Dear Client,

Thank you for Purchasing our HTDW-5A 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/draw test wire 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: whhuatian@163.com
- Website: www.whhuatian.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 body injury and prevent the product or other relevant subassembly to damage. In order to avoid possible danger, this product can only be used within the prescribed scope.

*Only qualified technician can carry out maintenance or repair work.*

--To avoid fire and personal injury:

**Use Proper Power Cord**

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

**Connect and Disconnect Correctly**

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

**Grounding**

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

shock, the grounding conductor must be connected to the ground.

Make sure the product has been grounded correctly before connecting with the input/output port.

**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 Circuit and Current Charged Metal**

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

**Do Not Operate with Suspicious Failures**

If you encounter operating failure, 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.

# Contents

# I. Overview of Instrument

At present, the test of earth resistance of geodetic network in electric power system is mainly measured with power frequency heavy current three-electrode method. In order to prevent against interference of power frequency generated by power grid during operation and improve the accuracy of measurement results, insulation preventive test specifications stipulate: the test current of power frequency heavy current method should not be less than 30A. Thus cumbersome test equipment, complicated test process, heavy working strength of testers, long test time and other many problems appeared.

HTDW-5A Ground Network Earth Resistance Tester adopts new type variable frequency AC power supply and microcomputer processing control, signal processing and other measures, which can properly solve the interference problem during test, simplify test operating process, improve precision and accuracy of test results as well as greatly reduce labor intensity of testers and test cost.

This instrument is applicable to the power frequency earth impedance, contact voltage, step voltage, equal power frequency characteristics and soil resistivity of various grounding devices, which can test earth network of substation (4Ω), hydraulic and thermal power plants, microwave station (10Ω), arrester (10Ω) multipurpose machine types.

This instrument adopts pilot frequency anti-jamming technique, which can accurately test the data under power frequency 50Hz in strong interference environment. Maximum test current is 5A, which will not cause too high electric potential of grounding device, it also has very strong anti-jamming capacity, so the measurement can be carried out with power.

# II.Performance Features

1. Good power frequency equivalence of measurement. Test current waveform is sine wave, the difference between frequency and power frequency is only 5Hz, measure with 45Hz and 55Hz frequency.
2. Strong anti-jamming capacity. This instrument adopts pilot frequency measurement method and modern software and hardware filter technique, enabling the instrument to have very high anti-jamming performance, thus achieving stable and reliable test data.
3. High precision. Intrinsic error is only 0.005Ω, which can be used to measure the geodetic network with very small earth resistance.
4. Powerful functions. Able to measure current pile, voltage pile, earth resistance,

step voltage and contact voltage.

5. Simple operation. Full Chinese menu operation, directly display the measurement results.
6. Small amount of wiring labour, requiring no heavy current line.

# III. Technology Index

1. Measurement scope: 0～200Ω (including impedance of current pile)
2. Resolution: .001Ω
3. Measurement error: ± (reading×1%+0.005Ω)
4. Maximum output voltage: AC 400V (45Hz, 55Hz, double frequency, sine wave)
5. Maximum output current: AC 5A (45Hz, 55Hz, double frequency, sine wave)
6. Current output gears: 5/4.5/4/3.5/3/2.5/2/1.5/1A，, one gear every 0.5A, totalling 9gears.
7. Anti-jamming capacity: power frequency resistance 50Hz voltage 10V
8. Requirement for measuring line:

   Sectional area of cooper core of current line≥1.5mm$^2$

   Sectional area of cooper core of voltage line≥1.0mm$^2$
9. Electric power supply: AC 220V±10%, 50Hz
10. Contour dimension: 295×340×310
11. Instrument weight: 30kg

# IV. Instrument Principle

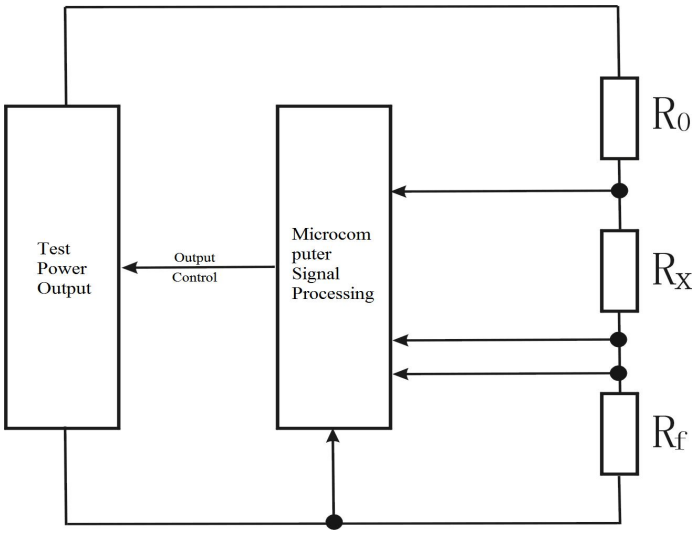



Fig. 1 Measurement Principle Diagram

R0 Loop resistance about 5～200Ω

Rx Test resistance about 0～200Ω

Rf Standard resistance

Measuring current line D: the length is 3～5 times as long as length of diagonal of earth network; wire diameter≥1.5mm$^2$

Measuring voltage line 1: length 0.618D; line diameter≥1.0mm$^2$

Measuring voltage line 2: connect measured earth network

Measuring earthing line: connect measured earth network

# V. Introduction to Panels

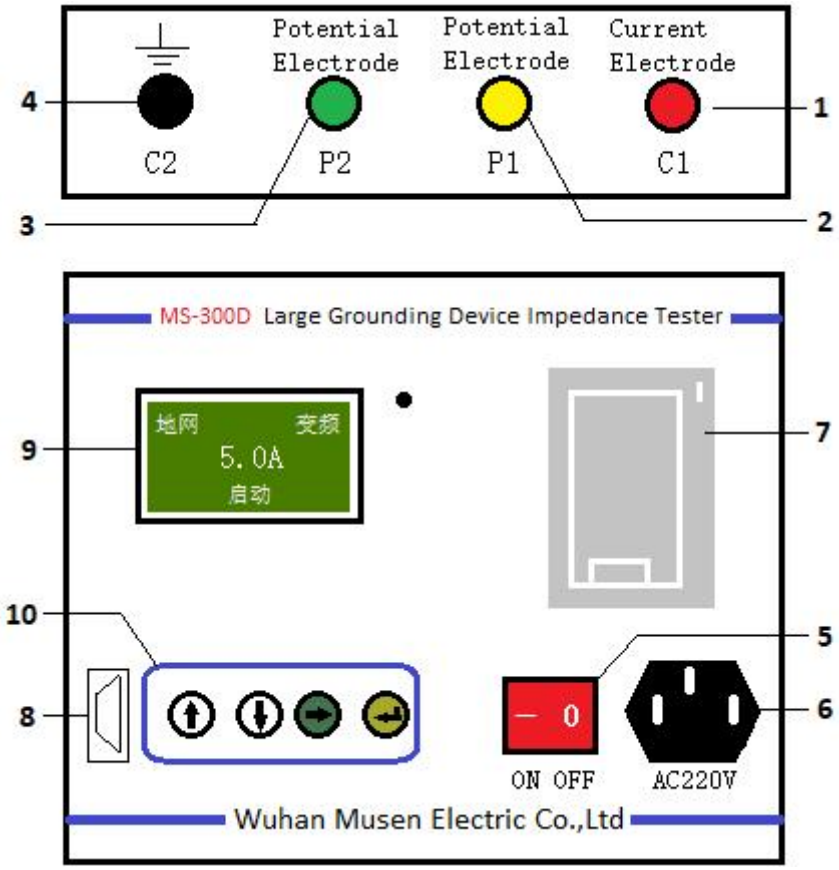



Fig. 2 Panel Diagram

1：Current electrode(C1)

2：Voltage electrode (P1)

3：Voltage electrode (P2)

4：Earthing network (C2)

5：Power switch

6：Power socket

7：Printer

8：RS232

9：Display

10：Key area

“增大”**Plus** key——Modify content of menu, adopt circulating rolling mode.

“减小”**Minus** key——Modify content of menu, adopt circulating rolling mode.

“功能”**Function** key——Select menu item, selected item is displayed with inverse highlight font.

“确定”**OK** key——Press this key on the option "Test" to enter test status.

# VI. Measurement Wiring

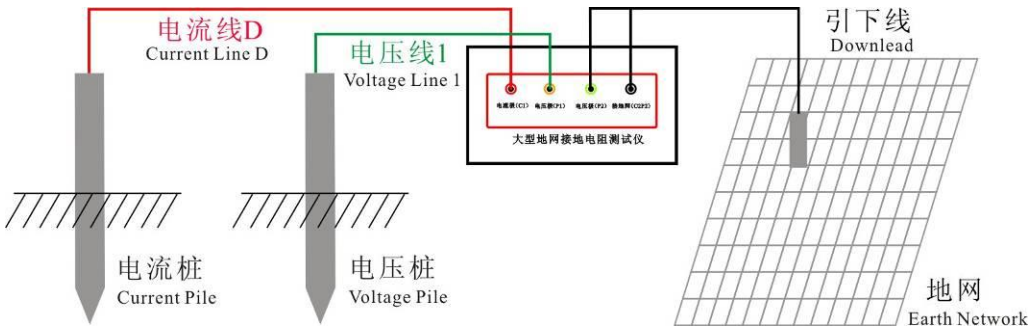



Fig. 3 Diagram of Measurement Wiring with Three-Electrode Method

Measuring current line D: line diameter ≥1.5mm$^2$ ,the length is 3～5 times as long as length of diagonal of earth network;

Measuring voltage line 1: line diameter≥1.0 mm$^2$ , length 0.618D;

Measuring voltage line 2: connect measured earth network

Measuring earthing line: connect measured earth network

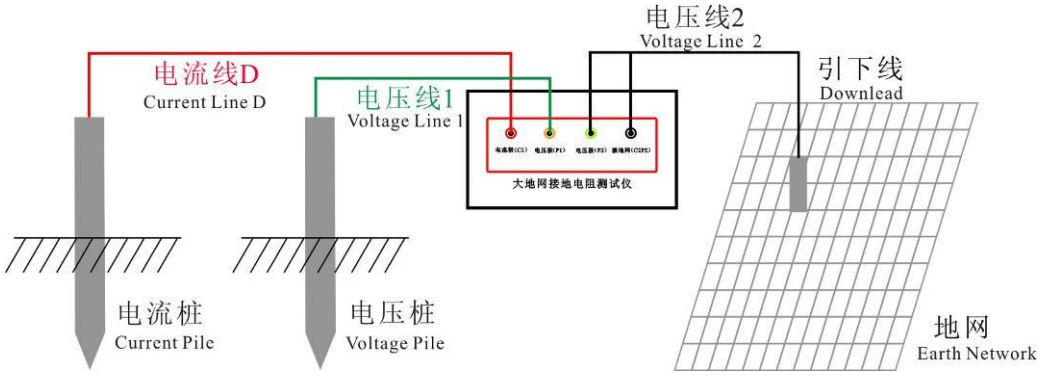



Fig. 4 Diagram of Measurement Wiring with Four-Electrode Method

When measuring with four-electrode method, lead out two connecting lines from the earth pile of earth network to be respectively connected to two connecting poles of

voltage electrode P2 and earthing network C2 of the instrument, then conduct test according to measurement operating steps.

# VII. Operating Steps

## 1. Operating Steps

**(i)** First check whether the current line, voltage line and earth network line for test have breaking phenomena (it can be measured with multimeter), whether the iron rust on the earth pile is cleared, whether the burial depth is proper (>0.5m), and check whether the connection between testing line and earth pile is conducted, if not, please connect again after processing.

**(ii)** Length breath ratio between current testing line and voltage testing line is 1:0.618, the length of current testing line should be 3～5 times as long as length of diagonal of earth network.

**(iii)** Connect one end of current testing line and voltage testing line and let out parallelly according to specification, the other end is respectively connected two earth pile (as shown in Fig. 3).

**(iv)** Check the testing line has been properly let out, connect one end of multimeter to current line or voltage line, connect the other end to earth network line, it means open circuit if there is no resistance indication, and make test after confirming it is in good condition.

**(v)** After checking the connecting is correct, connect the instrument with AC 220V/50Hz power supply to electrify the instrument.

**(vi)** Press Measure key to measure.

**(vii)** After the instrument displays the test is finished, record the test data (this instrument can measure repeatedly for many times).

**(viii)** After turning off the power source of the instrument, remove the wiring, the test process will be completed.

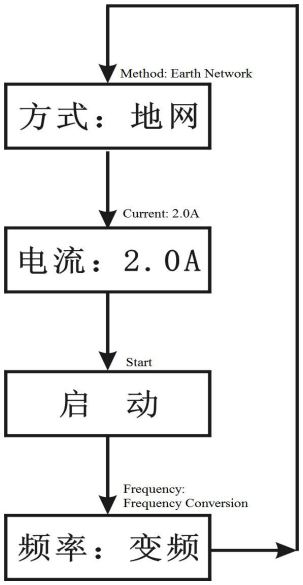
## 2. Operating Instructions:

**(i)** Turn on switch of power source, the computer will conduct self-checking, after several seconds, the LCD will display Chinese Main Menu as shown in Fig. 5, indicating the self-checking is successful.


Fig. 5 Chinese Main Menu

**(ii)** Press 功能 key to move the cursor to each menu item, and indicate in circulation.

The selected item will be displayed with inverse highlight font. Flow of key selection is as shown in Fig.



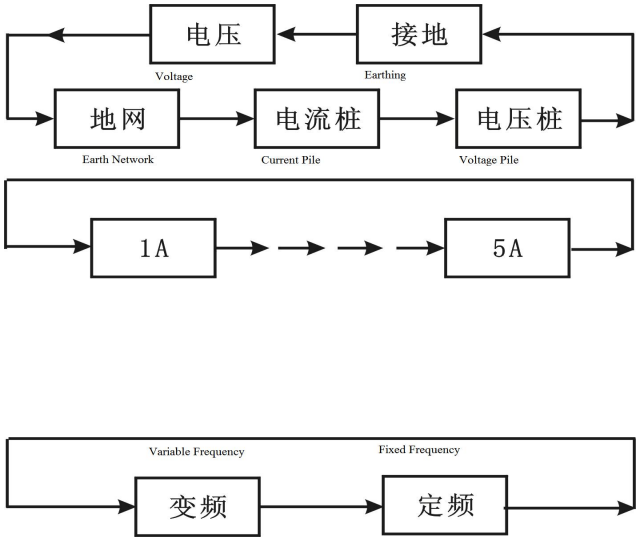




Fig. 6 Menu Flow Diagram Fig. 7 Parameter Setting Flow Diagram

**(iii)** At the item indicated by the cursor, press 增大 or 减小 key can alter the menu of the item, and indicate in circulation, the flow is as shown in Fig. 7.

**(iv)** After altering the menu to meet the requirements, press Select key to select the next item.

### 3. Test:

Turn on power switch, when the cursor is on testing item, press **OK** key for about 5s, the instrument will start testing.

The picture displayed during test is as shown in Fig. 8 (earth network, variable frequency), when the course below goes to 100%, the test will be completed, then the test results will be displayed as shown in Fig. 9. At this time, the cursor will indicate printer icon, press OK key to print the report.

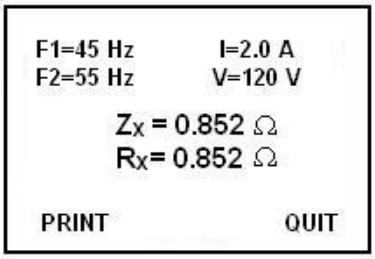




Fig. 8 Test Process Display Fig. 9 Measuring Results Display

The meaning of measuring results is as follows:

Zx: Measured impedance value of earth network

Rx: Measured resistance value of earth network

V: Applied voltage value

I: Current the testing product passed by

F1,F2: Test frequency

After printing, turn off power switch, remove wiring, the test will be completed.

During test, **Check Power Supply, Check Current Pile, Check Voltage Pile and Check Earth Network**appeared on the screen all refer to the instrument is under self-checking, generally about 15s, please wait patiently.

**4. Detailed Introduction to Testing Menu:**

**(i) Measuring mode:**

The instrument has three measurement options including "earth network", "current pile" and "voltage pile", which are respectively functioning to measure impedance of earth network, current pile and voltage pile. Under general circumstances, select "earth network" to measure the impedance of geodetic network during test. And when the user requires too measure the impedance of current pile or voltage pile, select the last two options to measure directly.

**(ii) Frequency selection:**

The instrument can choose two kinds of measuring frequency, "variable frequency" and "fixed frequency".

When conducting test on site, variable frequency must be selected for test in order to eliminate the disturbance of electromagnetic field on site.

"Fixed frequency" is only used for the test in the laboratory.

"Variable frequency" adopts 45Hz and 55Hz double variable frequency for measurement, and "fixed frequency" adopts strict 50Hz for measurement.

**(iii) Current selection:**

The instrument provides 9 kinds of measuring current including 5A, 4.5A, 4A, 3.5A,

3A, 2.5A, 2A, 1.5A and 1A.

Under normal circumstances, select testing current according to the strength of impedance of current pile, 3A current will be enough.

**(iv) Automatic printing:**

When the cursor is on the current, press OK key one time, small symbol Printer will appear or disappear at left bottom of the screen, standing for selecting or cancelling the automatic printing function. When choosing automatic printing, the test will be completed, the instrument will automatically print the results. When cancelling automatic printing, if printing is still required, then the results should be printed manually.

**(v) Manual printing:**

After testing the instrument, the page indicated in Fig. 9 will appear. Press 

key to select between print and quit.

If selecting print, press OK key to print the results.

If selecting quit, press OK key to return to initial page shown in Fig. 5.

**5. Introduction to Auto-diagnosis of Instrument during Testing**

**(i)** When "Please start and restart", it may be the internal electric source protection of the instrument, power off and restart.

**(ii)** When "Power module error, please contact the manufacturer", move the cursor to "earth network", press OK key 10 times, instrument horn will give sound one time, and printer symbol with inverse color will appear at left bottom of the screen.

**(iii)** When testing the current is 0.0A, it may be poor connection between "current line" wiring and "current electrode" earth pile or too little earth pile, increase the earth piles and reduce loop resistance

**(iv)** Depth of earth pile should not be less than 0.5m. Resistance of current pile should be less than 200Ω.

**(v)** If the measuring value indicated in the instrument is extremely low（＜0.01Ω） it may be that the voltage line is not connected.

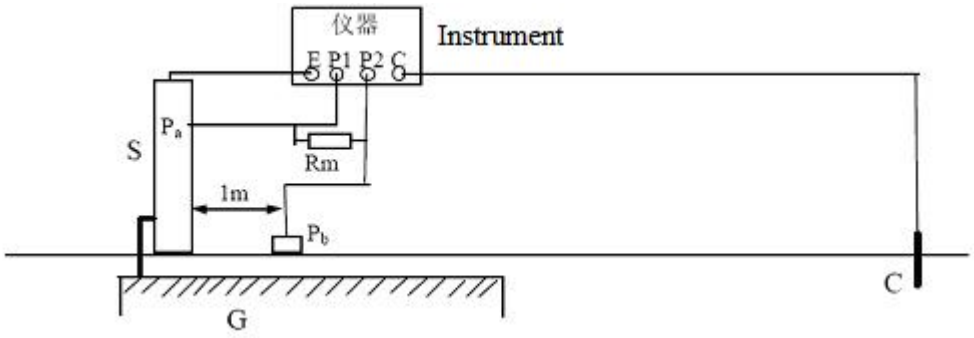
**(vi)** During detection, if the testing resistance is less than 20Ω, it is suggested to use 2A testing current to prevent the instrument against damage due to sudden increase of current.

# VIII. Precaution

1. In order to get smooth test, please first inspect and test whether the contact point between wire and earth pile is in good condition, and measure whether the line has been properly let out has breaking phenomena.
2. During measurement with four-electrode method, the instrument will automatically eliminate wiring error.
3. When the cursor is on the current, press OK key one time, small symbol Printer will appear or disappear at left bottom of the screen, standing for selecting or cancelling the automatic printing function.
4. In case of other faults of this instrument, please directly contact after-sales service department of our company, do not dismantle or check without permission.
5. Measuring line should be prepared by the user according to the dimension of the earth network.

# Appendix 1: Test of Contact Voltage and Contact Potential Difference

Measurement Wiring Diagram of Contact Voltage is shown in the Fig. 10 below. The test can be carried out according to the following steps.




*G-Earthing Device* *S-Equipment Framework* *C-Current Electrode*

*Pb-Metal Plate simulating Human Foot* *Rm-Equivalent Resistance of Human Body*

Fig. 10 Contact Voltage Measurement Wiring Diagram

Make an earth pile at the place far from the grounding device as current electrode, the distance from this current electrode to the edge of grounding device should be over 4 times as long as maximum diagonal length D of the grounding device.

Make reliable connection between C terminal of instrument panel and current electrode. Then use wire to connect the E terminal of the instrument to the structure of the tested equipment.

P1 terminal of the instrument is connected to Pa point on equipment structure, the height from Pa to ground is 1.8m. P1 terminal of the instrument is connected to electrode Pb of simulated foot, this electrode can adopt the metal round plate with diameter 20cm for wrapping wet cloth and press heavy object on it. Center of electrode is 1m away from the edge of equipment.

Equivalent resistance of human body Rm is connected in parallel between P1 and P2 terminals of the instrument, generally take Rm=1.5KΩ. After detecting the wiring is correct, connect instrument power, select to perform "grounding impedance measurement", then properly set up testing current, the instrument will begin measurement. After measurement, the impedance value Z can be read from LCD.

Finally calculate the contact voltage Uj according to the following formula

Uj=Z * Is

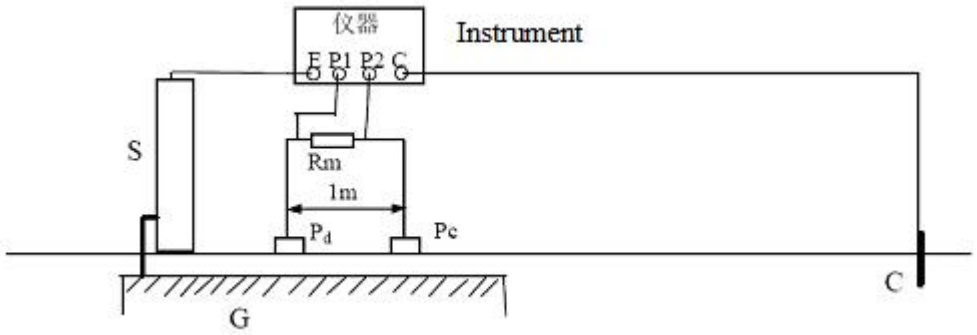
Where, Is is the system single-phase earth fault current in tested grounding device.

During the above measurement, if the voltage input terminal of the instrument is not connected with equivalent resistance of human body Rm in parallel, then the achieved

result will be contact potential difference.

# Appendix 2: Test of Step Voltage and Step Potential Difference

Measurement Wiring Diagram of Contact Voltage is shown in the Fig. 11. The test can be carried out according to the following steps.




*G-Earthing Device S-Equipment Framework C-Current Electrode*

*PcPd-Metal Plate simulating Human Foot Rm-Equivalent Resistance of Human Body*

Fig. 11 Measurement Wiring Diagram of Step Voltage

Make an earth pile at the place far from the grounding device as current electrode, the distance from this current electrode to the edge of grounding device should be over 4 times as long as maximum diagonal length D of the grounding device.

Make reliable connection between C terminal of instrument panel and current electrode. Then use wire to connect the E terminal of the instrument to the grounding downlead of the equipment.

P1 and P2 terminals of the instrument are respectively connected to electrode Pc and Pb of simulated human foot, this electrode can adopt the metal round plate with diameter 20cm for wrapping wet cloth and press heavy object on it. The distance between the centers of two electrodes is 1m.

Equivalent resistance of human body Rm is connected in parallel between P1 and P2 terminals of the instrument, generally take Rm=1.5KΩ. After detecting the wiring is correct, connect instrument power, select to perform "grounding impedance measurement", then properly set up testing current, the instrument will begin measurement. After measurement, the impedance value Z can be read from LCD.

Finally calculate the step voltage Uk according to the following formula

Uk=Z* Is

Where, Is is the system single-phase earth fault current in tested grounding device. During the above measurement, if the voltage input terminal of the instrument is not connected with equivalent resistance of human body Rm in parallel, then the achieved result will be contact potential difference.

# Appendix 3: Measurement of Soil Resistivity

When using this instrument, the soil resistivity can be measured with single electrode method or four-electrode method. Take four-electrode method as example for explanation as follows. Wiring for measure soil resistivity is as shown in Fig. 12.

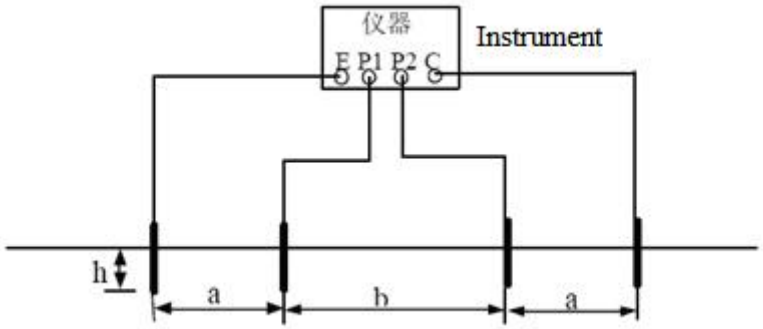



Fig. 12 Wiring Diagram of Soil Resistivity Measurement with Four-Electrode Method

In the diagram, a is the interval between current electrode and potential electrode, b is the interval between two potential electrodes, and h is electrode burial depth. When a=b, it is Wenner method. For convenience of calculation, please set electrode intervals a and b to be greatly more than burial depth h, normally meeting a, b>10h.

Electrode test should adopt the round steel with diameter not less than 1.5cm or angle steel with 25mm×25mm×4mm, both length should not be less than 40cm.

Properly embed the electrode and make wiring, then begin measurement. Measure the impedance Z with the above method for measuring the grounding impedance, then soil resistivity ρ is

$\rho=\pi a(a+b)Z/b$

The above formula will hold true when$a>>h$and$b>>h$ .

When a=b , the above formula shall be simplified as: $\rho=2\pi aZ$