Huazheng®

HZDW-DB
Ground Network Earth Resistance Tester

User Manual

Huazheng Electric Manufacturing (Baoding) Co., Ltd

Dear user:

Thank you for choosing HZDW-DB ground network earth resistance tester.

We hope that this instrument can make your work easier and more enjoyable, so that you can get the feeling of office automation in the test and analysis work.

Before using the instrument, please read this manual, and operate and maintain the instrument according to the manual to prolong its service life. "Just a light press, the test will be completed automatically" is the operating characteristics of this instrument.

If you are satisfied with this instrument, please tell your colleagues; if you are not satisfied with this instrument, please call (0312) 6775656 to tell you to serve you at all times-Baoding Huazheng Electric Manufacturing Co., Ltd., our company will definitely make you satisfied !

Contents

I.Use safety measures

1. Be sure to read this manual carefully before using this instrument.

2. Test personnel should have common sense of using general electrical equipment or instruments.

3. The tester must strictly abide by the safety operation regulations, and must fully understand the high-voltage test circuit and the main points of the instrument operation.

4. Non-testing personnel must stay away from the high-voltage test area. The test area must be clearly indicated by fences or ropes, police signs, etc.

5. This instrument can only be used on power-off equipment; it must be ensured that the ground terminals of the instrument and the equipment under test are reliably connected to the ground network.

6. When the fuse is damaged, you must make sure to replace the fuse of the same specification.

7. When the instrument fails, turn off the power switch and wait for one minute before checking.

8. The instrument should avoid severe vibration.

10. The maintenance, care and adjustment of the instrument should be carried out by professionals.

II.Instrument overview

At present, in the power system, the grounding resistance test of the earth network mainly adopts the power frequency high current three-pole method. In order to prevent the power frequency interference generated during the operation of the power grid and improve the accuracy of the measurement results, the insulation preventive test regulations stipulate that the test current of the power frequency high current method shall not be less than 30A. As a result, many problems such as heavy test equipment, complicated test process, high work intensity of test personnel, and long test time appeared.

The ground network earth resistance tester adopts a new variable frequency AC power supply, and adopts a microcomputer to control the earth network ground resistance tester and signal processing. It solves the anti-interference problem during the test and simplifies the test operation process. , Improve the accuracy and accuracy of the test results, greatly reduce the labor intensity of the test personnel and test costs.

The ground network earth resistance tester adopts a new variable frequency AC power supply is a special instrument for measuring the grounding resistance of the earth grid and the ground continuity between the grounding points. The instrument adopts frequency conversion anti-interference technology, does not need high current measurement, and can measure accurate data of 50Hz in the strong interference environment of the substation. The measurement results are displayed by the large-screen LCD, and the built-in micro printer can be printed out. The instrument can measure ground impedance and ground resistance at the same time, which can more truly reflect the actual characteristics of the ground network.

III.Functional features

1. The measured power frequency equivalence is good. The test current waveform is a sine wave, the minimum difference between the frequency and the power frequency is 0.1 Hz, and the maximum is 10 Hz. It can be used for measurement at 50hz or 60hz.

2. Strong anti-interference ability. This instrument adopts different frequency method to measure, and cooperates with modern software and hardware filtering technology, so that the instrument has high anti-interference performance, and the test data is stable and reliable.

3. High measurement accuracy. The basic error is only 0.005Ω, which can be used to measure the earth network with very small ground impedance.

4. Powerful function. It can measure current piles, voltage piles, ground grid impedance, ground resistance, ground continuity, soil resistivity, etc.

5. Full touch LCD screen, super large graphic operation interface, every process is very clear. Operators can use it without additional professional training. The whole process of

testing can be completed with a light touch.

6. Equipped with a calendar chip and a large-capacity memory inside, the results can be saved at any time. The history record can be viewed at any time, and can be printed out. The current time and storage time can be displayed and printed.

7. Scientific and advanced data management: The instrument data can be exported through U disk, and the data can be viewed and managed on any PC through special software. Ability to generate reports and test reports

8. Safe and reliable. The instrument has functions such as grounding protection, current limiting and voltage limiting protection, sound and light alarm to ensure the safety of test personnel and equipment.

9. With vector test function, it can measure ground network impedance and ground network pure resistance. The impedance angle can be measured.

10. Wiring labor is small, no need for large current wires.

11. All-in-one model, with standard resistance and constant current source, convenient for on-site testing and reducing on-site wiring.

12. The instrument is easy to operate, and the measurement process is controlled by the microprocessor. As long as the appropriate measurement method is selected, the data measurement can be automatically completed under the control of the microprocessor.

13. When the user needs a large current test (such as 30A), this instrument can be realized by an external power supply.

IV.Main Technical index

1. Measuring range: 0～5000Ω (including current pile impedance)

2. Resolution: 0.001mΩ

3. Measurement error: ±(reading×2%+0.005Ω)

4. Anti-power frequency 50Hz voltage interference capability: 10V

5. Test current waveform: sine wave

6. Test current frequency: Single frequency: 40-70Hz, resolution 0.1Hz, free setting

Dual frequency: 50±0.1Hz to 50±10.0Hz can be set at will

60±0.1Hz to 60±10.0Hz can be set freely

7. Output current: 5A or external power supply 30A

8. Output voltage: 400V or external power supply 1000V

9. Measuring line requirements: Current line copper core cross-sectional area ≥1.5mm2

Voltage line copper core cross-sectional area ≥1.0mm2

10. Test power supply: Built-in 2kW variable frequency power supply or external high-power variable frequency power supply.

11. Power supply: AC220V±10%, 50Hz

12. Dimensions: 500mm*377mm*330mm, instrument weight: 20kg

V.Instrument principle

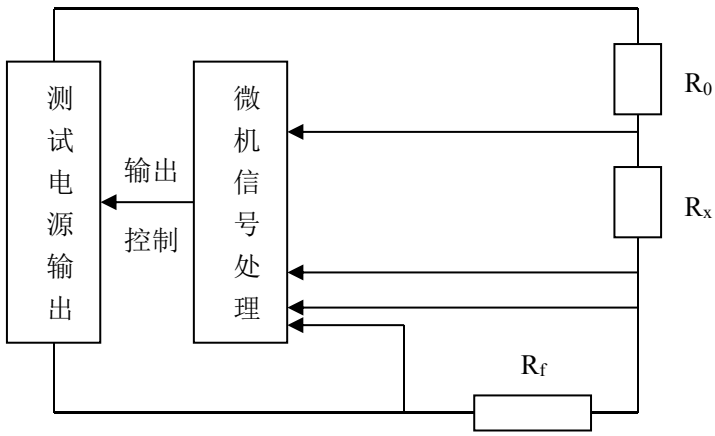


Figure 1 Schematic diagram of measurement principle

1. R0 loop resistance is about 5～200Ω

2. Rx test resistance is about 0～200Ω

3. Rf standard resistance

4. Measuring current line D: The length is 3 to 5 times the diagonal length of the ground grid; wire diameter: ≥1.5mm^2

5. Measuring voltage line 1: length is 0.618D; line diameter: ≥1.0mm^2

6. Measuring voltage line 2: connect to the measured ground network

7. Measuring ground wire: grounding net

VI.Panel introduction

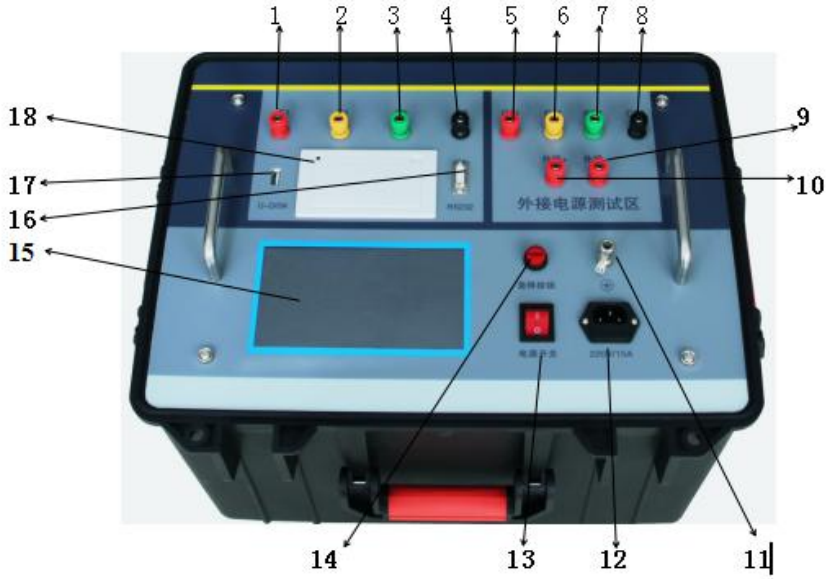


Figure 2 Panel diagram

1: Current pole (C1) 2: Voltage pole (P1) 3: Voltage pole (P2)

4: Grounding grid (C2) 5: Current pole (C11) 6: Voltage pole (P11)

7: Voltage pole (P22) 8: Grounding grid (C22)

9: External AC power supply 10: External AC power supply

11: Grounding pole 12: 220V power socket 13: Power switch

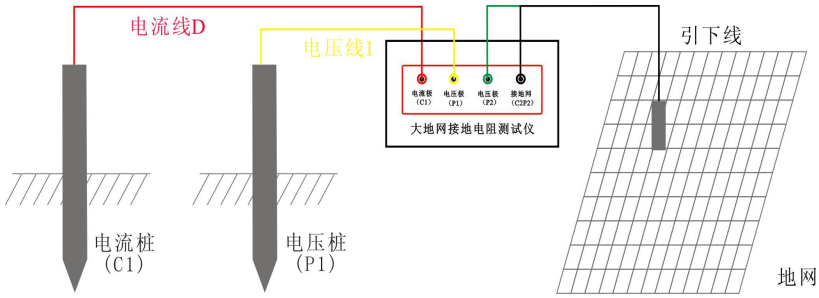
14: Emergency stop button 15: LCD screen 16: 232 serial port

17: U disk socket 18: Printer

Note: Terminals 5, 6, 7, 8, 9, and 10 are only used when an external power supply is connected.

When using the internal power supply, just leave it open.

VII.Measurement wiring



三极法测量接线图

Figure 3 Three-pole method measurement wiring diagram

1. Measuring current wire D: wire diameter ≥ 1.5mm2, length is 3 to 5 times the diagonal length of the ground net;

2. Measuring voltage wire 1: current wire with wire diameter ≥ 1.0 mm2 and length 0.618 times;

3. Measuring voltage line 2: Connect to a down-lead of the measured ground network.

4. Measure the ground wire: connect to a down wire of the measured ground network.

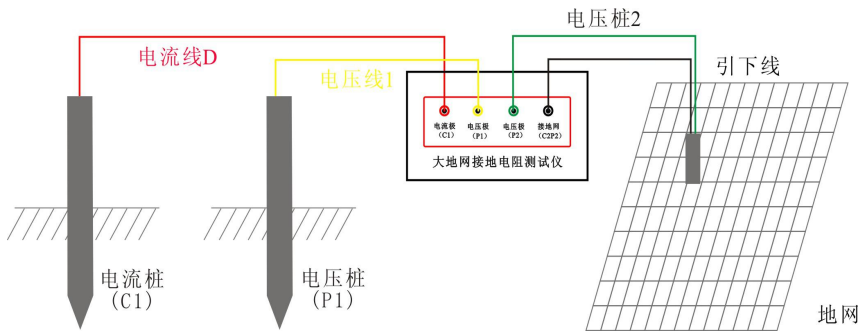


Figure 4 Wiring diagram for four-pole measurement

5. When measuring with four-pole method, draw out two connecting wires from the ground stakes of the ground grid and connect them to the voltage pole P2 and ground

grid C2 of the instrument respectively, and then perform the test according to the measurement procedure.

VIII.Operating steps

7.1. Preparation before operation

1. First check whether the current line, voltage line and ground network line used for the test are disconnected (can be measured with a multimeter), whether the rust on the ground pile is cleaned, and whether the buried depth is appropriate (>0.5m), and check at the same time Check whether the connection between the test line and the ground stake is connected. If it is not connected, please reconnect after handling.

2. The length ratio of the current test line to the voltage test line is 1:0.618, and the length of the current test line should be 3 to 5 times the diagonal of the ground network.

3. The current test line and the voltage test line are discharged in parallel after connecting one end to the instrument according to the specified length. The other end is connected to two ground piles (as shown in Figure 3 or Figure 4).

4. Check the placed test line again, connect one end of the multimeter to the current line or voltage line, and the other end of the grounding network line if there is no resistance value displayed, it is open, confirm that it is intact and test again.

5. After checking that the connection is correct, connect the AC 220V/50Hz power supply to the instrument and power on the instrument.

6. Press the measurement key to start measurement.

7. After the instrument displays the test, record the test data (the instrument can repeat the measurement multiple times).

8. After turning off the power of the instrument, disconnect the connection and the test process ends.

7.2. Operation instructions:

1. Turn on the power switch and the computer will perform self-test. After a few seconds, the LCD screen displays the main menu in Chinese as shown in Figure 5, indicating that the self-test is successful.

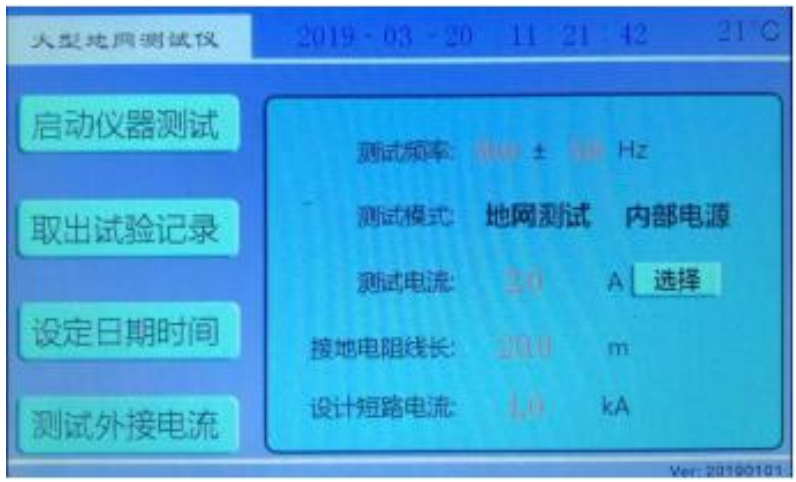


Figure 5 Boot interface

2. Test parameter selection explanation

1) Test frequency: 50.0±5.0Hz means using 45/55Hz double frequency conversion test. Generally choose 50±5Hz or 60±5Hz in field test. Of course, you can choose something else. If you want a single frequency such as 50Hz test, you can choose 50.0±0.0Hz. Here the frequency value is set freely in the range of 40-70HZ.

2) Test mode: ground network test. Here is the drop-down menu (refer to Figure 6)

Can choose grounding test grounding resistance

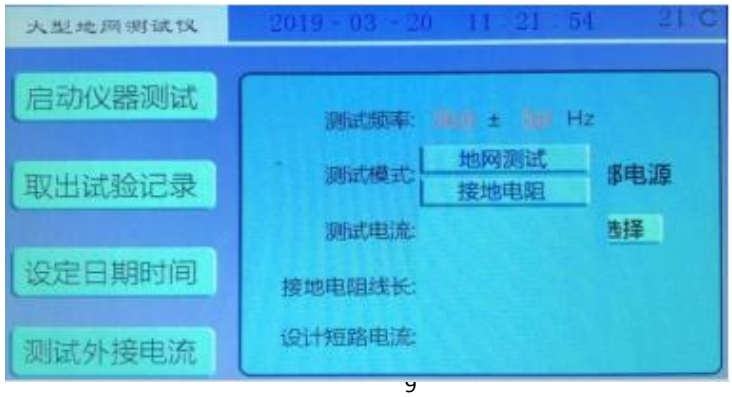


Figure 6 Test mode selection

3) Internal power supply: here is a drop-down menu, you can choose internal power supply or external power supply. (Picture 7)

4) Test current: 2.0A represents the value of the test current. The current value here can be set arbitrarily, such as 2.2A. Press the select button to select the current value. (Picture 8)

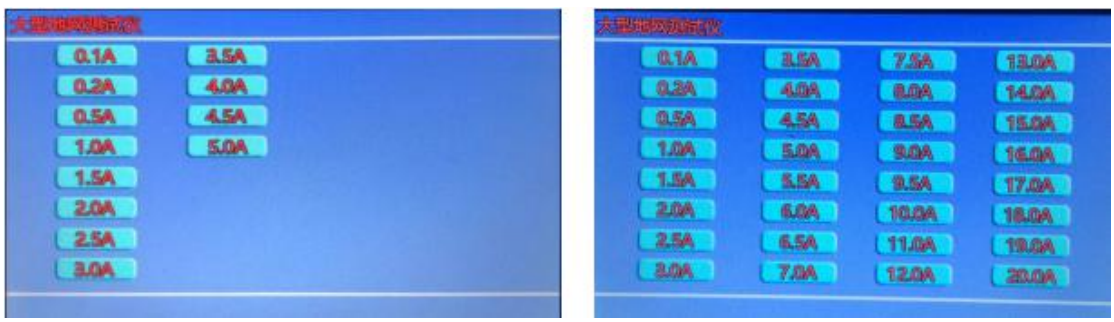


Figure 8

Test current selection (normally only to 5A, 20A needs to be customized)

5) Grounding resistance wire length: the wire length when testing grounding resistance, generally choose 20 meters.

6) Design short-circuit current: The current when a single-phase short-circuit occurs during the design of the substation. Generally 1kA.

7) Under the boot interface (Figure 5), the red numbers are modified. For items such as test frequency, you only need to use a touch screen pen or finger to click, and the numeric keyboard will pop up and then modify. (Picture 9)

Figure 9 Red digital parameter modification interface

After filling in the numbers, press the OK key, the keyboard disappears, and the input data is reflected in the input box.

After filling in the numbers and pressing the esc key, the keyboard disappears and the entered data is invalid.

7.3. Ground network resistance test

In the boot interface (Figure 5), select the test mode for ground network test, and use a touch screen pen or finger to click

Start the instrument test, and the test confirmation interface appears (Figure 10):

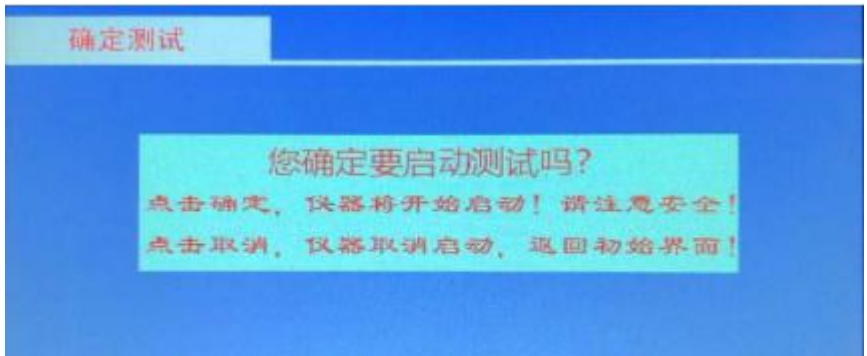


Figure 10 Test confirmation interface

Click OK to start the up-current test. Please confirm that the test line has been connected. At this time, the ground network test interface will appear (Figure 11). Click Cancel, and the instrument will return to the startup interface (Figure 5).

Figure 11 Ground network test interface

I=2.000A Instantaneous current during the test.

U=0.151V Instantaneous voltage during test.

R=0.075Ω instantaneous impedance during testing. F=55.00Hz constant current source frequency (double frequency conversion F1)

F=45.00Hz constant current source frequency (double frequency conversion F2)

Progress: 84% means 84% of the test is completed, etc.

To 100% test is completed.

After the test is completed, the ground network test result interface appears (Figure 12)

Figure 12 Ground network test result interface

The meaning of the measurement results is as follows:

Zx = 75.777mΩ: ground network impedance value

Rx = 75.770mΩ: pure resistance of the ground grid

Φ = 0.769°: vector angle value

X = 0.001Ω: ground network inductance value

L = 0.003mH: ground grid inductance value

Press exit at this time to return to the boot interface (Figure 5). Press print to print out the result.

Press the store button. The data storage interface appears (Figure 13).

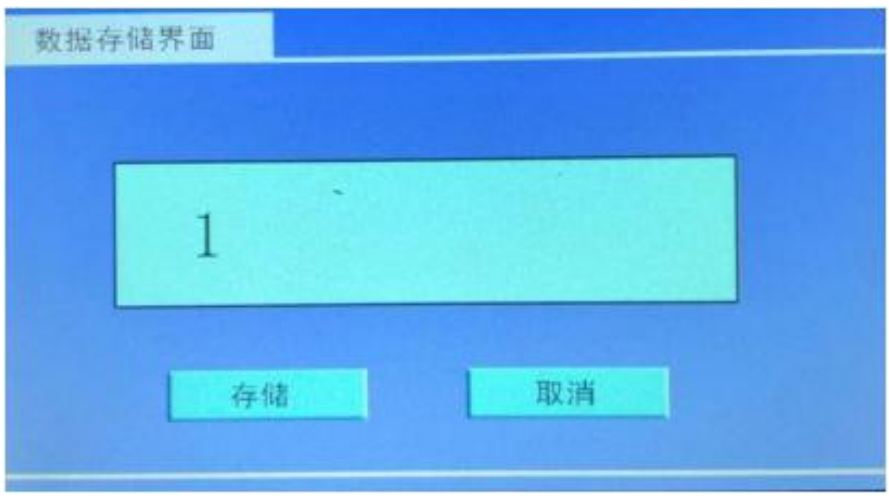
1. Click the data box, a small

Keyboard, fill in the storage serial number.

2. Press the store button, data

After storing, it will return automatically.

3. Press the cancel button to return without saving.



Data storage interface (Figure 13)

7.4 Ground resistance test

In the boot interface (Figure 5), select the ground resistance test mode, (the line length is generally 20 meters) use the touch screen pen or finger to click to start the instrument test, the test confirmation interface appears (Figure 14):

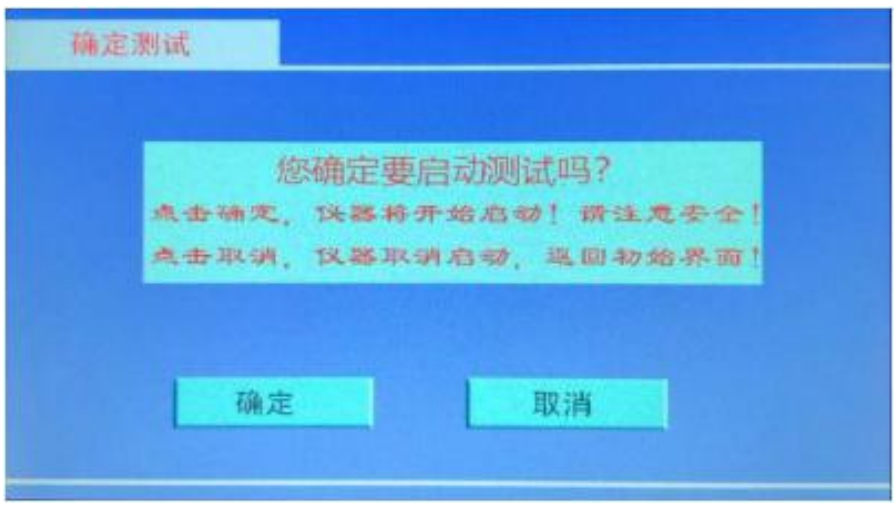


Figure 14 Test confirmation interface

Click OK to start the up-current test. Please confirm that the test wire has been connected. At this time, the grounding resistance test interface will appear (Figure 15). Click Cancel, and the instrument will return to the startup interface (Figure 5).

I=2.002A instantaneous current during testing.

U=0.153V The instantaneous voltage during the test.

R=0.076Ω instantaneous impedance during testing. F=55.00Hz constant current source frequency (double frequency conversion F1)

F=45.00Hz constant current source frequency (double frequency conversion F2)

Progress: 84% means 84% of the test is completed, etc.

To 100% test is completed.

Figure 15 Ground resistance test interface

After the test is completed, the ground resistance test result interface appears (Figure 16)

Figure 16 Ground resistance test result interface

The meaning of the measurement results is as follows:

R = 76.138mΩ: Grounding resistance value

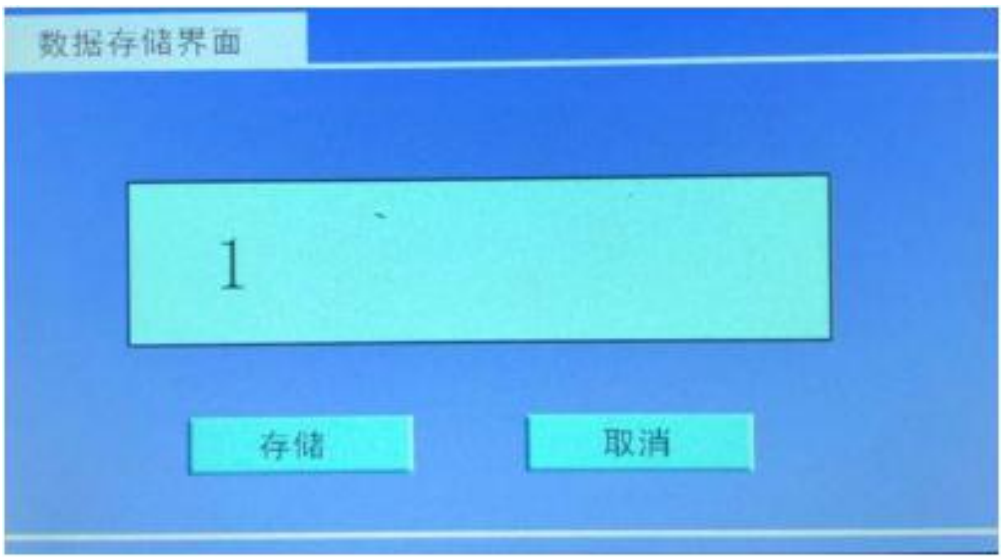
ρ=9.567Ω.m: soil resistivity value

I=2.000A: Test current value

U=0.152V: ground voltage value

Press exit at this time to return to the boot interface (Figure 5). Press print to print out the result.

Press the store button. The data storage interface appears (Figure 17).



Data storage interface (Figure 17)

1. Click the data box, a small

Keyboard, fill in the storage serial number.

2. Press the store button, data

After storing, it will return automatically.

3. Press the cancel button to return without storing.

7.5 Instructions for self-diagnosis of the instrument during the test

1) When [Please power on and restart], the internal power supply of the instrument may be protected, shut down and restart.

2) [Power module error, please contact the manufacturer], if the test continues, please contact the manufacturer.

3) When the test current is 0.0A, the connection of the [current line] may be in poor contact with the [current pole] ground pile or there are too few ground piles. It is necessary to add ground piles to reduce loop resistance. The pile depth is not less than 0.5m. The resistance of the current pile should be less than 80Ω.

4) If the measured value displayed by the instrument is extremely low (<0.01Ω), it may be that the voltage line is not connected.

5) When the instrument is tested, a resistor of more than 20 ohms can be connected in series to the C1 output terminal to simulate the field current pile resistance.

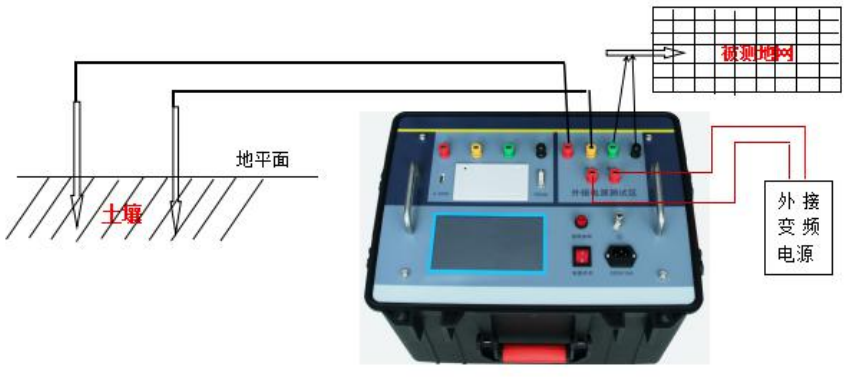
6) To make the test go on smoothly, please use a multimeter to check whether the contact point between the test lead and the ground pile is intact, and measure whether the laid line is open.

7) The instrument will automatically eliminate wiring errors during the four-pole measurement.

8) If there are other malfunctions in the instrument, please contact the after-sales service department of our company directly, and do not disassemble the machine privately.

4. The measuring line is configured by the user according to the size of the ground network.

IX. External power use



1. When using an external power supply, you only need to wire it as shown above.

2. Turn on the machine and select the external power supply on the initial interface.

3. Set the frequency so that the frequency is equal to the frequency of the external power supply.

4. Click the test external power button, and the screen displays the size of the external current. Adjust the external variable frequency power supply according to the size of this current to make the current meet the requirements of the test. Return to the initial interface.

5. Click the Start Instrument Test button to start the test.

6. All test methods of external power supply are exactly the same as internal power supply test. I will not repeat them here.

X.Measure ground continuity

C1/P1 is connected to a grounding device, C2/P2 (measurement grounding terminal) is connected to another grounding device.

note:

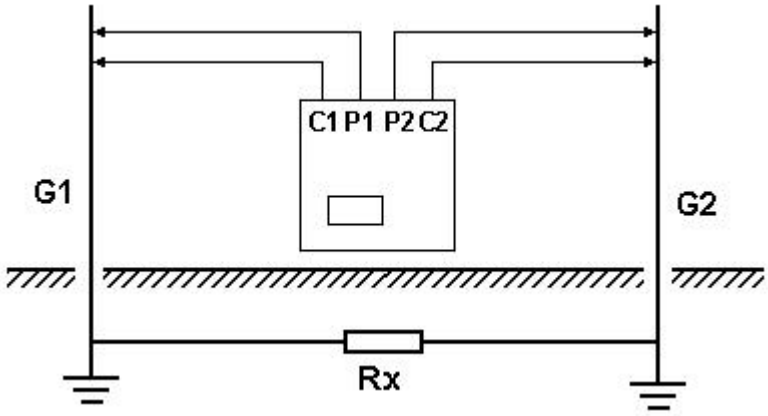
1. Do not coil the lead wire.

2. Keep voltage wires away from current wires as much as possible.

3. Both sides of the grounding clamp should be pressed tightly to prevent poor contact caused by paint corrosion.

4. To prevent current protection, select a current of 2A.

Select ground grid frequency conversion 2A



XI.Measuring soil resistivity

Using this instrument, you can use the unipolar method or the quadrupole method to measure soil resistivity. The following uses the quadrupole method as an example. The wiring for measuring soil resistivity is shown in Figure 12.

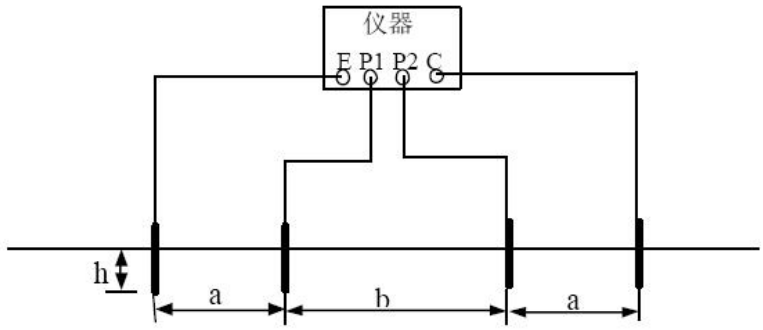


Figure 12

Wiring diagram for measuring soil resistivity by four-pole method

In the figure, a is the distance between the current electrode and the potential electrode, b is the distance between the two potential electrodes, and h is the buried depth of the electrode. When a=b, it is Winner's method. For the convenience of calculation, please make the electrode spacing a and b much larger than the buried depth h, and generally should satisfy a and b>10h.

The test electrode should be round steel with a diameter of not less than 1.5cm or angle steel with a diameter of 25mm×25mm×4mm, and the length is not less than 40cm.

After burying the electrode and connecting the wire, the measurement can be started. Measure the impedance Z by the above method of measuring ground impedance, then the soil resistivity ρ is $\rho=\pi a(a+b)Z/b$

The above formula holds when a>>h and b>>h.

When a=b, the above formula is simplified to: $\rho=2\pi aZ$

XII.Measurement of ground grid resistance by angle method

Under normal circumstances, the ground impedance test of large-scale grounding devices adopts the angle arrangement of current and voltage lines. Generally, the distance dCG between the current post C and the edge of the tested grounding device should be 4 to 5 times the diagonal length of the ground grid; the length of dPG is similar to dCG. The ground impedance formula can be modified by the following formula.

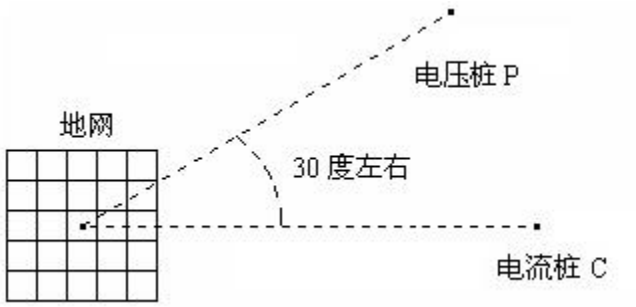
$$Z = \frac{Z'}{1 - \frac{D}{2}\left[\frac{1}{d_{PG}} + \frac{1}{d_{CG}} - \frac{1}{\sqrt{d^2_{PG} + d^2_{CG} - 2d_{PG}d_{CG}\cos\theta}}\right]} \quad \text{公式 (1)}$$

In the formula: θ—the angle between the current line and the voltage line;

Z'—the test value of ground impedance.

If the soil resistivity is uniform, an isosceles triangle wiring with equal dPG and dCG can be used. At this time, θ is about 30°, and the correction formula for dPG=dCG=2D grounding impedance is still the above formula.

Interface selection: ground network frequency conversion 2A



XIII. Packing List

No.	Name	Qty
1	Main engine	1
2	Power line	1
3	Ground stake	2
4	Ground lead	1
5	Voltage lines (P1 yellow, P2 green) each 5m	2
6	Current wire (C1 red, C2 black) each 5m	2
7	Fuse pipe (built-in)	2
8	Print paper	1

Note: Please do not disassemble the instrument, including the panel. Because it may break the internal connection line of the instrument and cause the instrument to malfunction. Failures caused by this situation are not covered by the warranty.

7 Ground Impedance Test of Grounding Device of Transmission Line Tower

General requirements for grounding impedance testing of transmission line tower grounding devices are as follows ：

a) tower grounding impedance test should be three-pole method, but also circuit impedance method. When three-pole method should be used to verify the test results.

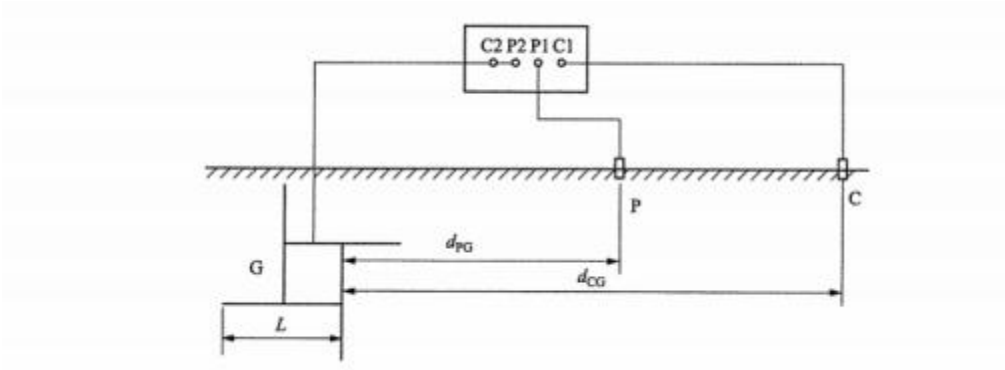
There is usually power frequency interference in b) transmission lines. The test current should be greater than 100 when using three-pole method mA, and the test current should be greater than 300 when using circuit impedance method to ensure the validity and accuracy of the test.

There is a certain inductive component in the grounding impedance and test circuit of the c) tower grounding device, and the output current of the test instrument should be 40 Hz~ 60Hz standard sine wave.

d) test should comply with site safety regulations, Lei Yun should stop testing and evacuate the test site when moving above the tower.

7.2.1 test methods

The method and principle of measuring the grounding impedance of transmission line tower grounding device by three-pole method are basically the same as that of substation grounding device, see figure 7. The maximum diagonal length of the tower grounding device is D, when the grounding device of the tower under test has rays, the ray length L. D taken Because there is usually no AC power supply and the ground grid is small, the portable grounding impedance tester is generally used in the test site.



G— test tower grounding device; C one current pole; P one potential pole; maximum ray length of L tower grounding device; distance between one current pole and tower grounding device; distance between da— potential pole and tower grounding device.

Fig .7 Test diagram of grounding impedance of tower grounding device of transmission line.

Before testing the grounding impedance of the tower, all the grounding lead lines of the tower should be removed, that is, the electrical connection between the tower body and the grounding device should be disconnected, and the grounding lead should be short connected.

7.22 Wiring requirements and modalities Wiring requirements refer to 61.2. The wiring

method refers to 6.2.1.2. if the laying path is narrow, the straight line method can be used, otherwise, the angle method can be used. a) straight line method. Usually the current pole C the straight line distance from the edge of the tower foundation dco take 3 D~4 if the soil around the earthing device is more Uniform, dcc can take 2 D. The linear distance P the potential pole from the base edge of the tower dpoa 0.6 dca. b) angle method. Usually dco take 3 D~4 D,d slightly less than the dc,0 usually 30°D~45; if the soil around the earthing device The resistivity is uniform, dco can take 2 D, current line and potential line 30 angle, dco=dko. 7.2.3 Notes Attention to testing grounding impedance of tower grounding device by three-pole method ： as follows a) should avoid placing the test potential and current poles on the radiation of the grounding device and should not be extended with the radiation of the grounding device The line is wired in the same direction. b) when it is found that the measured value of grounding impedance increases or decreases significantly compared with the previous test results, the layout direction of current pole and potential pole should be changed, or the distance of laying line should be increased, and the test should be carried out again. When c) test with the three terminal grounding resistance tester shown in figure 7, the C2 and P2 of the grounding terminal should be shortened as far as possible length of lead between devices.

7.3 Backward impedance

7.3.1 Conditions of application

Circuit impedance method applies to ： following conditions

a) there is no electrical connection between the tower and its earthing device.

b) there is a parallel circuit of multi-base tower in the distance, that is, the lightning protection line of the transmission line is well connected with the tower at this level, and it has been connected with the multi-stage tower in the distance all the time

The tower and its grounding device are well connected. For the number of parallel towers on lightning lines requiring direct grounding in the line section of the test tower, see Table 1 in the DL/T887—2004.

7.3.2 test methods

All grounding lead lines of the measured tower are removed and short connected with metal as the test lead of the grounding device. A test instrument is connected to the circuit formed by the grounding device, the grounding device tower, the lightning protection line, the remote multistage tower and its grounding device and the earth, as shown in figure 8, which generates the test current and measures the Z'tj. of the grounding impedance Since the parallel effect of the grounding impedance of the remote multistage tower grounding device, the Z'tj is larger than and similar to the grounding impedance of the grounding device of the measured tower Ztj, which is acceptable in the test of the grounding impedance of the tower.

W of lightning lines directly connected to multistage towers

Grounding impedance P10 tester o 2

Grounding device for pole tower/

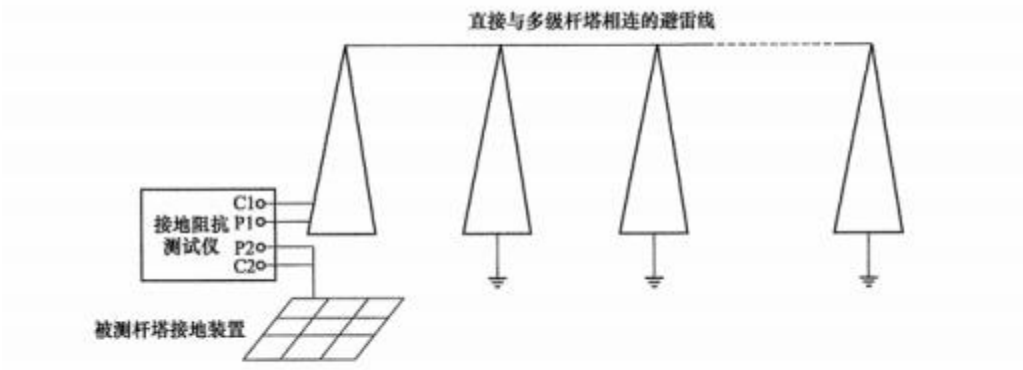


图 8 回路阻抗法测试杆塔接地阻抗示意图

Fig .8 Schematic diagram of grounding impedance test of tower by circuit impedanc.

The measured value of Z'tj sentence is too large or too small (if greater than 502 or less than 2 Q), or more than the empirical value, the three-pole method is used to verify.