Clamp Earth Resistance Tester

Manual

NOTE

Thank you for purchasing our **Clamp Earth Resistance Tester**. In order to use the product in a better way, please be sure:

----Read this user's manual carefully.

----Comply with the operating cautions in this manual.

- ◆ Under any circumstances, shall pay special attention to safety in using this tester.
- ◆ Pay attention to the measuring range and operating environment specified in this tester. Do not clamp and test power line.
- ◆ Pay attention to the text labeled on the front panel and back panel of the meter.
- ◆ Before turning on, pull the trigger once or twice to ensure the clamp jaws closed well.
- ◆ Do not pull the trigger, nor clamp any wires while turning on.
- ◆ After turn on properly, "OL Ω" symbol will be displayed, then clamp and test the object under measured.
- ◆ The clamp contact surfaces must be kept clean, cannot rubbed with caustics and coarse material.
- ◆ Avoid any impact onto this meter, especially the jaw contact surface.
- ◆ Please pay attention to explosion! Do not disassemble or replace the battery in hazardous locations.
- ◆ It is normal that the meter clamp will have some buzzing sound at resistance measuring. Pay attention to distinguish the "beep--beep--beep--" sound with the alarm.

- Do not measure the current for wire beyond the range on this meter.
- The greater of test current, the greater force of the clamp
- Please take out the batteries in the case of the Meter is idle for a long time.
- Disassembly, calibration, and repair of this tester must be performed by authorized personnel.
- Due to the reason of this instrument, if it is dangerous to continue using, should stopped and sealed immediately ,and handled by an authorized institution.

1. Introduction

This is an high-level multi-functional clamp earth resistance meter launched by our company's technical research and development team through constant innovation and improvement in the pursuit of technical excellence. With USB communication interface, storage data can be uploaded to the computer, through software analysis, report, printing and so on. At the same time, it could test 40A leakage current, increases real-time clock function to display present time, supports multi-parameter on-screen display function, can display grounding resistance and grounding leakage current at the same time, which is more practical, convenient, and efficient.

Its performance is mainly reflected in:

- It will get into testing work immediately break through the self-test to wait for a long time after turning on.
- Break through the relay self-test mode by using the advanced processing algorithms and digital integrated technology.
- Add real-time clock function to display real-time time of present test.
- New appearance design and better performance, panel operation with 6 keys.
- An increase of sound and light alarm, "beep—beep--beep --" alarm sound.
- Increase the function of interference signal recognition indicator.
- Add a variety of combination display mode, can choose resistance + current, resistance + time, current + time to display on same screen.
- More large measuring range: 0.01Ω-1500Ω、0.001mA-40.0A.
- Has the feature of lower power consumption, 999 Units stored data,

less than 50mA working current

- Rechargeable battery makes it more convenient to use.

The monitoring software has functions such as online real-time monitoring, historical inquiry, software alarm setting, historical data reading, saving, and reporting. Historical data can optionally be saved in Txt text or Word format.

This clamp earth resistance meter is widely used in grounding resistance measurement and loop resistance measurement of electric power, telecommunications, meteorology, oil field, construction, and industrial electrical equipment. When measuring the grounding system with loop, it is not necessary to disconnect the grounding down conductor, and auxiliary electrode, which is safe and fast. The tester can measure ground faults which cannot be measured in traditional ways. It can be used in occasion where traditional methods cannot be measured, because these series clamp grounding resistance meters measure the combined value of grounding resistance and grounding lead resistance.

2. Specification

2.1. Range and Accuracy

Mode	Range	Resolution	Accuracy
Resistance	0.010Ω-0.099Ω	0.001Ω	±（1%＋0.01Ω）
	0.10Ω-0.99Ω	0.01Ω	±（1%＋0.01Ω）
	1.0Ω-49.9Ω	0.1Ω	±（1%＋0.1Ω）
	50.0Ω-99.5Ω	0.5Ω	±（1.5%＋0.5Ω）
	100Ω-199Ω	1Ω	±（2%＋1Ω）
	200Ω-395Ω	5Ω	±（5%＋5Ω）
	400-590Ω	10Ω	±（10%＋10Ω）
	600Ω-880Ω	20Ω	±（20%＋20Ω）
	900Ω-1500Ω	30Ω	±（25%＋30Ω）
Current	0.00mA -0.999mA	0.001mA	±（1.5%＋0.5mA）
	0.00mA -9.95mA	0.01mA	±（2%＋1mA）
	10.0mA -99.0mA	0.1mA	±（2.5%＋5mA）
	100mA -300mA	1mA	±（2.5%＋20mA）
	0.30A-2.99A	0.01A	±（2.5%＋0.1A）
	3.0A-9.9A	0.1A	±（2.5%＋0.3A）
	10.0A-19.9A	0.1 A	±（2.5%＋0.5A）
	20.0A-40.0A	0.1 A	±（3%＋1A）

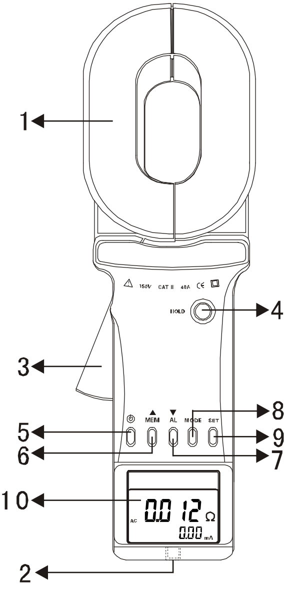
2.2. Technical specifications

Resistance Range	0.01Ω-1500Ω
Resistance Resolution	0.001Ω
Resistance Max Accuracy	±（1%＋0.01Ω）
Current Range	0.00mA-40.0A
Current Resolution	0.001mA

Current Max Accuracy	±（1.5%＋0.5mA）
Data Storage	999 Sets
Interface	USB interface, software monitoring, data upload computer, dynamic display
Self-test Time	takes ≤1s to go into the test mode quickly after turn on
Working Current	≤50mA
Operation Button	6 soft keys, better performance
Communication Cable Length	1.5m (USB Cable)
Clock Function	Displays the time
Alarm	"Beep--beep--beep--" alarm sound, press the AL key to turn on and off; LCD alarm flashing indication
Alarm Threshold Setting Range	Resistance:1-199Ω; Current: 1-499mA
Power Supply	3.7VDC (Rechargeable lithium batteries 2600mAh)
Auto Power Off	The instrument flashes 30S after 5 minutes without any operation, and then auto power off
Working Environment	-20℃-55℃; 10％RH-90％RH
LCD Size	47mm×28.5mm
Clamp Size	65mm×32mm
Clamp Opening Size	32mm
Meter Weight	1160g (include batteries)
Meter Size	285mm×85mm×56mm

Battery Cover	Screw knot fixation
Protection Level	Double insulation
Structural Features	Clamp CT
Shift	Auto Shift
External Magnetic Field, Electric Field	＜40A/m；＜1V/m
Single Measurement Time	0.5s
Resistance Measurement Frequency	＞1KHz
Measured Current Frequency	50/60Hz Auto

3. External Structure



3.1. Clamp jaw: 65mm*32mm

3.2. USB and rechargeable interface

3.3. Trigger: control the clamp jaws open

3.4. HOLD Key: lock / Release display / Storage

3.5. Power Key: Switch on/off

3.6. MEM Key: Data access / Up arrow

3.7. AL Key: Alarm Open / Down arrow

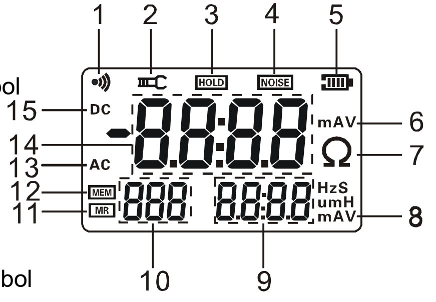
3.8. MODE Key: Switch mode/ exit access

3.9. SET Key: Setting / data delete selection

3.10. LCD

4. Liquid Crystal Display

4.1. LCD



4.1.1. Alarm symbol

4.1.2. Clamp jaw opening symbol

4.1.3. Data lock symbol

4.1.4. Interference symbol

4.1.5. Battery capacity symbol

4.1.6. Current, voltage unit symbol

4.1.7. Resistance unit symbol

4.1.8. Current, voltage unit symbol

4.1.9. 4-digit LCD digital display

4.1.10. 3-digit LCD digital display

4.1.11. Data access symbol

4.1.12. Full data storage symbol

4.1.13. AC symbol

4.1.14. 4-digit LCD digital display

4.1.15. DC symbol

4.2. Special symbol description

4.2.1. Clamp open symbol: As a jaw is in the open state, the symbol shows. At this point, trigger may be artificially pressed, or the jaws have been seriously polluted, and can no longer continue to measure.

4.2.2. "**Er**" is error symbol after turning on, Maybe trigger have been pressed or clamp jaw has been opened when turning on.

4.2.3. Battery capacity symbol, four bars indicate full charge; when the battery voltage is lower than 4.8v will display symbol , when the battery voltage is low, the accuracy cannot be guaranteed and the normal use of the instrument may be affected. The battery should be replaced in time when the voltage is low.

4.2.4. "**OL Ω**" symbol indicates that the resistance under measured is over Max. range.

4.2.5. "**L0.01 Ω**" symbol indicates that the resistance under measured is less than Min. range.

4.2.6. "**OL A**" symbol indicates that the current under measured is over Max. range.

4.2.7. The alarm symbol will display when the alarm function is turned on. When the measured value is more than the critical value of alarm setting, the symbol flashes, and the meter make intermittent "beep--beep –beep--" sound.

4.2.8. **MEM** It is full data storage symbol, memory is full of data units of 999 sets, and cannot continue to store data.

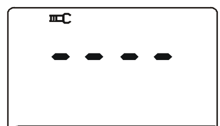
4.2.9. **MR** The data access symbol will display when you looking up the data, and saving the number of data at the same time.

4.2.10. **HOLD** The data lock symbol will display when the data lock, and save the data.

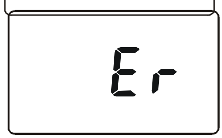
4.2.11. **NOISE** This symbol will flash and display When the earth loop under tested is interfered by the environment, and the meter gives the "beef-beef-beef " sound. The measured accuracy cannot be guaranteed at this time

4.3. Examples Illustrated

4.3.1. **J**aw is in open state, and cannot measure



4.3.2. After turning on error indicates Er (Error)



4.3.3. Test mode 2: Resistance + time

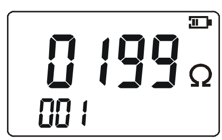
——the measured loop resistance is less than 0.01Ω

——present time：12:08

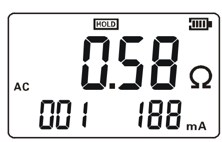
4.3.4. Test mode 1: Resistance threshold setting

—— the resistance threshold is 199Ω

—— two bar batteries left, pay attention to the low battery



4.3.5. Test Mode1: Resistance + Current



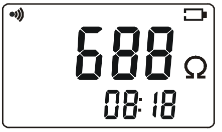
—— Resistance: 0.58Ω

—— Current: 188mA

—— Lock present measuring value: 0.58Ω, 188mA

—— automatically stored as 001unit data

4.3.6. Test Mode 2: Resistance +Time



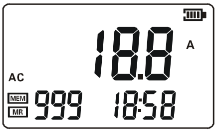
—— Loop Resistance: 688Ω

—— Time: 08:18

—— Battery power is running low, affecting normal use

——the alarm function is turned on, in case of the resistance alarm threshold is not set, the default is 199Ω. The value has been over threshold at this moment, and the resistance value and alarm symbol display and flash.

4.3.7. Test Mode 3: Current +Time



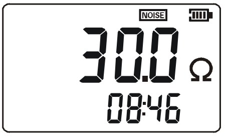
—— Reading storage data of 999th unit

——The measured current is: 18.8A

——Data storage time: 18:58

——Data storage is full

4.3.8. Test Mode 2: Resistance +Time



—— Resistance: 30.0Ω

—— Present time: 8:46

——This data is measured in a large interference signal.

5. Method of operation

5.1. Starting up

⚠	While the meter is turning on, do not press the trigger, open clamp jaw, and clamp any wires
	After turning on, do not press the trigger, open clamp jaw and clamp the measured wire until “OL Ω” symbol displays
	Before turning on, press the trigger once or twice to ensure the clamp jaw is well closed.
	While the meter is turning on, make sure to keep the meter in the natural and static state, do not overturn the meter, nor impose any external force on the clamp jaw. Otherwise, the measuring accuracy cannot be guaranteed.

Press the key ⏻ to start up, first the LCD will be tested automatically, all of symbols display (Figure1), meanwhile the meter self calibrate, after starting up "**OL Ω**" and “**0.00mA**” symbols display, automatically enter the Resistance + Current measurement mode (Figure 2).If the meter fail to turn on and auto calibrate, it will display "**Er**" symbol, indicates wrong starting up. (Figure 3).

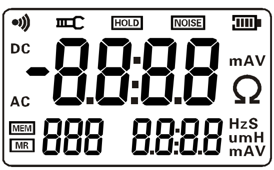


Figure 1

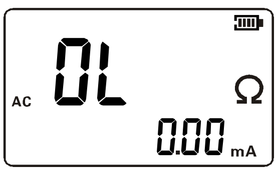


Figure 2

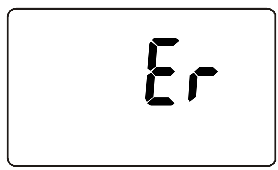


Figure 3

The wrong starting-up may be the jaw surface is dirty, or apply an external force on the trigger while turning on, or the clamp jaw is not closed properly, or the clamp jaw connect to the loop resistance while turning on. Please check the problems and then restart.

If after turning on and self-test, the symbol "**OL Ω**"

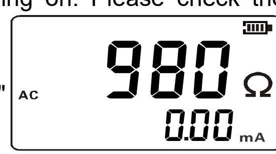


Figure 4

does not display, instead to show a larger resistance
(Figure 4). However, when measured with the
test ring, still gives the correct result, This shows that the tester only has a large error when measuring large resistance value (such as more than 100Ω), and still maintains the original accuracy when measuring small resistance value, it doesn't affect to use.

5.2. Power Off

Press ⓞ to Power Off. After the meter started up 5 minutes without any operating, the LCD screen entered flashing state, and would automatically shut down after the flashing state is sustained for 30 seconds to reduce battery consumption. Press any key in flashing state may delay the shutdown and keep it working.

In the **HOLD** state, need to press **HOLD** key to exit the **HOLD** state, then press ⓞ key to shut down. Other states could shut down directly.

5.3. Mode Selection

The default is displaying mode 1 after turning on, is resistance + current in the same screen mode, the resistance value displays in the middle of the screen, the current value displays in the right corner, see Figure 5; press the **MODE** key to switch to display mode 2, which resistance + time in the same screen mode, the resistance value displays in the middle of the screen, the time displays in the right corner, see Figure 6; press **MODE** key to switch to display mode 3, which current + time in the same screen mode, the current value displays in the middle of the screen, the time displays in the right corner, see Figure 7; press **MODE** key again Return to mode 1.

Figure 5 Mode 1

Figure 6 Mode 2

Figure 7 Mode 3

5.4. Measurement

After turning on and self-test, the default is displaying mode 1 which is resistance + current in the same screen, when “OLΩ” and “0.00mA” displayed, it can be measured. Now press the trigger, open the clamp jaw, clamp the loop under tested, reading the resistance and the leakage current value. The user can test with the test ring, the displaying value should same with the nominal value on the test ring (1.0 Ω or 10.0 Ω). The nominal value of the test ring is the value at temperature of 20 °C. It is normal that the displaying value different 1dgt from the nominal value. For example, the nominal value of the test ring is 1.0Ω, it is normal to display 0.9Ω~1.1Ω by tester. When the nominal value of the test ring is 10.0Ω, it is normal to display 9.9Ω~10.1Ω.

Press the **MODE** key could switch the display mode. When switching to display mode 2, resistance + time in the same screen mode, the resistance value displays in the middle of the screen, the time displays in the right corner; when switching to display mode 3, current + time in the same screen mode, the resistance value displays in the middle of the screen, the time displays in the right corner.

“OLΩ” displayed, the resistance under measured is over Max. range.

“OL A” displayed, the current under measured is over Max. range.

“L0.01Ω” displayed, the resistance under measured is less than Min. range.

The symbol •))) flash and there is an intermittent alarm sound, indicating that the measured value exceeds the alarm threshold.

The **Ω** symbol flashes, indicate that the resistance under measured is over the resistance alarm threshold.

The **AC** symbol flashes, indicate that the current under measured is over the current alarm threshold.

In **HOLD** state, need to press the **HOLD** key and exit the **HOLD** state, and then can continue measurement.

In **MR** state, must press the **MODE** key and exit the **MR** state and return to the measurement mode, then continue to measurement.

In setting state, should long press **SET** button for 3 seconds to exit the setting state, and then can continue measurement.

5.5. Data lock/Release/Storage

In the test mode, press the **HOLD** key to lock the present display value, display the **HOLD** symbol, and at the same time, automatically lock and store the lock value as a group of data, then press the **HOLD** key to cancel the lock, the **HOLD** symbol disappears, and the measurement can continue. Repeat the operation above, you can store 999 sets of data. If the memory is full, the **MEM** symbol will displays.

As shown in Figure 8, the measured resistance is 5.8Ω, the measured current is 188mA, and stored as the 001unit data.

As shown in Figure 9, the measured current is 278mA, the lock time is 12:52, and is stored as the 999 unit data. At this time, the memory is full and the **MEM** symbol is displayed.

In the data access mode, press the **MODE** key to exit the data access and then perform data lock and store operations.

In the setting state, long press the **SET** key 3 seconds to exit the setting state, and then perform data lock and data storage operations.

Switch off and sw itch on again, will not lose the stored data.

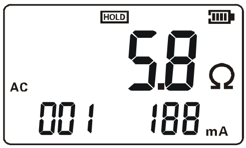


图8

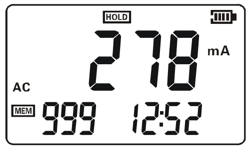


图9

5.6.Data Access and Data Delete

Press **MEM** key to enter the access storage data mode. If there is no any stored data, will display as shown in Figure 10. If there is stored data, will default display the 001 unit data as shown in Figure 11.

Short press the up arrow key, step up 1 to scroll through the stored data, long press the up arrow key, step up 10 to read the stored data;

Short press the down arrow key and step down 1 to scroll through the stored data. long press the down arrow key to step through 10 and scroll through the stored data.

In the data access mode, short press **SET** key to enter the data delete selection interface, press up arrow key or the down arrow key to select “NO” or “YES”. “NO” displays, and then short press **SET** key return to the data access state; Display “YES”, and short press the **SET** key to delete all stored data. After the data is cleared, which displays the same as that without saving data on the screen as shown Figure 10. And the data cannot be recovered after clearing.

Press the **MODE** key to exit the data access mode and return to the test mode. Return to the mode 1 in default.

In setting state, need to long press **SET** key for 3 seconds to exit the setting state, and then press the **MEM** key to enter the review storage data mode.

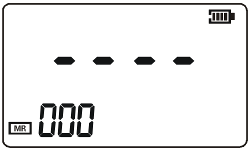


图10

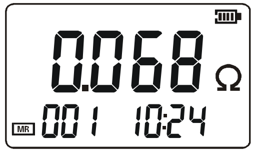


图11

5.7.Alarm Function Setting and Time Setting

In test mode, press **AL** key to turn the alarm function on or off. When the alarm function is turned on, the alarm symbol is continuously displayed. When the alarm function is turned off, the alarm symbol disappears. When the alarm condition is met, the alarm symbol flashes.

In the test mode, long press **SET** key for 3 seconds to enter the setting state. After enter the setting state, the default is the resistance threshold setting state. The displaying value in the middle of the screen is the resistance alarm threshold which is set at present, and it displays 001 in the left corner indicates the resistance threshold setting state, as shown in Figure 12. Press the **MODE** key to switch the setting state. It displays 002 in the left corner indicates the current threshold setting state, now the displaying value in the middle of the screen is the current alarm threshold which is set at present, as shown in Figure 13. It displays 003 in the left corner indicates the time setting state, now the displaying value in the middle of the screen is the current time, as shown in Figure 14.

In the setting status interface, the highest digit flashes first, and the highest digit is set first. Short press **SET** key to switch the digits from high to low, press up and down arrow keys to change the number from “0, 1,...9” when the current digits flash. After setting, long press **SET** key for 3 seconds to confirm the present setting value and automatically return to the measurement mode (you can set the resistance alarm threshold, current alarm threshold, and time value completely and then confirm exit).

After setting confirm, the meter is powered off, which will not lose the saved setting value. If the meter is powered off in the process of setting up which will lose the saved setting value.

The clock data will not be lost after the meter is powered off. After the battery is taken out, it is necessary to reset the time.

If the resistance value is more than the resistance alarm threshold, the resistance value, the alarm symbol and the Ω symbol will flash together, and make intermittent “beep--beep--beep--” sound at the same time.

If the resistance value is OL, only the alarm symbol will flash, and make an intermittent “beep--beep--beep--” sound.

If the current value is more than the current alarm threshold, the current value, the alarm symbol, and the AC symbol will flash together, and make an intermittent "beep--beep--beep--" sound at the same time.

In resistance + current same screen mode, if the resistance value is more than the resistance alarm threshold and the current value is more than the current alarm threshold, the resistance value, current value, alarm symbol, Ω symbol, and AC symbol will flash together, and make an intermittent “beep--beep--beep--” sound at the same time.

图12

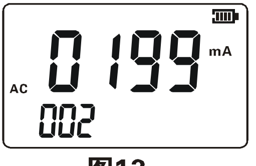


图13

图14

5.8. Data upload

Turn on the meter and enter in the test state, then connect the computer with USB cable, and run the monitoring software in the computer which is installed. If the communication is normal, the computer can monitor the online current in real time.

The monitoring software has functions such as online real-time monitoring, historical query, software alarm setting, historical data reading, review, saving, and reporting.

Historical data can optionally be saved in Txt text or Word format.

5.9. Monitoring software

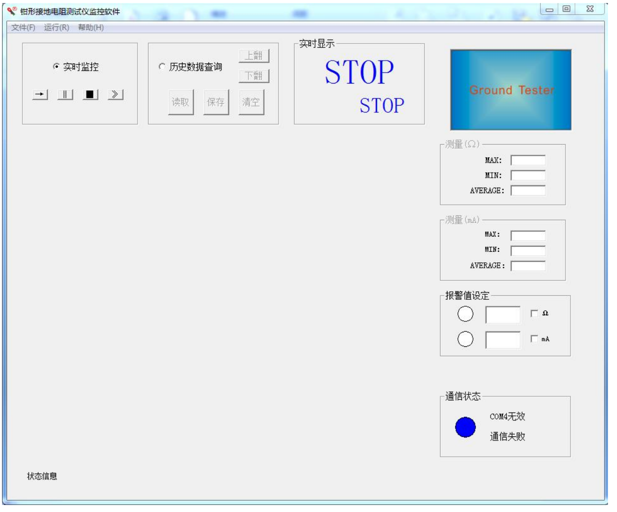
Monitoring software can be installed or used directly.

Click SETUP icon to install according to steps; or go into the SUPPORT folder and click the icon to run the software directly

The monitoring software has the function of automatically scanning serial port number and connecting, no need to manually setting serial port number.

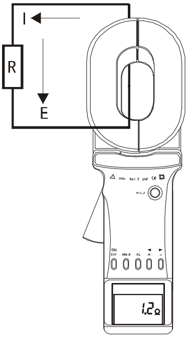
During the real-time monitoring, the current mode can be paused, stopped, continued, and switched. Historical data can be accessed and saved.

The software could set alarm threshold of the resistance or current, the tick indicates turn on the alarm. If larger than the setting value, the alarm light will flash. If the meter is off line or real-time monitoring is stopped, indicates "STOP".



6. Measurement Principle

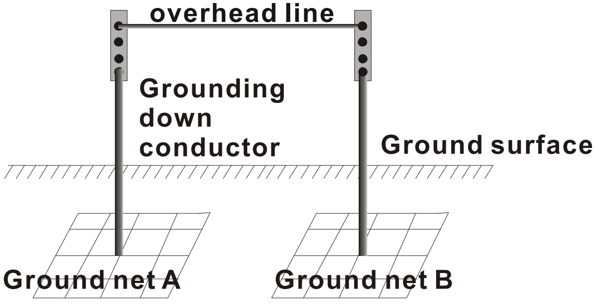
6.1. Principle of Resistance Measurement



The basic principle for measuring earth resistance is to measure the loop resistance, as shown in the figure. The part of the clamp jaw is comprised of voltage coil and current coil. The voltage coil provides output signal, and will induce a potential **E** on the loop under measured. Under the effects of the potential **E**, the current **I** generate on the loop under measured. The meter will measure **E** and **I,** you can get the resistance **R** under measured by the following formula **R=E/I**

6.1.1. Loop Resistance Definition

The loop resistance includes the ground resistance of point A, the metal conductor of the grounding lead, the overhead wire resistance, the resistance connected the grounding lead to the overhead wire (contact resistance), and the synthetic value of the ground resistance of point B.



6.1.2. If the synthetic value measured by the loop of ground net A and ground net B is 5Ω, which is RA + RB + R overhead wire + R grounding down lead = 5.0 Ω, then the actual grounding resistance which ground net A connects to the ground net B in parallel must be more than 2.5 Ω, which can judge the actual grounding resistance which ground net A connects to the ground net B in parallel is OK according to this.

6.1.3. Metal loop connect to resistance detection

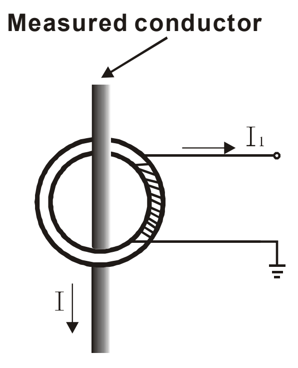
The ground net A and the ground net B are different. If the ground net A and the ground net B are connected together underground, the value you got is resistance of metal loop, and generally it is small, just less than 1 Ohm, not the grounding resistance value but the resistance value connected to the metal circuit, that is the equipotential connected to resistance value, it can judge the reliability which the grounding down lead connected (solders) to the ground net is OK according to this.

6.1.4. Single point grounding system：

If there's not the overhead line between the ground net A and the ground net B in the above figure, and both of them are independent single-point grounding. The meter cannot directly test the grounding resistance of the single-point grounding system. Now the grounding resistance of the ground net A and ground net B which will display the "OL" over-range symbol, indicating that it is over the limit range of the meter. For two or more single-point grounding systems in close proximity, the grounding down leads can be tested near the 2 single-point grounding systems on the ground with test leads.

Overall, for single-point grounding system, it can be tested through the loop formed by other grounding poles around, uch as fire hydrants, metal water pipes, building grounding etc., or build two auxiliary grounding poles, form a loop with 2-pole or 3-pole method to detect (refer the 2-point method and the 3-point method described later).

6.2. Current measurement principle



The basic principle to measure current is same with current sensor. As figure, The ACA **I** of wire under tested, an induction current **I_1** will be generated through the current magnetic loop and current coil; The meter will measure **I_1**, The current **I** under tested can be got by the following formula.

.

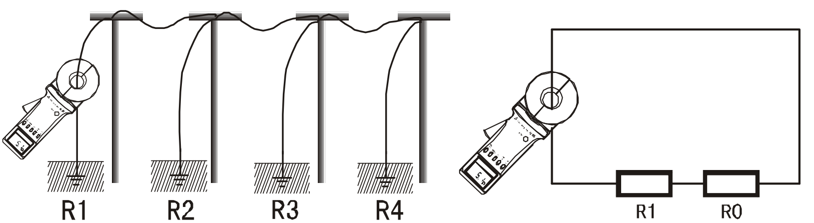
$$I = n \cdot I_1$$

Hint: n is the turn ratio of the secondary side and the primary side coil.

7. Grounding Resistance Measurement Method

7.1.Multi-Point Grounding System

For the multi-point grounding system (such as grounding system of transmission system tower and communication cable, some buildings etc.), they connected with the overhead ground wire (communication cable shielding layer) to form a grounding system. At the measurement, its equivalent electric circuit is shown in the figure below:



Hint: $\mathbf{R_1}$ is the grounding resistance under tested.

$\mathbf{R_0}$ is the equivalent resistance after grounding resistance of other transmission towers are in parallel.

Although strictly on the theoretical grounding, because of the existence of so-called "mutual resistance", $\mathbf{R_0}$ is not the usual parallel value of electrotechnology (slightly larger than parallel value of electrotechnology). But because grounding hemisphere of each transmission tower was much less than the distance between the towers, and with a great number of grounding point. $\mathbf{R_0}$ is much smaller than $\mathbf{R_1}$. Therefore, it can be justified to assume $\mathbf{R_0=0}$ from an engineering perspective. In this way, the resistance should be R1.

Many times of comparing tests in different environments and different occasions with the traditional method proved that the above assumption is entirely reasonable.

7.2. Limited Point Grounding System

This situation is quite common. For example, some of transmission towers which are five towers connected with each other through overhead ground wire; Besides, some of the buildings is not an independent ground grid, but several ground grid connected with each other through the wire.

Under such circumstances, the R_0 of above figure regarded as 0, will make more errors on the measuring results.

Due to the same reasons mentioned above, we ignore the impact of the mutual resistance; The equivalent resistance after the grounding resistance is parallel which is calculated by the usual theory. Thus, for the grounding system of N sets (N is less, but more than 2) ground grid, it can offer N equations:

$$R_1 + \frac{1}{\frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_N}} = R_{1T}$$

$$R_2 + \frac{1}{\frac{1}{R_1} + \frac{1}{R_3} + \ldots + \frac{1}{R_N}} = R_{2T}$$

.

.

.

$$R_N + \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_{(N-1)}}} = R_{NT}$$

Hint: **R1、R2、……R_N** are grounding resistances of the N sets ground grid.

R_{1T}、R_{2T}、……R_{NT} are the resistances which measured in the different grounding branches by the meter.

It is nonlinear equation groups with **N** unknown numbers and **N** equations. It indeed has a definite solution, but it is very difficult to solve artificially, even it is impossible when N is larger.

Therefore, please purchase the Limited-Position Grounding System Solution software produced by our company. Users can use the office computer or notebook computer to solve. （有限点：有限的接地位置；机解：机器解答之意）

In principle, in addition to ignoring the mutual resistance, this method does not caused the measuring errors by ignoring **R_0**.

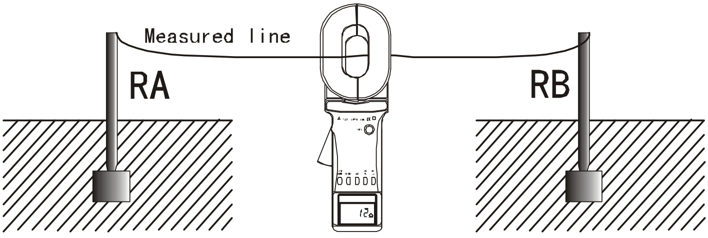
However, users need to pay attention: In your grounding system, there are several ground grid connected to each other, and you must measure the same number of measuring values for the program to calculate, not more or less. The program also outputs the same number of grounding resistance values.

7.3. Single-Point Grounding System

From the measuring principle, this meter just can measure the loop resistance, and cannot measure the grounding resistance in the single-point grounding system directly. However, users could make use of a wire and the grounding electrode near the grounding system to artificially create a loop for measuring. The two kinds of methods to measure the single-point grounding by the meter will be introduced below. These methods can apply to the occasion which could not test with traditional voltage-current testing methods.

7.3.1. Two-Point Method

As shown in the figure below, finding an independent ground grid R_B with good grounding (for example, near a water pipe or a building) in the vicinity of the ground grid R_A under measured. Connect the R_A and R_B with a measured line.



As the resistance value measured by the meter is the value which is connected by the two grounding resistances with resistance of measured line.

$R_T = R_A + R_B + R_L$

Hint: R_T is the resistance value measured by the meter.

R_L is the resistance value of the measured line.

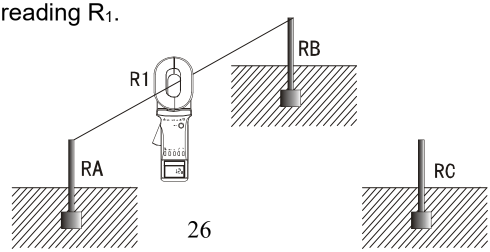
You can measure out the resistance value R_L by connecting the measured line with both ends.

So, if the measuring value is less than the limited value of the grounding resistance, then the two grounding bodies` grounding resistance are qualified.

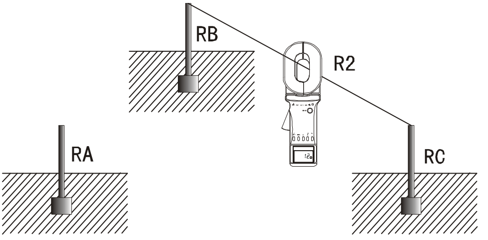
7.3.2. Three-Point Method

As shown in the figure below, finding two independent ground grid R_B and R_C in the vicinity of the ground grid R_A under measured.

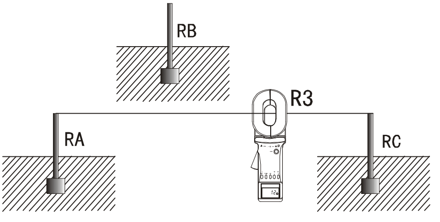
First, connect R_A to R_B with a test wire; as shown in the following figure. Use the meter to get the first reading R_1.



Second, connect R_B to R_C, as shown in the following figure. Use the meter to get the second reading R_2.



Third, connect R_C to R_A, as shown in the following figure. Use the meter to get the third reading R_3.



Each reading in the three steps above is the limit value which is connected by the two grounding resistance. In this way, we can easily calculate the value of each grounding resistance:

From: R1=RA+RB R2=RB+RC R3=RC+RA

We get: RA=（R1+R3-R2）÷2

This is the grounding resistance value of the ground grid R_A. To facilitate the memory of the above formula, three ground grid can be viewed as a triangle; then the resistance under measured is equivalent to the resistance of the adjacent side plus or minus the resistance of opposite side, then divided by 2.

The grounding resistance of the other two ground grids as a reference are:

RB=R1-RA RC=R3-RA

8. Field Application

8.1. Application in power system

8.1.1. Grounding resistance of transmission line tower measurement

Usually, the grounding of the transmission line tower constitutes a multi-point grounding system. The grounding resistance of the branch can be measured by clamping the grounding down lead by the meter.

8.1.2. Measurement of transformer neutral point grounding resistance

There are two situations for the earth wire of transformer to connect the ground: If grounding is over and over again, which will form multi-point grounding system; If not, just measure according to single point grounding. If there are stay wires of cement tower on both sides of the transformer, the buried part of 2 stay wires can be used as the auxiliary grounding part and test with the 3-point method. If there's no the grounding part of stay wire, use a grounding pin or steel spade to hit into the ground as an auxiliary grounding part.

At measuring, if the meter displays "L 0.01Ω", there may be more than two grounding down leads on the same transmission tower or transformer, and connect underground. At this time, the other grounding down leads should be untied, keep only one grounding down lead.

8.1.3. Application in power station, power substation

This meter can test the contact and connection of the loop. With the help of a test wire, the connection between the device in the station and the ground net can be measured. Grounding resistance can be measured according to the single point grounding.

8.2. Application in telecommunication system

8.2.1. Measurement of building machine room grounding resistance

The machine room in the telecommunication system generally is in the upper floor of the building, and it is difficult to measure with the megger meter. However, it is very convenient by this clamp tester. Connect the fire hydrant to the earth electrode under measured with test wire, then measure the test wire by meter.

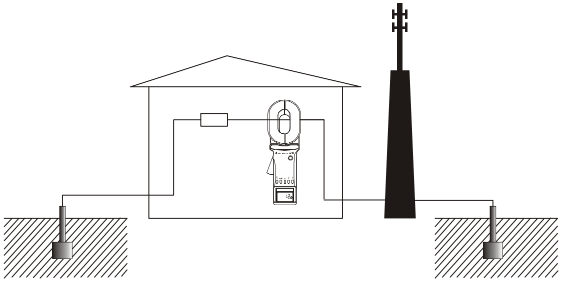
Meter value= grounding resistance of machine room + test wire resistance + grounding resistance of fire hydrant

If the grounding resistance of fire hydrant is very small, then:

the grounding resistance of machine room ≈ meter resistance – resistance of test wire.

8.2.2. Measuring the grounding resistance for machine room and the launch tower

The grounding of the machine room and the launch tower is generally independent in the field. Connected to both of them with the test wire, as shown in the figure below, to form a 2-point grounding system and testing. If both of them are connected together after grounding, it can be clamped for testing directly. Actually 3-point method can also be used as an auxiliary reference by using the buried stay wire around the launch tower:

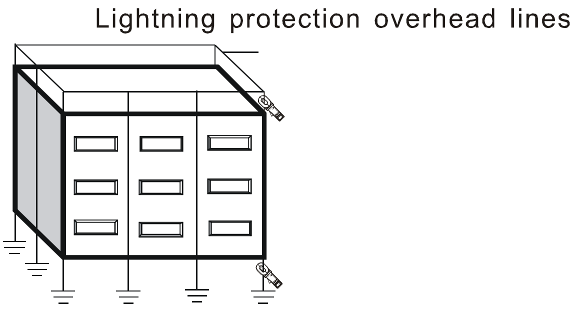


If the measuring value is less than the limit value of grounding resistance, then the grounding resistance of machine room and the launch tower is valid. If on the contrary, please measure according to single point grounding method.

8.3. Application in lightning protection system of building

If the earth electrode of the buildings are independent with each other and not connected together underground, the grounding resistance will be measured for earth electrode is shown in the figure below:

If they are connected together underground is metal loop connection resistance value, it can be tested by the 2-point method with the help of another building grounding or fire hydrant.



9. Notes of Grounding Resistance Measurement

9.1. Users sometimes compare the measurement between this meter and the meter with traditional voltage and current method, and there are big differences. For this, we would like to remind the user pay attention to the following questions:

9.1.1. Whether separate the ground grid under measured from the grounding system or not when tested by the traditional voltage-current method.If not, then the grounding resistance which will be measured is the value connected to all the grounding resistance in parallel.

It is no meaningful to measure the value connected to the grounding resistance of all the ground grids in parallel., because the purpose of measuring ground resistance is to compare it with a limit value specified in the relevant standards, so that judge whether the grounding resistance is conformity with standard or not.

For example: The limit value of grounding resistance is only stipulated for the "each transmission tower" in the GB50061-97 design specifications for less than 66KV overhead circuit. It is clearly stated in the standard interpretation: "the grounding resistance of each transmission tower refers to the resistance value measured by the ground grid is electric disconnection to the earth wire. If not, the grounding resistance will be measured by more transmission towers connected to the grounding resistance in parallel.

This standard is very explicit.

As mentioned above, the reading measured by this clamp meter is the grounding resistance of each branch, which is the grounding resistance of a single ground grid when the earth wire is in good contact.

Obviously, in this case, the results which tested by this meter and the meter with the traditional voltage-current method are not comparable at all. since the subjects under tested are not same, it is quite normal to get the significantly different results.

9.1.2. The grounding resistance measured by this clamp meter is the synthetic resistance of the grounding branch. It includes the contact resistance, the lead resistance and the grounding grid resistance of the GND wire to the branch. However, the value is only the resistance of ground grid which is measured under the condition of separating the ground grid under measured from the grounding system by traditional voltage-current method.

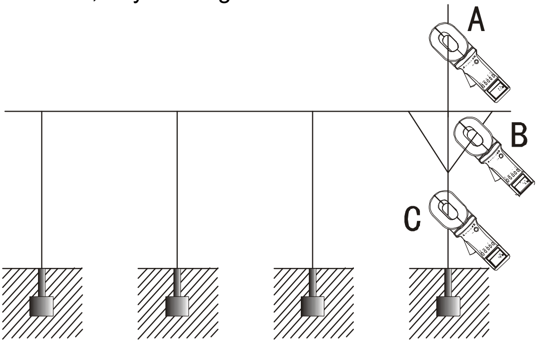
Obviously, the value of the former is larger than that of the latter. The difference reflects the contact resistance between the branch and the GND wire.

It should be indicated that the grounding resistance specified in the national standard includes grounding lead resistance. The terms in DL/ t621-1997 "grounding of AC electrical device" include the following stipulation: "the sum of the resistance to ground of the ground electrode or natural ground electrode and the resistance of earth wire is called the grounding resistance of the grounding device."

This kind of stipulations are clear as well. This is because the lead resistance and the grounding resistance of ground grid are equivalent for the lightning protection.

9.2. Selection of measuring point

In some grounding system, show figure as below, should chose a correct point for measurement, or you will get different result



When measuring at A point, the measured branch doesn't form loop circuit, the meter displays "OL Ω", then should change the measuring point.

When measuring at B point, the measured branch is the loop circuit formed by the metal conductor, the meter displays "L 0.01Ω" or the resistanceof metal loop circuit, then should change the measuring point.

When measuring at C point, the measured value is grounding resistance under the branch.

10. Packing list

Meter	1 piece
Test Loop	1 piece
CD	1 copy
USB cable	1 piece
Charger	1 piece
Carrying Case	1 piece
User's Manual	1 piece

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

The contents of this user manual cannot be used as a reason to use the product for special purposes.

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