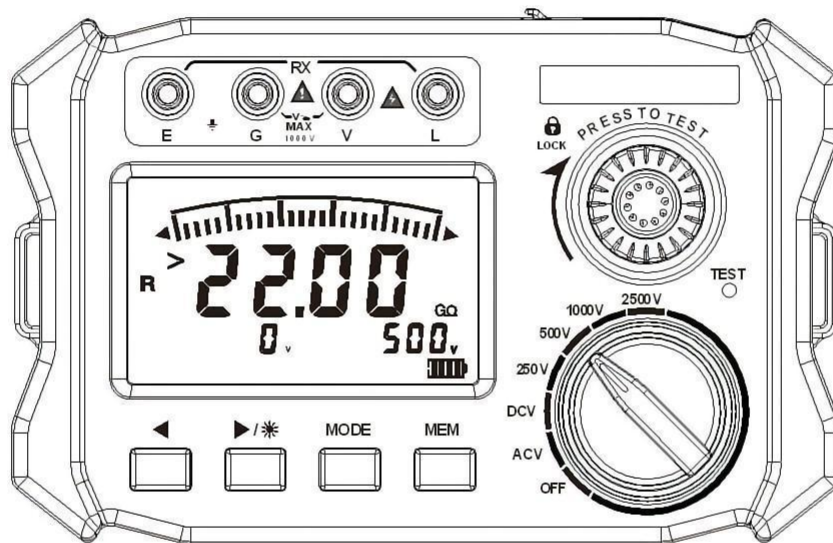


# Insulation Resistance Tester



## FR3015

## Contents Wireshark

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# 1. Safety rules and precautions

Thank you for purchasing **the insulation resistance tester of our company** . Before you use the instrument for the first time, in order to avoid possible electric shock or personal injury , please **read carefully and strictly abide by the safety rules and precautions listed in this manual.**

In any case, special attention should be paid to safety when using this instrument.

- ✧ The instrument is designed, produced and inspected according to the IEC61010 safety standard.
- ✧ In any case, special attention should be paid to safety when using this instrument.
- ✧ When measuring, do not use high-frequency signal generators such as mobile phones next to the meter to avoid errors.
- ✧ Pay attention to the text and symbols on the body of the instrument.
- ✧ Before use, confirm that the instrument and accessories are in good condition, and that the insulation layer of the instrument and test wires is not damaged, exposed, No broken line can be used.
- ✧ During the measurement, it is strictly forbidden to touch the exposed conductor and the circuit being measured.
- ✧ Confirm that the connecting plug of the wire has been tightly inserted into the instrument interface.
- ✧ Do not measure in flammable places, sparks may cause explosion.
- ✧ When the instrument is in use, if the case or test line breaks and the metal is exposed, please stop using it.
- ✧ Do not in high temperature and wet with dew of place and placed under direct sunlight for a long time and storage instrument.

- ✧ When replacing the battery for the meter, please confirm that the test line has been removed from the meter and the meter is turned off.
- ✧ The meter displays the low battery voltage symbol "  ", the battery should be charged or replaced in time.
- ✧ Charging or data transmission operations are strictly prohibited during the measurement process.
- ✧ Pay attention to the measurement range and operating environment specified by the instrument.
- ✧ The use, disassembly, calibration and maintenance of this meter must be operated by authorized personnel.
- ✧ Due to the reason of this instrument, if continuing to use it will bring danger, you should stop using it immediately and seal it immediately.
- ✧ Deposits are handled by authorized institutions.
- ✧ The safety warning sign “  ” in the instrument and the manual, the user must be strictly in accordance with this manual Allow safe operation.
- ✧ instrument output high pressure, be sure to connect well test line after line left hand press test to test. Otherwise there is a risk of electric shock.
- ✧ After the test is completed, wait for one minute for the discharge to complete before removing the test line. When removing the test line, remove the instrument first end of the test line and put the test line away.

## 2. Introduction

FR3015 digital insulation resistance meter also known as megohm meter, high voltage insulation resistance tester, used for insulation resistance testing. This instrument has LCD large screen grey backlight display, data storage, data access, and other functions. At the same time, it also has the function of measuring DC voltage and AC voltage absorption ratio and polarization index. The machine is beautiful and high-grade, wide range, high resolution, convenient operation, easy to carry, accurate, reliable, stable performance, strong anti-interference ability.

FR3015 also has a shock-proof, dust-proof, moisture-proof structure, adapt to the harsh working environment, is the electric power, post and telecommunications, communication, mechanical and electrical installation and maintenance and the use of electricity as industrial power or energy industrial enterprise sector commonly used and essential instrument. It is suitable for measuring the resistance value of various insulating materials and the insulation resistance of transformers, motors, cables and electrical equipment.

FR3015 digital insulation resistance meter is composed of medium and large scale integrated circuit. The output power of this table is large, and the output voltage levels are many. The rated insulation test voltage is up to 2500V and the measured insulation resistance is up to 100.0GΩ. The DC voltage ranges from 2.0 V to 1000V, and the AC voltage ranges from 2.0 V to 1000V.

## 3. Range and accuracy

### 3.1. Insulation resistance range and accuracy

Measurement function	The output voltage	Measuring range	precision	resolution
<b>Insulation resistance</b>	100V (±10%)	0.06MΩ ~ 0.60MΩ	±3%rdg±5dgt	0.01MΩ
		0.60MΩ ~ 6.00 MΩ	±3%rdg±5dgt	0.01MΩ
		6.0MΩ~60.0MΩ	± 5 %rdg±5dgt	0.1MΩ
		60MΩ~600MΩ	± 7 %rdg±5dgt	1MΩ
		0.60GΩ~5.00GΩ	± 10 %rdg±5dgt	0.01GΩ
	250V (±10%)	0.10 MΩ~1.00 MΩ	±3%rdg±5dgt	0.01MΩ
		1.00MΩ~10.00 MΩ	±3%rdg±5dgt	0.01MΩ
		10.0MΩ~100.0 MΩ	± 5 %rdg±5dgt	0.1MΩ
		100MΩ~1000MΩ	± 7 %rdg±5dgt	1MΩ
		1.00GΩ~10.00GΩ	± 10 %rdg±5dgt	0.01GΩ
	500V (±10%)	0.20 MΩ~2.00 MΩ	±3%rdg±5dgt	0.01MΩ
		2.00MΩ~2 0.00 MΩ	±3%rdg±5dgt	0.01MΩ
		20.0MΩ~2 00 .0 MΩ	± 5 %rdg±5dgt	0.1MΩ
		200MΩ~2000MΩ	± 7 %rdg±5dgt	1MΩ
		2.00GΩ~20.00GΩ	± 10 %rdg±5dgt	0.01GΩ
	1000V (±10%)	0.50 MΩ~5.00 MΩ	±3%rdg±5dgt	0.01MΩ
		5.00MΩ~50.00 MΩ	±3%rdg±5dgt	0.01MΩ
		50.0 MΩ~500.0 MΩ	± 5 %rdg±5dgt	0.1MΩ
		500 MΩ~5000MΩ	± 7 %rdg±5dgt	1 MΩ
		5.00GΩ~50.00GΩ	± 10 %rdg±5dgt	0.01GΩ
2500V (±10%)	1.00MΩ~10.00 MΩ	±3%rdg±5dgt	0.01MΩ	
	10.00MΩ~100.0 MΩ	±3%rdg±5dgt	0.1MΩ	
	100 MΩ~1000MΩ	± 5 %rdg±5dgt	1MΩ	
	1.00GΩ~10.00GΩ	± 7 %rdg±5dgt	0.01 GΩ	
	10.00GΩ~100.0GΩ	± 10 %rdg±5dgt	0.1GΩ	

**Note: Conversion of commonly used electrical units**

1 GΩ (Giga ohm) = 1000 MΩ = 10<sup>9</sup> Ω

1MΩ (Mega ohm) = 1000KΩ = 10<sup>6</sup> Ω

### 3.2. Voltage range and accuracy

Measurement function	Measuring range	precision	resolution
DC voltage	DC 2.0V ~ 1000V	$\pm 3\% \text{rdg} \pm 3 \text{dgt}$	0.1V
AC voltage	AC 2.0V ~ 1000V	$\pm 3\% \text{rdg} \pm 3 \text{dgt}$	0.1V


## 4. Model difference

Model	FR3015	FR3015E
Rated voltage (V)	100-1000V	250-2500V
Insulation resistance range	0.06M $\Omega$ -50.00G $\Omega$	0.10M $\Omega$ -100.0G $\Omega$
Insulation resistance resolution	0.01M $\Omega$	0.01M $\Omega$
DC voltage range	2.0 ~ 1000V	2.0 ~ 1000V
DC voltage resolution	0.1V	0.1V
AC voltage range	2.0 ~ 1000V	2.0 ~ 1000V
AC voltage resolution	0.1V	0.1V
Absorption ratio and polarization index measurement	●	●
USB data upload function	●	●
Data storage	●	●
Real-time indicator of battery power	●	●
Backlight	●	●
Battery low voltage indicator	●	●
<p>○ Empty indicates no</p> <p>● Solid indicates yes</p>		

## 5. Technical specifications

<b>Function</b>	Insulation resistance test, voltage test
<b>Baseline conditions</b>	23°C ± 5°C, below 75%rh
<b>Rated voltage (V)</b>	100~2500V
<b>Measuring voltage (V)</b>	Rated voltage × (1±10%)
<b>Insulation resistance range</b>	0.06MΩ ~ 100.0GΩ
<b>Insulation resistance resolution</b>	0.01MΩ
<b>DC voltage range</b>	2.0~1000V
<b>DC voltage resolution</b>	0.1V
<b>AC voltage range</b>	2.0~1000V
<b>AC voltage resolution</b>	0.1V
<b>Output short circuit current</b>	≥ 1.5mA (1000V)
<b>Absorption ratio and polarization index measurements</b>	Have
<b>Power supply</b>	1.5V (AA) alkaline batteries 8 pieces
<b>Backlight</b>	Controllable gray and white screen backlight, suitable for use in dark places
<b>Auto off</b>	Instrument shut down after 15 minutes without operation
<b>Display mode</b>	4-digit super large LCD display, gray and white screen backlight
<b>LCD display size</b>	73 mm x 43 mm
<b>Meter size</b>	175mm (L) × 112mm (W) × 53mm (H)
<b>Test line</b>	High voltage test line red 1 meter, black 1 meter



<b>USB interface</b>	With USB interface, data reading, save record data
<b>Data storage</b>	500 groups, flashing "FULL" symbol means storage is full
<b>Data review</b>	Data query function: "MEM" symbol display
<b>Overflow display</b>	Over-range overflow function: "OL" symbol display
<b>Power consumption</b>	Standby time: 18mA Max (backlight off)
	Power on backlight: 43mA Max
	Measurement: 326mA Max (with backlight on )
<b>Quality</b>	1230g (including battery)
<b>Battery voltage</b>	The battery voltage is insufficient, and the low battery symbol "  " is displayed
<b>Insulation resistance</b>	$\geq 50M\Omega$ (1000V)
<b>withstand voltage</b>	AC3kV/50Hz 1min
<b>Operating Temperature and Humidity</b>	-10°C ~ +50°C < 85%RH
<b>Storage Temperature and Humidity</b>	-15°C ~ +55°C < 90%RH
<b>Suitable for safety regulations</b>	IEC61010-1, IEC1010-2-31, IEC61557-1, 5, IEC60529 (IP54), pollution, etc. 2, CAT III 300V

# 6. Instrument structure

1. EARTH interface

2. GUARD interface

3. V interface

4. LINE interface

5. Left button

6. Right key/backlight key

7. "MODE" mode key

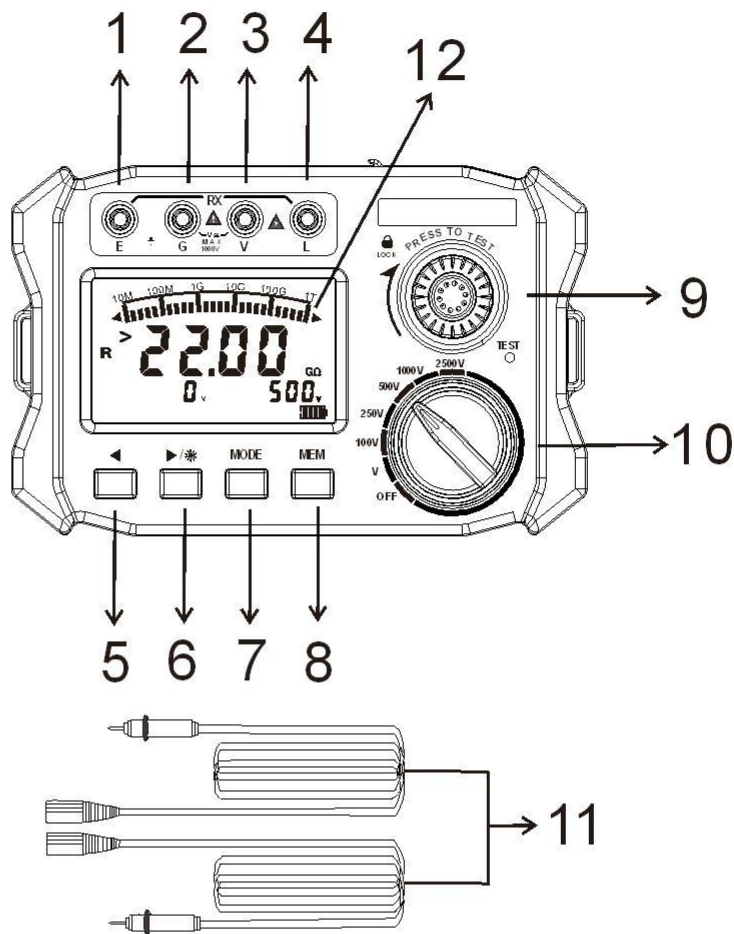
8. "MEM" save key/read key

9. Test key

10. Turntable control keys

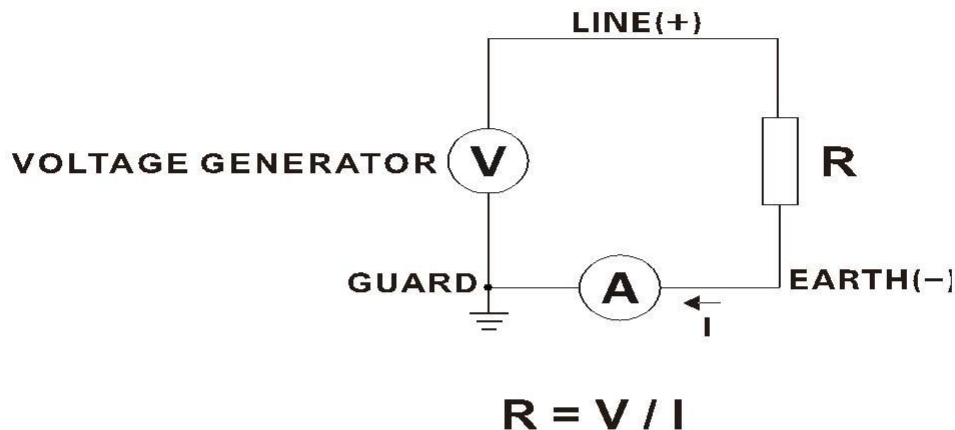
11. Test line (one red and one black)

12. LCD display




## 7. Measuring principle

Insulation resistance measurement uses a voltage generator to generate a voltage  $V$ , which is applied to both ends of the resistor. By measuring the current  $I$  flowing at both ends of the resistor, the grounding resistance value  $R$  is calculated according to the formula  $R=V/I$ .




## 8.operation method

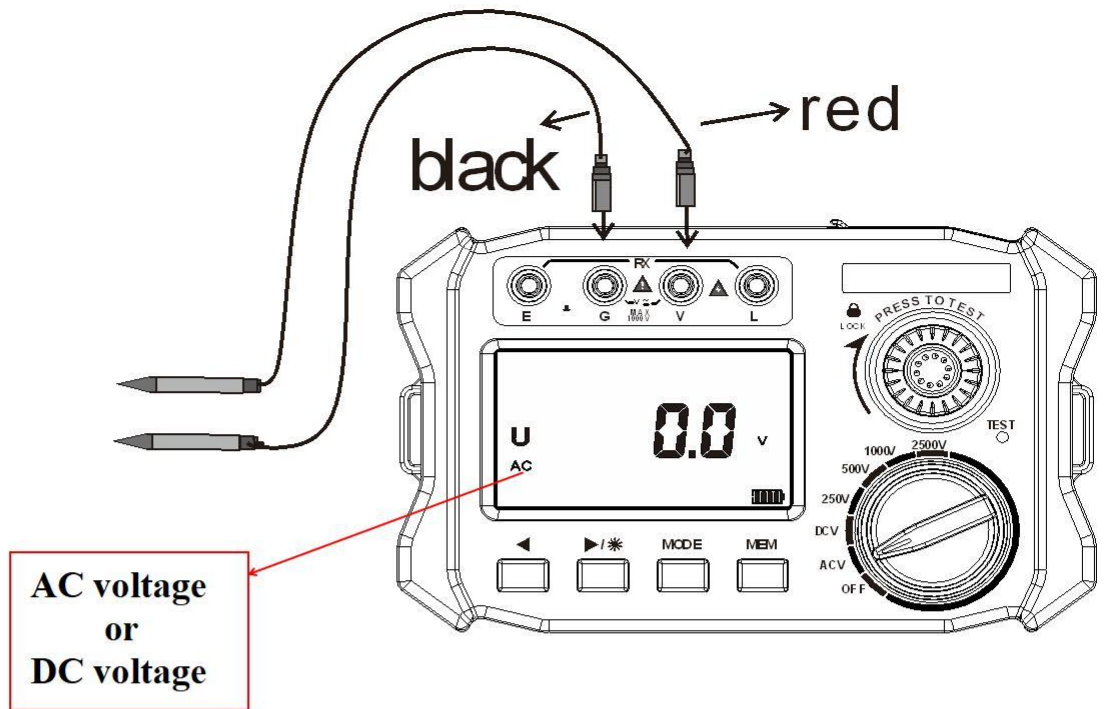
### 8. 1. Battery voltage check

After starting up, if the LCD displays the low battery voltage symbol "  ", it means that the battery is low, please charge it in time. Only when the battery power is sufficient can the accuracy of the measurement be guaranteed.

### 8. 2. Voltage test


	<b>The DC voltage input to the meter cannot exceed 1000V.</b>
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Wiring method: When measuring voltage, connect the red test lead to the positive pole of the power supply, and the black test lead to the negative pole of the power supply.




Short press the "MODE" key to switch between voltage AC test mode and voltage DC test mode .

### 8. 3. Insulation resistance test

	<p>The insulation resistance test can only be carried out on a non-charged circuit. Before the test, please check whether the test line wire is intact and whether the circuit under test is live. The live line may damage the instrument and affect the measurement accuracy.</p>
	<p>Must wear high-voltage insulating gloves to operate.</p>
	<p>In the insulation resistance range, press the test switch to generate high voltage at the head of the test line and the circuit under test, please avoid touching it.</p>
	<p>Be sure to connect the ground wire (black) to the ground port of the circuit under test.</p>
	<p>Do not touch the circuit immediately after testing. Stored charge may cause electric shock.</p>
	<p>Do not take off the test lead immediately, you must wait until the discharge is completed before touching the circuit under test.</p>
	<p>In order to ensure the measurement accuracy, do not twist the test wires together.</p>

#### 1、 Precautions for testing high voltage insulation resistance:

	<p>The greater the resistance value of the high-voltage insulating material, the smaller the current passing through it after adding a DC voltage, and it is easily affected by the interference of the external environment, resulting in a</p>
--	--

	large test error.
	The higher the measured resistance value, the longer the measurement time.
	As humidity increases, surface leakage increases and bulk conductance current increases.
	The resistance value of general materials decreases with the increase of ambient temperature and humidity.

2、 Temperature and humidity values to ensure insulation resistance accuracy

Insulation resistance range	Humidity value to ensure insulation resistance accuracy	Temperature value to ensure the accuracy of insulation resistance
0Ω-100MΩ	<85% RH (no condensation)	23°C ± 5°C
100MΩ-20GΩ	<75% RH (no condensation)	
20GΩ-1000GΩ	<65% RH (no condensation)	

3、 Insulation resistance test operation

1. The insulation resistance test can only be carried out on an uncharged circuit. Before the test, check whether the test wire is in good condition and confirm whether the circuit under test is charged.

2. In the non-test state, you can turn the dial to select the voltage value to be tested.

3. One end of the grounding wire (black) is connected to **the EARTH** terminal of the instrument , and the **other** end is connected to the grounding terminal of the circuit under test. (Red) One end is connected to the **LINE** terminal of the instrument , and the other end is in contact with the circuit under test, as shown in the figure, turn the " TEST " test button to start the test ( the LED light will be on when the test is performed ). The insulation resistance value can be read only after the measurement is completed and the displayed value is fixed.

## 8.4. Polarization Index (PI) and Absorption Ratio (DAR)

### 1. The role of polarization index (PI) and absorption ratio (DAR):

The polarization index (PI) and absorption ratio (DAR) are tests to check whether the leakage current of an insulator is increased in time. Verify that the leakage current does not increase during the application time. The meter automatically calculates the value of the polarization index PI and the absorption ratio DAR, which are used as the basis to judge the insulation performance. Both the polarization index PI and the absorption ratio DAR represent the change of the insulation resistance within a period of time after the object is subjected to the measured voltage.

### 2. The difference between polarization index (PI) and absorption ratio (DAR):

For general insulation tests, such as housing insulation, tool handles, etc. can generally be tested in a relatively short period of time to increase the leakage current with the increase of the voltage application time, so generally can be tested with a short time

test, the short-term insulation resistance ratio DAR is called the absorption ratio (see the following formula for the specific test time), but for the large-capacity and long-term absorption process, such as transformers, generators, cables, capacitors and other electrical equipment, sometimes the absorption ratio (DAR) is not enough to reflect the whole process of absorption, and the insulation resistance ratio can be used for a longer time, that is, the ratio between the insulation resistance (R10min) at 10 minutes and the insulation resistance (R1min) at 1 minute describes the entire process of insulation absorption, and PI is called the polarization index.

The PI and DAR values are calculated by the following formula:

$$\text{PI(Polarization Index)} = \frac{R_{10 \text{ Min}}}{R_{1 \text{ Min}}}$$

$$\text{DAR (Absorption ratio)} = \frac{R_{60 \text{ Sec}}}{R_{15 \text{ Sec}}}$$

$$\text{DAR (Absorption ratio)} = \frac{R_{60 \text{ Sec}}}{R_{30 \text{ Sec}}}$$

- Remark:**
- 1: R10Min= resistance value measured by the voltage applied for 10 minutes
  - 2: R1Min=R60Sec=the resistance value measured by the voltage applied for 1 minutes
  - 3 : R30Sec=It is the resistance value measured by the voltage applied for 30 seconds
  - 4: R15Sec=It is the resistance value measured by the voltage applied for 15 seconds
  - 5: DAR calculation time can choose 15 seconds or 30 seconds

### 3. Polarization index (PI) and absorption ratio (DAR) test

1. The polarization index (PI) and absorption ratio test (DAR) can only be carried out on an uncharged circuit. Before the test, check whether the test wire is in good condition and confirm whether the circuit under test is charged.

2. In the non-test state, you can turn the dial to select the voltage value to be tested.

3. Press the " **MODE** " key to select the corresponding mode, the LCD displays "10:01m" in the lower left corner of the polarization index mode, displays "60:15S" for the 15-second mode of the absorption ratio mode, and displays "60:30S" for the absorption ratio mode of 30 In the second mode, the lower left corner of the LCD does not display anything for the insulation resistance measurement mode.

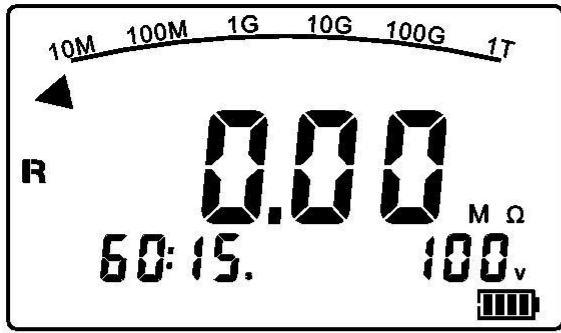


Figure 9-1 Absorption ratio mode 15 seconds mode

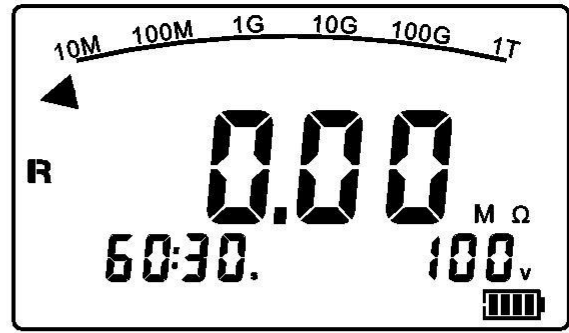


Figure 9-2 Absorption ratio mode 30 seconds mode

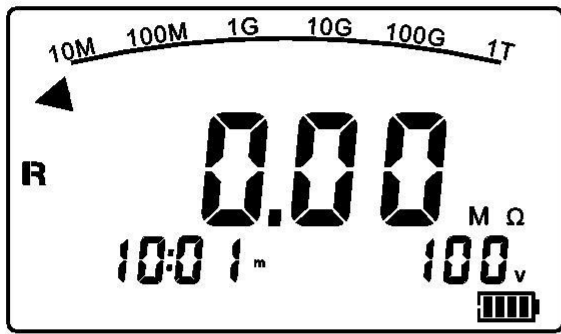


Figure 9-3 Polarization index mode

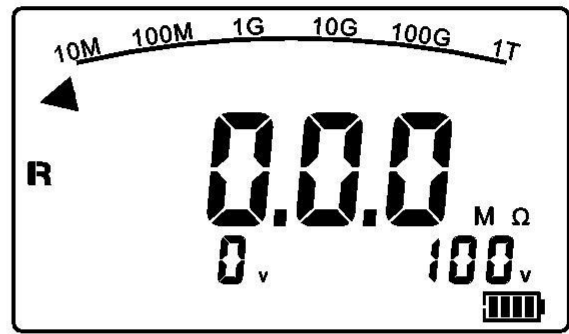


Figure 9-4 Insulation resistance measurement mode

4. One end of the ground cable (black) to the EARTH end of the instrument and the other end to the earth end of the loop under test. (red) One end is connected to the LINE end of the instrument, and the head of the other end is in contact with the circuit under TEST, as shown in the figure. Turn the test key "TEST" to start the test (the test LED light will light up). The insulation resistance value can be read only after the display value is fixed and the measurement time is up. Absorption ratio or polarization index value can be read.

5. After the test is completed, press "◀" to switch to view the dividend and ratio of absorption ratio or polarization index value, or press "▶" to switch to view the ratio and divisor of absorption ratio or polarization index value (for example, in "60:15S" mode, "60:15S" displayed in the lower left corner is the ratio, "15S" displayed is the dividend, "60S" displayed is the divisor, and "60s" displayed is the divisor. Other patterns are the same).

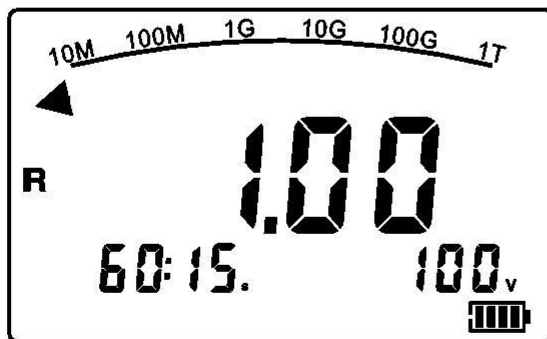


Figure 9-5 Ratio

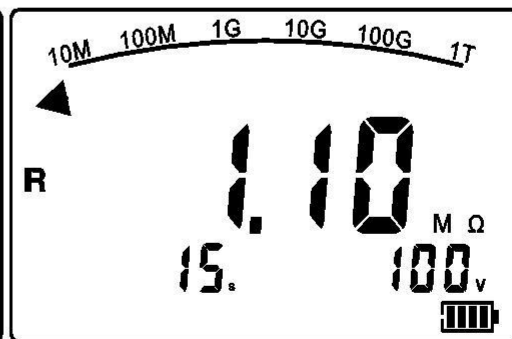


Figure 9-6 Divisor

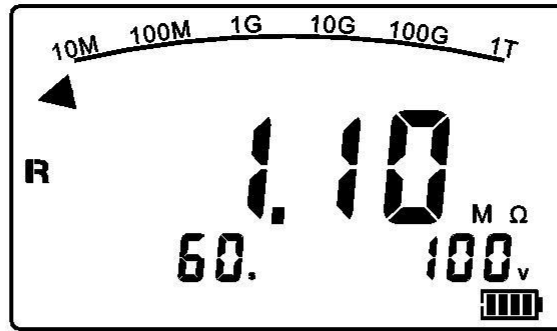
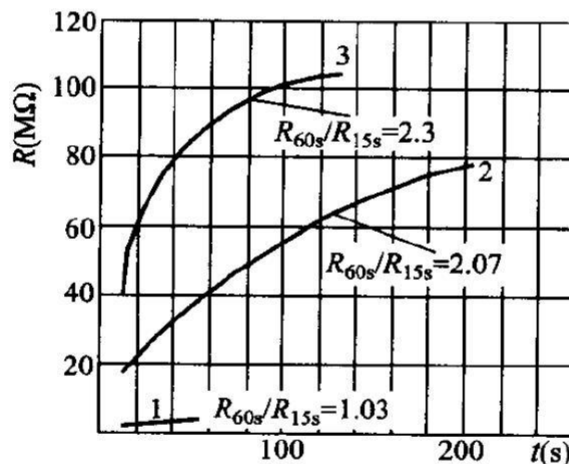


Figure 9-7 Divisor

#### 4. Polarization index (PI) and absorption ratio (DAR):

In engineering, insulation resistance and absorption ratio (or polarization index) can reflect the degree of moisture exposure of generator, oil-immersed power transformer and other equipment insulation. The absorption ratio (or polarization index) value of insulation decreases after moisture exposure (as shown in Figure 1), so it is an important index to judge whether insulation is damp.

It should be noted that sometimes the insulation has more obvious defects (such as insulation breakdown at high pressure) and the absorption ratio or polarization index values are still good. Absorption ratio or polarization index can not be used to find other local insulation defects other than damp and dirty.



1-Befor dryilig, 15 degree Celsius: 2-then the end of drying, 73.5 degree Celsius:3-fter running 72h, and cooled to 27 degree Celsius

**Figure 1 The relationship between the insulation resistance R of a generator and the time t**

Polarization index reference judgment value:

Polarization index	Above 4	4~2	2.0~1.0	Below 1.0
Judge	The best	Good	Need to pay attention	Bad

Absorption ratio reference judgment value:

Absorption ratio	Above 1.4	1.25~1.0	Below 1.0
------------------	-----------	----------	-----------



Judge	The best	Good	Bad
-------	----------	------	-----

## 8. 5. Backlight control

After power on, press and hold the "☀️" button to turn on or off the backlight. The backlight function is suitable for dark places. The backlight is turned off by default every time the device is turned on.

## 8. 6. Data lock/storage

1. After the measurement is completed after starting up, short press the "**MEM**" key to lock the current display data and display the "DH" symbol, and automatically store the number, short press the "**MEM**" key again to exit the lock, if the storage is full, the indicator will display the "**FULL**" symbol.

2. Save and display an example as shown in the figure below: the measured data is 100.0 MΩ, short press "**MEM**" to display and store as the first group of data.

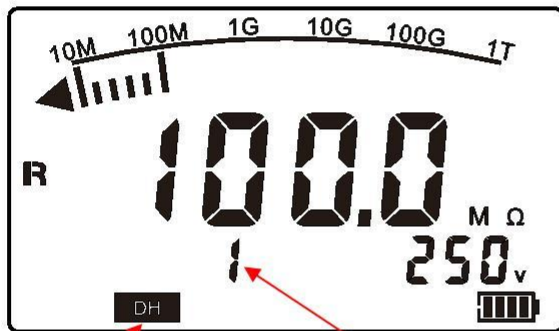


Figure 12-1 Lock and save display

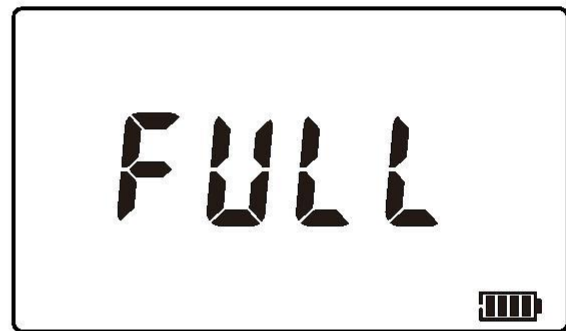


Figure 12-2 Storage full display

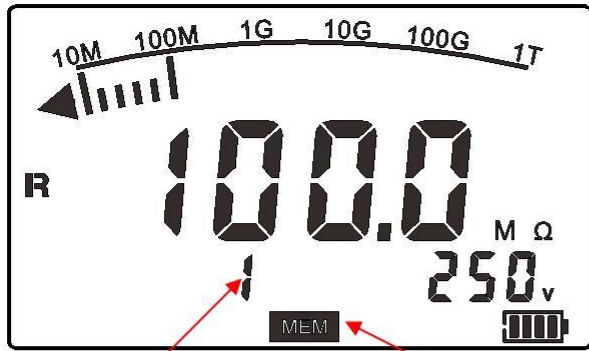
"DH" locks the identifier

"Value" stores the index value

## 8. 7. Data review/deletion

1. After startup, if the instrument has saved data, long press the "**MEM**" key to enter the data query, the "MEM" symbol will be displayed on the interface for reading stored data. Press "◀" or "▶" to query the corresponding data with the step value as 1, hold down "◀" or "▶" to query the corresponding data with the step value as 10, and then press "**MEM**" to exit the query.

2. As shown in the following figure: The number 1 in the lower left corner of the screen indicates the first data saved. If no data is stored, the LCD displays "NULL".



Look up the index value, section 1 data

Look up the data identifier

Figure 13-1 Resistor lookup

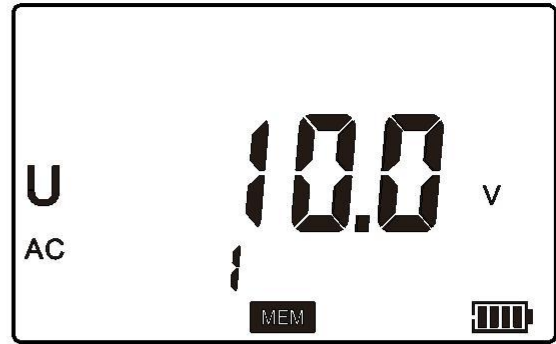


Figure 13-2 AC voltage lookup

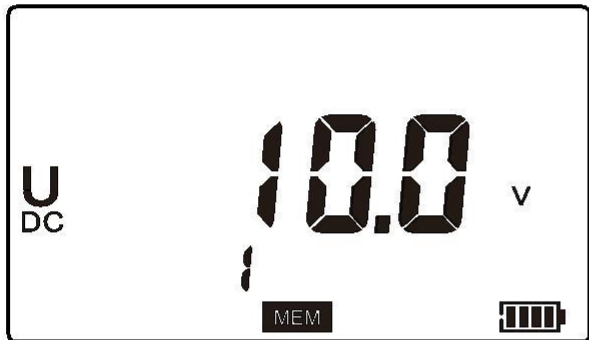


Figure 13-4 DC voltage lookup

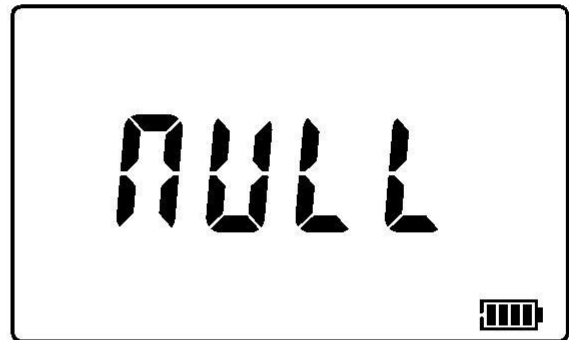


Figure 13-3 No stored data

3. In the data query state, long press the "MODE" key to enter the data deletion, short press the "◀" key to delete the stored data and exit the query mode, short press the "▶" key to return to the query interface without deleting, and the deletion page is displayed as shown below.



Figure 13-6 Delete display

## 8. Packing list

Instrument	1PC
High voltage test line line	3PCS (black , red , green each 1 )
Monitoring software CD	1PC
USB communication line USB	1PC
Specification,certificate of warranty	1SET
Cell number	8PC
Instrument box ( bag )	1PC

The contents of this user's manual do not justify the use of the product for any particular purpose.

The company is not responsible for other losses caused by use.

The company reserves the right to modify the contents of the user manual. Changes will be made without prior notice



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