EAGLOTEST

S480

4T EARTH TESTER



USER MANUAL

CATALOG

Safety Warnings 1

Introduction 3

Specification 4

Structure 9

LCD 10

Working Principle 11

Operation 14

7.1 Basic Operation 14

7.2 Test 17

Battery Management 29

Packing List 30

SECTION 1

Safety Warnings

- The instrument is designed, manufactured, and inspected according to the IEC61010 safety standard.
- The RS232 port and internal circuit of the instrument are not isolated. Do not connect to the computer when conducting the tests, otherwise, the instrument will be damaged or it may cause an electric shock. The voltage test line must first be removed from the instrument before connecting to the RS232 data port to read data on the computer. The real-time monitor function in manuals is not applicable to monitor voltage.
- Please carefully read the labels and symbols on the instrument.
- Do not operate this equipment until you are sure that you are completely familiar with the safe operation of the equipment, all accessories, and safety equipment. Improper use can lead to severe injury. This manual defines the proper use of this equipment. Before using this equipment for any other use, please consult us. Contact us if you do not understand any procedure or operation concerning this equipment or this manual.
- Before use, make sure that the instrument and accessories are in good condition, and that the insulation layer of the instrument and test leads are not damaged, exposed, or broken before use.
- Please confirm the position of the FUNCTION dial before starting the test.
- Ensure the test leads are securely plugged in.
- Do not apply an AC or DC voltage exceeding 600V between the test terminal and the interface, otherwise, it may damage the instrument.
- Do not operate the instrument in a flammable environment. Sparks may cause explosions.
- Do not use or store the instrument in places with high temperature, humidity, condensation, or under direct sunlight.

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- If the instrument is wet, please dry it first before storing
- When charging the battery, please confirm that the test line has been removed from the instrument and the FUNCTION dial turned to the "OFF" position.
- A low battery symbol will appear when the instrument is low in battery, please charge it when possible.
- Please charge the battery when the battery is low and charge the battery every 3 months even if the equipment is not being used, this is to ensure the battery's proper function in the future.
- Please be aware of the measuring range and use environment specified in this instrument.
- Disassemble and periodic maintenance of this instrument must be operated by authorized personnel.
- Stop using the instrument immediately in case of any danger caused by continued usage of it. Please safely seal the equipment and hand it to an authorized organization to dispose of it.
- Please pay attention to the danger sign during the operation. Users must follow the instructions for safety reasons.
- Safety warning signs in meters and manuals shall be operated in strict accordance with the contents of this manual.

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SECTION 2

Introduction

The 4T EARTH TESTER is specifically designed for the measurement of ground resistance, soil resistivity, grounding voltage, AC voltage.

The instrument can conduct precision 4, 3, or 2 terminal method to measure ground resistance, using 20mA current paired with microprocessor technology, FFT (Fast Fourier Transform) technology, AFC (Automatic frequency control) technology, it will automatically identify interference and select the appropriate measurement frequency, minimizing the effect of interference, and provide a more accurate ground resistance value.

This instrument has high adaptability in different environments, due to its anti-interference ability and the consistency of its results. The measurement it obtains is highly precise and reliable. The S480 is widely used in industries such as electrical engineering, telecommunications, meteorology, oil fields, construction, and lightning protection, etc.

The 4T EARTH TESTER comes with a base station, data software, test leads, auxiliary grounding rod, and communication cable. The industrial design of the base station is low in density, light, sturdy, abrasion resistance, heat resistance, and insulated. The box can withstand 200 kg of pressure to ensure high precision, high stability, and high versatility in various environments. The base station comes with a large LCD backlight display, a bar graph that can be seen clearly, it can store up to 300 sets of data. By using the data software, it can be used for viewing data, saving, generating a report, and printing.

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SECTION 3

Specification

Function	Grounding resistance, soil resistivity test; grounding voltage, AC voltage test
Power	11.1V DC, 2600mAh, rechargeable Li-battery
Backlight	Adjustable backlight brightness, suitable for dark environments
Testing method	Precision 4&3 terminal testing and simple 2 terminal ground test
Measure method	Earth Resistance: Rated current pole changing method, measurement current 20mA Max
	Soil Resistivity: 4-terminal measurement (Wenner method)
	Voltage To Ground: average rectification (between P (S)-ES)
Measurement Range	2, 3, and 4 Terminal Method (R): 0.000Ω～200k0Ω
	Soil Resistivity (ρ): 0.00Ωm～9999kΩm
	Grounding Voltage: AC 0.001～600.0V (50/60Hz)
Resolution	2, 3, 4 Terminal Method (R): 0.001Ω
	Soil resistivity (ρ): 0.01Ωm
	Grounding Voltage: 0.001V

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Accuracy	2, 3, 4 Terminal Method (R): ±2%rdg±5dgt (0.000Ω～10.00kΩ) ±3%rdg±5dgt (10.00kΩ～100.00kΩ) ±3.5%rdg±5dgt (100.00kΩ～200.00kΩ)
	Soil resistivity (ρ): depends on R accuracy (ρ=2πaR a: 1 m～100m; π=3.14)
	Grounding voltage: ±2%rdg±5dgt (50Hz/60Hz)
	Note: When interference is 5V, the accuracy decreases ≤±5%rdg±5dgt。
Waveform	Sine Wave
Testing Frequency	412Hz/825Hz/1280Hz (Automatic frequency selection)
Short Circuit test Current	AC 10mA max
Open Circuit Test Voltage	AC 75V max
Electrode Spacing	1m～100m
Automatic Range Shift	Grounding resistance: 0.000Ω～200kΩ Full automatic shift
	Soil resistivity: 0.00Ωm～9999kΩm Full automatic shift
LCD	6-bit LCD, white screen backlight

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LCD Size	128mm×75mm
LCD Display Size	124mm×67mm
Testing Indication	LED flashing indicates it is currently conducting the test paired with a count down, and there is also a progress bar to indicate test progress
Charging Indication	When charging the indicator on the charger is red, a green light indicates it is fully charged
Dimension	Base Station: Length Width Height 320mm×275mm×145mm
	Packaging Size: Length Width Height 400mm×245mm×335mm
Standard Test Leads	Total 4 cables: red lead 15m, black lead15m, yellow lead 10m, green lead 10m,
2 Terminal Test Leads	Total 2 cables: Red lead 1.6m, black lead 1.6m
Auxiliary Grounding Rod	4 pcs: ϕ10mm×200mms
Test Interval	Ground voltage: approx 2times/sec; ground resistance: approx 7 sec/time; soil resistivity: approx 7 sec/time
Number of Tests	Above 5000 times (short circuit test will be tested at 30 seconds interval.)
Circuit's Voltage	Test AC below 600V
Communication	With RS232 port, stored data can be uploaded to the

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Port	computer or printing.
Communication Wire	RS232 communication wire 1pcs, length 1.5m
HOLD Function	The **HOLD** symbol indicates data is held
Save Function	Can save up to 300 sets of data by pressing the HOLD function. A **FULL** symbol indicates that the storage is full.
View Data	The **READ** symbol indicates viewing saved data
Overload Display	Exceeding measurable range: **OL** symbol will display
Interference	The system will detect interference automatically, when interference voltage exceeds 5V, the **NOISE** symbol will be displayed
Warning Function	When the measured value exceeds the preset value, there will be an alarm sound.
Battery	When the instrument is low in battery, the battery voltage low symbol will be displayed, please charge the battery when possible
Automatic Shut Down	The instrument will turn off automatically after 15 minutes of inactivity.
Power Consumption	Standby: 25mA (With Backlight off); Backlight: 25mA Max (backlight consumption); While Testing: 150mA (Backlight shut off)
Weight	Base Station: 2.66kg (with battery)

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	Gross Weight: 6.88kg (with packaging)
Weight Toolbox	The industrial box is designed to withstand up to 200kg
Ideal Working Conditions	-10℃～40℃; below 80% Rh
Ideal Storage Condition	-20℃～60℃; 70% Rh below
Overload Protection	Measure ground resistance: **C (H)-E, P (S)-ES** between each port AC 280V/3sec
Dielectric Strength	More than 20MΩ (between circuit and housing 500V)
Withstand voltage	AC 3700V/RMS (between circuit and housing)
Electromagnetic Type	IEC61326 (EMC)
Safety Standards	IEC61010-1 (CAT Ⅲ 300V, CAT IV 150V, pollution class2); IEC61010-031; IEC61557-1 (ground resistance); IEC61557-5 (soil resistivity); JJG 366-2004 (ground resistance meter)。

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SECTION 4

Structure





1.Product Model

2.C(H) Port (Current Terminal)

3.E Port (Ground Terminal)

4.P(S) Port (Voltage Terminal)

5.Es Port (Ground Terminal)

6.USB Port

7.DC Charging Port

8.LCD

9.Rotary Turn Dial

10.Function Buttons

11.USB

12.S480 Terminal Tester

13.Test Wire (4 Terminal Method)

14.Test Wire (2 Terminal Method)

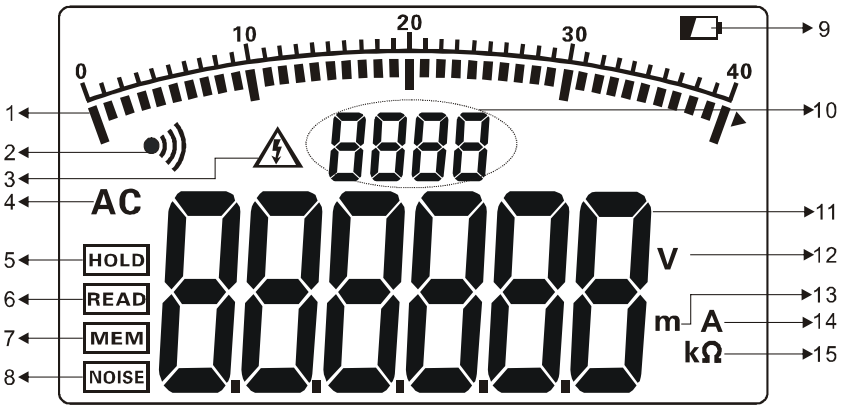
15.Auxiliary Grounding Rod

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SECTION 5

LCD



1. Analog Bar Graph
2. Alarm Indicator
3. Overvoltage Warning
4. AC Indicator
5. Data Hold
6. Data Recall
7. Data Storage
8. Noise Indicator
9. Low Battery
10. Memory Index
11. Measurement Value
12. Voltage Unit (V)
13. Length Unit (m)
14. Current Unit (A)
15. Resistance Unit (kΩ)

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SECTION 6

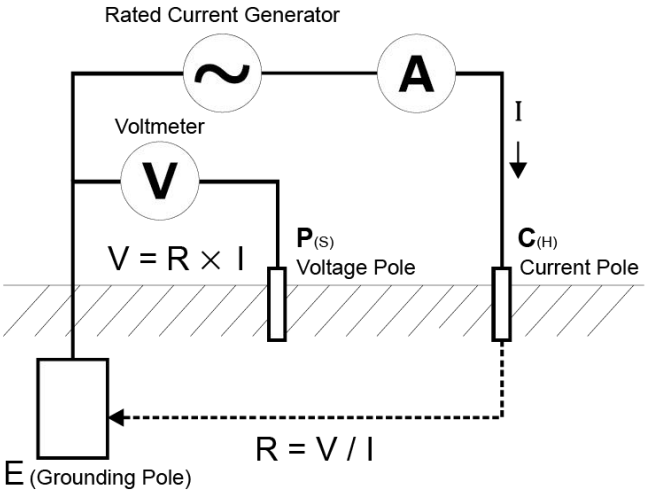
Working Principle

The measurement of ground voltage adopts the average value rectification method.

The grounding resistance measurement adopts the method of changing the pole of rated current, the AC rated current I flows between the object being measured E ground electrode and the C (H) current electrode, and the potential difference V between the E ground electrode and the P (S) voltage electrode is obtained, then the grounding resistance value R can be calculated using the formula R=V/I. To ensure the accuracy of the test, a four-terminal method is designed and the ES auxiliary ground pole is added. In the actual test, ES and E are clamped on the same point of the grounding body. The four-terminal method can eliminate the resistance of contact resistance (usually dirt or rust), auxiliary ground rod, test clip, instrument's input port on the measurement, as well as the wire's resistance. It is a much more accurate measurement method

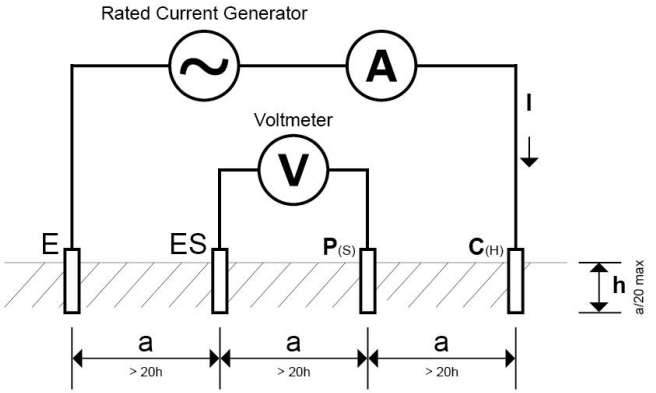
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SECTION 6



The soil resistivity (ρ) is measured by the 4-terminal (Wenner method): the alternating current I flows between the E ground electrode and the C (H) current electrode, and the potential difference V between the P (S) voltage electrode and the ES auxiliary ground electrode is calculated. The potential difference V is divided by the alternating current I to get the resistance value R between the area of two adjacent test rods. a (m) is the distance between 2 adjacent test rods, which should be spaced out equally. The soil resistivity can then be calculated using the formula ρ=2πaR (Ωm). For the convenience of calculation, please make the electrode spacing (a) far greater than the buried depth h by at least 20 times as shown in the figure below.

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Among the above methods, the working error (B) is the error obtained within the rated working conditions, which is calculated from the inherent error (A) and variable error (Ei) of the instrument.

$$B=\pm\left(|A|+1.15\times\sqrt{E_2^2+E_3^2+E_4^2+E_5^2}\right)$$

A: inherent error

E_2: changes in power supply voltage variations

E_3: variation of temperature variation

E_4: changes caused by disturbance voltage changes

E_5: changes in resistance of contact electrodes

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SECTION 7

Operation

7.1 Basic Operation

Turn the **FUNCTION key** to switch between functions of the instrument, at the **OFF** position, the instrument is turned off. This instrument will shut down automatically after 15 minutes of inactivity. After the automatic shut-down, the function knob will need to be turned to the **"OFF"** position before it can switch to other functions.

After turning the instrument on, if the LCD" " , indicates that it is low in battery, please charge the battery according to the instructions. Low battery may affect the accuracy of the results.

To switch on the backlight, press the  button to turn on or off the backlight. The backlight function is suitable for dark environments. By default, the backlight is turned off.

Warning Settings

To change the warning settings please turn the **FUNCTION** to the R_{EARTH} position, and press the  key to turn on or off the warning function. Hold the  button (about 3 seconds) to enter the alarm threshold setting page,

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press **HOLD** the button to move the cursor towards the left. By pressing the will lower the preset value. Press **ENTER** to save and exit. If the warning function is turned on,  will be displayed, and when the measured value exceeds the preset value, a beeping sound will be produced.

Data Saving

During tests, press the **HOLD** button to lock the currently displayed data, the **HOLD** symbol will be displayed when this function is activated. Data that are held will be saved automatically as well. Press the **HOLD** key again to release the lock. If the storage is full, the indicator will display the **FULL** symbol.

View Data

In test modes, hold the **HOLD** button for 3 seconds to view the saved data, press the ▲/AL or ▼/DEL button to view data at the step value of 1. The default data is the result of ground resistance or soil resistivity data. Press the **SET** key to view the value of "a", and then press the **HOLD** **key** to exit the view data mode.

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If there is no saved data, LCD will display "-----"

Delete Data

While viewing data, hold the ▲/AL to delete the data, press ▲/AL or ▼/DEL select Yes or No, and press **ENTER** to confirm. Once deleted LCD will display "----" and return to test modes.

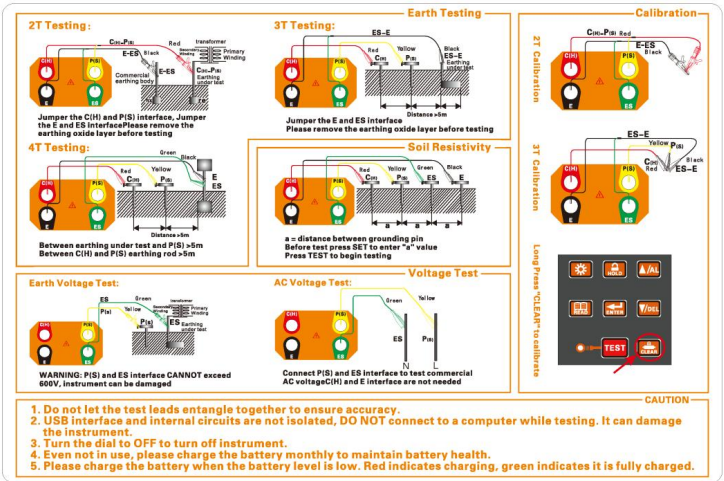
Please be aware that once the data are deleted, it cannot be recovered.

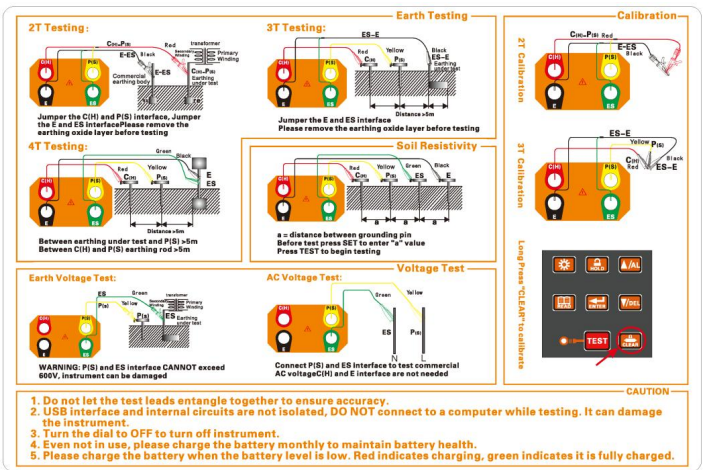
Data Transfer

The data stored in the instrument can be uploaded to a computer. Connect the USB cable between the computer and the instrument, then turn on the instrument. Run the data software. If the software shows that the serial port is open and the connection is successful, the stored data can be viewed, uploaded, or saved to a computer, and it can even print the data.

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7.2 Test





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SECTION 7

Four Terminal Earth Testing

	When testing for the grounding resistance, please measure the voltage of the grounding lead first, the C (H) and E or P (S) and ES voltage value must be below 20V. If the grounding voltage is above 5V, the instrument will show the NOISE symbol, if the measurements are conducted under this condition, the grounding resistance measurement may be inaccurate. Please turn off the electrical equipment that are connected to the ground to lower the grounding voltage before carrying out the test.

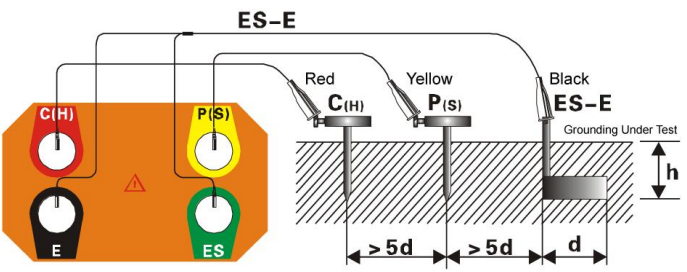
Four-Terminal

Four-Terminal tests can eliminate the influence of contact resistance between the grounding body and the auxiliary grounding rod, test clamp, instrument input interface (usually dirty or rusty) surface on the measurement. It can also minimize the influence of line resistance during the measurement, it is more accurate than the 3 terminal method.

As shown in the figure below: From the object to be tested the **P (S) and C (H)** auxiliary grounding rods should be generally 5m ～ 20m apart, the rods are buried in a straight line and deep into the ground. The grounding test leads (black, green, yellow, red) should be connected **E, ES, P (S), and C (H)** port of the instrument respectively. Then the test leads should connect to the respective E, P (S), &C (H) points.

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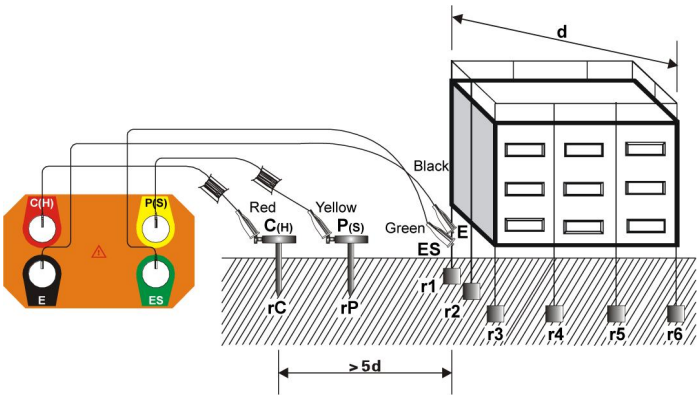
	The distance between the grounding body E and the current electrode C (H) should be at least five times the depth (h) of the grounding body under test or five times the length (d) of the electrode under test.
	When measuring the total grounding resistance of a complex grounding system, and the distance of d should be the distance of the longest diagonal distance of the grounding system.
	When testing, the test leads cannot be entangled, otherwise, it may affect the accuracy of the test.



For multi-point independent grounding system or grounding system of the earth grid, users can choose longer test lines by themselves, and the electrode spacing is 5 times longer than the maximum diagonal length of the ground grid under test. As follows:

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SECTION 7



R=r1 // r2 // r3 // r4 // r5 // r6 // … // rn (r1…rn are independent grounding points)

R——The number on the instrument will be the total earth resistance value of the whole grounding system.

R1...Rn—they are all independent grounding points, and each grounding wire is separately placed.

RC——The resistance to ground of the auxiliary current rod C (H);

RP——The resistance to ground of the auxiliary voltage rod P (S);

n——The number of independent grounding points. The more the number of points, the smaller the R-value.

After connecting the test line, turn the **FUNCTION** to **"REARTH"** position to

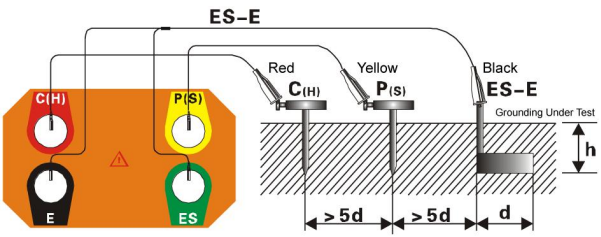
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enter the grounding resistance test mode and press the **TEST button** to start the test. During the test process, there is a countdown and test progress bar chart. After the test, the grounding resistance value of the tested grounding body R will be displayed.

Three Terminal Test Grounding Resistance

Three-line test:

As shown below, combining the **E&ES** leads on the instrument, the instrument operation of the three-terminal test and the four-terminal test is the same. the three-terminal test cannot eliminate the influence of wire resistance, nor can it eliminate the influence of contact resistance between the instrument and test leads, or the test leads and the grounding rod. The oxide layer on the surface of the grounding object should be removed in measurement.



Two Terminal Test Grounding Resistance

Two-Terminal test:

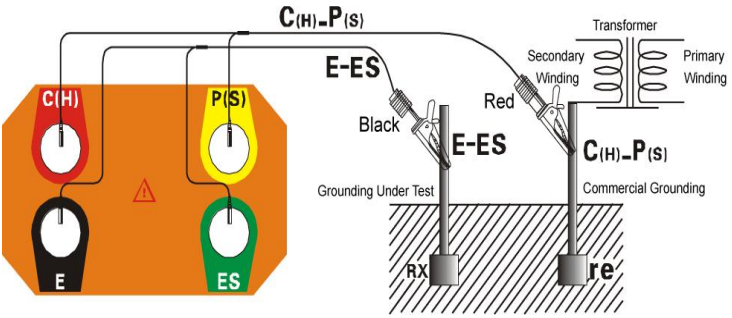
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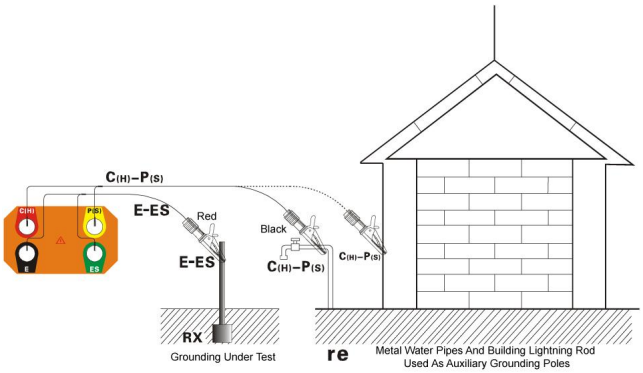
This method is a simple measurement method without an auxiliary grounding rod, using the existing grounding with the smallest grounding resistance as the grounding electrode, using two simple test lines to connect (combine **C (H) - P (S), and E - ES** on the instrument). Grounding rod **C (H) and P (S)** of 4 terminal method can be replaced by metal pipe, fire hydrant, common grounding of commercial power system, lightning protection grounding electrode of building, etc., but please remove the oxide layer of the connection point of the selected metal grounding body when testing. The wiring is shown below, and the operation of the instrument is the same as the four-line test.

	When choosing a commercial power system grounding as a grounding electrode, it must be confirmed that the metal is used for grounding, otherwise, it may trip the circuit breaker, which can be dangerous.
	When using the 2 terminal method, try to choose a grounding body with a small re value as the auxiliary grounding electrode, so that the meter reading is closer to the true value. When measuring, please choose metal water pipes and metal fire hydrants as auxiliary grounding electrodes.

The instrument reading is the sum of the grounding resistance value of the grounding body under test and the grounding resistance value of the commercial grounding body, which is **R = RX + Re**.

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Among them: **R** -- for meter reading value;

RX - the grounding resistance value of the grounded body

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Re -- The grounding resistance value of the common grounding body such as the fire hydrant

So the grounding resistance of the tested grounding body is **R x =R- Re**

Soil resistivity test

The soil resistivity ρ is an important factor that determines the ground resistance of the grounding body. Soils of different types will have different soil resistivities, but even soil will the same type will have significant changes in soil resistivity due to differences in temperature and water content. Therefore, to have a correct basis for the design of the grounding device, so that the designed grounding device can better meet the needs of actual purpose, it is necessary to measure the soil resistivity.

Soil resistivity is measured by the quadrupole method (**Wenner Method**).

According to formula **ρ=2πaR** (Ωm), the soil resistivity **ρ** unit is Ωm.

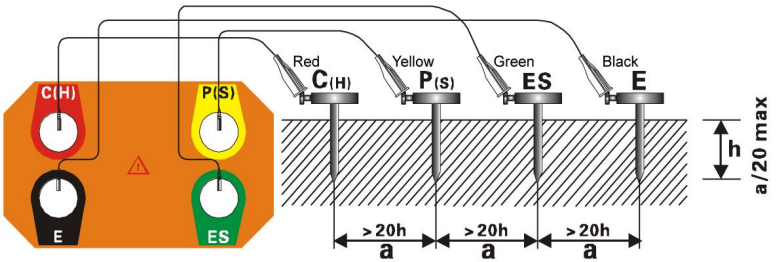
a --- electrode spacing; the resistance of the soil between **R --- P (S) -ES** electrode.

4 Terminal method (Wenner method):

Connect the test wires as shown in the figure below, be aware of the spacing and embedment depth between the auxiliary ground rods and place the C (H), P (S), ES, and E auxiliary ground rods in a straight line in the ground. Connect

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the ground test leads (red, yellow, green, black) from the respective C (H), P (S), ES, and E ports of the instrument to the C (H), P (S), ES, E grounding rod.



According to Wenner's method, the measured results are about the soil resistivity at the depth of (a). The (a) value can be manipulated to design a suitable grounding system of different depths.

Ground Rod Spacing Setting:

After connecting the test wire, first turn the **FUNCTION** to the "ρ_{EARTH}" position to enter the soil resistivity test mode, and hold the **SET** button (about 3 seconds) to enter the auxiliary ground rod spacing settings, press the "**HOLD** " button to move the cursor, press the ▲/AL or ▼/DEL key to decrease the value ((a) value range: 1m～100m), and then hold the **ENTER** key to save the value, and return to the soil resistivity test mode. After setting the value of (a), in the soil resistivity test mode, press the **TEST** button to start the test. A countdown will start to indicate the test progress, and once the test is

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completed, a steady result will be displayed.

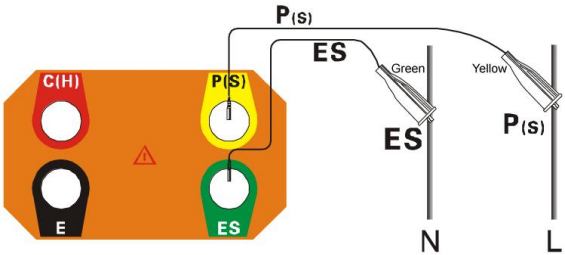
AC voltage test

	AC voltage test must not exceed 600V
	Connect the P (S) and ES ports to test commercial AC voltage, the C (H) and E ports are not needed.

AC voltage test refers to the general commercial AC voltage test. Please be aware of the difference with ground voltage. This meter can be used to test the AC line voltage below 600V.

Refer to the figure below: first, connect the test leads to the **P (S) and ES** ports of the instrument, and then connect the test line to the line to be tested. After all connections have been connected securely, turn the **FUNCTION** to the "EARTH VOLTAGE" position to start the test. The LCD will display the test results.

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Grounding's voltage test

	Only requires 1 auxiliary grounding rod for grounding voltage test.
	As long as the meter is connected to the ground through the test leads and auxiliary ground rod, the other test leads of the meter cannot be connected to the L and N cables of the commercial power supply. Otherwise, it will cause leakage and the circuit breaker may be tripped, which can be dangerous.
	Grounding's voltage test must not exceed 600V.
	It cannot be used for commercial voltage tests, otherwise, the instrument will be damaged.

Grounding's Voltage Test:

This is the measurement of the potential difference between the case of electrical equipment, grounding wire, grounding body, and the neutral

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reference point. The grounding's voltage is based on the ground as the reference point and the potential difference with the grounding of electrical equipment.

An auxiliary ground rod is required for the ground voltage test. Pay attention to the difference with the commercial AC voltage test. See the figure below: After the meter, auxiliary ground rod, and test wire are connected, turn the **FUNCTION** to the **EARTH VOLTAGE** position to start testing the ground's voltage, and the LCD displays the test result.

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SECTION 8

Battery Management

- Please charge the battery when the battery is low and charge the battery every 3 months even if the equipment is not being used, this is to ensure the battery's proper function in the future.
- Warning! If the battery cover cannot be securely fit on the instrument, please do not use the instrument, as it is highly dangerous.
- Please be aware of any damages to the battery. Once the structural integrity of the battery is compromised or any internal parts of the battery are exposed, stop using the instrument immediately.
- When the instrument is low in battery, please charge it when possible.
- When the battery requires replacement, please make sure the instrument is powered off, then loosen the screw of the battery cover to remove the cover. Place the new batteries in the instrument and once the new batteries are securely fit in the instrument with the correct polarity, close the battery cover plate, and tighten the screws.
- If the battery cannot be replaced, please contact us.

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SECTION 9

Packing List

Instrument	1
Tool bag	1
Auxiliary Grounding Rod	4
Test Leads	4 (Red15m; Yellow10m; Green10m; Black15m)
2t Test Leads	2 (Red1.6m; Black1.6m)
USB Cable	1
Manual, Warranty Card, Certificate Of Conformity	1 Set
Charger	1 Set

Note:

- We are not responsible for other damages caused by the use of this product.
- The contents of this user manual do not justify the use of the product for special purpose.
- The Company reserves the right to modify the contents of the user manual. In the case of modification, no further notice will be given.

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