3.2 Measurement Functions

3.2.1 AC and DC Voltage measurement

> ⚠ ***To avoid electrical shock and/or damage to the instrument, do not attempt to take any voltage measurement that might exceed 1000Vdc or 750Vac rms.***
>
> ***To avoid electrical shock and/or damage to the instrument, do not apply more than 1000Vdc or 750Vac rms between the common terminal and the earth ground.***

The polarity of ac (alternating current) voltage varies over time; the polarity of dc (direct current) voltage is constant.

The Meter's DC voltage ranges are 400.0mV, 4.000V, 40.00V, 400.0V and 1000V; AC voltage ranges are 400.0mV , 4.000V, 40.00V, 400.0V and 750V.

(AC 400.0mV range only exists in manual ranging mode).

To measure ac or dc voltage:

1. Set rotary switch to the DCV or ACV range.
2. Connect the black and red test leads to the COM and V terminals respectively.
3. Connect the test leads to the circuit being measured
4. Read the displayed value. The polarity of red test lead connection will be indicated when making a DCV measurement.

NOTE:

- Unstable display may occur especially at 400mV range, even though you do not put test leads into input terminals, in this case, if an erroneous reading is suspected, short the V terminal and the COM terminal, and make sure the zero display.

- For better accuracy when measuring the dc offset of an ac voltage, measure the ac voltage first. Note the ac voltage range, then manually select a dc voltage range equal to or higher than the ac range. This improves the accuracy of the dc measurement by ensuring that the input protection circuits are not activated.

3.2.2 Resistance measurement

> ⚠ ***To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before measuring resistance.***

The Meter's resistance ranges are 400.0Ω, 4.000kΩ, 40.00kΩ, 400.0kΩ, 4.000MΩ and 40.00MΩ.

To measure resistance:

1. Set the rotary switch to **Ω** range.
2. Connect the black and red test leads to the COM and Ω terminals respectively.
3. Connect the test leads to the circuit being measured and read the displayed value.

Some tips for measuring resistance:

- The measured value of a resistor in a circuit is often different from the resistor's rated value. This is because the Meter's test current flows through all possible paths between the probe tips.
- In order to ensure the best accuracy in measurement of low resistance, short the test leads before measurement and memory the test probe resistance in mind. This necessary to subtract for the resistance of the test leads.

- The resistance function can produce enough voltage to forward-bias silicon diode or transistor junctions, causing them to conduct. To avoid this, do not use the 40MΩ range for in-circuit resistance measurements.
- On 40MΩ range, the meter may take a few seconds to stabilize reading. This is normal for high resistance measuring.
- When the input is not connected, i.e. at open circuit, the figure "OL" will be displayed for the overrange condition.

3.2.3 Diode Test

⚠ ***To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before testing diodes.***

Use the diode test to check diodes, transistors, and other semiconductor devices. The diode test sends a current through the semiconductor junction, then measures the voltage drop across the junction, A good silicon junction drops between 0.5V and 0.8V.

To test a diode out of a circuit:

1. Set the rotary switch to ⊣◀ range.
2. Press the **SELECT** key to activate Diode Test.
3. Connect the black and red test leads to the COM and VΩ terminals respectively.
4. For forward-bias readings on any semiconductor component, place the red test lead on the component's anode and place the black test lead on the component's cathode.

5. The meter will show the approx. forward voltage of the diode.

In a circuit, a good diode should still produce a forward bias reading of 0.5V to 0.8V; however, the reverse-bias reading can vary depending on the resistance of other pathways between the probe tips.

3.2.4 Continuity Check

⚠ ***To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before testing for Continuity.***

To test for continuity:

1. Set the rotary switch to ⊣◀ range.
2. Press the **SELECT** key to activate Continuity Check.
3. Connect the black and red test leads to the COM and Ω terminals respectively.
4. Connect the test leads to the resistance in the circuit being measured.
5. When the test lead to the circuit is below 50Ω, a continuous beeping will indicate it.

Note:

- Continuity test is available to check open/short of the circuit.

3.2.5 Transistor measurement

⚠ ***To avoid electrical shock and/or damage to the instrument, do not apply more than 250Vdc or 250Vac rms between the hFE terminal and the COM terminal.***

To test the hFE of transistor:

1. Set the rotary switch to **hFE** range.
2. Connect the “com” plug and “+” plug of the special multi-function socket to the **COM** and **hFE** terminals.
3. Determine whether the transistor to be tested is NPN or PNP type and locate the Emitter, Base and Collector leads.
4. Insert leads of the transistor into proper holes of the special multi-function socket.
5. The meter will show the approx. hFE value at test condition of base current 10μA and Vce 2.8V.

3.2.6 Capacitance measurement

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

Capacitance is the ability of a component to store an electrical charge.

The unit of capacitance is the farad (F). Most capacitors are in the nanofarad to microfarad range. The Meter measures capacitance by charging the capacitor with a known current for a known period of time, measuring the resulting voltage, then calculating the capacitance. The measurement takes about 1 second per range.

The Meter's capacitance ranges are 4.000nF 40.00nF, 400.0nF, 4.000μF, 40.00μF and 200.0μF.

To measure capacitance:

1. Set the rotary switch to ⊣⊢ range.
2. Connect the black and red test leads to the **COM** and ⊣⊢ terminals respectively. (or you can measure the capacitance by using the special Multi-Function Socket)
3. Connect the test leads to the capacitor being measured and read the displayed value.

Some tips for measuring capacitance:

- The meter may take a few seconds (200μF range, 30 seconds) to stabilize reading. This is normal for high capacitance measuring.
- To improve the accuracy of measurements less than 4nF, subtract the residual capacitance of the Meter and leads.

3.2.7 Frequency and Duty Cycle measurement

⚠ ***Do not measure Frequency on high voltage (>250Vdc or 250Vac rms) to avoid electrical shock hazard and/or damage to the instrument.***

To measure frequency or Duty Cycle:

A） To measure frequency by Hz range

- Set the rotary switch to Hz range.
- Connect the black and red test leads to the **COM** and **Hz** terminals respectively.
- Connect the test leads across the source or load under measurement, and read the displayed value.
- To make a duty cycle measurement, press the **Hz %** key again.
- Read the percent of duty cycle on the display.

Note:

- Reading is possible at input voltages above 3V rms, but the accuracy is not guaranteed.
- In noisy environment, it is preferable to use shield cable for measuring small signal.

B) To measure frequency by AC Voltage (or AC Current) range

- Set the rotary switch to the desired range (AC Voltage or AC Current).
- Connect the black and red test leads to the **COM** and **V** (or **mA**) terminals respectively.
- Connect the meter to the signal source; then press Hz/% key.
- For 5V logic signals (TTL), use the 4Vdc range. For 12V switching signals in automobiles, use the 40Vdc range.
- Read the frequency of the AC signal on the display.
- To make a duty cycle measurement, press the **Hz %** key again.
- Read the percent of duty cycle on the display.

Note:

- If the reading is 0.000Hz or is unstable, the input signal may be below or near the trigger level.

  These problems can frequently be fixed by selecting a lower range, which increases the sensitivity of the meter. In the DCV function, the lower ranges also have lower trigger levels.
- If a reading seems to be a multiple of what you expect, the input signal may be distorted.

Distortion can cause multiple triggering of the frequency counter. Selecting a higher voltage range might solve this problem by decreasing the sensitivity of the meter. Also, try selecting a dc range, which raises the trigger level. In general, the lowest frequency displayed is the correct one.

3.2.8 Current measurement

⚠ ***To avoid damage to the Meter or injury if the fuse blows, never attempt an in-circuit current measurement where the open-circuit potential to earth is greater than 250V.***

To avoid damage to the meter, check the meter's fuse before proceeding. Use the proper terminals, function, and range for your measurement. Never place the probes in parallel with a circuit or component when the leads are plugged into the current terminals.

The Meter's current ranges are 400.0μA, 4000μA, 40.00mA, 400.0mA, and 10.00A.

To measure current:

1. Turn off power to the circuit. Discharge all high voltage capacitors.
2. Set the rotary switch to the μA, mA or A range.
3. Press the **SELECT** key to select DCA or ACA measuring mode.
4. Connect the black test lead to the **COM** terminal and the red test leads to the mA terminal for a maximum of 400mA. For a maximum of 10A, move the red test lead to the **10A** terminal.

5. Break the circuit path to be tested.
   Touch the black probe to the more negative side of the break; touch the red probe to the more positive side of the break. (Reversing the leads will give a negative reading, but will not damage the Meter.)
6. Turn on power to the circuit; then read the display. Be sure to note the measurement units at the right side of the display (μA, mA or A). When only the figure "OL" displayed, it indicates overrange situation and the higher range has to be selected.
7. Turn off power to the circuit and discharge all high voltage capacitors. Remove the Meter and restore the circuit to normal operation.

4 TECHNICAL SPECIFICATIONS

4.1 GENERAL SPECIFICATIONS

- Environment conditions:
  1000V CAT. II and 600V CAT. III
  Pollution degree: 2
  Altitude < 2000m
  Operating temperature:
  0~40℃, 32℉~122℉ (<80%RH, <10℃ non- condensing)
  Storage temperature:
  -10~60 ℃, 14℉~140℉ (<70% RH, battery removed)
- Temperature Coefficient:
  0.1×(specified accuracy) / ℃ (<18℃ or >28℃)
- MAX. Voltage between terminals and earth ground:
  750V AC rms or 1000V DC.
- Fuse Protection:
  μA and mA: Resettable fuse(400mA/250V);

  10A: F 10A/250V ∅6.3×32 mm.
- Sample Rate: 3 times/sec for digital data.
- Display:
  3 3/4 digits LCD display. Automatic indication of functions and symbols.
- Range selection: automatic and manual.
- Over Range indication: LCD will display "OL".
- Low battery indication:
  The "  " is displayed when the battery is under the proper operation range.
- Polarity indication: "–" displayed automatically.
- Power source: DC 4.5V ⎓
- Battery type: 1.5V AAA.
- Dimensions: 195×92×55 mm.
- Weight: 400g. Approx. (battery included).

4.2 Measurement specifications

Accuracy is specified for one year after calibration, at operating temperatures of 18℃ to 28℃, with relative humidity at 0% to 75%.

Accuracy specifications take the form of: ± (% of Reading + Number of Least Significant Digits)

4.2.1 DC Voltage

Range	Resolution	Accuracy
400mV	0.1mV	±（0.7% of rdg +2 digits）
4V	1mV	
40V	10mV	
400V	100mV	
1000V	1V	±（0.8% of rdg +2 digits）

Input impedance: 10MΩ
Max. input voltage: 1000Vdc or 750V ac rms.

4.2.2 AC Voltage

Range	Resolution	Accuracy
400mV	0.1mV	±(3.0% of rdg + 3 digits)
4V	1mV	±（0.8% of rdg +3 digits）
40V	10mV	
400V	100mV	
750V	1V	±（1.0% of rdg +3 digits）

Input impedance: 10MΩ

Max. input voltage: 1000Vdc or 750V ac rms.

Frequency Range: 40Hz-200Hz for 4V range, 40Hz-1kHz for other ranges.

Response: Average, calibrated in rms of sine wave

4.2.3 Resistance

Range	Resolution	Accuracy
400.0Ω	0.1Ω	±（1.2%% of rdg +2 digits）
4.000kΩ	1Ω	
40.00kΩ	10Ω	
400.0kΩ	100Ω	
4.000MΩ	1kΩ	
40.00MΩ	10kΩ	±（2.0% of rdg +5 digits）

Open Circuit Voltage: approx. 250mV.

Overload protection: 250V dc or 250Vac rms.

4.2.4 Audible continuity

Range	Continuity beeper
	≤50Ω

Open circuit voltage: approx.0.5V.

Overload protection: 250Vdc or 250Vac rms.

4.2.5 Diode

Range	Resolution	Function
	1mV	Display read approx. forward voltage of diode

Forward DC Current: approx. 1mA

Reversed DC Voltage: approx. 1.5V

Overload protection: 250Vdc or 150Vac rms.

4.2.6 Transistor

Range	Description	Test Condition
hFE	Display read approx. HFE value (0-1000) of transistor under test (all type).	Base Current approx. 10μA, Vce approx. 2.8V.

Overload protection: Resettable Fuse (F400mA/250V)

4.2.7 Capacitance

Range	Resolution	Accuracy
4nF	1pF	±(5.0% of rdg+5 digits)
40nF	10pF	±(3.0% of rdg+3 digits)
400nF	100pF	
4μF	1nF	
40μF	10nF	
200μF	100nF	

Overload protection: 250V dc or 250Vac rms.

4.2.8 Frequency

Range	Resolution	Accuracy
9.999Hz	0.001 Hz	±(2.0% of rdg+5 digits)
99.99Hz	0.01 Hz	
999.9Hz	0.1 Hz	
9.999kHz	1Hz	
99.99kHz	10Hz	
199.9kHz	100Hz	
>200kHz	100Hz	Unspecified @ >200kHz

- By Hz range:

Overload protection: 250V dc or 250V ac rms.

Input Voltage range: 0.6V-3V ac rms (Input voltage must be enlarged with increasing frequency under measurement)

Frequency Response: 10Hz-200kHz, sine wave.
0.5Hz-200kHz, square wave.

- By AC Voltage range：

Input Voltage range: 1V-750Vac rms (Input voltage must be enlarged with increasing frequency under measurement)

Frequency Response: 1Hz-10kHz, sine wave.

Maximum input voltage: 1000V dc or 750V ac rms.

Input impedance: 10MΩ

- By AC Current range:

Input current range: 5μA -4000μA ac rms for μA range。
5mA-400mA ac rms for mA range.。
(Input current must be enlarged with increasing frequency under measurement)

Frequency Response: 1Hz-10kHz, sine wave.

Maximum input current: 400mA dc or 400mA ac rms for μA and mA ranges.

4.2.9 DC CURRENT

Range	Resolution	Accuracy
400μA	0.1μA	±(1.2% of rdg+3 digits)
4000μA	1μA	
40mA	0.01mA	
400mA	0.1mA	
10A	10mA	±(2.0% of rdg+5 digits)

Overload protection: F 10A/250V fuse for 10A range. Resettable fuse(F400mA/250V) for μA and mA ranges.

Maximum input current: 400mA dc or 400mA ac rms for μA and mA ranges, 10A dc or 10A ac rms for 10A ranges.

For measurements>5A, 4 minutes maximum ON to measure 10 minutes OFF.

4.2.10 AC CURRENT

Range	Resolution	Accuracy
400μA	0.1μA	±(1.5% of rdg+5 digits)
4000μA	1μA	
40mA	0.01mA	
400mA	0.1mA	
10A	10mA	±(3.0% of rdg+7 digits)

Overload protection: F 10A/250V fuse for 10A range.
Resettable fuse(400mA/250V) for μA and mA ranges.

Maximum input current: 400mA dc or 400mA ac rms for μA and mA ranges, 10A dc or 10A ac rms for 10A ranges.

Frequency Range: 40Hz-1kHz

Response: Average, calibrated in rms of sine wave

For measurements>5A, 4 minutes maximum ON to measure 10 minutes OFF.

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.

To clean the terminals:

- Turn the meter off and remove all test leads.
- Shake out any dirt that may be in the terminals.
- Soak a new swab with a cleaning and oiling agent (such as WD-40).
- Work the swab around in each terminal. The oiling agent insulates the terminals from moisture-related contamination.

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 specified ratings.***

To replace the Meter's fuse (see Figure 2.):

1. Set rotary switch to the OFF position.

2. Disconnect test leads and/or any connectors from the terminals.
3. Use a screwdriver to unscrew the two screws secured on the battery cover.
4. Take out the battery cover from the meter.
5. Remove the fuse by gently prying one end loose, then sliding the fuse out of its bracket.
6. Install the replacement fuses only with specified ratings:

   F 10A/250V ∅6.3×32
7. Rejoin the battery cover and secure by the two screws.

5.3 Battery replacement

> ⚠ ***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 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.***

To replace the battery (see Figure 2.):

1. Set rotary switch to the OFF position.
2. Disconnect test leads and/or any connectors from the terminals.
3. Use a screwdriver to unscrew the two screws secured on the battery cover.
4. Take out the battery cover from the meter.
5. Remove the used batteries.
6. Replace with three new 1.5V batteries (AAA).
7. Rejoin the battery cover and secure by the two screws.

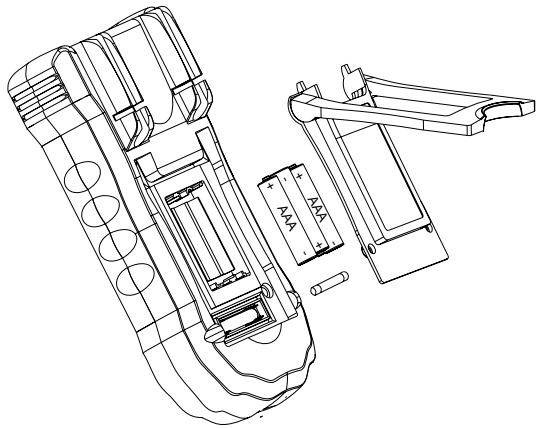

Figure 2. Battery and Fuse Replacement

⚠ **CAUTION:**

"Using this appliance in an environment with a strong radiated radio-frequency electromagnetic field9approximately 3V/m), may influence its measuring accuracy. The measuring result can be strongly deviating from the actual value"

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PRECISION MASTECH ENTERPRISES CO.
Room 1708-09, Hewlett Centre, 54 Hoi Yuen Road, Kwun Tong, Kowloon, Hong Kong.
Tel: 852 - 23430007 Fax: 852 - 23436217
E-mail: info@p-mastech.com

SHENZHEN HUAYI MASTECH CO., LTD.
East Wing, 8/F., Block 4, Saige Science and Technology Industrial Garden, Hua Qiang Bei Rd. Shenzhen, China
Tel: 0755 - 83769588 Fax: 0755 - 83768150
E-mail: info@mastech.cn

DONGGUAN HUAYI MASTECH CO., LTD.
Yulianwei Industrial Area, Qingxi Town, Dongguan, China
Tel: 0769 - 87318226 Fax: 0769 - 87318228

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