

Dear Client,

Thank you for Purchasing our HTDW-3A Ground Network Earth Resistance Tester. Please read the manual in detail prior to first use, which will help you operate the equipment skillfully.

Our aim is to continually improve and perfect the company's products, so there may be slight differences between your purchase equipment and its instruction manual. You can find the changes in the appendix. Sorry for the inconvenience. If you have further questions, welcome to contact with our service department.



The input/output terminals and the test column may bring voltage, when you plug in/pull out test line or power outlet, they will cause electric spark. PLEASE CAUTION RISK OF ELECTRIC SHOCK! To avoid

risk of electric shock, be sure to follow the operating instructions!

Company Address:

- ◆ **T4, No. 1, High-tech 2 Road, East Lake High-tech Development Zone, Wuhan**
- ◆ Sales Hotline: 86-27-87492243
- ◆ After Service Hotline: 86-27- 87459656
- ◆ Fax: 86-27- 87803129
- ◆ E-mail: whhuation@163.com
- ◆ Website: www.whhuation.com

◆ **SERIOUS COMMITMENT**

All products of our company carry one year limited warranty from the date of shipment. If any such product proves defective during this warranty period we will maintain it for free. Meanwhile we implement lifetime service. Except otherwise agreed by contract.

◆ **SAFETY REQUIREMENTS**

Please read the following safety precautions carefully to avoid personal injury and to prevent the product or any other attached products being damaged. In order to avoid possible danger, this product can only be used within the scope of the provision.

Only qualified technician can carry out maintenance or repair work.

--To avoid fire hazard or personal injury:

Use Proper Power Cord

Only use the power wire supplied by the product or meet the specifications of this product.

Connect and Disconnect Correctly

When the test wire is connected to the charged terminal, please do not connect or disconnect the test wire at will.

Grounding

The product is grounded through the power cord; besides, the ground pole of the shell must be grounded. To prevent electric

shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, please do check that the product is properly grounded.

Pay Attention to the Ratings of All Terminals

To prevent the fire hazard or electric shock, please be care of all ratings and labels/marks of this product. Before connecting, please read the instruction manual to acquire information about the ratings.

Do Not Operate without Covers

Do not operate this product when covers or panels removed.

Use Proper Fuse

Only use the fuse with type and rating specified for the product.

Avoid Touching Bare Wire and Charged Conductor

Do not touch the bare connection points and parts of energized equipment.

Do Not Operate with Suspicious Faults

If you encounter operating faults/suspect there is damage to this product, do not continue. Please contact with our maintenance staff.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in Explosive Atmospheres.

Ensure Product Surfaces Clean and Dry.

— **Security Terms**

Warning: indicates that death or severe personal injury may result if proper precautions are not taken

Caution: indicates that property damage may result if proper precautions are not taken.

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I. Instrument introduction

Currently in the electric system, the grounding resistance of large grounding grid is mainly measured with the high power frequency current three-pole method. In order to prevent the power frequency interference generated in the operation of the power grid and increase the accuracy of the measuring results, it's stipulated in testing regulations of the insulation prevention that the testing current of the heavy power-frequency current method shall be no less than 30A. And thus many problems emerge, such as heavy testing equipment, complex test procedures, high working strength of the test personnel and long duration.

The grounding resistance tester can measure on the facilities of the grounding grid at the transformer substation (4Ω), hydraulic/heat-engine plant, microwave station (10Ω) and lightning rod (10Ω). New variable frequency power is used and measures like the microcomputer processing controlling and signal controlling are adopted, perfectly solving the issues of interfering prevention in the testing process, simplifying the operation, increasing the accuracy and veracity of the testing results and reducing the labor intensity and testing cost of the testing personnel.

The instrument can be used to measure power-frequency

grounding impedance, grounding resistance and the auxiliary instrument and other characteristic parameters of various grounding devices as well as earth resistivity. Pilot frequency anti-resistance technology is applied to the instrument, enabling it to accurately measure the data under the power frequency of 50Hz. The highest testing current is 3A, which would not cause high potential of the grounding device and it has great anti-interference ability, so it can carry out the test with persistent power supply.

II. Performance features

1. Good power frequency equivalence of test. The testing current is displayed in the form of sine wave, of which the frequency is only 5 Hz different from the power frequency. The frequencies of 45Hz and 55Hz are used for test.
2. Strong anti-interference capability. The pilot frequency method is used for test in the instrument, with the modern hardware and software filtering technology, giving the instrument high anti-interference ability with stable and reliable testing results.
3. High accuracy. Its intrinsic error is only 0.005 Ω , making it feasible to measure the large grounding grid with little grounding impedance.
4. Powerful function. It is possible to measure current piles, voltage piles, grounding resistance, auxiliary instrument and earth

resistivity.

5. Simple operation. Chinese menu-type operation directly shows the measuring results.

6. A small sum of labor in wiring and no need of large current line.

III. Technical indicator

1. Range of testing for impedance: 0Ω - 200Ω

2. Resolution ratio: 0.001Ω

3. Measuring error: $\pm(\text{reading} \times 2\% + 0.005\Omega)$

4. Anti-interference ability under the power frequency of 50Hz: 10V

5. Waveform of testing current: sine wave

6. Frequency of testing current: Dual-frequency of 45Hz, 55Hz

7 Maximal output current: 3A

8 Maximal output voltage: 400V

9. Requirements of measuring line: Sectional area of copper core of current line is $\geq 2.0\text{mm}^2$

Sectional area of copper core of voltage line is $\geq 1.5\text{mm}^2$

10. Power supply: AC220V $\pm 10\%$, 50Hz

11. Boundary dimension: 440 \times 350 \times 210

12. Weight of the instrument: 10kg

Vi. Operation process and function description of instrument test

1. Measurement principle block diagram and test wiring diagram

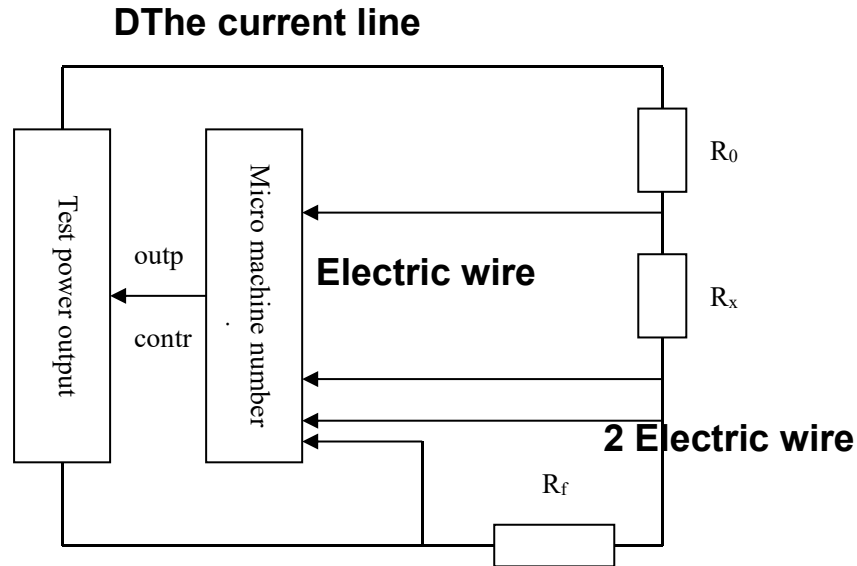


Figure 1 schematic diagram of measurement principle

R_0 loop resistance about 5 ~ 200

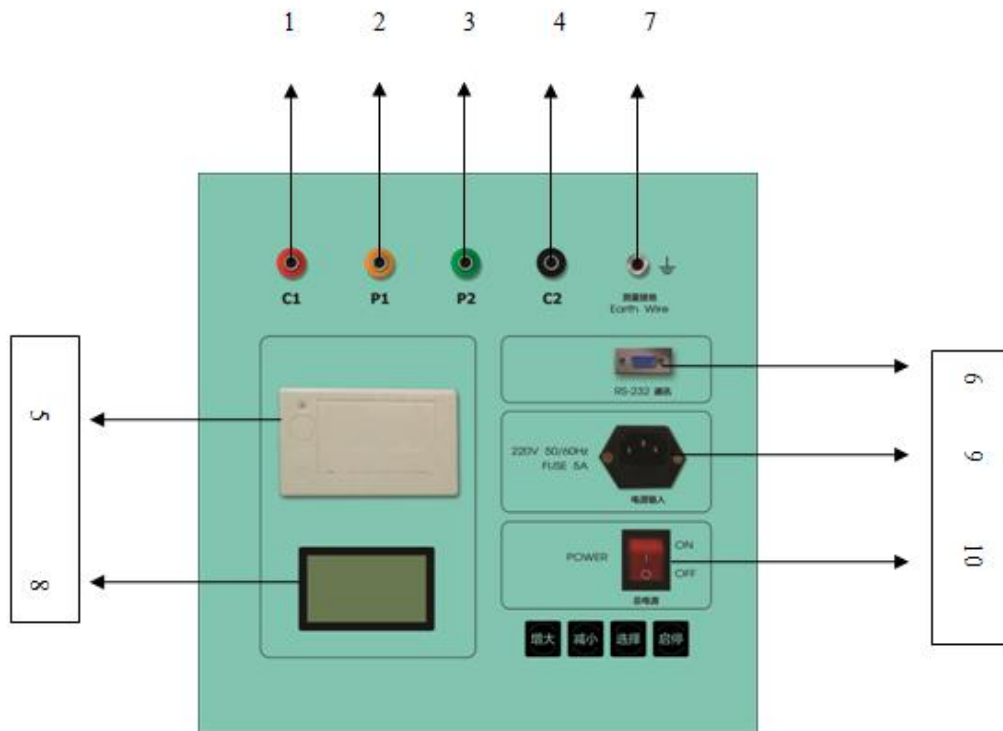
R_x testing Ω resistance about 0 ~ 200

R_f standard resistance

Measuring current line D: the length is 3 ~ 5 times of the diagonal length of the ground network; Wire diameter: 1 or more was

Measuring voltage line 1: length is 0.618d; Wire diameter: p was 1.0

Voltage line 2: connect to geodesic net



Schematic diagram of internal power host panel

1. Current pole (C1)
2. Voltage pole 1(P1)
3. Voltage pole 2(P2)
4. Grounding grid (C2)
5. The printer
6. Serial port
7. Ground wire
8. Liquid crystal display
9. Power input
10. Power switch

Measuring wiring is shown below

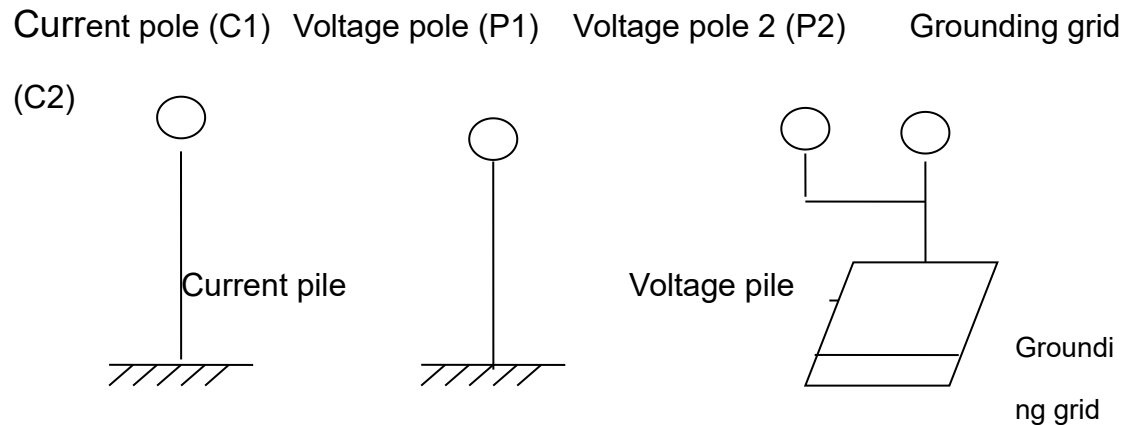


Figure 2 Measuring Wiring Diagram through the Three-pole Method

Note: Both voltage pole 2 (P2) and grounding grid (C2) must be connected to the instrument, and then the testing can be carried out according to the testing steps.

2. Operation procedures of the test

- 1). Firstly, it should check whether there is any open circuit (multimeter can be used here) at the current line, voltage line and grounding grid; the iron rust is clearly removed and the burial depth is proper (>0.5 m). Meanwhile, check whether the testing line is connected with the grounding pile; if not, please reconnect them after treatment.
- 2). The ratio of length of the current measuring line and voltage measuring line should be 1:0.618; the length of the current measuring line should be 3-5 times of the diagonal of grounding grid.
- 3). After one end is connected respectively to the instrument

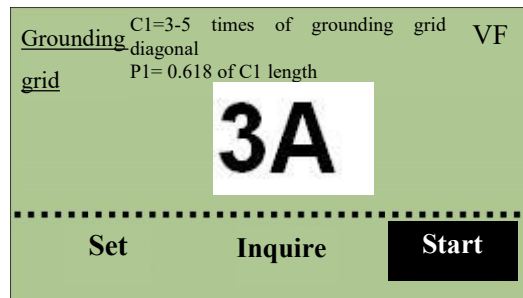
according to the regulated length and then set in parallel, it is necessary to release the measuring lines of current and voltage. The other end of the lines shall be connected respectively to two grounding piles (as shown in the Figure 2).

- 4). Check the settled testing lines and connect multimeter to the current line or voltage line on one end and to the grounding grid on the other end. If the value of resistance is zero, then there should be an open circuit. The test should be carried out after confirming the circuit is ready.
- 5). After the confirmation on a correct wiring, it should connect the instrument to the power source of AC220V/50HZ to energize the instrument.
- 6). Start measuring by pressing "Measure" button
- 7). After the test is finished according to the display on the instrument, it should record the testing data.
- 8). After turning off the power of the instrument, the wiring shall be disconnected and the test is over.

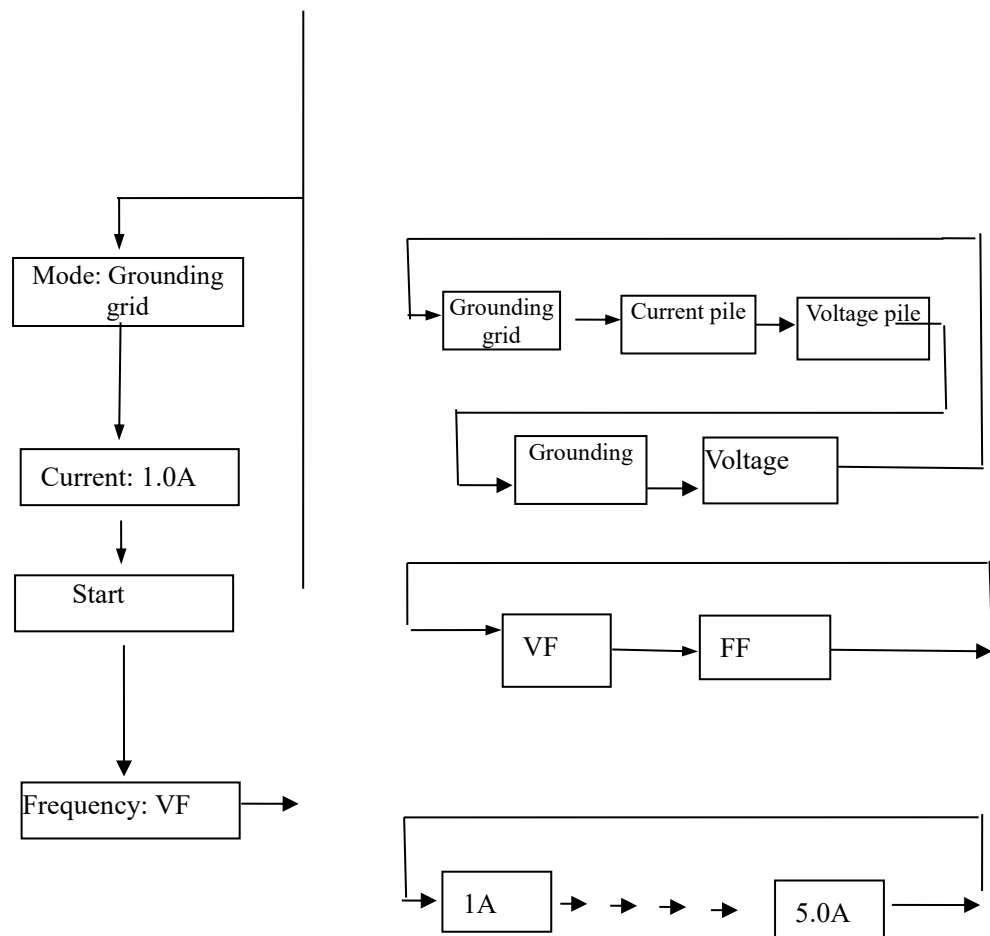
3. Operating instructions of the instrument:

- 1).After the starting of the switch, the computer will do self-inspection and then enter the start-up interface.

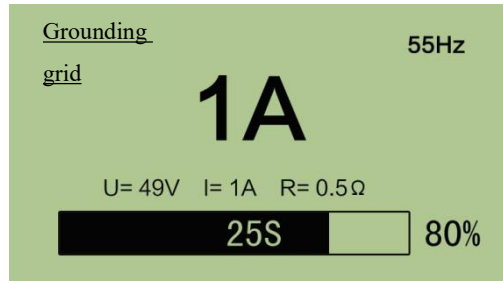
2). By pressing the function key, the cursor can be moved to various menu items for cycle instructions. The selected items will be in reverse video.



3). On the currently shown item, pressing the ▼ ▲ can change the menu item and provide cycle instructions.



After selecting the function corresponding to the test requirements, click Start to enter the following testing interface.



5) Test: Turn on the HV switch, and when the cursor is on the start item, press Enter for about 5 seconds to start the test. The picture displayed during the testing process is shown in the above figure (grounding grid, VF). When the process reaches 100%, the test is over, and then the testing results will be displayed, while the cursor is on the icon of printer, and press Enter to print the report. The meanings of the measuring results are as follows:

Zx: Impedance of grounding grid in the test Rx:

Resistance of grounding grid in the test

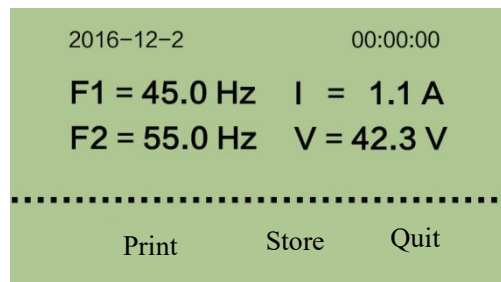
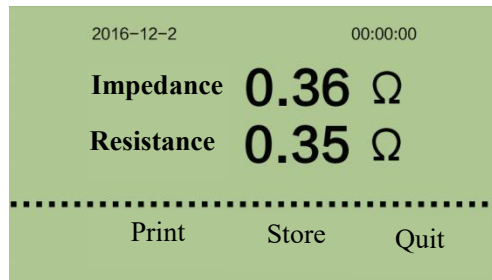
V: voltage applied (voltage on the current pile)

I: Current flowing on the testing object

F1, F2: Test frequency

After the printing is over, turn off the power source and the

test is over.



Press Up and Down keys to select among the three interfaces to show the testing parameters.

6). The information of **"check power source"**, **"check current pile"**, **"check voltage pile"** and **"check grounding grid"** all mean that the instrument is checking them automatically. Generally it may take about 15 seconds and please wait in patience.


4. Details of test menu

1). **Mode of testing:** Five testing modes can be selected for the instrument, including the **"grounding grid"**, **"current pile"**, **"voltage pile"**, **"grounding"** and **"voltage"**. The functions of the first three modes are to measure the impedances of grounding grid, current pile and voltage pile. Usually the "grounding grid" mode should be selected in the experiment to measure the impedance of large grounding grid. If the test of impedance of current pile or voltage pile is required, corresponding modes can be selected. The function of **"grounding"** mode is to measure the grounding resistance and earth resistivity. Its default line is 20m long, which can also be modified. The function of **"voltage" mode** is to measure step voltage, contact voltage and other parameters. (**Note: corresponding electrode is required for the "voltage" mode**)

2). **Frequency selection:** Two testing frequencies can be selected, including "VF" and "FF". The "VF" shall be selected in experiment on site, since the disturbance of electromagnetic field can be eliminated. The "FF" shall only be used in experiments in the laboratory. The "VF" is optional, including 45Hz and 55Hz. And the "FF" is strictly 50Hz.

3). Current selection: 5 kinds of testing currents are provided in the instrument, which are 5/4/3/2/1A, with every 1A being a grade and totally 5grades. The testing current can be chosen according to the impedance of the current pile. Generally, using the current of 1A is OK.

4). Auto printing: When the cursor is on the item of current, press OK and the printer symbol will appear or disappear at the left bottom, representing the selection or cancellation of auto printing function. When the auto printing function is on, after testing the instrument will print the results automatically. When the auto printing function is off, if you want to print the results you should do it manually.

5). Manual printing: When the testing is over, the interface as shown in Figure 7 will appear. By pressing , you can choose between "print" and "quit". If you select "print" and press OK, the results will be printed. If you select "quit" and press OK, it will return to the initial interface, as shown in Figure 3.

5. Self-diagnosis instructions of the instrument

- 1). When the information "please restart" is shown, it may be the power protection inside the instrument, and you should reboot.
- 2). When the information "power module error, please contact the manufacturer" is shown, put the cursor on the "grounding grid"

item and press OK for ten times. Then you hear a sound of the speaker of the instrument, and a symbol of printer in reverse video is shown at the left bottom. And then turn off and on again. If the measurement cannot be continued, please contact the manufacturer.

- 3). When the testing current is 0.0A, bad contact may exist on the wiring between the "current line" and the "current pole" or quantity of the ground piles is too small. More ground piles need to be added to reduce the resistance in the loop. The depth of the ground pile shall be no less than 0.5m. The resistance of the current pile shall be less than 200Ω.
- 4). If the measured value shown on the instrument is much too low (<0.01Ω), may be the voltage line is not connected.
- 5). Resistance of over 20Ω shall be connected in series at the C1 output end in the test to simulate the on-site resistance of current pile, otherwise it may result in large measurement error.

V. Precautions

1. In order to carry out the test smoothly, please check the contact point of the link and ground pile with multimeter before the test and whether there is any open circuit in the settled line.
2. The instrument will automatically eliminate the wiring error

in the test by four-pole method.

3. When the cursor is on the item of current, press OK and the printer symbol will appear or disappear at the left bottom, representing the selection or cancellation of auto printing function.
4. In case of other errors of the instrument, please contact the after-sale service department of our company and do not uninstall or repair it by yourself.

VI. Accessories included

1. Host	1
2. Line for test	4
3. Grounding line	1
4. Power source line	1
5. Ground stud	2
6. Reference resistance	1
7. Fuse	2
8. Operating manual	1
9. Testing report	1
10. Printing paper	1 roll

Note: You shall prepare the testing line according to the size of grounding grid.

Note: Please don't open the instrument without permission, including the panel. Because the internal wires might be broken, causing failure of the instrument ! ! ! !

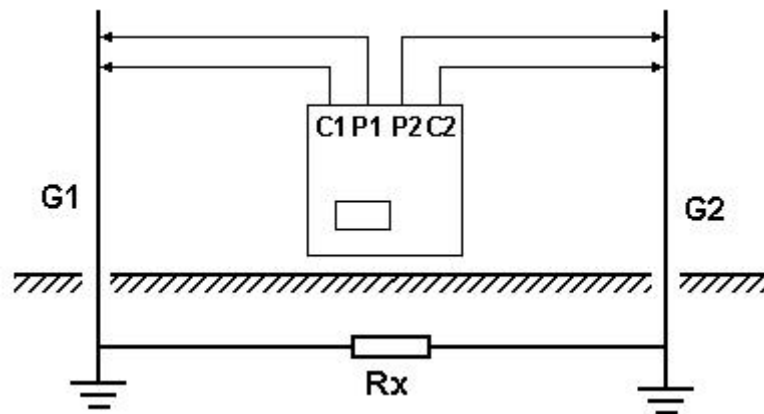
Internal power supply test wiring reference:

1. Measuring grounding connectivity

Connect C1/P1 to one grounding device, and C2/P2 (measuring ground terminal) to another.

Note:

- (1) Don't entwine the lead.
- (2) Keep the voltage line far away from the current line.
- (3) Both ends of the earth clamp should press the grounding line to be measured tightly to prevent the bad contact caused by corrosion of the oil paint.
- (4) The current shall be 1A to avoid current protection. Select grounding grid VF 1A



2. Measurement of grounding impedance of the grounding grid

2.1 Inclined angle method

Generally, test of impedance of large grounding device shall be carried out according to the inclined angle between current line and voltage line. Usually the distance d_{CG} between current pile C and edge of the grounding device to be tested should be 4-5 times of the diagonal of the grounding grid. The length of d_{PG} and d_{CG} are close. The grounding impedance formula can be modified with the following function.

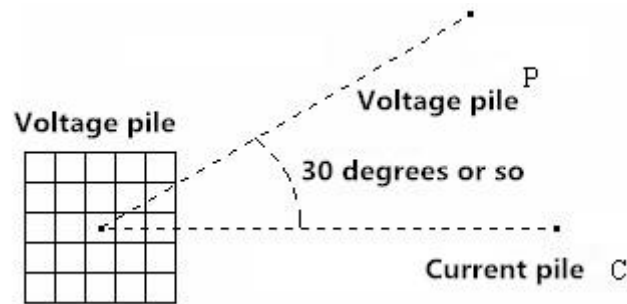
$$Z = \frac{Z'}{1 - \frac{D}{2} \left[\frac{1}{d_{PG}} + \frac{1}{d_{CG}} - \frac{1}{\sqrt{d_{PG}^2 + d_{CG}^2 - 2d_{PG}d_{CG} \cos \theta}} \right]} \quad \text{Formula (1)}$$

Wherein: θ —the inclined angle between current line and voltage line;

Z' —the tested value of the grounding impedance.

If the earth resistivity is even, the isosceles triangle wiring method with identical length of d_{PG} and d_{CG} can be applied. Herein θ is about 30° and $d_{PG}=d_{CG}=2D$, so the modified formula of grounding impedance is still the formula above.

Interface selection: Grounding grid VF 1A



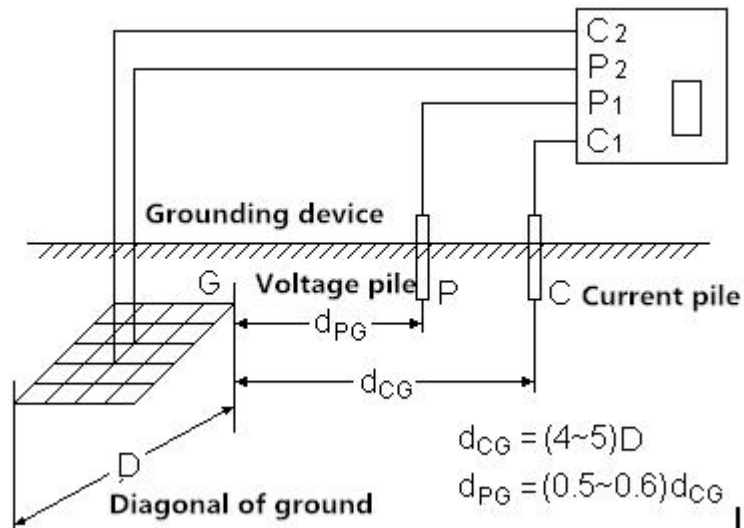
2.2 Straight-line method

Current pile, voltage pile and the grounding device to be measured should be in a straight line. Usually the distance d_{CG} between current pile C and edge of the grounding device to be tested should be 4-5 times of the diagonal of the grounding grid. The distance d_{PG} between the voltage pile P and the edge of the grounding device to be measured should be $(0.5-0.6) d_{CG}$. During wiring, the current line shall be kept far away from the voltage line to reduce the effects on the testing results of the electromagnetic coupling.

The resistance of the current pile shall be reduced as much as possible and the resistance can be reduced by watering if necessary. In selection of the "current pile" or "voltage pile" modes

of the instrument, the resistance of the current pile shall be less than 80Ω , that of the voltage pile shall be less than 200Ω .

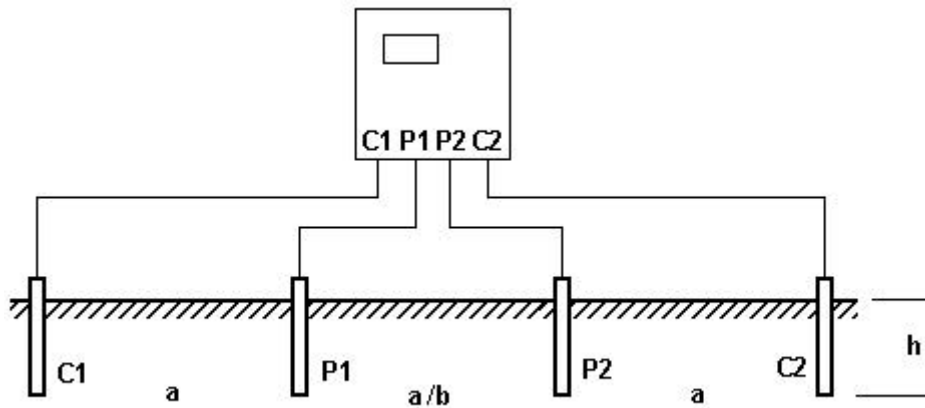
Interface selection: Grounding grid VF 1A



3. Measure earth resistivity with four-pole equidistance method

The four ground piles should be placed in a straight line with the distance between two piles being a . The depth h of the piles should be no more than one twentieth of a . The value of a can be 5, 10, 20, 30, 40m, etc. (the default value is 20m). The value shall be larger when the size of the ground to be measured is large. The resistivity can be calculated through the ground resistance R : $\rho = 2\pi aR$.

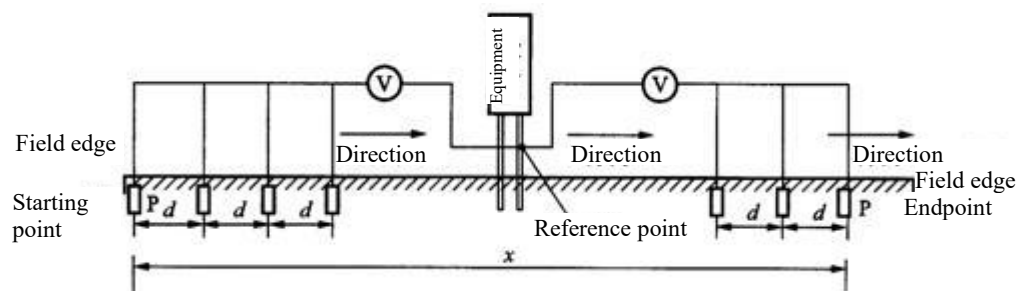
Interface selection: Grounding VF 1A



4. Measurement of earth surface potential gradient

Inject VF current with the power source mode same with that of the instrument and measure the potential difference with the frequency selective voltmeter.

Interface selection: Voltage VF 1A

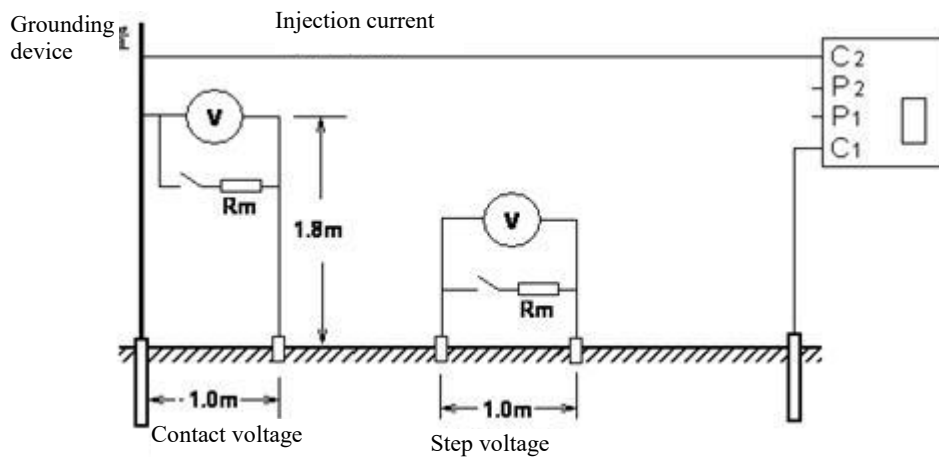


5. Measurement of step voltage and contact voltage

Inject VF current with the power source mode same with that of the instrument and measure the step voltage or contact voltage with the frequency selective voltmeter.

Inside the frequency selective voltmeter, there is a human body simulation resistance R_m , which can be put in if needed.

Interface selection: Voltage VF 1A

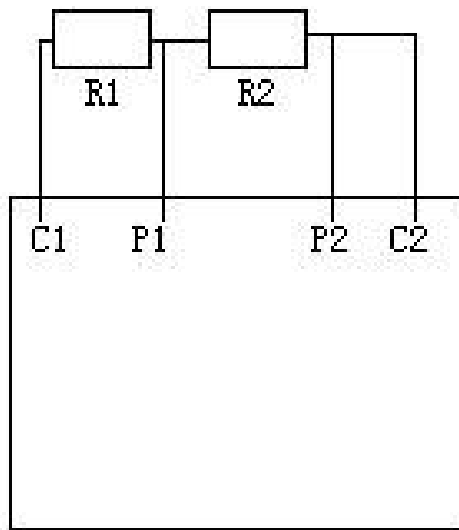


6. Verification of the instrument

Resistance of over 20Ω shall be connected in series at the C1 output end in the test to simulate the on-site resistance of current pile, otherwise it may result in large testing error or direction protection of the instrument, of which the wiring can be referred to the following figure.

R_1 is the load resistance to simulate the resistance of the current pile on site and R_2 is the standard resistance.

Interface selection: Grounding VF 1--3A



It is recommended to select the 1A current in verification if there is no high-power resistance, and the wiring can be referred to the following figure.

R1 is the standard resistance.

Interface selection: Grounding VF 1A

