- When the rotary switch is set to position mV, frequency, diode, resistance or capacitance, the maximum overload protection voltage will be 250V (effective value). When set to μ A or mA, the overload protection current will be 0.64A.
- Over range indication OL.
- Fuse Protection: μ A and mA: F 0.63A/600V.
- Power: 6x AAA batteries.
- Low battery voltage indicator, displayed when the total voltage of the 6 AAA batteries is < 6.8V.
- Operating temperature: 0°C ~ 30°C (32°F ~ 86°F): relative humidity 0 ~ 80%; 31°C ~ 51°C (87°F ~ 124°F): relative humidity 0 ~ 50%
- Storage temperature: -20°C ~ 60°C (relative humidity <= 80%)
- Altitude: Operation at less than 2000 m, Storage at less than 10,000 m
- Volume: 200 mm x 100 mm x 40 mm (7.90" x 3.9" x 1.6")
- Weight: 560g (1.23lbs.)

Technical Specifications

4.2 Measurement Specifications

The accuracies listed below are guaranteed within one year of use under normal operating conditions at temperatures between 18°C and 28°C (64°F and 82°F) and a relative humidity of less than 80%. The accuracy is stated as: \pm (xx % of reading + x number of lower digits).

4.2.1 AC Voltage

Range	Resolution	Accuracy
		40Hz~400Hz
500mV	0.1mV	$\pm(0.8\% +4)$
5V	1mV	$\pm(0.8\% +4)$
50V	10mV	$\pm(0.8\% +4)$
500V	0.1V	$\pm(0.8\% +4)$
1000V	1V	$\pm(1.0\% +4)$

Notes: above accuracies can be guaranteed within 10% ~ 100% of the full range.

4.2.2 DC Voltage

Range	Resolution	Accuracy
500mV	0.1mV	$\pm(0.1\% +2)$
5V	1mV	$\pm(0.1\% +2)$
50V	10mV	$\pm(0.1\% +2)$
500V	0.1V	$\pm(0.1\% +2)$
1000V	1V	$\pm(0.1\% +2)$

Notes: above accuracies can be guaranteed over the full range

Technical Specifications

4.2.3 AC Current

Range	Resolution	Accuracy	Voltage Drop
		40Hz~400Hz	
500μA	0.1μA	±(0.8% +4)	102μV/μA
5000μA	1μA	±(0.8% +4)	
50mA	10μA	±(0.8% +4)	1.5mV/mA
500mA	0.1mA	±(0.8% +4)	

Notes: above accuracies can be guaranteed within 10% ~ 100% of the full range

4.2.4 DC Current

Range	Resolution	Accuracy	Voltage Drop
500μA	0.1μA	±(0.2% +2)	102μV/μA
5000μA	1μA	±(0.2% +2)	
50mA	10μA	±(0.2% +2)	1.5mV/mA
500mA	0.1mA	±(0.2% +2)	

Notes: above accuracies can be guaranteed over the full range

4.2.5 Resistance

Range	Resolution	Accuracy
500Ω	0.1Ω	±(0.3% +5)
5KΩ	1Ω	±(0.3% +5)
50KΩ	10Ω	±(0.3% +5)
500KΩ	100Ω	±(0.3% +5)
5MΩ	1KΩ	±(0.3% +5)
50MΩ	10KΩ	±(0.8% +5)

Notes: above accuracies can be guaranteed over the full range

Technical Specifications

4.2.6 Capacitance

Range	Resolution	Accuracy
50nF	0.01nF	±(2.5% +10)
500nF	0.1nF	±(2.5% +10)
5μF	1nF	±(2% +10)
50μF	10nF	±(2% +10)
500μF	0.1μF	±(2% +10)
1000μF	1μF	±(3% +10)

Notes: above accuracies can only be guaranteed over the full range for film capacitors or capacitors of better quality.

For other capacitor types the accuracy is +/-10%.

4.2.7 Diode

Range	Resolution	Accuracy
2.5V	1mV	±(1%+5)

Notes: the test current is approximately 0.7mA

4.2.8 Frequency of Square Waveforms

Frequency Range	Sensitivity	Resolution	Accuracy
5Hz~2MHz	V _p 2~5V square wave	0.001Hz	±4counts

4.2.9 Temperature

Frequency Range	Resolution	Accuracy
-40°C ~ 537°C	0.1°C	±(1% +1.5°C)

4.2.10 Frequency of Sinusoidal Signals

Frequency Range	Voltage/Current Range	Sensitivity	Resolution	Accuracy
5Hz~200KHz	500mV	200mV	0.001Hz	±4 counts

Technical Specifications

(sine wave)	5V	0.5V		
	50V	4V		
	500V	40V		
	1000V	400V		
	5000 μ A	1mA		
	500mA	100mA		

Notes: The accuracy will be reduced for signals with low voltage or low frequency.

4.2.11 Duty Cycle

Frequency Range	Duty Cycle Range	Resolution	Accuracy
5Hz~500KHz	5% ~ 95%	0.01%	$\pm 0.02\%$

4.2.12 Insulation Resistance

Test Voltage	Resistance Range	Resolution	Accuracy
50V	50K~10M	0.01M Ω	$\pm(3\% +5)$
	10M~50M	0.1 M Ω	
100V	100K~10M	0.01M Ω	$\pm(3\% +5)$
	10M~100M	0.1 M Ω	
250V	250K~100M	0.1M Ω	$\pm(1.5\% +5)$
	100M~250M	1M Ω	
500V	500K~100M	0.1M Ω	$\pm(1.5\% +5)$
	100M~500M	1M Ω	
1000V	1M~100M	0.1M Ω	$\pm(1.5\% +5)$
	100M~2G	1M Ω	

5. Maintenance

This section provides basic maintenance information, including fuse and battery replacement instructions.

Do not attempt to repair or service your meter unless you are qualified to do so and have the relevant calibration, performance test, and service information.

5.1 General Maintenance




To avoid electrical shock or damage to the meter, do not get water inside the case. Remove the test leads and any input signals before opening the case.

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Dirt or moisture in the terminals can affect readings.

Stop using this instrument if you find any defects.

5.1 Battery Replacement

To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the battery indicator () appears.

Before installing or replacing the batteries, disconnect test leads and/or any connectors from any circuit under test, turn the meter off and remove the test leads from the input terminals.

Use a screwdriver to unscrew the two screws on the battery cover on the back of the unit near the bottom, behind the stand.

Remove the battery cover from the meter. If you are replacing the batteries: remove the used AAA batteries. Install six new AAA batteries. Pay attention to polarity when you insert each battery, the polarity is indicated inside the battery compartment. Replace the battery cover and tighten the screws. Do not use the meter until the battery cover has been properly installed.

5.2 Fuse Replacement

Before replacing the fuse, disconnect test leads and/or any connectors from any circuit under test. To prevent damage or injury replace the fuse only with a fuse of the correct ratings.

Use a screwdriver to unlock the four screws on the rear cover. Remove the rear cover from the meter.

1. Remove the fuse by gently prying it out of its bracket.
2. Install a replacement fuse that has the following ratings: F 0.63A/600V Ø6.35x30
3. Replace the rear cover and tighten the screws. Do not use the meter until the rear cover has been properly installed.

Notes: In general, the fuse will not blow during normal use of the meter. In case the fuse does blow, try to find out the reason first and take it into account for future use of the meter.

The two most common reasons the fuse may blow are:

1. A voltage measurement is performed with the meter set up to measure current.
2. The measured current exceeds the range.

6. Accessories

Package Contents:

- Insulation Multimeter eM870M
- 1x Pair of test leads with probes
- 1x Pair of test leads with alligator clips
- 1x Thermocouple Probe
- 6x AAA Batteries
- User Manual
- Carrying Case

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