

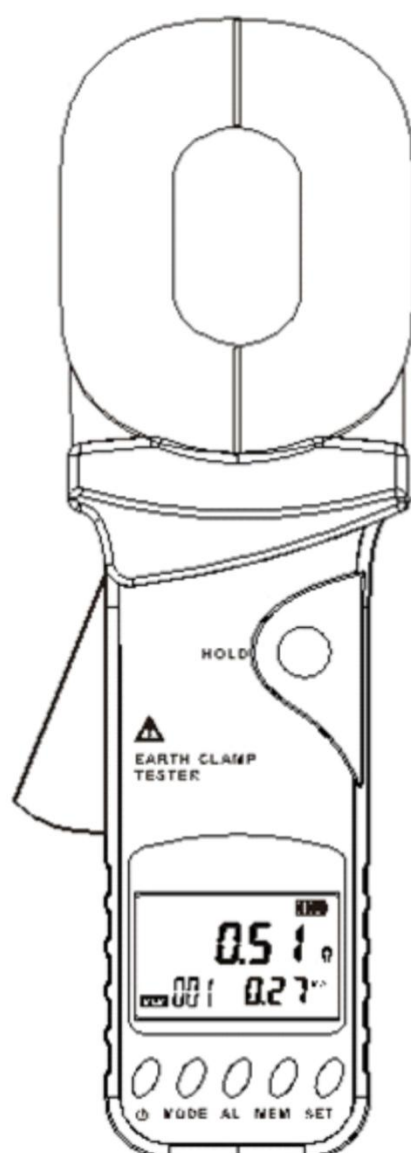
Clamp Ground Resistance Tester

FR2000+

FR2000A+

FR2000C+

FR2000B+



User Manual

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I. Safety rules and precautions

Thank you for purchasing our company's clamp-on grounding resistance tester. Before you use the instrument for the first time, in order to avoid possible electric shock or personal injury, please be sure to: 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 IEC61010 safety specifications.

- ◆ In any case, pay special attention to safety when using this instrument.

- ◆During measurement, do not use high-frequency signal generators such as mobile phones near the instrument to avoid errors.

- ◆Pay attention to the text and symbols on the label of the instrument body.

- ◆Make sure the instrument and accessories are in good condition before use.

- ◆Before starting the machine, squeeze the trigger once or twice to ensure that the jaws are well closed.

- ◆ Do not measure in flammable places, sparks may cause explosion.
 - ◆ When the machine is turned on, do not hold the trigger or clamp any wires.
 - ◆ The object to be measured can only be clamped after the “OL Ω” symbol is displayed after it is turned on normally.
 - ◆ Do not place and store the meter for a long time in places with high temperature and humidity, condensation and direct sunlight.
 - ◆ When replacing the battery of the meter, please make sure that the meter is turned off.
 - ◆ The meter displays the low battery voltage symbol “”, the battery should be replaced in time, otherwise it will lead to ground error.
 - ◆ The contact surface of the jaws must be kept clean and cannot be wiped with corrosives and rough objects.
 - ◆ When opening the trigger, avoid shock to the clamp meter, especially the jaw interface.
 - ◆ When the clamp meter is measuring resistance, the clamp head will make a slight noise, which is normal.
- Pay attention to the "beep-beep-beep--" sound to distinguish the alarm.

- ◆Pay attention to the measurement range and operating environment specified by this instrument.
- ◆The current of the measuring lead should not exceed the upper limit of the clamp meter.
- ◆The use, disassembly, calibration and maintenance of this instrument must be operated by authorized personnel.
- ◆Due to the reasons of this instrument, if it is dangerous to continue using it, you should stop using it immediately and seal it up immediately.
- ◆Deposits shall be processed by authorized institutions.
- ◆The “” safety warning sign in the instrument and manual, the user must strictly follow the instructions in this manual for safe operation.

II. Introduction

Clamp ground resistance tester, also known as loop resistance tester, is used to test ground resistance. This instrument uses a new black luxury screen design, the resistance current is displayed on the same screen, and it also has functions such as data storage, data review, alarm, and automatic shutdown. The whole machine is beautiful and high-grade, with a wide range, high resolution, convenient operation, convenient carrying, accurate, reliable, stable performance and strong

anti-interference ability. Moreover, it has a shock-proof, dust-proof and moisture-proof structure. It is a common and indispensable instrument for telecommunications, electricity, meteorology, computer rooms, oil fields, electromechanical installation and maintenance, and industrial enterprises that use electricity as industrial power or energy. It is suitable for measuring grounding resistance of various telecommunications, electric power, meteorology, computer room, oil field, power distribution lines, tower transmission lines, gas stations, factory grounding grids, lightning rods, etc.

The clamp ground resistance tester is controlled by a microprocessor and can accurately detect ground resistance. It uses fast filtering techniques to minimize interference. Simultaneous data storage and data upload functions.

III. Model parameters

Model	Resistance Range	Current Range
FR2000A+	0.01 Ω–200 Ω	--
FR2000+	0.01 Ω– 500 Ω	--
FR2000C+	0.01 Ω–1200 Ω	0.00mA–20A
FR2000B+Explosion-proof	0.01 Ω–1200 Ω	

IV. Range and Accuracy

Measurement Mode	Measuring Range	Resolution	Accuracy

Resistance	0.010 Ω -0.099 Ω	0.001 Ω	$\pm (1\% + 0.01 \Omega)$
	0.10 Ω -0.99 Ω	0.01 Ω	$\pm (1\% + 0.03 \Omega)$
	1.0 Ω -49.9 Ω	0.1 Ω	$\pm (1\% + 0.1 \Omega)$
	50.0 Ω -99.5 Ω	0.5 Ω	$\pm (1.5\% + 0.5 \Omega)$
	100 Ω -199 Ω	1 Ω	$\pm (2\% + 1 \Omega)$
	200 Ω -395 Ω	5 Ω	$\pm (5\% + 5 \Omega)$
	400-590 Ω	10 Ω	$\pm (10\% + 10 \Omega)$
	600 Ω -880 Ω	20 Ω	$\pm (20\% + 20 \Omega)$
	900 Ω -1200 Ω	30 Ω	$\pm (25\% + 30 \Omega)$
*Current	0.00mA -9.95mA	0.01mA	$\pm (2.5\% + 1\text{mA})$
	10.0mA -99.0mA	0.1mA	$\pm (2.5\% + 5\text{mA})$
	100mA -300mA	1mA	$\pm (2.5\% + 10\text{mA})$
	0.30A-2.99A	0.01A	$\pm (2.5\% + 0.1\text{A})$
	3.0A-9.9A	0.1A	$\pm (2.5\% + 0.3\text{A})$
	10.0A-20.0A	0.1 A	$\pm (2.5\% + 0.5\text{A})$

*Only available for instruments with current function

V. Technical Specifications

Function	Ground resistance test, loop resistance test, leakage current test
Ambient Temperature and Humidity	23°C±5°C, below 75%rh
Power Supply	DC 6V (4 AA dry batteries)
Measurement Method	mutual inductance
Resistor Resolution	0.001 Ω
*Current resolution	0.01mA
Jaw size	55mm×32mm
* Ω + A sync display	Ω + A sync display
Ground voltage measurement function	None
Display Mode	4-digit LCD display, black screen design
LCD size	46mm×29mm
Meter size	Length, width and height:285mm×85mm×58mm
Measure Time	2 times/sec
Data Storage	300 groups, "MEM" storage indication, displaying "FULL" symbol means the storage is full

Data Access	"MR" symbol indication when viewing data
Overflow Display	"OL" symbol indication when over range overflow
Interference Test	Automatically identify interference signals, and the "NOISE" symbol indicates when the interference current is large
Alarm Function	When the measured value exceeds the alarm setting value, an alarm prompt will be issued
Battery Voltage	Real-time display of battery power, reminding to charge in time when the battery voltage is low
Automatic shut-down	Automatic shutdown after 5 minutes of startup
Power consumption	50mA Max
Quality	Meter: 1180g (including battery)
Working temperature and humidity	-10°C~40°C; below 80%rh
Storage temperature and humidity	-20°C~60°C; below 70%rh

Insulation resistance	Above 20MΩ (500V between circuit and case)
Pressure resistance	AC 3700V/rms (between circuit and case)
External Magnetic Field	<40A/m
External Electric Field	<1V/m
Suitable for safety regulations	IEC61010-1 (CAT III 300V, CAT IV 150V, pollution degree 2); IEC61010-031; IEC61557-1 (grounding resistance);

*Only available for instruments with current function

VI. Instrument structure

1. Pliers

2. Jaw open and close trigger

3. LCD display

4. Power key

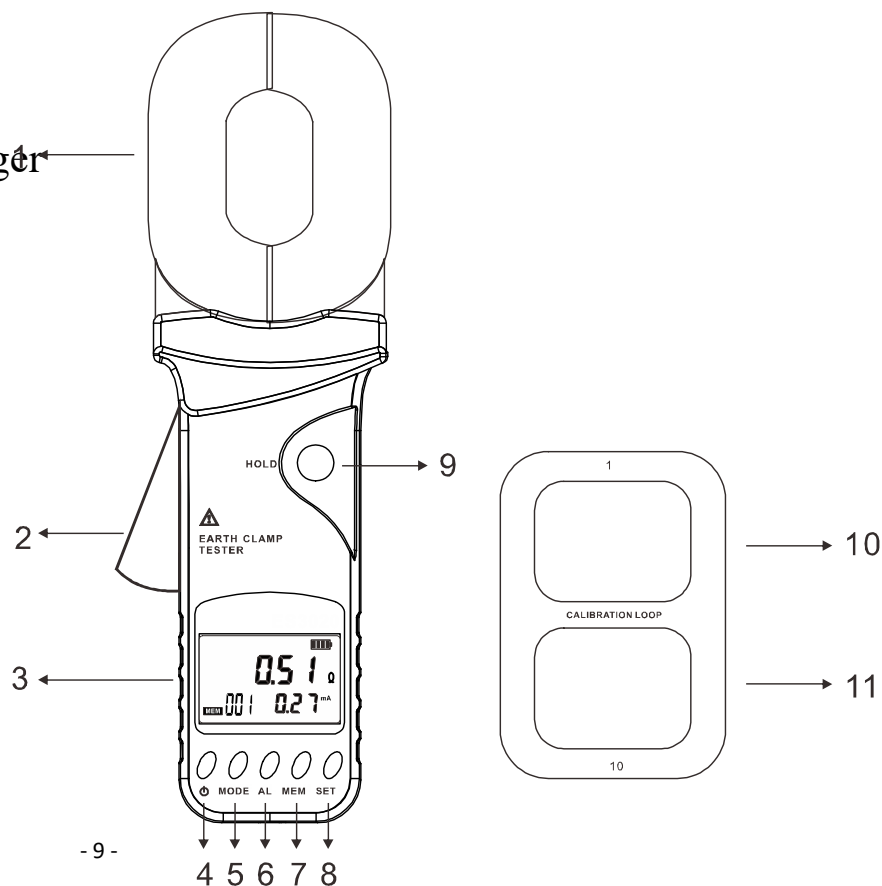
5. MODE key

6. AL alarm key

7. MEM memory key

8. SET key

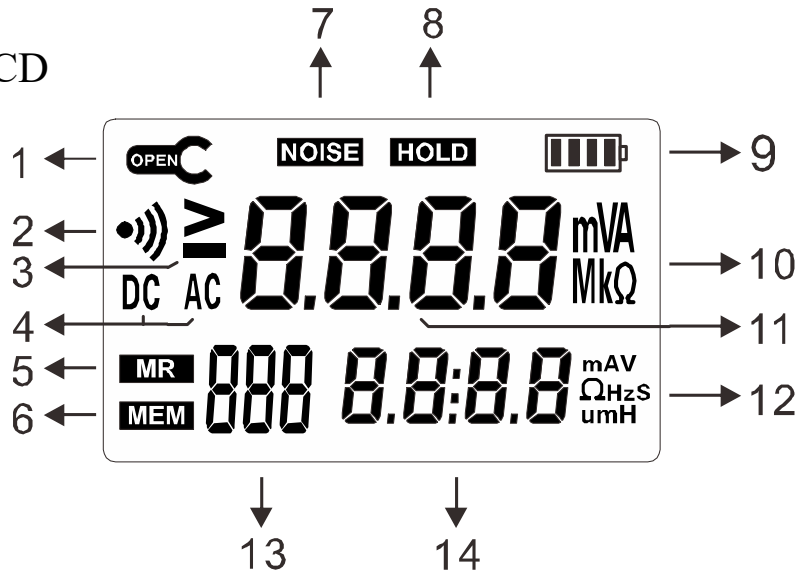
9. HOLD key



10. Check loop 1Ω loop

11. Check loop 10Ω loop

VII. LCD



1. Clamp head open symbol 2. Alarm indication symbol

3. Greater than symbol 4. AC and DC indication symbols

5. Data access symbols 6. Data storage symbols

7. Noise indicator symbol 8. Data lock symbol

9. Battery level indicator 10. Unit indication

11. Four-digit resistance data 12. Unit indication

13. Number of storage groups 14. Four digits indicate current

Description of special symbols:

(1).  The jaw opening symbol, when the jaw is opened, this symbol is displayed. At this time, the trigger may be squeezed artificially; or the jaws are seriously polluted, and the

measurement cannot be continued.

(2). "Er" is the error symbol when starting up, it is possible that the trigger was pressed or the jaws were opened when starting up.

(3).  Low battery voltage symbol, when the battery voltage is lower than 5.0V, this symbol displays, the measurement accuracy cannot be guaranteed at this time, and the battery should be replaced.

(4). The "OL Ω " symbol indicates that the measured resistance exceeds the upper limit of the clamp meter.

(5). The "L0.01 Ω " symbol indicates that the measured resistance exceeds the lower limit of the clamp meter.

(6). "OL A" symbol, indicating that the measured current exceeds the upper limit of the clamp meter.

(7).  Alarm symbol, when the measured value is greater than the set alarm threshold, the symbol will flash and display, and the instrument will emit intermittent "beep-beep-beep--" sound.

(8). MEM data storage symbol, flashes when saving data.

(9). MR refers to the data symbol, which is displayed when referencing data, and the number of the stored data is displayed at the same time.

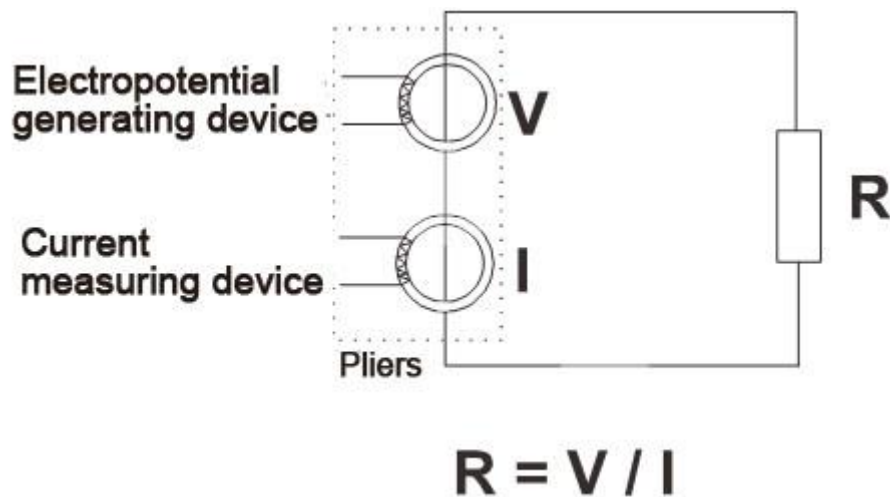
(10).NOISE symbol, when the ground loop under test has a large interference current, this symbol flashes and displays, and the instrument emits a "beep-beep-beep--" prompt sound. The accuracy of the test cannot be guaranteed at this time.

VIII. Principle of Resistance Measurement

The basic principle of the clamp-type grounding resistance tester to measure the grounding resistance is to measure the loop resistance. See below. clamp meter

The mouth part is composed of a voltage coil and a current coil. The voltage coil provides the excitation signal and induces a potential V on the loop under test. Under the action of the potential V , a current I will be generated in the circuit under test. The clamp meter measures V and I , and the measured resistance R can be obtained by the following formula.

$$R=V/I$$



IX.Operation

1. Switch Machine

	When starting up, do not depress the trigger, open the jaws, or clamp any wires.
	After the boot is completed and "OL Ω " is displayed, the trigger can be pulled, the jaws are opened, and the conductor under test can be clamped.
	Before starting the machine, squeeze the trigger once or twice to make sure the jaws are well closed.
	When starting up, keep the clamp meter in a natural static state, do not turn the clamp meter over, and do not apply external force to the jaws, otherwise the measurement accuracy cannot be guaranteed.

Press the power button to switch the machine on and off. The

meter automatically calibrates when powered on, and displays “OL Ω ” after it is powered on, and automatically enters the resistance measurement mode. If there is no normal boot-up self-calibration, the meter will display the “Er” symbol, indicating a power-on error. Common reasons for power-on errors are that the jaws are not closed well, Clamp wires etc. when starting up.

It will automatically shut down after 5 minutes of turning it on. Before the automatic shutdown, the meter will flash for 30 seconds. Pressing the power button again will delay the on-off time for 5 minutes.

2. Battery Voltage Check

After power on, if the LCD displays the low battery voltage symbol “”, it means the battery is low, please replace the battery. The battery power is sufficient to ensure the accuracy of the measurement.

3. Resistance current or ground voltage test



When the user thinks that the grounded value is not in line with the normal, you can use the random calibration ring to check whether the clamp meter is normal. The check loop has two resistance values of 1Ω and 10Ω respectively.

After the power-on self-test is completed, the large number in the middle displays "OL Ω ", and the resistance measurement can be performed. At this point, squeeze the trigger, open the jaws, clamp the circuit to be tested, and read the resistance value.

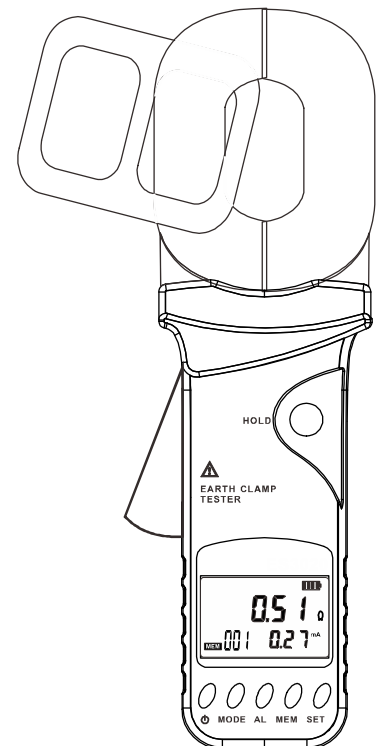
Resistance and earth leakage can be measured at the same time.

Press the "MODE" button to switch between "resistance + current" and "resistance" modes after power on.

The large number in the middle shows "OL Ω ", indicating that the measured resistance exceeds the upper limit of the clamp meter.

The large number in the middle shows "L0.01 Ω ", which means that the measured resistance exceeds the lower limit of the clamp meter.

In the "resistance + current" mode, the lower right of the display shows the current value, such as "0.00mA", if you need to measure the current, switch to this mode to read the current value directly.



Resistance + Current Mode:

The measured resistance value is 0.51Ω ,

The number of saved groups is 1 group, and the measured loop current is 0.00mA

4. Alarm system

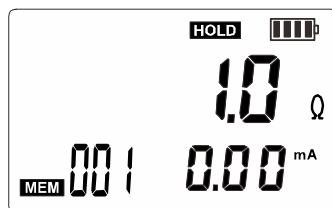
After power on, short press the "AL" key to turn on or off the alarm function, long press the "SET" key to set the resistance, current, and voltage alarm values, change the current number by pressing the "AL" key and "MEM" key, and short press the "MODE" key to switch the alarm mode, then long press the "SET" key to save and exit. When the measured resistance value is greater than the alarm critical set value and the alarm function is turned on, the meter flashes the "•••••" symbol and emits an alarm sound of "beep-beep-beep--". The maximum value of the ground resistance alarm setting is 200Ω . As shown below:



5. Data Lock

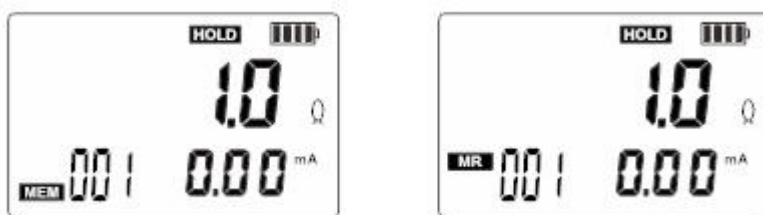
After the measurement is stable after power-on, short press the "HOLD" key to lock the current display data and save the data, and then short press the "HOLD" key to exit the lock mode. As

shown below:



6. Data storage/review/deletion

When the measurement is completed after power on, short press the "HOLD" key to store the data. The "MEM" symbol flashes and automatically numbered. If the storage is full, the meter flashes the "MEM" symbol. Take the interface "MR" symbol display. Press the "AL" or "SET" key to select the data corresponding to the array number with a step value of 1, and then short press the "MEM" key to exit the search. See the picture below, the left picture is the flashing “MEM” symbol when data is stored, and the current storage group number is 1; the middle picture is the data review mode, and the current reference group number is 1.



In the data review state, long press the "MEM" button, then press the "Power button" button to delete the stored data.

X. Battery Description

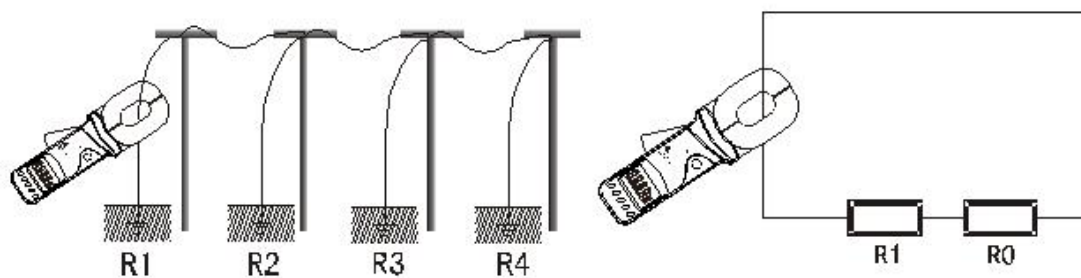
When the voltage drops to 5.0V, the power symbol “” will

be displayed, please replace the battery. Low battery voltage affects measurement accuracy.

XI.Live Application

1. Multipoint Grounding System

For multi-point grounding systems (such as transmission system tower grounding, communication cable grounding systems, certain buildings, etc.), they are connected through overhead ground wires (the shielding layer of communication cables) to form a grounding system. See below. When measured with a clamp meter, its equivalent circuit is as follows:



Where: R_1 is the predicted ground resistance.

R_0 is the equivalent resistance of the grounding resistances of all other towers in parallel.

Although, from the strict grounding theory, due to the existence of the so-called "mutual resistance", R_0 is not a parallel value in the usual electrotechnical sense (it will be slightly larger than the parallel value in the electrotechnical sense), but, since the grounding hemisphere of each tower is much smaller than the

distance between towers, and after all, the number of grounding points is large, R_0 is much smaller than R_1 . Therefore, it is reasonable to assume $R_0=0$ from an engineering point of view. In this way, the resistance we measure should be R_1 . Contrasting experiments with traditional methods in different environments and occasions have proved that the above assumptions are completely reasonable.

2. Limited Point Grounding System

This situation is also more common. For example, in some towers, five towers are connected to each other through overhead ground wires; for example, the grounding of some buildings is not an independent grounding network, but several grounding bodies are connected to each other through wires.

In this case, if the R_0 in the above figure is regarded as 0, it will bring a large error to the measurement result.

For the same reason as above, we ignore the influence of mutual resistance, and calculate the equivalent resistance of the grounding resistance in parallel with the calculation method in the usual sense. In this way, for a grounding system with N (smaller, but greater than 2) grounding bodies, N equations can be listed:

$$\begin{aligned}
R_1 + \frac{1}{\frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N}} &= R_{1T} \\
R_2 + \frac{1}{\frac{1}{R_1} + \frac{1}{R_3} + \dots + \frac{1}{R_N}} &= R_{2T} \\
R_N + \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_{(N-1)}}} &= R_{NT}
\end{aligned}$$

Among them: $R_1, R_2, \dots, R_N$ is the grounding resistance of the N grounding bodies we require.

$R_{1T}, R_{2T}, \dots, R_{NT}$ are the resistances measured by the clamp meter in each grounding branch.

This is a nonlinear system of equations with N unknowns, N equations. It has a definite solution, but it is very difficult to solve it manually, and it is even impossible when N is large.

In principle, in addition to ignoring mutual resistance, this method does not have the measurement error caused by ignoring R_0 .

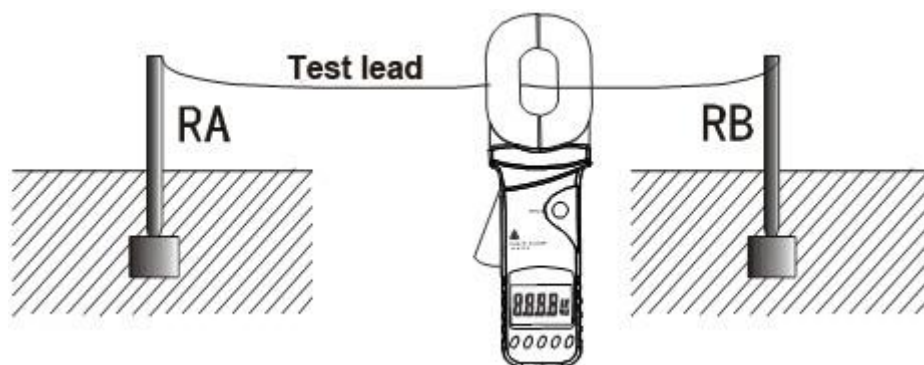
However, users need to pay attention to this: in your grounding system, there are several grounding bodies connected to each other, and the same number of test values must be measured for the program to solve, not more or less. The program also outputs the same number of grounding resistance values.

3. Single Point Grounding System

From the test principle, the clamp meter can only measure the loop resistance, and cannot measure the single-point grounding. However, users can use a test lead and a ground electrode near the grounding system to artificially create a loop for testing. The following introduces two methods for measuring single-point grounding with a clamp meter. This method can be applied to the occasions that cannot be tested by the traditional voltage-current method.

(1). Two Point Method

See the figure below, find an independent grounding body RB (such as a nearby water pipe, building, etc.) near the grounding body RA to be tested. Connect RA and RB with a test lead.



Because the resistance value measured by the clamp meter is the series value of the two grounding resistances and the resistance value of the test lead.

$$R_T = R_A + R_B + R_L$$

Among them: R_T is the resistance value measured by the clamp meter.

R_L is the resistance value of the test line.

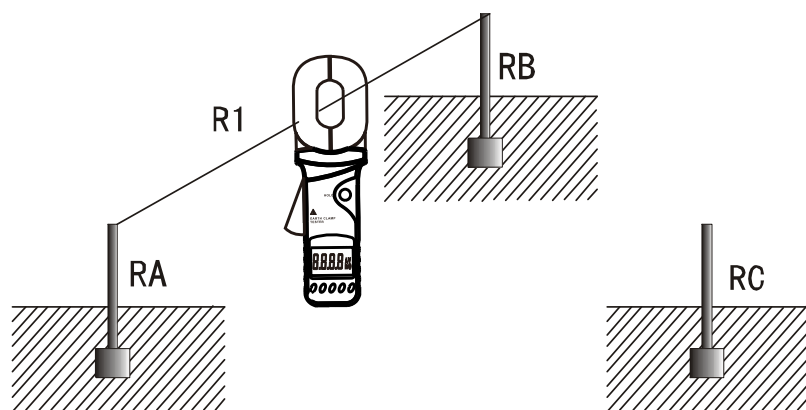
The resistance value R_L can be measured with a clamp meter by connecting the end of the test lead to the end.

Therefore, if the measured value of the clamp meter is less than the allowable value of the grounding resistance, then the grounding resistances of the two grounding bodies are qualified.

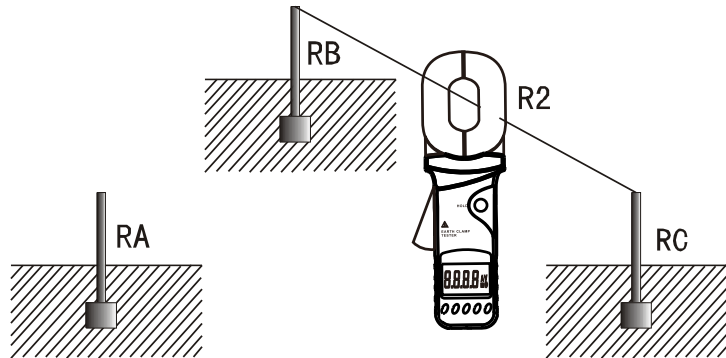
(2). Three Point Method

As shown in the figure below, find two independent grounding bodies R_B and R_C near the measured grounding body R_A .

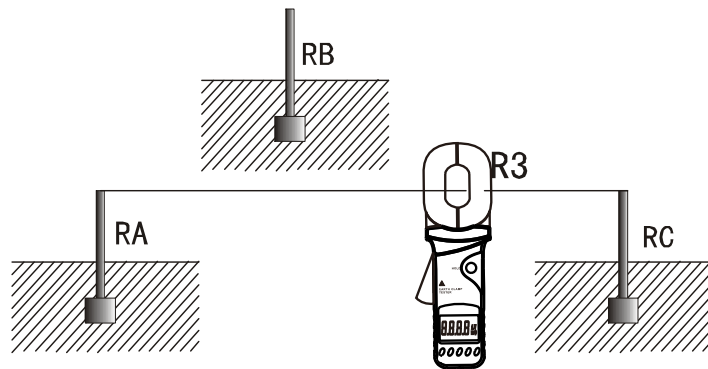
The first step is to connect R_A and R_B with a test lead, see the picture below. Read the first data R_1 with a clamp meter.



The second step is to connect R_B and R_C , as shown in the figure below. Use the clamp meter to read the second data R_2 .



The third step is to connect RC and RA, as shown in the figure below. Use the clamp meter to read the third data R3.



In the above three steps, the reading measured in each step is the series value of the two grounding resistances. In this way, each ground resistance value can be easily calculated:

$$\text{Since: } R1=RA+RB \quad R2=RB+RC \quad R3=RC+RA$$

$$\text{So: } RA=(R1+R3-R2)\div 2$$

This is the ground resistance value of the ground body RA. In order to facilitate the memorization of the above formula, the three grounding bodies can be regarded as a triangle, and the measured resistance is equal to the adjacent side resistance plus

minus the opposite side resistance divided by 2.

The grounding resistance values of the other two grounding bodies as reference objects are:

$$R_B = R_1 - R_A \quad R_C = R_3 - R_A$$

XII. Packing List

Meter	1pc
Battery	Number 5 dry battery with 4 sections
Check Ring	1pc
Manual, Warranty	1 set
Instrument box	1pc

The contents of this user manual are not intended to justify the use of the product for special purposes.

The company shall not be liable for any other loss caused by the use.

The company reserves the right to modify the contents of the user manual. If there is any modification, no further notice will be given.



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