

# Grounding Resistance Meter Manual

## 1. Generalization

This instrument is an intelligent multifunctional earth resistance tester, can perform the standard three-pole earth resistance measurement and calculation of soil resistivity.

● The design conforms to the following Safety Requirements:

DLT 845.2-2004 General specifications for measuring resistance equipments Part2: power frequency earth resistance testers

JJG 366—2004 Verification Regulation of Earth Resistance Meters

● Basic measurement function

Grounding voltage and DC voltage measurement, 3-pole method, 2-pole method grounding resistance measurement

● Resistance measurement over range display  $>1999 \Omega$  /  $>999 \Omega$

● Automatic voltage releasing function.

● White backlight function is easy to work in dark light.

● With backlight off and automatic power off function.

● Small, strong structure design, easy to work with both hands neck strap, simple man-machine operation, adapt to the site transportation and harsh environment.

## 2. Open-case Inspection

Check the product to see whether it is damaged in the shipment or not. Check the materials to see whether they are the same as shown in the packing list. Keep the packing materials for late delivery.

Standard and chosen accessories supplied are listed as follows. Chosen ones are bought at purchaser's options.

Standard accessories:

Test wire 1.6m (red, black) 2Pcs

Test wire 5m (green) 1Pc

Test wire 10m (yellow)1Pc ·

Test wire 15m (red)1Pc ·

Auxiliary grounding rod 2Pcs

Manual1Pc


Carrying Bag 1Pc


Hand rope 1Pc

Optional accessories (additional cost required)): Power adapter (DC12V)

### 3. Safety Information

The design, manufacture and test of the instrument reach the IEC61010-1, IEC61557-1 and IEC61557-5 Safety Requirements. This Manual contains all warnings and safety regulations that must be followed to ensure safe operation and retain the Instrument in safe condition. Read the following instructions before operation.

Mark  in the Instrument means the operator needs to refer to related parts in the Manual to ensure safe operation.

 **Danger is reserved for conditions and actions that are likely to cause serious or fatal injury.**

 **Warning is reserved for conditions and actions that are likely to cause serious or fatal injury.**

 **Caution is reserved for conditions and actions that can cause injury or instrument damage.**

 **Warning**


- Read carefully and make sure well understanding of the Manual before using this Instrument.
- Follow the instructions in the Manual whenever operating, keep the Manual in good condition for reference whenever necessary.

- Mis-operation may cause accidents and damages to the Instrument in measurement.
- Never attempt to make any measurement if appear any abnormal conditions, such as a broken cover or exposed metal parts are present on the Instrument and Test Leads.
- Replace Test Lead with new one in same specification and same electrical specification when it is broken.
- Do not replace batteries if the Instrument is wet.
- Ensure that the Test Leads are firmly inserted into the terminal of the meter.
- Ensure that the Instrument powers off when the battery cover is open.

**⚠ Danger**





- Never make measurement on a circuit in which electrical potentials exceeding AC/DC250V.
- Do not attempt to make measurement in the presence of flammable gasses. Otherwise, the use of the Instrument may cause sparking, which can lead to an explosion.
- Never attempt to use the Instrument if its surface or your hands are wet.
- Do not exceed the maximum range allowed.
- Do not press the PRESS TO TEST key when connecting the Test Leads.
- Never open the battery cover during a measurement.
- Cut off the power and remove any measuring parts connected to the Instrument before opening the battery cover.

**⚠ Caution**

- Set and ensure the Range Switch to the appropriate position before making measurement.
- After used and remove the Test Leads.
- Remove and store the batteries if the Instrument used for a long period.
- When the battery power is low, a " " symbol will appear on the screen, which means the battery needs to be replaced.

- Do not use or keep the Instrument in high-temperature, high-humidity, explosive, strong electromagnetic and dewy environment or expose to direct sunlight.
- Do not use abrasives or solvents. Use a damp cloth/ neutral detergent for cleaning the Instrument.
- Do not store the Instrument if it is wet. Store it after it dries.

## 4. Symbols

	Possible danger of electronic shock		Warning
	Ground		Dual insulation


## 5. Technical Specification

### 5. 1. Safety and Conformity

Overload Protection	Between E-V port voltage function: AC1000V/DC1500V 10 seconds
Legal Conformity	IEC61010-1(CAT III 600V,POLUTION degree II) IEC61557-1,5(electronic safety requirements for low voltage distribution system below AC 1000V and DC 1500V)
Electromagnetic Compatibility	conforms to IEC61326-1, Group 1, Class B
Surge Protection	6kV (as per IEC61010.1-2001)
Identification Mark	CE

Quality Standard	develops, designs, and manufactures according to ISO 9001
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## 5. 2. General Feature

Display Screen	digit: displays in 2000 digits, white backlight
Operation Temperature and Moisture Range	0~40 °C, relative moisture≤85%(no condensation)
Storage Temperature and Moisture Range	-20 °C~60 °C, relative moisture≤90%( no condensation)
Accuracy Required Temperature and Moisture Range	23±5°C, relative moisture≤75% (no condensation)
Ambient Condition for Operation	Indoor, outdoor operation(no waterproof),at an altitude of 0 ~ 2,000 meter
Indicator for Over-range	Voltage: OL; Ground resistance:>1999 Ω / >999 Ω
Battery Type	eight 1.5V Alkaline (LR6) batteries
Low Battery	displays low battery mark 
Automatic Power-off	The default value is 10 minutes if no operation, and adjustable.
Closed – case Calibration	no internal adjustments needed
Measurement	178(L)×110(W)×59(D)mm
Weight	about 600g

Calibration Period	One year
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### 5. 3. Measurement Range and Accuracy

Error limits are given as:  $\pm$  ( [ % of reading ]+[ number of least significant digits ]),warranty for one year.

(Note: ‘number of least significant digits’ means the digits increased or decreased in least significant digits)

Ambient temperature:  $23\pm 5^{\circ}\text{C}$  ; Ambient moisture: 45~75%RH

#### Ground voltage (E.V)

Measurement range	Resolution	Frequency range	Accuracy
0V~1000V	1V	45~1000Hz sine	$\pm(2\%+5)$
Input resistance: about 10M $\Omega$ ; Measurement rate: about 3 times/second; Maximum overload: AC1000Vrms			

#### DC voltage (1500V)

Measurement range	Resolution	Accuracy
0V~ $\pm 1500\text{V}$	1V	$\pm(1\%+5)$
Input resistance: about 10M $\Omega$ ; Measurement rate: about 3 times/second; Maximum overload :DC1500V		

#### Ground resistance RE

Range	Measurement range	Resolution	Accuracy
10 $\Omega$	0.10 $\Omega$ ~9.99 $\Omega$	0.01 $\Omega$	$\pm(2\%+10)$
100 $\Omega$	0.0 $\Omega$ ~99.9 $\Omega$	0.1 $\Omega$	$\pm(2.0\%+3)$
1000 $\Omega$	0 $\Omega$ ~999 $\Omega$	1 $\Omega$	

- Add  $0.2\Omega$  error when resistance is less than  $2\Omega$ .
- Use a probe to measure current and voltage according to IEC61557-5.
- Open circuit voltage  $U_m$ : Maximum about 50Vpp, rectangular wave.
- Short circuit current  $I_m$ : Maximum about 3.5 mA.
- Measurement time: < 2 seconds.
- Auxiliary grounding resistance  $500\Omega$  (error  $\pm 5\%$ ); Grounding voltage  $\leq 10V_{ac}$

The maximum operating error percentage within the measurement range shall not exceed  $\pm 30\%$  of the base value which is subject to the measured value, subject to the base value according to the determined measurement value below list.

Operating errors apply to the rated operating conditions specified in IEC61557-1 and below the following conditions:

- System frequency of 400Hz, 60Hz, 50Hz, 16 2/3Hz or using respectively the DC voltage crossed to inject series interference voltage through the terminals E(ES) and S. And the r.m.s (root mean square value ) of series interference voltage should be 3V;
- Resistance of auxiliary grounding electrode and probe:  $4k\Omega + 100 \times R_E \leq 50k\Omega$

Basic error/ Influence quantity	Reference condition /stipulation work scope	Symbol	Requirements/tests of the IEC61557 related parts	Test type
Basic error	Reference condition	A	Section 6.1 of Part 5	R
Supply voltage	Manufacturer's limit value	E2	Sections 4.2 and 4.3 of Part 1	R
Temperature	0°C and 35°C	E3	Section 4.2 of Part 1	T

Series interference voltage	See 4.2 and 4.3	E4	Sections 4.2 and 4.3 of Part 5	T
Resistance of auxiliary grounding electrode and probe	$4k\Omega + 100R_{E}$ but $\leq 50k\Omega$	E5	Section 4.3 of Part 5	T
Operation error	$B = \pm (   A   + 1.15 \sqrt{E_2^2 + E_3^2 + E_4^2 + E_5^2} )$		Section 4.3 of Part 5	R
A=Basic error En= Change quantity		R=Routine test T= Type test	$B = [\%] = B / Basevalue * 100\%$	

## 6. Instrument Layout

### 6. 1. Instrument Body

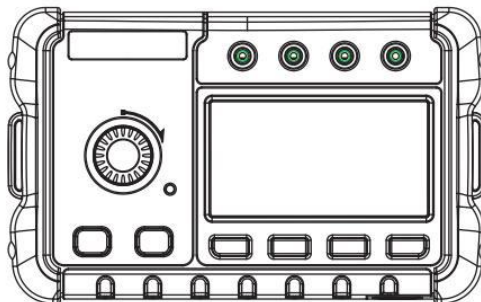


Figure 1



## 6. 2. Terminals



Figure 2

Terminal	Illustration	
V	voltage terminal	Red line
E	earth ground terminal(voltage terminal)	Green line
P	Potential pole	Yellow line
C	Current pole	Red line

### 6. 3. Display unit

Cautions and Warnings item are using all kinds of signs or information to show, the signs and information are described in detail here.

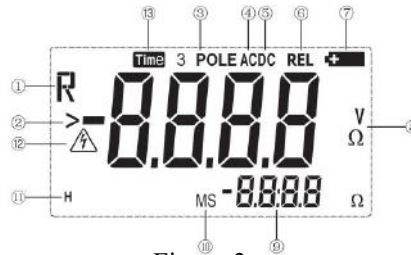









Figure 3

No.	Mark and information	Illustration
1.	R	Main display function: R
2.		<p>Main screen</p> 

3.	3 POLE	Ground resistance test method 3 POLE
4.	AC	Alternating current
5.	DC	Direct current
6.	REL	Relative value measurement
7.		Low battery mark
8.		Main display area unit: Voltage :V(volt) Resistance unit: Ω (ohm)
9.		Auxiliary screen
10.	MS	Time minute, second
11.	H	Data hold
12.		High voltage mark, displays when voltage is higher than 24V
13.		Timing measurement

## 6. 4. Press Key

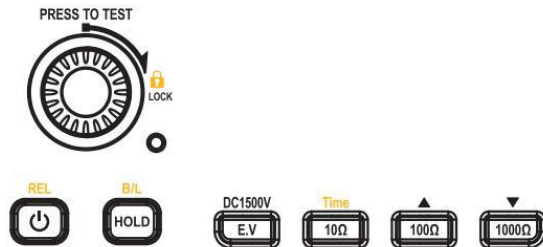








Figure 4

Press key	Illustration
	Press for more than 2 seconds to turn on/off the meter; and perform relative value measurement for less than 2 seconds.
	Press for more than 2 seconds to turn on/off the backlight, press for less than 2 seconds; and perform data hold for less than 2 seconds
	Press this key to select ground voltage or DC voltage measurement function
	Press this key to select 10 Ω ground resistance measurement function. In the resistance measurement function: press this key for more than 2 seconds to set the measurement time;
	Press this key to select 100 Ω ground resistance measurement function. In the measurement setting time; function: press this key to add the measurement time;
	Press this key to select 1000 Ω ground resistivity measurement function. In the measurement time function: press this key to reduce the measurement time;



Press this key to start measurement once, it will hold the current measurement data after 1 minute by default, it can cancel the hold state if you measure continuously. it will also hold the current measurement data if you turn off the measurement button before the time is up

## 6. 5. Use the power adapter

Open the soft rubber door on the side of the instrument, and insert the special power adapter of the instrument into the power socket (the instrument must be turned off when inserting or pulling out the special power adapter; It is best to remove the battery when using a special power adapter).

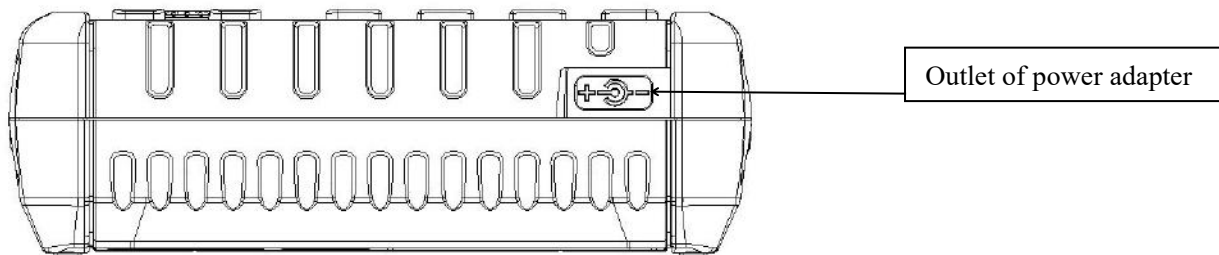




Figure 5

## 7. Preparation before Measurement

### 7. 1. Power-on

To turn on the Instrument, press  key for more than 2seconds to connect with the power.

To turn off the Instrument, press  key for more than 2seconds to cut the power.

When being powered-on, the Instrument starts inner-self diagnose and displays power-on mark firstly, and then undertakes relevant operations.


 Note

Power-on: to guarantee correct power-on operation, cut off the power for 2seconds before restarting.

## 7. 2. Automatic Power-off

The factory default sets that the Instrument will automatically power off if no operation is conducted within 10 minutes.

## 7. 3. Turning on the Data hold/Backlight

After powering on, short press  key to turn on the data hold, the instrument screen appears "H" character.

At the same time, the test data will latch, long press  key for more than 2seconds to turn on the backlight,

long press  key for more than 2seconds again to turn off the backlight.

## 7. 4. Automatically Turning off the Backlight





The default value is 30seconds; the Instrument will turn off the backlight if Users does not turn off the backlight within 30seconds.

## 7. 5. Relative value measurement

Short press REL key for relative value measurement, resistance range can only be used this function at

resistance measurement, apply to deduct the between two lines resistance value.


## 7. 6. Measuring time setting

At resistance 10  $\Omega$  /100  $\Omega$  /1000  $\Omega$  ranges, press  key for more than 2 seconds to enter the time setting and press  key to increase the time, press  key to decrease the time. The default value is 1 minute and the maximum value is 3 minutes. After the setting is completed, press  key for more than 2 seconds to exit the setting.


⚠ Note:

1. When measuring or data holding, time setting cannot be carried out.
2. After the power is turned off, the time returns to the default value.

## 7. 7. Low Battery Display

Mark  displayed in the Screen after powering on means low battery, please replace with new ones and then use.

⚠ **Warning**

To avoid electrical shock hazard or personnel injury due to wrong readings, replace the batteries as soon as possible if the Screen displays  mark; or charge the batteries if they are chargeable.

## 7. 8. Connection of ground test wire/auxiliary grounding rod

Insert fully the ground test wire into the corresponding instrument jack respectively. Poor connection or contact may cause error of test value. If measuring at disconnected wire state, the instruments display erre indication. Before installing the auxiliary grounding rod, ensure that the auxiliary grounding rod is outside the potential gradient range of the grounding electrode and the auxiliary grounding electrode. This condition is usually satisfied by leaving a distance of 5-10m between the ground electrode and the auxiliary ground rod,

and between the auxiliary ground rods.

## 7.9. Grounding resistance test requirements:

- a. AC working grounding, grounding resistance should not be greater than  $4\ \Omega$  ;
- b. Safe working ground, grounding resistance should not be greater than  $4\ \Omega$  ;
- c. Dc working grounding, grounding resistance should be determined according to the specific requirements of the computer system;
- d. The grounding resistance of the lightning protection ground should not be greater than  $10\ \Omega$  .
- e. If the shielding system is grounded jointly, the grounding resistance should not be greater than  $1\ \Omega$

## 8. Starting Measurement

Ground resistance measurement (connection picture as shown in Figure 6)

Precision test (3 pole method)

### **⚠ Danger**

When testing ground resistance, do not apply voltage between test terminals!

This method is a general grounding resistance test method. The test result of grounding resistance does not include the auxiliary grounding resistance, including the resistance of the test wire for port E.

Grounding resistance ports applied: ports E, P, and C.

Voltage ports applied: V, E port.

The test wire corresponding to ports E, P, and C.


Auxiliary ground rods: 2pc, respectively connected to ports P and C.

(1) Display 3 POLE at the top of the screen;



## (2) Ground voltage test



Please press the  button to select the ground voltage measurement, the ground object uses the red wire to connect with V port, the auxiliary steel chisel uses the green wire to connect with E port (do not plug the test wire for the other test terminals, and then connect the tested point, the LCD will display the measured value of the ground voltage (Note: it is not necessary to press TEST key to measure the ground voltage), please confirm that the ground voltage  $\leq 10V$ , if the voltage is greater than 10V, it may cause wrong result, at this moment, power off device applied to the tested grounding object to decrease the grounding voltage and then test the grounding resistance again.

## (3) Grounding entry and wiring of auxiliary grounding rod

Starting from the ground object to be measured, line up the auxiliary ground rod for port P and the auxiliary ground rod for port C in a straight line and drive them deep into the earth. Starting from ports E, P and C of the instrument, connect the test wire (green)(yellow)(red) in the order of the ground object to be measured, auxiliary ground rod P and auxiliary ground rod C.

## (4) Ground resistance test

Press  $10\ \Omega / 100\ \Omega / 1000\ \Omega$  to select ground resistance range measuring and press Test.key The screen displays "- - -" during the test. After the test is complete, the screen displays the ground resistance RE value. Note: In order to avoid the influence of inter-wire resistance on the measurement results, please short-circuit the E/P\C three wire before measurement, to measure the resistance of the wire, and press REL button for relative value measurement, so as to eliminate the influence of inter-wire resistance on the measurement results.

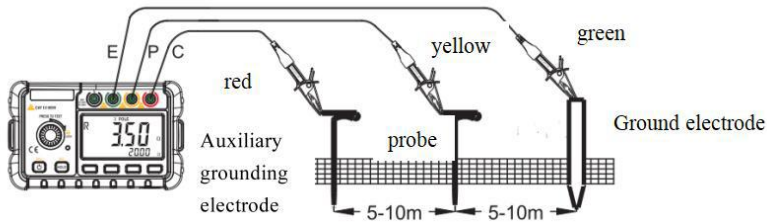


Figure 6

Simple measurement-2-pole method (measuring with the supplied simple test line) (see Figure 7):

This method can perform when the auxiliary grounding nail is not convenient to use, Make an electrode using an exposed object with low grounding resistance, such as metal sink, water pipe, power supply line public ground, building grounding terminal, all can use the 2-wire type method (E and P&C terminal).

Wiring as shown in Figure 7:

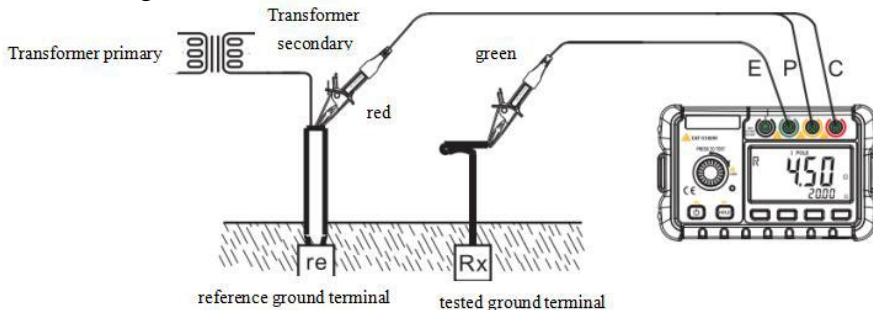


Figure 7

### **⚠ Note**

- If the auxiliary grounding resistance is too large, the display value may cause error. Please be careful when driving auxiliary grounding rod P and C into a place with much moisture, and make sure that all connecting parts are fully contacted.
- If you have to test in a place with dry or many small stones, and sand, please sprinkle water on the ground entry part of the auxiliary ground rod to keep it fully wet.
- When testing on concrete, lay the auxiliary grounding rod flat and soak it in water or place it on the auxiliary grounding rod with wet cloth or other for testing.

### **⚠ Danger**

If a ⚠ warning appears, do not perform measuring. A voltage more than 20V is applied to the port of the instrument.

## **9. Instrument maintenance**

This section provides some basic maintenance steps. Repair, calibration and maintenance of instruments not included in the manual should be carried out by experienced personnel. For maintenance procedures not covered in this manual, please contact our authorized service center.

### **9.1. General maintenance**

- Clean regularly the outer shell of the instrument with a damp cloth and mild cleaner, do not use abrasive and solvent.
- Please take out the battery when it is not used for a long time.
- Dirt or moisture on the wiring port can affect the reading.

### **9.2. Follow the below steps to clean the port:**

- (1). Power off the instrument and remove all test wires.
- (2) Clean the dirt on the wiring port.

(3).Clean each wiring ports with a new cotton swab soaked alcohol.

### **9. 3. Replace the battery**

This instrument uses eight LR6 (AA) alkaline batteries.

#### **⚠ Warning**

To avoid electric shock or personal injury:

- Remove the test wire from the instrument before open the battery cover.
- Tighten the screws on the battery cover before using the instrument.

#### **⚠ Note**

- Old and new batteries cannot be mixed.
- Pay attention to the battery direction during installation. And it should install in accordance with the polarity direction marked in the battery box.
- Please take out the battery when it is not used for a long time.
- Dispose of waste batteries in accordance with local regulations.

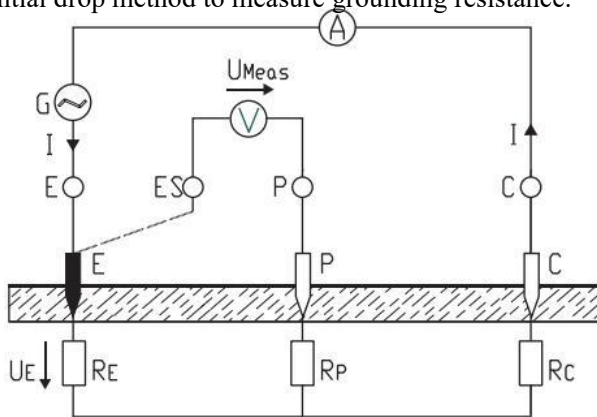
#### **Follow below steps to replace the battery:**

- (1). Turn off the instrument and disconnect the test wire.
- (2) Remove the battery cover by a straight screw driver to turn the screw cover 1/4 circle counter clockwise on the battery cover.
- (3) Replace the battery and install the battery cover. Turn the screw 1/4 circle clockwise on the battery cover to tighten the battery cover.

## 10. Appendix

### 10. 1. Principle of testing ground resistance

The instrument uses potential drop method to measure grounding resistance.



A alternator  $G$  feeds current  $I$  through the ground electrode  $E$ (ground resistance  $R_E$ ) and the auxiliary ground electrode  $R_C$  (auxiliary ground resistance  $R_C$ )

The voltage  $U_E$  is detected and measured by the probe  $P$  through the ground resistance  $R_E$ . Connect socket  $E$  with socket  $ES$  of instrument each other by using what is called a three-wire circuit.

In a four-wire circuit, connect the socket  $ES$  with the ground electrode by use another cable .by this way, the voltage drop of the cable between socket  $E$  and the grounding electrode is not measured. Due to the high impedance of the voltage measuring circuit, the influence of the probe resistance  $R_P$  is negligible within a

certain limit.

Thus the ground resistance can be calculated:

$$R_E = \frac{U_{Meas}}{I}$$

And it has nothing to do with the auxiliary grounding electrode resistance  $R_C$ . The generator operates at a frequency between 70 and 140Hz.

It must keep no less than 5Hz interval with 16 2/3, 50 or 60Hz and a specified frequency between their harmonics.

- The present operation instruction is subject to change without notice.
- The content of the operation instruction is regarded as correct. Whenever any user finds its mistakes, omission, etc, he or she is requested to contact the manufacturer.
- The present manufacturer is not liable for any accident and hazard arising from the customer misuse or inadvertent operation.
- The functions described in this operation instruction should not be used as grounds to apply this product to a particular purpose.