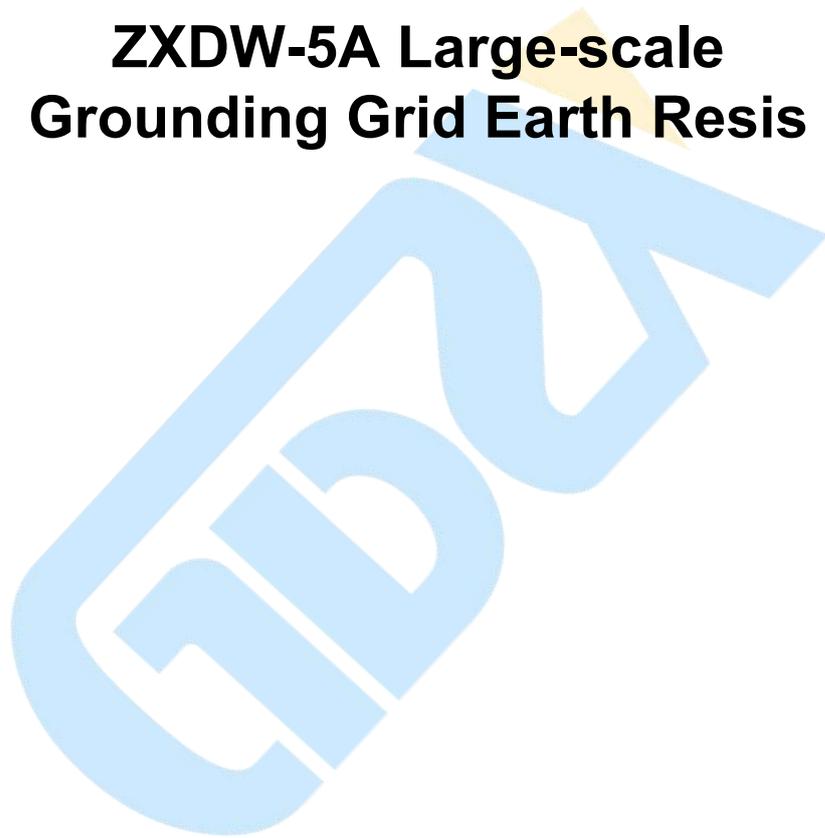


**ZXDW-5A Large-scale  
Grounding Grid Earth Resis**



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## I. Overview

Presently the power frequency, large current and three-electrode method is mainly adopted to test the grounding resistance for large earthing grid in the electric power system. To prevent any power frequency interference in operation of power grid and improve the accuracy of measurement results, the Preventative Test Code for Insulation prescribes that the test current for the power frequency and large current method should not be less than 30A. For this reason, a lot of problems occur, such as heavy testing equipment, complex test process, great labor intensity of operators, overlong test time and so on.

This tester for large earthing grid is multi-purpose and applicable for earthing grid ( $4\Omega$ ) for substation, hydro and thermal power plant, micro relay station ( $10\Omega$ ) and lightning rod ( $10\Omega$ ). It adopts the new mode variable frequency AC power, microcomputer processing and control and signal processing measures to successfully solve anti-jamming problem in testing, simplify the test process and greatly improve the precision and accuracy of testing results and reduce the labor intensity of operators and the test cost significantly.

It is suitable for testing power frequency grounding impedance, touch voltage, step voltage and other characteristic parameters of power frequency of all kinds of grounding devices as well as soil resistivity. The adoption of pilot frequency anti-jamming technology enables this instrument to get the accurate data under 50 Hz power frequencies in heavy jamming environment. The test current should be controlled within 5A to avoid over-high electrical potential of grounding device during testing. In addition, it is provided with strong anti-jamming capability, which allows measurement with power on.

## II. Product Features

1. Good power frequency equivalence for measurement. The waveform of test current is sine wave and the difference between frequency and power frequency is merely 5Hz. 45Hz and 55Hz frequencies are used for measurement.
2. Strong anti-jamming capability. This instrument takes pilot frequency method for measurement and matches with the modern software and hardware filter technology so as to achieve high anti-jamming performance and stable and reliable testing data.
3. High precision. Since the elementary error is only  $0.005\Omega$ , it can be used testing the large earthing grid with small grounding impedance.
4. Powerful function. It can measure **Pill-I, Pill-U, grounding resistance, Grid grounding resistance , on resistance, soil resistivity .**
5. Simple operation. It can be operated in Chinese menu and display the testing results directly.
6. Small wiring labor cost, with no need of large current lines.

## III. Technical Index

1. Impedance measurement range:  $0\sim 5,000\Omega$
2. Resolution:  $0.001m\Omega$
3. Measurement error:  $\pm (\text{reading}\times 2\% + 0.005\Omega)$
4. Anti-jamming capacity of power frequency 50Hz voltage: 10V
5. Waveform of test current: Sine wave
6. Frequency of test current: 45, 50, 55, 60, 65Hz single frequency  
45/55Hz, 55/65Hz, 47.5/52.5Hz automatic dual frequency
7. Maximum output current: 5A
8. Maximum output voltage: 400V
9. Requirement for measuring lines: Section area of copper core of current

line  $\geq 1.5\text{mm}^2$ , Section area of copper core of voltage line  $\geq 1.0\text{mm}^2$

10. Power supply: AC180~270V, 50/60Hz

11. Overall dimension: 370×285×285mm

12. Net Weight: 18kg

## IV. Operation and Functions

### 1. Measurement Principle Block Diagram and Wiring Diagram

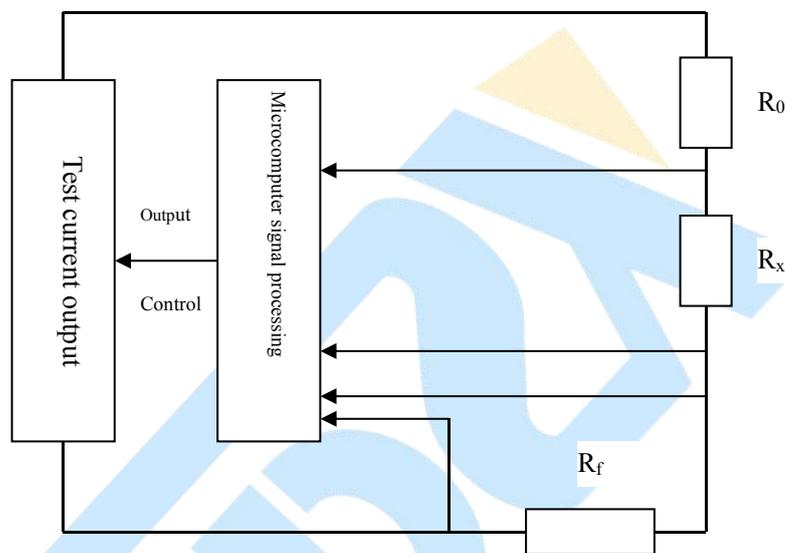


Diagram 1 Measurement Principle Block Diagram

$R_0$  loop resistance is about 5~200 $\Omega$

$R_x$  testing resistance is about 0~200 $\Omega$

$R_f$  standard resistance

Measuring current line D:

It is about 3 ~5 times as long as that of diagonal line of earthing grid;  
wire diameter  $\geq 1.5\text{mm}^2$

Measuring voltage line 1: Length is 0.618D; wire diameter:  $\geq 1.0\text{mm}^2$

Measuring voltage line 2: Connect with measured earthing grid

Measuring grounding line: Connect with measured earthing grid

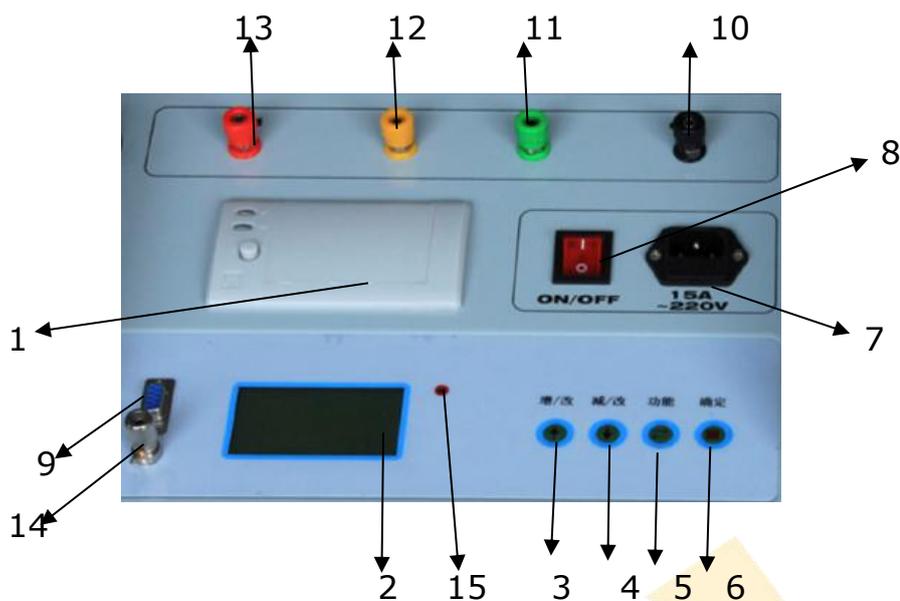


Diagram of panel

1. Printer—Print the measurement data
2. Displayer—128×64 dot matrix LCD displayer, display menu, all prompts and measurement results.
3. ▲ key—Modify the menu items in cycle and rolling mode.
4. ▼ —Modify the menu items in cycle and rolling mode.
5. ► key —Select menu item and the selected item will be displayed in reverse type.
6. OK key—Press this key on “test” option to enter in testing mode.
7. Power on/off—Switch on and off the power of instrument.
8. Power socket—AC 220V±10%, 50Hz power input with fuse
9. RS232 serial port
10. Earthing grid (C2)
11. Voltage electrode 2 (P2)
12. Voltage electrode 1 (P1)
13. Current electrode (C1)
14. Ground —Terminal of ground wire.

Wiring diagram for measurement is as below:

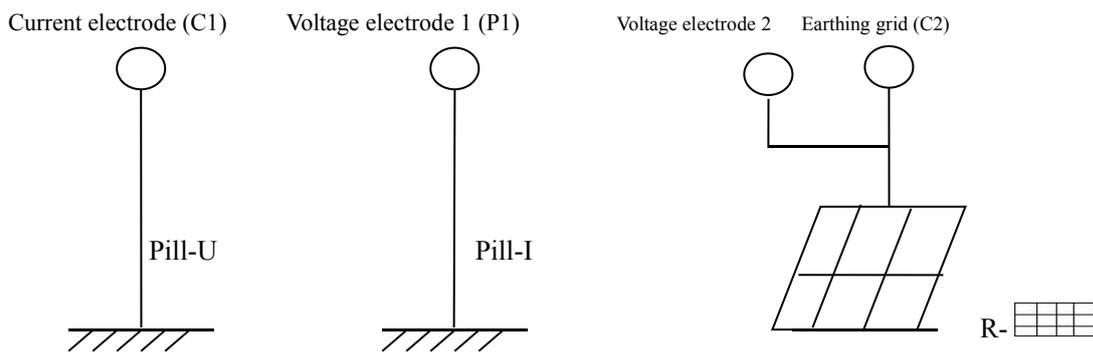


Diagram 2 Diagram for three-electrode measurement wiring

Note: Voltage electrode 2(P2) and earthing grid (C2) must be connected to the instrument before starting test by steps.

## 2. Testing Operation Procedures

- 1) Firstly, check if there is open circuit in current line, voltage line and earthing grid line used for test (testing with the multimeter), if the rust on ground stake is eliminated and the embedded depth is appropriate (>0.5m). Also check if the testing line and ground stake are conducted. If not, reconnect them after proper disposal.
- 2) The length proportion of current testing line to voltage testing line is 1: 0.618, the length of current testing line should be greater than that of diagonal line of earthing grid by 3 to 5 times.
- 3) Connect the current testing line and voltage testing line to the instrument at one terminal by specified length and then send out in parallel. Connect the other terminals to two ground stakes respectively. (as shown in Diagram 2)
- 4) Check the settled testing line once again; connect the multimeter with current line or voltage line by one terminal and with earthing grid line by the other terminal. If there is no resistance reading, and the circuit is open, start testing after confirming it is in good condition.

- 5) After the wiring is confirmed correct, connect AC220V/50HZ power supply to the instrument to power it on.
- 6) Press the measurement key to start measuring.
- 7) After the instrument indicates the completion of test, record the testing data.
- 8) Turn off the power of instrument, remove the wires and the test is finished.

### 3. Instrument Operation Instructions

- 1) Power on the instrument and the computer will start self-diagnosing. The LCD screen will display the menu as shown in diagram 3.
- 2) Press  key to move the cursor to each menu item and indicate in cycle. The selected item will be displayed in reverse type. The specific procedures are shown in Diagram 4.
- 3) On the current item pointed by cursor, press   key to change the current item and indicate in cycle. The specific procedures are shown in Diagram 5.
- 4) Modify the menu item to satisfy the testing requirement and then select the next item by pressing selection keys.

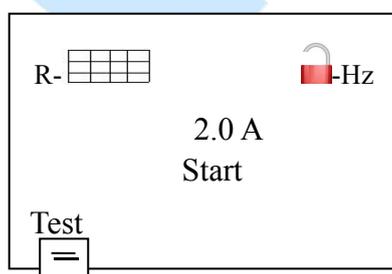


Diagram 3

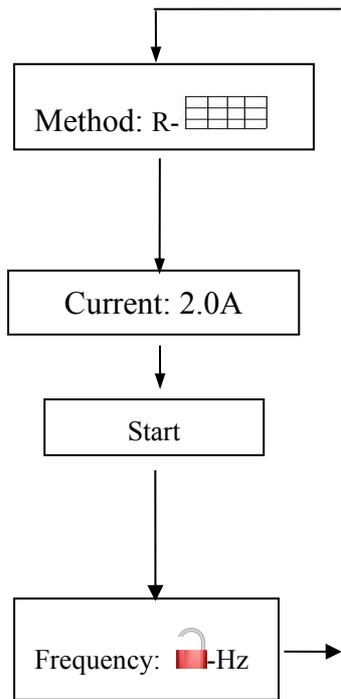


Diagram 4

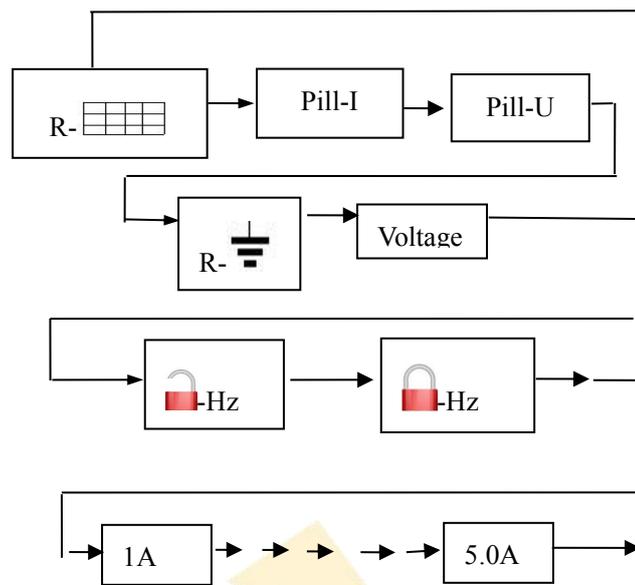


Diagram 5

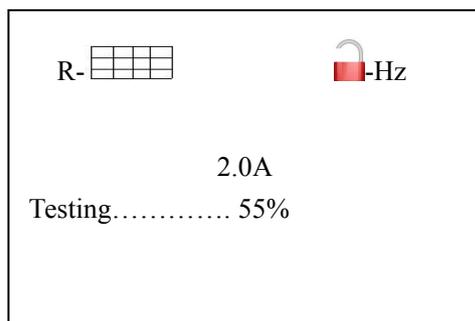


Diagram 6

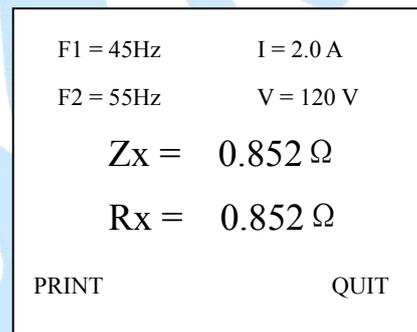


Diagram 7

- 5) Test: Turn on the high voltage switch. When the cursor is at test item, press OK key for about 5 seconds to start testing. It will display as shown in Diagram 6 (R- [grid] , [lock]-Hz) in testing process. When the following procedure proceeds to 100%, the test is completed and it will display the testing result as shown in Diagram 7. Here, the cursor will point at the printer icon; press OK key to print the report. The measuring result bears the following meanings:
- Zx: Measured earth grid impedance
  - Rx: Measured earth grid resistance
  - V: Applied voltage value (voltage on the Pill-I)

I: Current though the measured sample

F1,F2 : Test frequency

Turn off the power after printing and the test is completed.

- 6) **Check power supply, check Pill-I, check Pill-U, check R-**  appearing on the screen in testing process indicate that the instrument is in self-diagnosis, which may last for about 15 seconds. Here, you should be patient and just wait.

#### 4. Explanations for Testing Menu

**(1) Measuring method:** There are five measuring modes: "R-  ", "Pill-I", "Pill-U", "R-  " and "voltage". The purposes of the first three modes are respectively measuring the earthing grid impedance, Pill-I impedance, Pill-U impedance. Normally, "R-  " should be adopted in experiment to measure impedance of the earthing grid. However, if the user requires to measure Pill-I or Pill-U impedance, make direct measurement after selecting it. "R-  " is used for measuring grounding resistance and soil resistivity. The length of line is 20m by default, but its length can be modified. "Voltage" is to measure step voltage, touch voltage and other parameters. **(Note: "voltage" needs to be matched with corresponding electrode)**

**(2) Frequency selection:** There are two kinds of measuring frequencies: "-Hz" and "-Hz". When conducting an experiment on site, "-Hz" must be selected to eliminate the magnetic field interference on site. "-Hz" is only used when conducting an experiment in laboratory. "-Hz" refers to 45Hz and 55Hz dual frequency while "-Hz" must be 50Hz.

**(3) Current selection:** There are 5 kinds of measuring current: "1A", "2A",

“3A”, “4A” and “5A”. The test current should be determined according to the Pill-I impedance. Normally, 2A current is appropriate.

**(4) Automatic printing:** When the cursor is at current, press “OK” key and there will be a small sign of printer appearing or disappearing on the left bottom of screen, which means selecting or quitting automatic printing function. If automatic printing is selected, the instrument will print the result automatically after finishing the testing. If it is quitted, the result can be only printed manually when necessary.

**(5) Manual printing:** Upon completion of testing, the interface will appear as shown in Diagram 7. Press  $\rightarrow$  key to select between “print” and “quit”. If “print” is selected, press “OK” key to print the result. Otherwise, if “quit” is selected, press “OK” key to return to the initial interface as shown in Diagram 3.

## 5. Instruction for Instrument Self-diagnosing in Testing

1) When “Please Restart” appears, it may be internal power protection; shutdown and restart it.

2) When it shows “power module errors, please contact manufacturer”, move the cursor to “R- 


” and press “OK” key for ten times until the instrument beeps once and a sign of printer occurs in reverse type on left bottom of screen. Then, shutdown and restart it. If testing fails, please contact the manufacturer.

3) If the testing current is 0.0A, the possible reason may be that the “current line” is in poor contact with ground stake of “current electrode” or the ground stake is insufficient. It is necessary to add ground stake to decrease loop resistance. The embedded depth of ground stake should not be less than 0.5m, and the resistance of Pill-I should be less than 200 $\Omega$ .

4) If the instrument displays an extremely low measured value (<0.01 $\Omega$ ), the possible reason is that the voltage line is disconnected.

5) In testing process, concatenate an over 20  $\Omega$  resistance to the output end of C1 to stimulate the Pill-I resistance on site. Otherwise, it will possibly cause excessive errors existing in the measured data.

## V. Notes

1. To ensure a smooth test, check if the test lead is in good contact with the contact point of ground stake with a multimeter before test. After that, check if there is any open circuit in the well-placed wire.
2. The four-electrode method measurement will enable the instrument eliminate wiring errors automatically.
3. When the cursor is at current, press "OK" key for once and the sign of printer will appear or disappear on the left bottom of screen. It means that the automatic printing function is selected or quitted.
4. If this instrument has other faults, please contact the after-sale department of our company and do not open and check it by yourself.

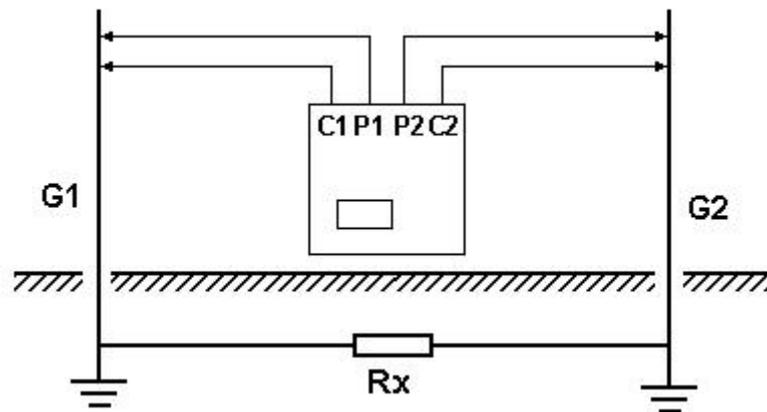
## VI. Wiring Diagram for Measurement

### 1. Ground conduction measurement

Connect C1/P1 to a grounding device, and connect C2/P2 (grounding terminal of measurement) to the other.

Note:

- (1) Do on coil the lead.
- (2) Take the voltage line away from the current line.
- (3) The grounding lines to be tested should be tightened by grounding clamp at two sides so as to prevent poor contact caused by paint and rust.
- (4) 2A is selected to avoid current protection. Select **R-**, -Hz ,**2A**.



## 2. Measurement of grounding impedance of R- | | | | | |--|--|--|--| | | | | | | | | | |

### 2.1 Angle method

Normally, testing for grounding impedance of large grounding device is conducted in angle wiring method of current and voltage lines. Normally, the distance between Pill-I C and the edge of measured grounding device ( $d_{CG}$ ) should be 4 to 5 times of the length of diagonal of earthing grid; length of  $d_{PG}$  is very close to that of  $d_{CG}$ . Formula of grounding impedance can be corrected as bellow.

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

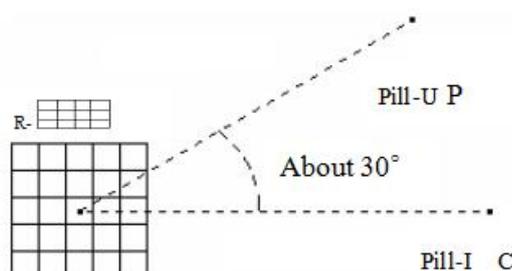
Where:  $\theta$ —included angle between current line and voltage line

$Z'$ —test value of grounding impedance

If the soil resistivity is in uniformity, conduct the wiring in an isosceles triangle with equal  $d_{PG}$  and  $d_{CG}$ .  $\theta$  is about  $30^\circ$ , the correction formula of grounding impedance  $d_{PG}=d_{CG}=2D$  remains unchanged.

**Interface selection: R-


, -Hz 1A**

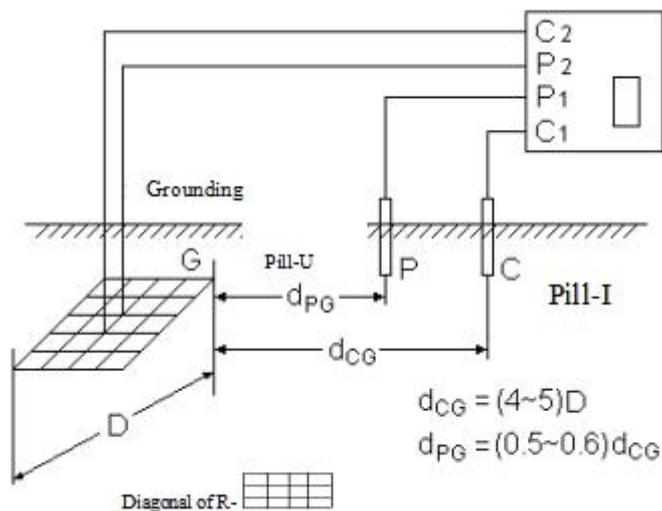


## 2.2 Straight line method

Current line and voltage line are in straight with measured grounding device. Normally, the distance between Pill-I C and the edge of measured grounding device ( $d_{CG}$ ) should be 4 to 5 times of the length of diagonal of earthing grid; distance between the Pill-U P and the edge of measured device  $d_{PG}$  should be  $(0.5 \sim 0.6) d_{CG}$ . When surveying, the distance between current line and voltage line should be kept as far as possible so as to reduce the influence of electromagnetic coupling on test result.

Minimize the resistance of Pill-I as much as possible, or water it to decrease the resistance if necessary. When making measurement with "Pill-I" or "Pill-U", the resistance of Pill-I should be less than  $80\Omega$ , and the resistance of Pill-U should be less than  $200\Omega$ .

**Interface selection: R-** , -Hz **1A**



## 3. Measure soil resistivity with four-electrode isometric method

Four ground stakes are arranged on a straight line and share the same distance a each other. The embedded depth of ground stake h should not be greater than one-twentieth of a. a can be 5, 10, 20, 30 or 40m etc (20m by

default). In case of larger measured ground, the interval should remain wider. The electric resistivity is calculated via resistance R:  $\rho = 2\pi aR$ .

**Interface selection:** R-  , -Hz 1A

## VII Complete set of instrument

1. Host	1
2. Power cord	1
3. ground stud	4
4. Ground wire	1
5. pressure-wire	2
6. electric streamline	2
7. Frequency selective surface voltage line	2
8. 5A fuse	2
9. Printing paper	1
10. Specification	1
11. Inspection report	1