

*0.001 milliohm resolution*

# HIGH PRECISION MILLIOHM METER

Model : MO-2013



Your purchase of this MILLIOHM METER marks a step forward for you into the field of precision measurement. Although this MILLIOHM METER is a complex and delicate instrument, its durable structure developed. Please read the following instructions carefully and always keep this manual within easy reach.

## OPERATION MANUAL

## Caution Symbol



***Caution :***

- \* Risk of electric shock !



***Caution :***

- \* Do not apply the overload voltage, current to the input terminal !
- \* Remove test leads before open the battery cover !
- \* Cleaning - Only use the dry cloth to clean the plastic case !

## Environment Conditions

- \* ***Installation Categories II.***
- \* ***Pollution Degree 2.***
- \* ***Altitude up to 2000 meters.***
- \* ***Indoor use.***
- \* ***Relative humidity 80% max.***

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# 1. FEATURES

- \* 4 terminal devices for accurate measurement of very low resistance.
- \* Ideal for measuring the resistance of components precisely.
- \* Ideal for testing protective conductors, lightning conductors and welded points.
- \* High/Good/Low set-function for input quality control.
- \* Build in buzzer sound (GOOD STATUS) to assist the Q.C. judgment.
- \* Especial "CALCULATE" function to measure cable / wire length.
- \* Wide measuring range, 0.001 m ohm - 20K ohm, 7 ranges.
- \* RS232/USB computer interface.
- \* 26.7 mm large size and back-light LCD display, easy read-out.
- \* LSI circuit provides high accuracy, reliability and durability.
- \* Built-in over input protection.
- \* Durable bench type housing plastic case stand.

# 2. SPECIFICATIONS

## ***2-1 General Specifications***

Test Range (Test Current)	20 m ohm ( 1 A DC ) 200 m ohm ( 1 A DC ) 2 ohm ( 100 mA DC ) 20 ohm ( 10 mA DC ) 200 ohm ( 1 mA DC ) 2 K ohm ( 100 uA DC ) 20 K ohm ( 10 uA DC )
Warning Setup	* Warning LCD Indicator * Buzzer
Operating Temp.	0 to 50 °C ( 32 to 122 °F ).
Operating Humidity	Less than 80 %RH.
Power Supply	AC 110V +/- 15%, 50/60 Hz or AC 230V +/- 15%, 50/60 Hz.
Power Consumption	AC 110V : Approx. 33 mA AC 230V : Approx. 15 mA

Data Output	RS 232/USB PC serial interface. * Connect the optional RS232 cable UPCB-02 will get the RS232 plug. * Connect the optional USB cable USB-01 will get the USB plug.
Fuse for Power Supply	* 500 mA / 250 V * Size : 5 X 20 mm dia..
Dimension	280 x 210 x 90 mm ( 11.0 x 8.3 x 3.5 inch)
Weight	Approx. 2.04 Kg ( 4.49 LB ).
Standard Accessories	Power Cord.....1 PC. 4 wire with 2 Kelvin clips.....1 pair. Instruction Manual.....1 PC.
Optional Accessories	RS232 cable, UPCB-02 USB cable, USB-01 Data Acquisition software, SW-U801-WIN

### ***2-2 Electrical Specifications ( 23± 5 °C )***

Range	Resolution	Test current	Accuracy
20 m ohm	0.01 m ohm	1 A	± ( 0.2 % + 12 d )  ± ( 0.2 % + 4 d )
200 m ohm	0.1 m ohm	1 A	
2 ohm	1 m ohm	100 mA	
20 ohm	0.01 ohm	10 mA	
200 ohm	0.1 ohm	1 mA	
2 K ohm	0.001 K ohm	100 uA	
20 K ohm	0.01 K ohm	10 uA	
<i>@ The above accuracy is based on the reading value.</i>			
<i>@ Spec. tested under the environment RF Field Strength less than 3 V/M &amp; frequency less than the 30 MHz only.</i>			

Range	Open Circuit Voltage
20 m ohm	Approx. DC 4.54 V
200 m ohm	Approx. DC 4.54 V
2 ohm	Approx. DC 4.50 V
20 ohm	Approx. DC 4.06 V
200 ohm	Approx. DC 3.51 V
2 K ohm	Approx. DC 3.08 V
20 K ohm	Approx. DC 2.32 V

### 3. FRONT / REAR PANEL DESCRIPTION

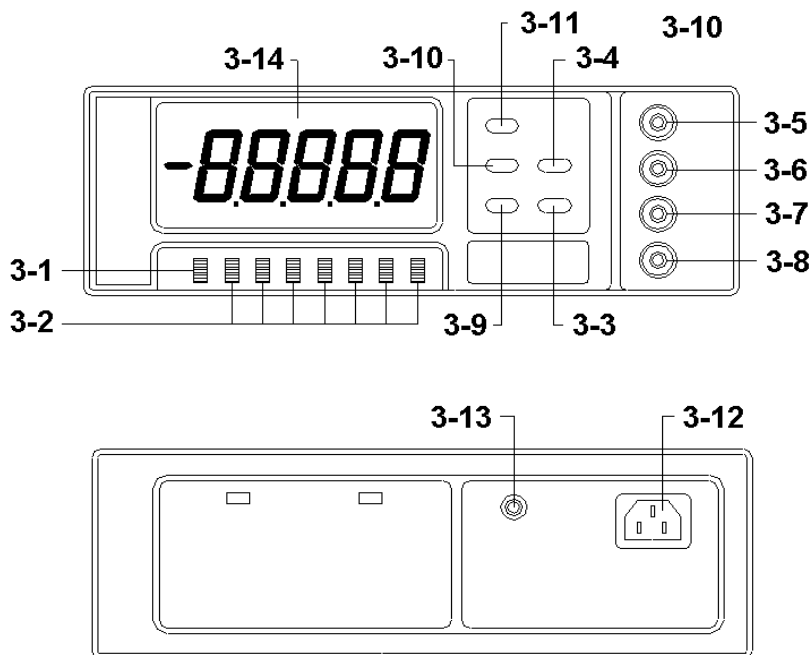


Fig. 1

- |     |                      |      |                            |
|-----|----------------------|------|----------------------------|
| 3-1 | Power Switch         | 3-8  | Force Terminal "-"         |
| 3-2 | Range Selector       | 3-9  | Hold ▼ Button              |
| 3-3 | SET / TEST Button    | 3-10 | BEEP ▲ Button              |
| 3-4 | COMP. / SHIFT Button | 3-11 | ZERO Button                |
| 3-5 | Force Terminal "+"   | 3-12 | Power Plug (Fuse included) |
| 3-6 | Sense Terminal "+"   | 3-13 | RS-232 Output Terminal     |
| 3-7 | Sense Terminal "-"   | 3-14 | LCD Display                |

## 4. BASIC 4 WIRES MEASURING PRINCIPLE

*The DIGITAL MILLIOHM METER is a precise, wide range, small resistance and high resolution measuring instrument. As for preventing any measuring errors, especially to avoid the influence of " LEAD STRAY RESISTANCE " or " TEST WIRE'S RESISTANCE ", the meter is designed according to the following "4 WIRES MEASURING PRINCIPAL" to maintain the meter in high accuracy.*

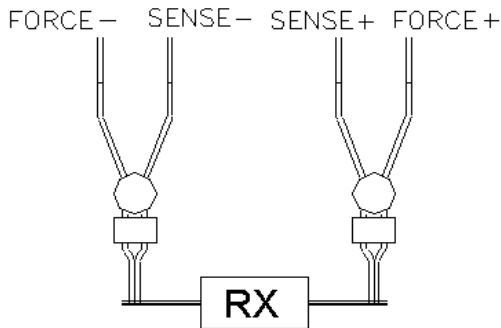


Fig. 2

- \* Please refer to 2-2 Electrical Specification ( page 2 ), each range exists fixed test current ( from 20K to 20m ohm ).
- \* The fixed current flow through the unknown resistor Rx.
- \* From the terminal " Sense + " and " Sense - " can measure a voltage  $V_x = I_s \times R_x$ .
- \* According the  $V_x$  value, then meter can get the unknown resistance (Rx) values from following formula :

$$R_x = V_x / I_s$$

- \* The measured resistance value between " Sense + " and "Sense -" is not affected by any stray resistance of test wire.

## 5. PRECAUTION & PREPARATIONS FOR MEASUREMENT

- \* Please check carefully the meter's power supply is AC 110 V or AC 230 V ( 220 V, 240 V ) before operating the meter. There is a label at the rear of the meter that shows the power source of the meter.
- \* It's prohibited to input voltage to the 4 wire input terminal ( Force +, Sense +, Sense -, Force - ) to prevent any internal circuit damage.

## 6. MEASURING PROCEDURES

### *6 -1 Buttons instructions*

<b><i>Buttons</i></b>	<b><i>Function</i></b>
Power Button	Press this key to power on and off.
HOLD Button	Press this key to do data hold .
Range Selector	Press these push buttons to choose range.
SET Button	Press this key to do HI/LO limit setup.
BEEP Button	Press this key to open /close buzzer function.
ZERO Button	When the display indicate few reading before measure.
COMP. Button	Press this key to start " HIGH, LOW, GOOD " status judgment.
SHIFT Button	Press this key to select digit unit.
▼ ▲ Button	Press these keys to up/down value.



## ***6 -2 Symbols & units of display***

<b><i>Symbol and Unit</i></b>	<b><i>Function</i></b>
<b>mΩ KΩ</b>	Ohm unit
(←→)	Appears on the " BEEP " function have started.
<b>SET</b>	Appears on the " SET " function have started.
<b>H</b>	Appears on the " HOLD " function have started.
<b>COMP.</b>	Appears on the " COMPARE " function have started.
<b>GOOD</b>	Appears on finished compare operate. It is pass Q.C.
<b>HIGH</b>	Appears on finished compare operate. It is higher than maximum acceptance value.
<b>LOW</b>	Appears on finished compare operate. It is lower than minimum acceptance value.
<b>HI LO</b>	Appears on the " SET " function have started.

## **6 -3 Resistance Measurement**

### **1) Plugs installation :**

*Connect the*

- \* Red cable ( with white O ring marker ) to " Force + " terminal ( 3-5, Fig. 1 )*
- \* Red cable ( no white O ring marker ) to " Sense + " terminal ( 3-6, Fig. 1 )*
- \* Black cable ( with white O ring marker ) to " Force - " terminal ( 3-8, Fig. 1 )*
- \* Black cable ( no white O ring marker ) to " Sense - " terminal ( 3-7, Fig. 1 )*

2) Power on the instrument by pressing the " Power Switch " ( 3-1, Fig. 1 ) to the " ON " position and then select measuring range from 20 m ohm to 20K ohm according to your requirement.

- \* Always select the highest range (20K ohm) if you don't know the resistance value of the resistor and then select lower range in sequence.*
- \* Over range LCD shows "----".*
- \* Try to select the convenient range that will get high resolution ( more digits display ).*

### **3) ZERO ADJUSTMENT**

If short the Kelvin clips before measurement and find few value ( not zero ) on the display, Press " ZERO button " ( 3-11, Fig. 1 ) once to execute the " Zero adjustment ".

- 4) Connect the 2 Kelvin clips as following Fig. 3 to measure the unknown resistance.

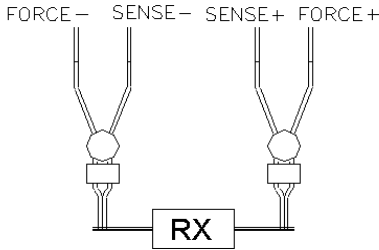


Fig. 3

- 5) Connect the 2 Kelvin clips as following Fig. 4 to measure the unknown resistance between two test points, such as PCB layout.

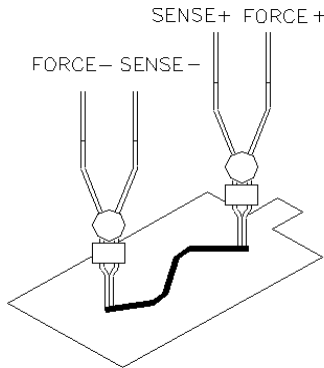



Fig. 4

#### **6-4 Data Hold**

During the measurement, press the " HOLD button " ( 3-9, Fig. 1) once will hold the measured value & the LCD will indicate a "  " symbol, press once again to delete hold function.

## 7. HI/LO WARNING SETUP

The instrument build in Hi, Lo warning value setup function and with one buzzer which are designed for quality control specially,

Press the " SET Button " ( 3-3, Fig. 1 ) to enter setting mode.

### 1) Hi warning value setup

The 1st digit will flash and show " HI "and " SET " symbols, press " ▼▲ " buttons to increase or decrease the digit's setting warning value.

*\* Press the " SHIFT Button " ( 3-4 , Fig. 1 ) to shift 1st digit to next digit unit (10th, 100th, 1000th), other procedures same as above.*

### 2) LO warning value setup

Finished 1) procedure, then press the " SET Button " again, the 1st digit will flash and show " LO " and " SET " symbols, other procedures are same as 1).

- 3) Finished 1), 2) procedure, press the " SET " button again the function will return " TEST MODE ", Display will indicate measure value when clipping the resistor.
- 4) During the measurement period press " COMP Button " ( 3-4 , Fig. 1 ) once, the display will show " GOOD " or " HIGH " or " LOW " symbols to inform the measurement status.

### ***For example***

Hi warning value setup to 180.9.

LO warning value setup to 179.1.

Measurement value is 180.0.

- a. The measurement value was readout 180.0, The display will show " GOOD " symbol and buzzer sounds. It indicate measurement resistance value is within the accuracy and pass the Q.C. ( Quality Check ).

*\* Press " BEEP Button " ( 3-10, Fig 1 ) button once will disable ( stop ) the " BEEP " function.*

*Press " BEEP Button " ( 3-10, Fig 1 ) button once again will enable ( start ) the " BEEP " function.*

- b. If the measurement value readout 181.0, the display will show " HIGH " symbol, it indicate measurement resistance value is out of the accuracy.
- c. If the measurement value readout 179.0, the display will show " LOW " symbol, it indicate measurement resistance value is out of the accuracy.

## **8. CALCULATE CABLE / WIRE LENGTH**

When measuring resistance, press "BEEP Button " + " COMP Button " together at one time until the display do not indicate any symbols, it is enter " length measure" mode.

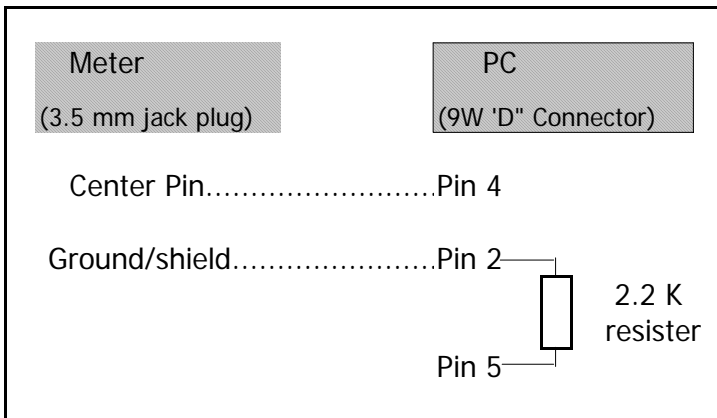
- 1) Primary to take one sample cable/wire, its length is 1 meter or 1 feet.
- 2) Wait a moment until the reading have been stable, press SET Button " once, the display will indicate " 1.0 " value.
- 3) Use test leads to measure a new cable/wire will got total length in the unit " meter " or " feet ".

## 9. RS232 PC SERIAL INTERFACE

The instrument has RS232 PC serial interface via a 3.5 mm terminal ( 3-13, Fig. 1 ).

The data output is a 16 digit stream which can be utilized for user's specific application.

A RS232 lead with the following connection will be required to link the instrument with the PC serial port.



The 16 digits data stream will be displayed in the following format :

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0

**Each digit indicates the following status :**

D15	Start Word = 02		
D14	4		
D13	1		
D12 & D11	Annunciator for Display		
	ohm = 38	m ohm = B1	
	K ohm = 39		
D10	Polarity 0 = Positive 1 = Negative		
D9	Decimal Point(DP), position from right to the left 0 = No DP, 1= 1 DP, 2 = 2 DP, 3 = 3 DP		
D8 to D1	Display reading, D8 = MSD, D1 = LSD For example : If the display reading is 1234, then D8 to D1 is : 00001234		
D0	End Word = 0D		

**RS232 setting**

Baud rate	9600
Parity	No parity
Data bit no.	8 Data bits
Stop bit	1 Stop bit

## **10. THE ADDRESS OF AFTER SERVICE CENTER**

