

9455-TR Series

INSULATION RESISTANCE TESTERS OPERATION MANUAL

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MN-9455-TR Series-E

I. Safety rules and precautions

Thank you for purchasing our Digital High Voltage Insulation Resistance Meter. Before you use the instrument for the first time, in order to avoid possible electric shock or personal injury, please be sure to: read in detail and strictly observe the safety rules and precautions listed in this manual.

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

- ☆The instrument is designed, manufactured and tested according to IEC61010.
- ☆In any case, special attention should be paid to safety when using this meter.
- ☆Do not use high-frequency signal generators, such as cellular phones, next to the meter during measurement to avoid errors.
- ☆Note the labeling text and symbols on the body of this instrument.
- ☆Before use, it should be confirmed that the instrument and accessories are intact, and the insulation of the instrument and test line is not broken, exposed or disconnected before use.
- ☆During measurement, it is strictly prohibited to touch the exposed conductors and the circuit being measured.
- ☆Verify that the wire connection plugs are tightly inserted into the meter connector.
- ☆Do not measure in flammable places; sparks may cause an explosion.
- ☆Discontinue use of the meter if metal is exposed due to breakage of the housing or test cable during use.
- ☆Do not place and store the meter for a long time in a hot and humid place or under direct sunlight.
- ☆When replacing the batteries in the meter, make sure that the test leads are moved away from the meter and that the meter is turned off.
- ☆The meter shows low battery voltage symbol "□", should be charged in time, otherwise it will cause error.
- ☆Charging or data transfer operations are strictly prohibited during measurement.
- ☆Pay attention to the measurement range and operating environment specified for this instrument.
- ☆Use, disassembly, calibration, and maintenance of this meter must be performed by authorized and qualified personnel.
- ☆If, due to this instrument, continued use poses a hazard, it shall be immediately discontinued and immediately sealed and disposed of by an authorized and qualified agency.
- ☆The "△" safety warning signs in the instrument and the manual, the user must strictly follow the contents of this manual for safe operation.
- ☆The meter outputs high voltage, please be sure to connect the test line and leave the test line before pressing the test button 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 cable. When removing the test cable, first remove the test cable from the meter end and then put the test cable away.

II. Introduction

Digital Insulation Resistance Tester is also known as Megohmmeter, High Voltage Insulation Resistance Tester, etc. It is used for insulation resistance testing. This meter has LCD large screen gray backlight display, data storage, data access, alarm, automatic shutdown and other functions. At the same time also has the measurement of DC voltage AC voltage absorption ratio and polarization index function. The whole machine is beautiful and high-grade, wide range, high resolution, convenient operation, easy to carry, accurate, reliable, stable performance, strong anti-interference ability. And has a shockproof, dustproof, moisture-proof structure, is the telecommunications, electric power, meteorology, engine room, oilfield, electromechanical installation and maintenance and the use of electric power as industrial power or energy of the industrial enterprise sector commonly used and indispensable instrumentation. It is suitable for measuring the resistance value of various insulating materials and insulation resistance of transformers, motors, cables and electrical equipment.

Rated insulation test voltage range 100V~5000V, insulation resistance measurement range 0.01MΩ~2000GΩ. DC voltage measurement range 0~1000V, AC voltage measurement range 0~750V.

III. Range and accuracy

Test voltage	Range	Accuracy	Resolution
100V (only 9455-TR05)	0.05MΩ~5MΩ	±(3%+5d)	0.01MΩ
	5MΩ~50MΩ	±(3%+5d)	0.01MΩ
	50MΩ~500MΩ	±(3%+5d)	0.1MΩ
	0.5GΩ~5GΩ	±(5%+5d)	0.01GΩ
	5GΩ~20GΩ	±(20%+5d)	0.1GΩ
250V	0.1MΩ~10MΩ	±(3%+5d)	0.01MΩ
	10MΩ~100MΩ	±(3%+5d)	0.1MΩ
	100MΩ~1000MΩ	±(3%+5d)	1MΩ
	1GΩ~10GΩ	±(5%+5d)	0.01GΩ
500V	10GΩ~30GΩ	±(20%+5d)	0.1GΩ
	0.2MΩ~20MΩ	±(3%+5d)	0.01MΩ
	20MΩ~200MΩ	±(3%+5d)	0.1MΩ
	200MΩ~2000MΩ	±(3%+5d)	1MΩ
	2GΩ~20GΩ	±(20%+5d)	0.01GΩ
1000V	20GΩ~50GΩ	±(20%+5d)	0.1GΩ
	0.5MΩ~50MΩ	±(3%+5d)	0.01MΩ
	50MΩ~500MΩ	±(3%+5d)	0.1MΩ
	500MΩ~5000MΩ	±(3%+5d)	1MΩ
2500V	5GΩ~50GΩ	±(20%+5d)	0.01GΩ
	50GΩ~100GΩ	±(20%+5d)	0.1GΩ
	1MΩ~10MΩ	±(3%+5d)	0.01MΩ
	10MΩ~100MΩ	±(3%+5d)	0.1MΩ
	100MΩ~1000MΩ	±(3%+5d)	1MΩ
5000V	1GΩ~10GΩ	±(10%+5d)	0.01GΩ
	10GΩ~100GΩ	±(20%+5d)	0.1GΩ
	100GΩ~300GΩ	±(20%+5d)	1GΩ
	2MΩ~20MΩ	±(3%+5d)	0.01MΩ
	20MΩ~200MΩ	±(3%+5d)	0.1MΩ
10kV (only 9455-TR10)	200MΩ~2000MΩ	±(3%+5d)	1MΩ
	2GΩ~20GΩ	±(10%+5d)	0.01GΩ
	20GΩ~200GΩ	±(20%+5d)	0.1GΩ
	200GΩ~2000GΩ	±(20%+5d)	1GΩ
	5MΩ~50MΩ	±(3%+5d)	0.01MΩ
10kV (only 9455-TR10)	50MΩ~500MΩ	±(3%+5d)	0.1MΩ
	500MΩ~5000MΩ	±(5%+5d)	1MΩ
	5GΩ~50GΩ	±(10%+5d)	0.01GΩ
	50GΩ~500GΩ	±(20%+5d)	0.1GΩ
	500GΩ~2000GΩ	±(20%+5d)	1GΩ

Note: Conversion of common electrical units

1TΩ (Tera ohm) = 1000GΩ = 10¹²Ω

1GΩ (Giga ohm) = 1000MΩ = 10⁹Ω

1MΩ (Mega ohm) = 1000kΩ = 10⁶Ω

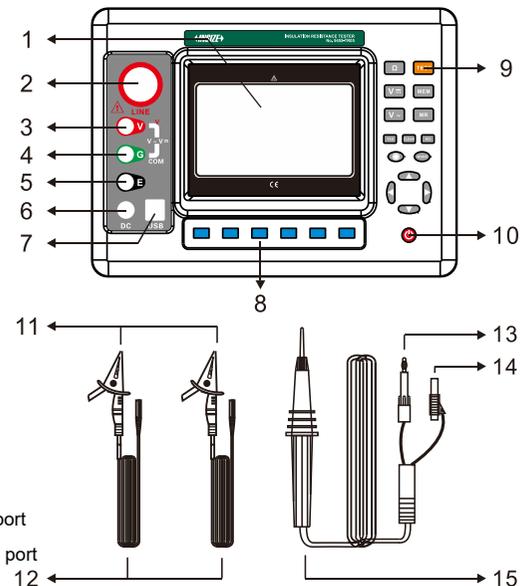
Measurement function	Range	Accuracy	Resolution
DC voltage	DC 0.0V~1000V	±(1.5%+3d)	0.1V
AC voltage	AC 0.0V~750V	±(1.5%+3d)	0.1V

IV. Technical specifications

Function	insulation resistance test, voltage test
Reference condition	23°C±5°C
Rated voltage (V)	100V, 250V, 500V, 1000V, 2500V, 5000V, 10kV
Measured voltage (V)	(100%~110%)U _N
Insulation resistance range	0.01MΩ~2000GΩ
Insulation resistance resolution	0.01MΩ
DC voltage range	0~1000V
DC voltage resolution	0.1V
AC voltage range	0~750V
AC voltage resolution	0.1V
Output short circuit current	≥5mA(5kV, 9455-TR05; 10kV, 9455-TR10)
Other functions	PI and DAR measurements
Power supply	12.6V rechargeable lithium battery
Backlight	Suitable for use in dark places
Display	4-digit large LCD display, display size 108mm x 65mm
Dimension (L×W×H)	277mm×227.5mm×153mm
Communication interface	USB interface, software monitoring, data transmission
Communication line	USB communication cable 1pc
Test leads	High-voltage rod 3m, high-voltage test line 1.5m (black and green)
Data storage	500 groups, blinking "FULL" symbol for full storage
Access to data	Data access function: "MR" symbol display
Overload display	Overload display: "OL" symbol display
Alarm function	Alarm indication when the alarm setting is exceeded
Power consumption	standby: 30mA Max (backlight off)
	power on backlight: 42mA Max
	measurement: 300mA Max (backlight off)
Weight	2750g (including battery)
Battery charge	low battery symbol displayed "□"
Automatic shutdown	automatic shutdown in about 15 minutes without operation
Electrical insulation	≥ 50 MΩ (between measurement line and enclosure)
Voltage withstand performance	AC3kV/50Hz 1min
Operating condition	-10°C~+40°C; ≤85%RH
Storage condition	-10°C~+55°C; ≤85%RH

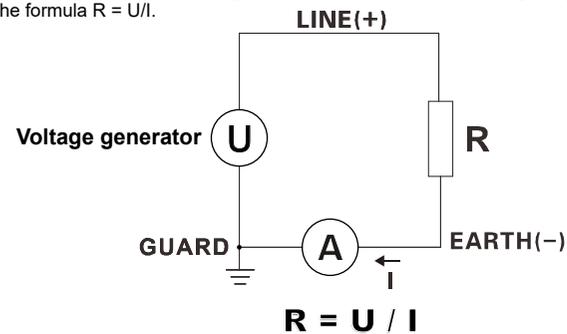
V. Instrument structure

- LCD display
- LINE connector
- V connector
- GUARD interface
- EARTH interface
- Charging port
- USB port
- Voltage selection key
- Test key
- On/Off key
- Safety crocodile clips
- Test lead (1 green and black each)
- Banana plug for high voltage test to LINE port
- Shielded cable connection plug to GUARD port
- High-voltage rod test lead



VI. Measurement principle

Insulation resistance measurements use a voltage generator to produce a voltage that is applied to both ends of the resistor, by measuring the current flowing across the resistor and calculating the grounding resistance value R according to the formula $R = U/I$.



VII. Method of operation

- Turning on and off
Press the **POWER** key to realize the switch on/off. The lower corner of the display shows "APO" after the power is turned on, and the power is automatically turned off after about 15 minutes of inactivity.

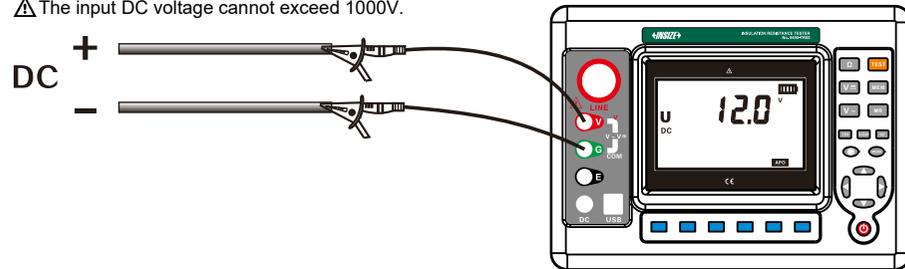
2. Battery voltage check

After power on, if the LCD displays the low battery voltage symbol "⏻", it means the battery power is insufficient, please charge it in time. The battery power is sufficient to ensure the accuracy of measurement.

3. DC voltage test

When measuring, press the **V_{DC}** button to switch to DC voltage test mode, connect the green meter pen to the **V** terminal, and the black meter pen to **COM**, the LCD will display the real-time DC voltage value.

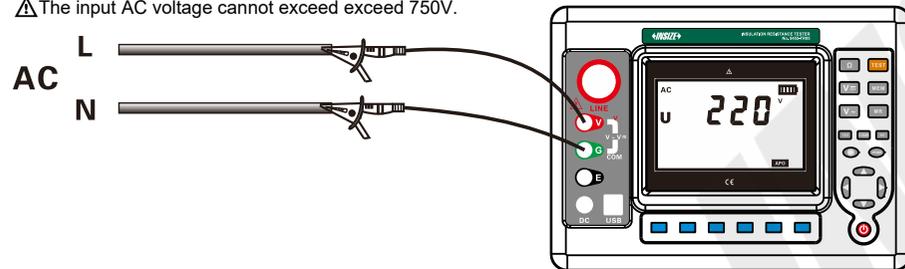
⚠ The input DC voltage cannot exceed 1000V.



4. AC voltage test

When measuring, press the **V_{AC}** button to switch to AC voltage test mode, connect the green pen to the **V** terminal and the black pen to **COM**, the LCD will display the real-time AC voltage value.

⚠ The input AC voltage cannot exceed 750V.



5. Insulation resistance test

⚠ Insulation resistance test can only be carried out on a non-electrified circuit, before testing, please check whether the test line conductors are intact, and whether the circuit under test is electrified, the electrified line may damage the meter and affect the measurement accuracy.

⚠ High-voltage insulating gloves must be worn to operate.

⚠ During insulation resistance range, high voltage will be generated in the head of the test lead and the circuit under test when the test switch is pressed, so please be careful to avoid touching it.

⚠ Be sure to connect the ground wire (black) to the ground port of the circuit under test.

⚠ Do not touch the circuit immediately after testing. The stored charge may cause an electric shock.

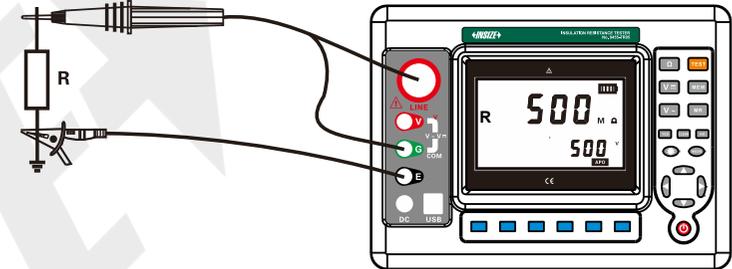
⚠ Do not remove the test lead immediately and wait until the discharge is complete before touching the circuit under test.

⚠ To ensure measurement accuracy, do not twist the test leads together during the test.

Insulation resistance tests should only be performed on uncharged circuits. Before testing, check that the test leads are in good condition and make sure that the circuit under test is not energized. When testing large-capacity products (cables, large-capacity transformers, etc.), please press and hold down the **TEST** button for 3 seconds to enter the standard test mode. At this time, the screen displays the "NOISE" symbol.

Press the **Ω** key to switch the test model and then press the **100V** (9455-TR05 only) or **250V** or **500V** or **1KV** or **2.5KV** or **5KV** or **10KV** (9455-TR10 only) key to select the voltage value to be tested over the line.

The ground wire (black) connects one end to the **EARTH** terminal of the meter connection and the other end to the ground terminal of the circuit under test. High-voltage rod test line (red) one end connected to the instrument **LINE** end of the other end of the head to contact the circuit under test, the green wire for the shielded wire, test when connected to the **GUARD** port better accuracy. As shown in the figure, press the **TEST** button (the meter will emit intermittent beeping during the test: "Drip~Drip~Drip..."). The LCD will display the measured value, and read the insulation resistance value after the measured value is fixed.

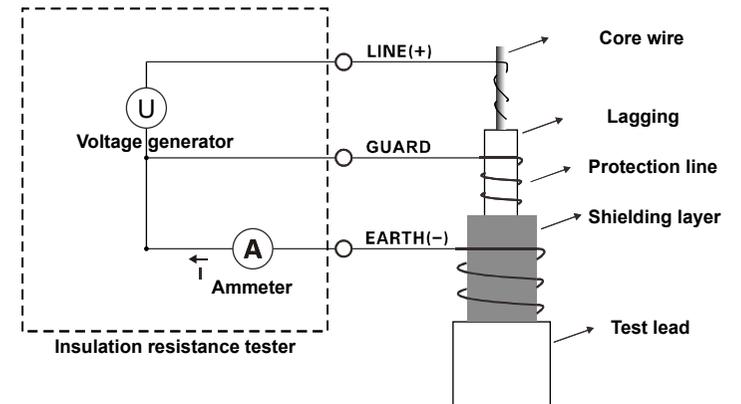


Temperature and humidity values to ensure accuracy of insulation resistance

Insulation range	Reference humidity range	Reference temperature range
0MΩ~100MΩ	≤85%RH(condensationless)	23°C±5°C
100MΩ~20GΩ	≤75%RH(condensationless)	
20GΩ~100GΩ	≤65%RH(condensationless)	
100GΩ~2000GΩ	≤50%RH(condensationless)	

6. Use of **GUARD** protective wire

When measuring the insulation resistance of a cable, the leakage current covering the surface converges with the current through the inside of the insulator, causing errors in the insulation resistance value to occur. To avoid this phenomenon, as shown in the figure below, the insulation resistance of the insulator can be measured accurately by using a protective wire (any conductive bare wire) to coil the portion through which the leakage current flows, and connecting it to the protective port so that the leakage current does not flow through the indicator. Please use the attached protective test wire to connect the protection port.



7. Polarization index (PI) and absorption ratio (DAR)

7.1 Polarization Index (PI) and Absorption Ratio (DAR) Function:

Polarization Index (PI) and Absorption Ratio (DAR) are tests to check whether the leakage current of an insulator increases with time. It confirms that there is no increase in leakage current while applying time. The meter automatically calculates the polarization index PI and absorption ratio DAR values as a basis for judging insulation performance. Both the polarization index PI and the absorption ratio DAR indicate the change in insulation resistance of the insulated object for a period of time after it has been subjected to the measured voltage.

7.2 Polarization index (PI) and absorption ratio (DAR) difference:

For general insulation testing, such as shell insulation, tool handles, etc. generally in a shorter period of time can test whether the leakage current increases with the increase in the time of the applied voltage, so generally with a shorter period of time the test can be tested, a short period of time to test the ratio of insulation resistance DAR is called the absorption ratio (see the formula below for the specific test time), but for the large-capacity and longer absorption process of the tested products, 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, can be used for a longer period of time insulation resistance ratio, that is, 10 minutes when the insulation resistance (R10min) and 1 minute when the insulation resistance (R1min) of the ratio of the insulation resistance (R1min) PI to describe the whole process of insulation absorption, PI is known as the polarization index, the value of PI and DAR through the following The PI and DAR values are calculated by the following formula:

$$PI = \frac{R_{10min}}{R_{1min}}$$

$$DAR = \frac{R_{60sec}}{R_{15sec}}$$

$$DAR = \frac{R_{60sec}}{R_{30sec}}$$

- Note: 1: R10min -- resistance value measured with voltage applied for 10 minutes;
- 2: R1min=R60sec -- resistance value measured with voltage applied for 1 minute;
- 3: R30sec -- resistance value measured with voltage applied for 30 seconds;
- 4: R15sec -- resistance value measured with voltage applied for 15 seconds;
- 5: The calculation time of DAR can be selected from 15sec or 30sec.

7.3 Polarization Index (PI) and Absorption Ratio (DAR) Tests

Polarization Index (PI) and Absorption Ratio (DAR) tests can only be performed on an uncharged circuit. Before testing, check that the test leads are in good condition and verify that the circuit under test is not charged.

Press the **Ω** key to switch the test model and then press the **100V** (9455-TR05 only) or **250V** or **500V** or **1KV** or **2.5KV** or **5KV** or **10KV** (9455-TR10 only) key to select the voltage value to be tested over the line.

Press **MODE** key to set the corresponding mode, the lower left corner of LCD displays "10:01m" for polarization index mode, "60:15s" for absorption ratio mode 15 seconds mode, "60:30s" for absorption ratio mode 30 seconds mode. Display "60:15s" for absorption ratio mode 15 seconds mode, display "60:30s" for absorption ratio mode 30 seconds mode, and the small digits do not show anything for insulation resistance measurement mode.

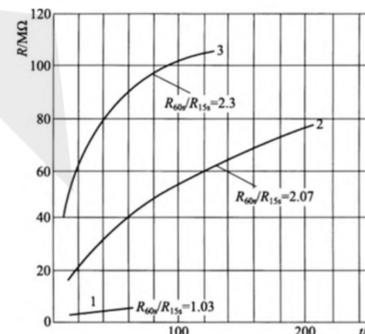
The ground wire (black) connects one end to the **EARTH** terminal of the meter and the other end to the ground terminal of the circuit under test. The high voltage rod test line (red) is connected to the **LINE** end of the instrument at one end and the head of the other end is in contact with the circuit under test. Press the **TEST** button, the LCD displays the measured value, and read the absorption ratio or polarization index value after the measured display value is fixed.

When the test is complete press "▲" to view the divisor of the absorption ratio or polarization index value (e.g., the value of 60s in the "60:15s" mode), and press "▼" to view the absorption ratio or polarization index value's divisor (e.g. the value of 15s in "60:15s" mode). Press the "▲" or "▼" key again to return.

7.4 Polarization Index (PI) and Absorption Ratio (DAR) Applications:

Insulation resistance and absorption ratio (or polarization index) can reflect the degree of moisture in the insulation of generators, oil-immersed power transformers and other equipment. The absorption ratio (or polarization index) value decreases after the insulation is damped, so it is an important indicator to determine whether the insulation is damped.

It should be noted that sometimes insulation with more obvious defects (e.g., insulation breakdown at high voltage) can still have good absorption ratio or polarization index values. The absorption ratio or polarization index cannot be used to detect localized insulation defects other than moisture and dirt.



A graph of insulation resistance R versus time t for a generator

- Curve 1 - 15°C before drying;
- Curve 2 - 73.5°C at the end of drying;
- Curve 3 - after 72h of operation and cooling to 27°C

Polarisation index reference determination value:

PI	>4.0	4.0~2.0	2.0~1.0	<1.0
insulation state	excellent	good	mediocre	dangerous

Absorption ratio reference determination value:

DAR	>1.4	1.25~1.0	<1.0
insulation state	excellent	good	dangerous

8. Backlight control

After power on, press the "☀" key to turn on or off the backlight, the backlight function is suitable for dim places. The backlight is off by default every time you switch on the unit.

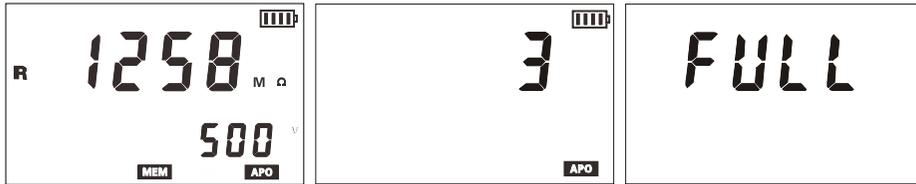
9. Alarm Setting

After power on, long press "☀" key to turn on or off the alarm function. Long press **MODE** key to set the resistance alarm value, change the current number size by pressing "▲" or "▼"key, then long press **MODE** key to save and exit. When the measured voltage value is greater than the alarm threshold setting value or insulation resistance value is less than the alarm threshold setting value and the alarm function has been turned on, the instrument flashes the "⚡" symbol and emits the "beep-beep-beep-beep" alarm sound. The maximum value of voltage alarm is 600V, and the maximum value of insulation resistance alarm is 9999MΩ, as shown below:



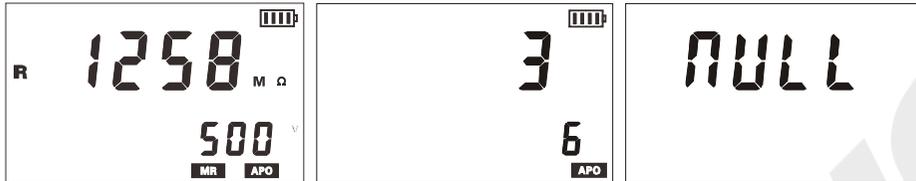
10. Data lock/storage

After the measurement is completed after power on, short press **MEM** key to lock the current display data, and automatically store the number, if the storage is full, the meter displays "FULL" symbol. If the storage is full, the meter will display "FULL" symbol. As shown in the figure below: the measured data is 1258MΩ, press **MEM** key briefly to display and store the data as the 3rd group.



11. Data Access/Deletion

After power on, if the meter has saved data, short press **MR** key to enter the data access, stored data reading interface "MR" symbol shows. Short press the "▲" or "▼" key to step to 1 to select the data corresponding to the array number, long press and hold the "▲" or "▼" key to step to 10 to select the data corresponding to the array number, then press the **MR** key to exit the access. The following figure: the number 3 is the current number of groups, 6 is the total number of groups, if there is no stored data, the LCD displays "NULL".



Under the state of data checking, short press **CLEAR** key to enter data deletion, press **NO** key without deletion to return to the page of preparing for measurement, press **YES** key to delete the stored data, and the deletion page is displayed as the following figure.



VIII. Battery Description

The instrument is powered by a 12.6V lithium battery. When the voltage drops to 10V, the power symbol shows "□", please charge in time. Low power affects the measurement accuracy.