MODEL: MO-1210

Digital DC Milliohm Meter

OPERATING INSTRUCTION

Index

SAFETY PRECAUTION AND SYMBOL

 THIS METER IS NOT APPLICABLE FOR CAT II,III and IV

BELOW SYMBOLS MAY APPEAR IN THIS MANUAL OR THE METER

 HIGH VOLTAGE HAZARD

 REFERENCE TO MANUAL

 PROTECTED CONDUCTOR TERMINAL

 EARTHING TERMINAL

1. Product Introduction

1-1 Introduction

MO-1210 is a DC milli-ohm meter with high accuracy adequate for low resistance measurement in switches, electric relay, PCBs, connectors and relevant equipments.

With PT-100 temperature probe, the meter can control measuring impedance to accommondate environment changes.

The meter can be used to measure contact resistance in switches, relays, PCBs, cables, connectors, and component testing in resistors, motors, fuses, hot resistance wires.
It can also be used in warehousing inspection, quality check and conductivity evaluation in product design.

1-2 Features

- 2000 counts
- measure range 10μΩ ~ 200kΩ
- 0.3% accuracy
- temperature compensation and measurement
- four terminal kelvin method
- PASS/FAIL alarm settings
- sample rate 3 times per second

1-3 Specification

Specification is designed and used under following conditions:

- calibrated once a year
- ambient temperature 18℃~28℃ (64.4℉~82.4℉)
- relative humidity < 80% RH
- indication of accuracy:±(%+digits)

1.MEASUREMENT OF RESISTANCE				
2000 counts（ rate: 3 times/seconds ）				
Range	Resolution	Test current	Accuracy	Open circuit Voltage
20m	10μ	250mA	0.5%+5	5V
200m	100μ	250mA	0.3%+6	
2	1m	100mA	0.3%+3	
20	10m	50mA	0.3%+2	
200	100m	5mA	0.3%+2	
2k	1	500μA	0.3%+2	
20k	10	50μA	2%+2	
200k	100	5μA	2%+2	
Accuracy of 2000counts （rate：3times/sec.）		±5 count		
Measurement		Four wires Kelvin method		
Overrange		OL		
Max. rated voltage		50VpDC		
Records		500 sets		
Buzzer		NON,PASS,FAIL		

2. **Measurement of Temperature**		
Temperature	Pt resistor	
Rnage	Resolution	Accuracy(Sample :2times/ sec.)
- 9.9℃ ~ 100℃	0. 1℃	± 1%+1℃
3. **Temperature Compensation**		
Temp. Compensation Range	0. 0℃~40.0℃	
Reference Temp. Range	0℃~90℃	
Heat factor Range	± 9999ppm	
Temp. Range	Accuracy of temp. compensation 3930ppm/copper wire	
* Other configured -temperature factor must calculate separately in accordance with different conditions. * In case temperature factor environment is over a normal operation range from configured temp erature, the compensated reading may vary greatly.		
4. **Environment**		
Operating Environment	Indoor use, altitude<2000m Ambient temp. 0. 0℃~40.0℃ Max. Relative humidity 80%RH Pollution deg. 2	
Storage temp.	- 10℃ ~ 50℃	
5. **Other**		
Power	8x1.5VAA	
Accessories	Test wire x1 , Manual x1 , Temperature sensor x1	

2 Introduction of Machine

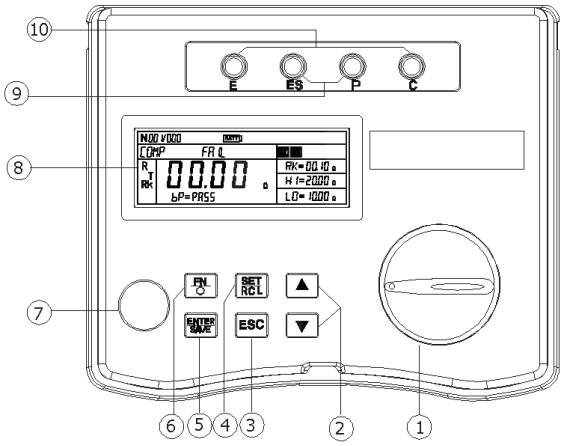


图2-1

2-1 Panel

1) Range rotary

2) Up/Down button for digit selection

3) Esc button for cancellation operation

4) SET/RCL button short press to configure parameters, long press to review stored data

5) ENTER/SAVE button

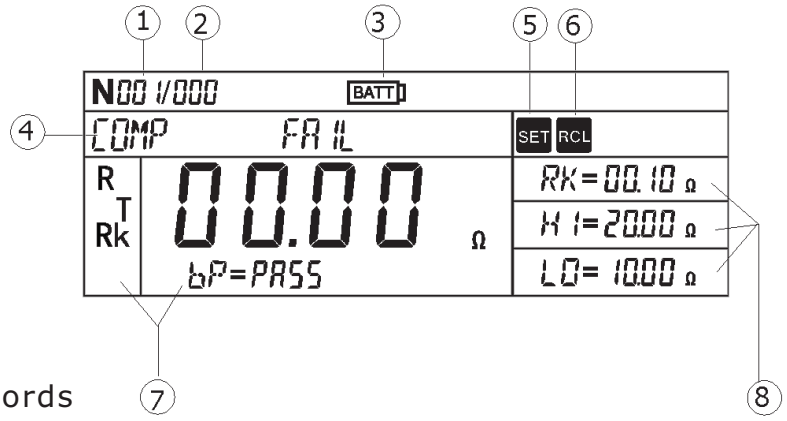
6) FN/back lit button short press for function selection, long press for back lit On/off

7) temperature probe connector

8) LCD

9) measuring terminals

10) current source terminals



2-2 LCD

1) Number of records

2) Maximum numbers of stored records

3) low battery symbol

4) Message indication

5) Setting status symbol

6) Records reviewing symbol

7) Main display area

8) sub display area

3- Operation instruction

3-1 Over range indication

If the input resistor exceeds the selected range, LCD shows OL.

3-2 Battery voltage acknowledgement

If low battery warning symbol is on when measuring, please stop measurement and replace batteries. The meter will not measure until the batteries are replaced.

3-3 Automatic measurement

There is no Test button in this meter. The meter starts measurement if proper range is selected and connection is correct.

4 Function introduction and configuration.

Testing conditions must be configured properly before measurement. Settings is shown in sub display area. Press FN button to switch configuration.

4-1 Common test fuction ®:

As soon as the meter is powered on, the meter shows common test function below. Now it is ready for measurement.

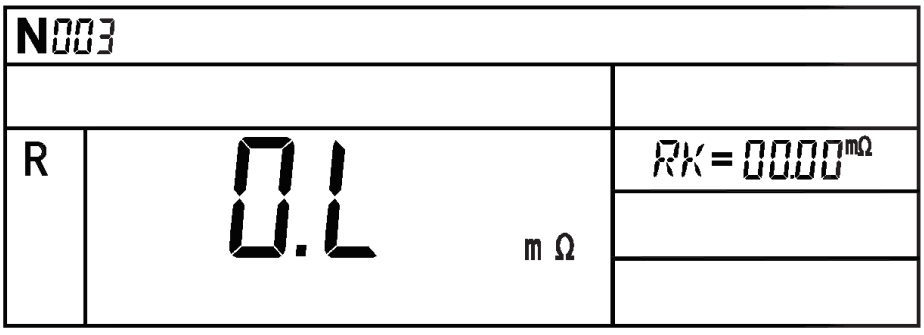


Fig. 4-1 common test function interface

Parameter settings:

Rk: Residual resistors of test wires. Test and save Rk of testing wires before measurement. The meter will automatically remove Rk before showing final readings to provide a more accurate result.

Configuration procedures of Rk:

- Select measuring range
- Press "SET/RCL" button to enter Rk settings with flickering "SET" symbol shown on LCD as below.

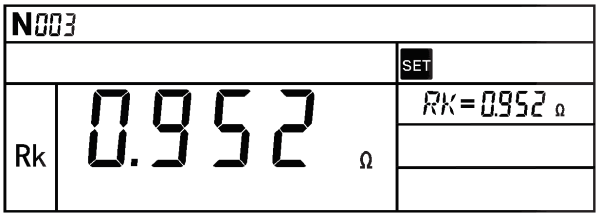


fig.4-2 Rk configuration□Rk in sub display is flickering

- Connect the test wires shorted together to automatic measure Rk.
- Press "ENTER/SAVE" to save the measured Rk and back to common measuring mode.

Press "ESC" button to discard savings and back to common measuring mode.

IMPORTANT NOTE: Rk value is deleted in case the range of measurement is changed or the power is off.

4-2 Comparision Selection function (CR):

As below shown, press "FN/☼" button to enter comparison measurement.

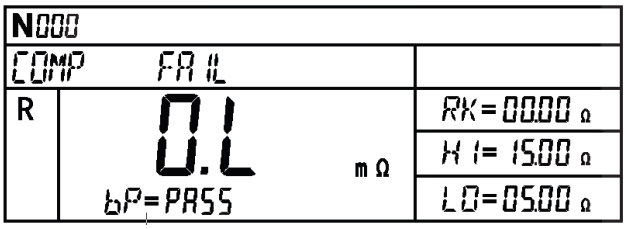


Fig.4-3 Interface of Comparison Selection function

In accordance with the input up/low limit, the meter shows PASS/FAIL to the measured resistance on LCD with buzzer.

For instance,
Standard value: 100.0
upper limit: 110.0
low limit: 80.0
PASS/FAIL indication shows if the measured resistance is as below:
109.0 measured, PASS symbol on
120.0 measured, FAIL symbol on
70.0 measured,FAIL symbol on

Parameters to configure:
Rk: residual resistance of test lines
Hi/Lo: up/low limit
bp: buzzer has three conditions optional. "PASS" means buzzer will sound when the measured resistance is passed . "FAIL" means buzzer will sound when measured resistance is failed in the test. "NON" means buzzer will not work.

Operating instruction:
Rk configuration , please refer to "Common test function" to complete the setting of Rk.

HI/LO, bp settings:
- In Comparison function mode, press "SET/RCL" button to light on configuration symbol "set" as below Fig.4-4 shown, short press "SET/RCL" to switch between configurable parameters.

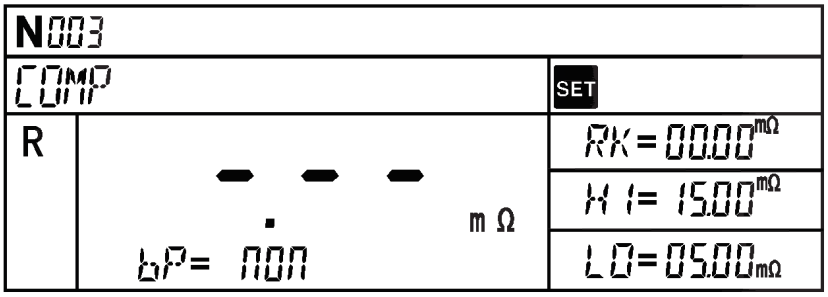


Fig.4-4 Configuration of Comparision Selection. The selected parameter to configure is flickering.

- Press ▲ or ▼ button to change value.

- Press "ENTER/SAVE" to save the setting and swtich to next parameter. Press "ESC" to discard changes and return to Comparison function mode (fig.4-3).

- As soon as all parameters are well configured and saved, press "ESC" to complete configuration and return to Comparison function mode (fig.4-3).

Important note: HI/LO values and bp buzzer are not erased if test mode is changed, however, need to be configured again if resistance range is changed or power is off.

Buzzer does not sound if the meter is not working in Comparsion function mode.

4-3 Temperature measurement mode(T):
(1) Connect the temperature probe to panel connector (Fig.4-5)

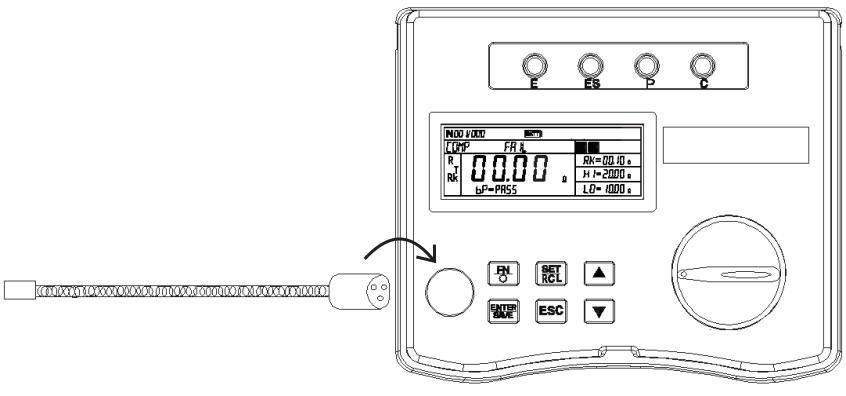


Fig.4-5 Connection of temperature sensor and machine

(2) Press "FN/☼" button to enter temperature measurement function. (Fig.4-6)

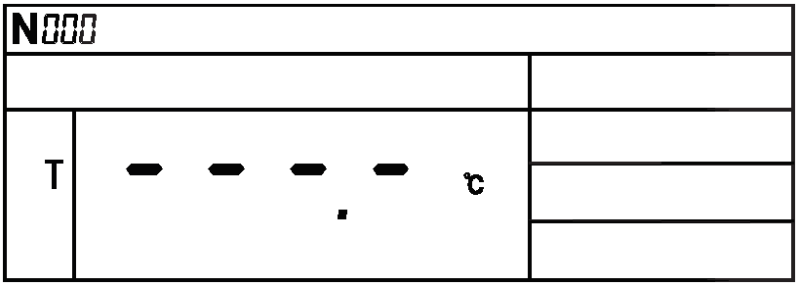


Fig.4-6 Temperature measurement

(3) Temperature measurement can be used in every range.
(4) The measured temperature is directly shown on LCD main display area.

4-4 Function of temperature compensation measurement(TC)

Correct impedance of the object can be calculated by measured ambient temperature, input material temperature factor and input target temperature.

(1) Connect temperature sensor properly to connector of meter as fig.4-5.
(2) Press "FN/☼" button to enter temperature compensation measurement mode (fig. 4-7). Measured reading is shown on main display area. Rc is the calculated impedance value of the measured object.

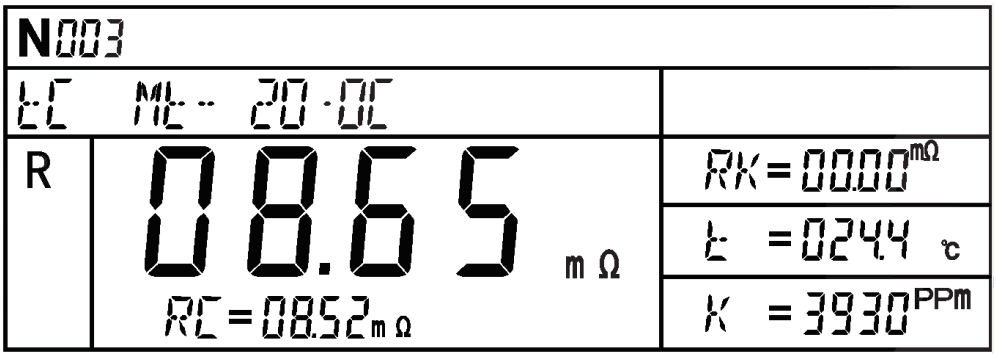


Fig.4-7 Temperature Compensation Measurement

Parameters to configure:
Rk: Residual resistor of test wire.
K: Material correction factor
Mt: target temperature (expected temperature)

Operating instruction:
Rk configuration , please refer to "Common test function" to complete the setting of Rk.

Configuration of K, Mt:
- In temperature compensation mode, press "SET/RCL" button to enter configuration with set symbol on (Fig. 4-8). Short press "SET/RCL" to switch between parameters.

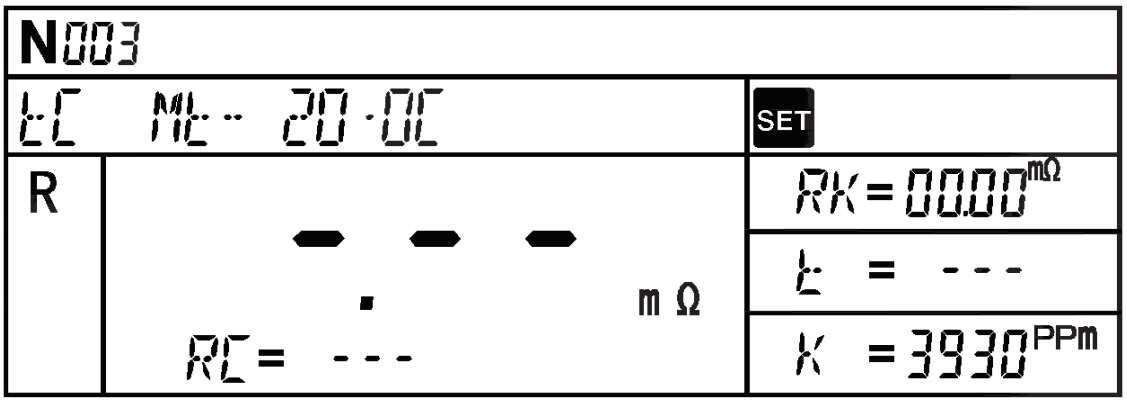


图4-8温度补偿测量功能设定画面，当前可设定的参数呈闪动状态

- Press ▲ ▼ buttons to change value.

- Press "ENTER/SAVE" to save the setting and swtich to next parameter. Press "ESC" to discard changes and return to Temperature measurement mode (fig.4-7).

- As soon as all parameters are well configured and saved, press "ESC" to complete configuration and return to Temperature measurement mode (fig.4-7).

Important note: The input K/Mt values are not erased if function mode is changed. The input values are deleted if the meter is powered off.

4-5 Recall the stored records

Long press "SET/RCL" button to review all stored records. Press up/down button to browse by number. Total records is 500 units with number N001 . Press "ENTER/SAVE" button to delete the record by selection between dL_ONE to delete current record and "DL_ALL" to delete all records. Press "ENTER/SAVE" button again to confirm deletion of one or all.

In case MEM EMPty is flickering on LCD, there is no record stored in the meter. If MEM FULL is shown on LCD, the memories are full.

4-6 Backlit

Long press "FN/☼" to turn on backlit for 30 seconds. During this period, long press "FN/☼" again to turn off backlit if required.

5 Connection of test leads

5-1 Four wires measurement method
Fore wires measurement method can remove residual resistance Rk to result a more accurate reading. Please see Fig. 5-1 for connection.

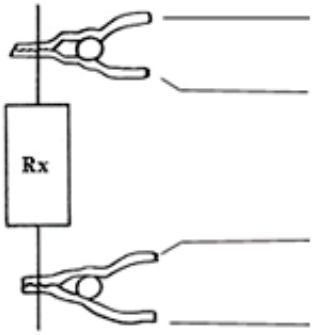


Fig. 5-1

Principle
1- Tranditional two wires meareument method, as fig.5-2, are interfered by residual resistance Rk. The measured reading is:

$$\frac{V}{I} = r1 + R + r2$$

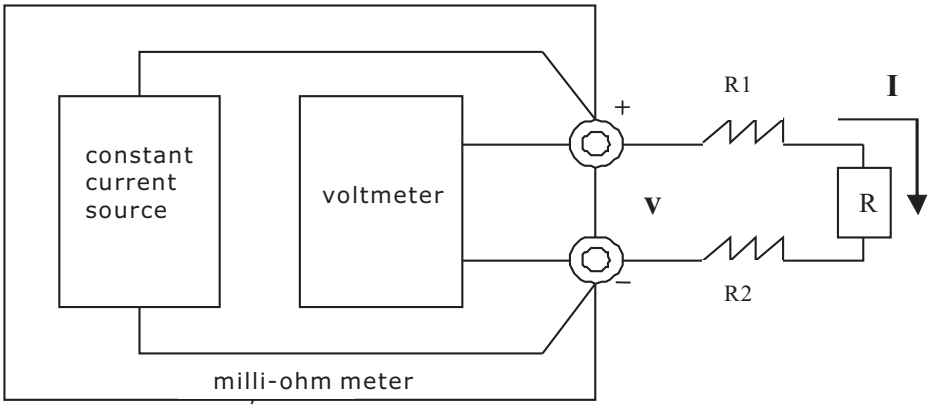


Fig. 5-2

2- Four wires measurement method works with high input impedance of voltage meter.
There is no voltage drop and current through on r3 and r4.(see fig. 5-3) Hence, voltage can measure resistance accurately. The measured reading is:

$$R = \frac{V}{I}$$

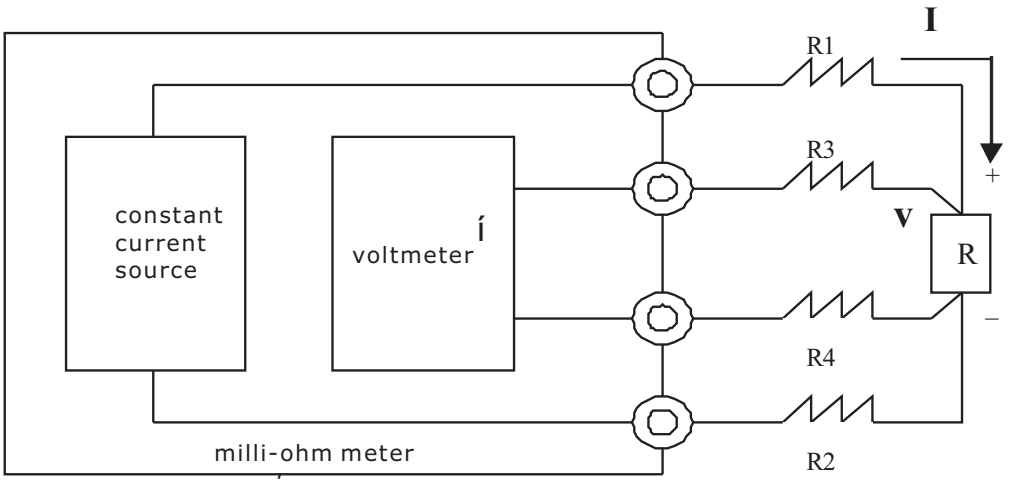


Fig. 5-3

5-2 Temperature measurement

(1) Reference temperature

International Temperature Standard (ITS) is based on fix point and relevant temperature of 17 types of materials in Table 5-1.

Materials	Type	Temperature	
		K	¡ æ
(H_2) hydrogen	3 phase point	13.8033	-259.3467
(Ne) neon		24.5561	-248.5939
(O_2) oxygen		54.3584	-218.7916
(Ar) argon			
(Hg) hydrargyrum	3 phase point	234.325	-38.8344
(H_2O) water	3 phase point	273.16	+0.01
(Ga) gallium	Melting point	302.9146	29.7646
(In) indium	Freezing point		
(Sn) tin	Freezing point	505.078	231.928
(Zn) zinc		692.677	419.527
(Al) aluminum		933.473	660.323
(Ag) silver		1234.93	961.78
(Au) gold		1337.33	1064.18

Note:
(1) unit of temperature
thermodynamic temperature: T
degree Kelvin: K

(2) thermometric scale
centigrade degree : °C
rankine temperature : °R
degree Fahrenheit: °F

(2) Sensor of temperature measurement
Impedance temperature sensor RTD converts temperature to eletric signal.

Characteristic reference is as table 5-2.

Table 5-2

	Characteristic	Description
1.	Accuracy	Highly accurate
2.	Resolution	0.1~1.0℃
3.	Response time	Slow
4.	Self Heating	Yes
5.	Long term stability	Good
6.	Output curve	Approxi. 0.4 ohm/℃, nearly linear

(3) Optional Pt resistor temperature sensor
This sensor conforms to DIN43760:1968, three wires measurement method.
Relation between temperature and impedance is as formula below:

$R_{RTD}=R_0[1+AT+BT^2+CT^3(T-100)]$

Here:
RRTD is the calculated impedance of RTD
R0 is the known impedance of RTD in temperature 0°C
T is temperature unit °C

A=alpha [I+(delta/100)]
B=-I(alpha)(delta)(Ie-4)
C=-I(alpha)(beta)(Ie-8)

Values of Alpha, beta and delta please see table 5-3 below

Table 5-3

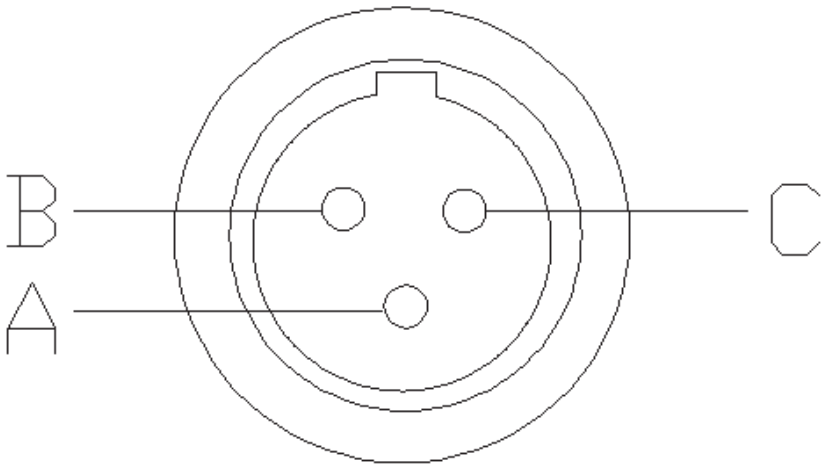
Type	Standard	Alpha	Beta	Delta	Ohms in 0℃
PT-100	ITS90	0.003850	0.10863	1.49990	100Ω

For instance:
Calculate impedance value of PT-100 RTD in temperature 100°C. Alpha, beta and delta values of R0 (the ohms value in temperature 0°C) applied in calculation of PT-100 RTD are:
T=100°C
R0 (the ohms value in temperature 0°C)=100ohms
Alpha=0. 003850
Beta=0. 10863
Delta=1. 49990

A,B and C values are calculated in accordance with below reference:
A=0. 00391
B=5. 77e-7
C=4. 18e-12

Then, RTD in temperature 100°C (R100) can be calculated below:
$R100=R0[1+AT=BT^2+CT^3(T-100)$
$=100\{1+[(0.00391)(100)+[(-5.77e-7\ (100^2)+[(-4.18E-12)$
$(100^3)(100-100)]]$
$=100[1+0.391+(-0.006)+0]$
$=100(1.385)$
$=138.5\Omega$

(4) Temperature sensing terminal



Wire A connects a fix terminal of sensor, Wire B and C connect to another two terminals. Wire B and C can be exchanged. If extension wire of temperature sensor is required, the length and specification of three wires must be consistent.

6 Maintenance

6-1 Replace battery

- Do not open battery cover if the housing of meter is moist.
- DO not replace batteries during measurement. To avoid electric shock, please turn of the meter and disconnect test wires.
- Open back batteries cover and replace batteries.

Note: All of stored records are deleted after the batteries are replaced.

6-2 Cleaning

- To keep the meter clearn, please use wet cloth with detergent to clean meter. Do not use scrub agent and solvent.

7 Accessories

a) Specific gold-plating test wire x1
b) Pt temperaturesensor x1
c) AA 1.5V batteries x8
d) carry case x1
e) operating instruction x1

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