

Operating Instructions For Earth Resistance Tester

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1. PRECAUTIONS & SAFE MEASUREMENT

This instrument is in compliance with EN61557-1, EN61557-5 & EN61010-1 standards.

 **Warning:** for the safety of your own and this instrument, before using, please carefully read the operating instructions, especially the items marked with "

Please carefully read the following before using:

-  Do not use this instrument in humid environment;
-  Do not use this instrument at the places with gas or flammables and explosives;
-  Do not connect this instrument to other electric circuit when it is powered on or operating;
-  Do not let this instrument contact exposed metal, unused port or circuit;
-  Do not use this instrument any longer in case of any problem with this instrument (such as damage, deformation, leakage, incomplete display, etc.)
-  Be twice as careful in case measured voltage is higher than 25V (such as construction site, swimming pool, etc.) or higher than 50V (normal circumstances) to avoid electric shock.

The following will be shown in operating instructions:

 **Warning:** any operation in breach of operating instructions will cause damage to this instrument, subassemblies or personal injury.



Function Switching Knob

1.1. BEFORE USING INSTRUMENT

- ☞ This instrument is applicable to the environment of which the pollution level reaches II. It is also applicable to 250V electric system reaching CAT III standards.
- ☞ Safety standards are necessary to:
 - Ensure your own safety and avoid any danger due to unstable current.
 - Avoid any damage to this instrument due to improper operation.
- ☞ The accessories provided together with this instrument are also in compliance with related safety standards. Please take care of them and replace with new ones in case necessary.
- ☞ This instrument is applicable to TT, TN, IT and electric system for industrial, civil or medical use (with 25V contact voltage) or special environment (with 50V contact voltage).
- ☞ Do not use this instrument in electric system with current and voltage exceeding specified limits.
- ☞ Do not use this instrument in circumstances other than specified in section 9.2.
- ☞ Make sure batteries are correctly installed.
- ☞ Make sure function switching knob is in position before connecting crocodile clamp to test circuit.
- ☞ Make sure function shown on display is the same as pointed by function switching knob.

1.2. USING INSTRUMENT

Please carefully read the following:

 **Warning:** any operation in breach of operating instructions will cause damage to this instrument, subassemblies or personal injury.

-  It is necessary to disconnect crocodile clamp and test circuit before rotating function switching knob.
-  Once this instrument is connected to electric circuit, please do not let it contact any unused port.
-  In case of external voltage, stop measurement; despite protection function of this instrument, it will go out of order due to too high voltage.

 **Warning:** stop measurement and replace batteries in case of low battery, i.e. battery icon changes from  to  (refer to section 8.2), when this instrument will save data and switch to internal power supply.

1.3. AFTER USING INSTRUMENT

-  Turn "OFF" function switching knob after use.

In case this instrument will not be used in short term, please take batteries out.

2. PREFACE

You will get precise measurement as long as you use this instrument according to operating instructions.

This instrument can be used to measure the following:

- ☞ **EARTH 2 WIRES:** Earth 2 wires to measure resistance
- ☞ **EARTH 3 WIRES:** Earth 3 wires to measure resistance
- ☞ **ρ :** Earth 4 wires to measure soil resistance coefficient

2.1. BUTTONS

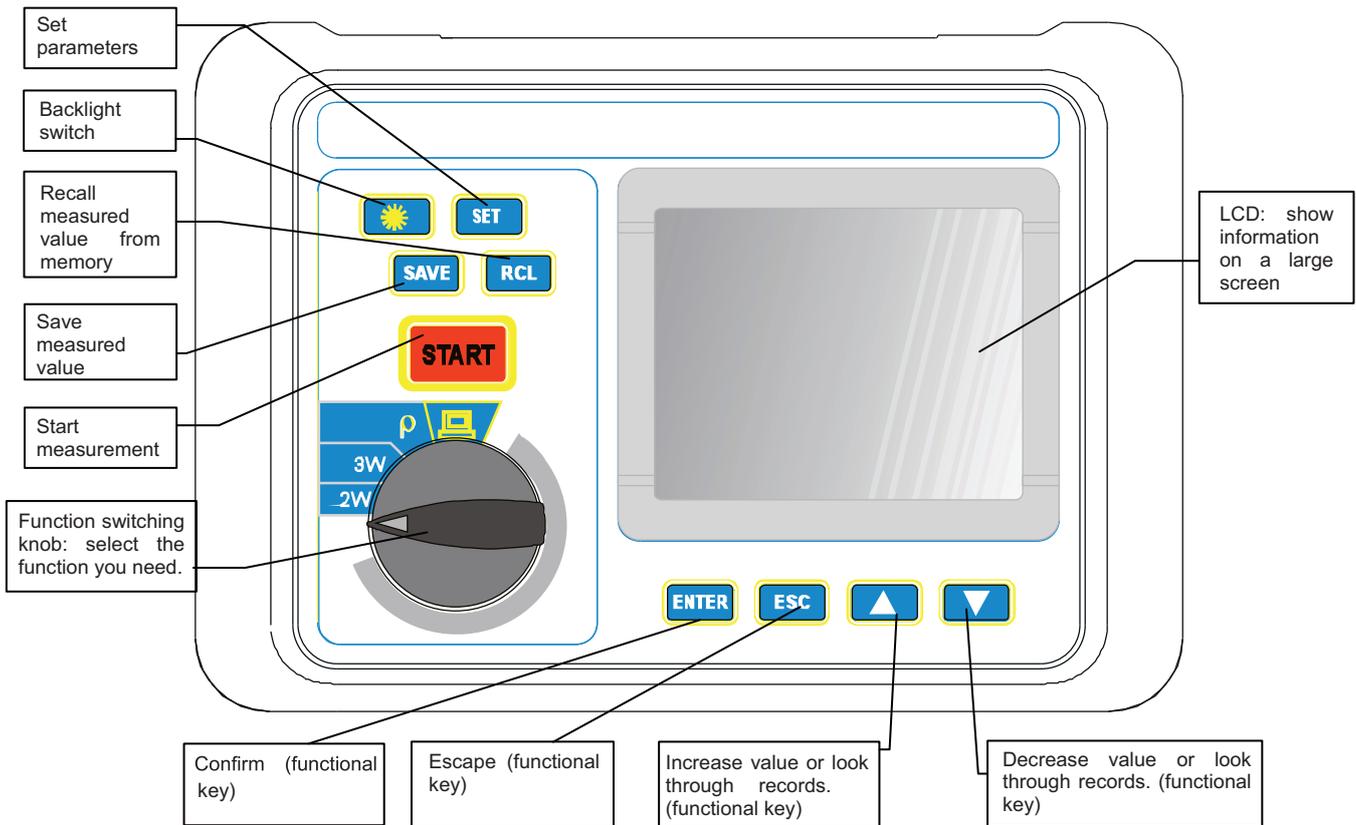


Figure 1. Front View

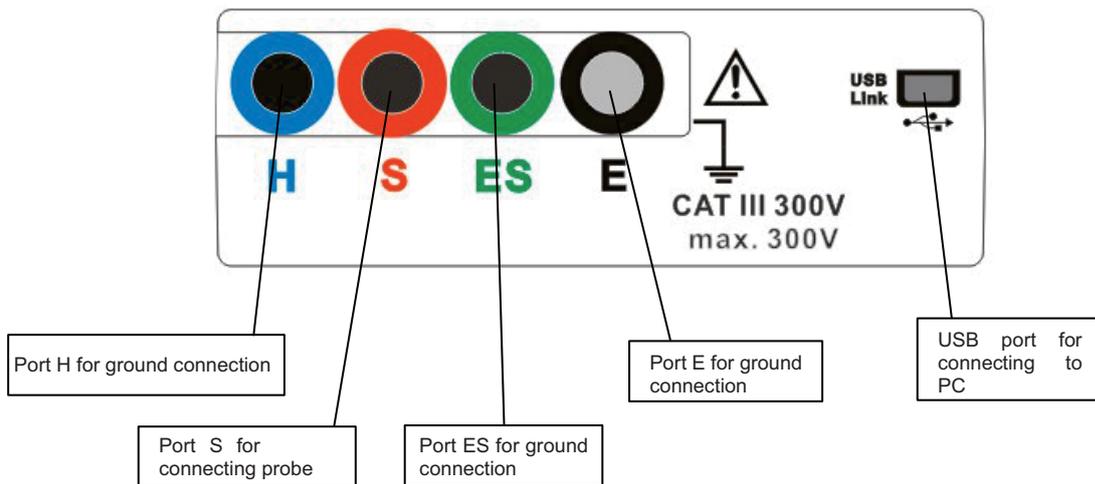


Figure 2. Side View

3. PREPARATIONS

3.1. INITIAL TEST

This instrument has passed related tests concerning electric system and mechanical system before delivery.

Protective measures have been taken to avoid damage during transportation.

However, it is necessary to check this instrument upon receipt to make sure it is not broken.

In case of any problem, please immediately contact local carrier.

In addition, please check all parts or subassemblies according to section 9.3.1. In case of any discrepancy, please contact distributor for help.

Please return this instrument to supplier according to section 10 if necessary.

3.2. POWER SUPPLY

This instrument needs 8 pcs 1.5V R14SG SIZE C batteries for power supply. For details, please refer to section 9.1.

Regarding battery installation, please refer to section 8.2.

In case of low battery, i.e. battery icon changes from  to , please replace with new batteries according to section 8.2.

3.3. CALIBRATION

This instrument is in compliance with standards mentioned in operating instruments. It is provided with one-year warranty period since purchasing.

3.4. STORAGE

Once this instrument has been kept in severe environment for a certain period of time, please wait it to resume normal condition before using (Regarding environmental requirements, please refer to section 9.2.1).

4. FUNCTION SWITCHING

4.1. EARTHING 2 WIRES FOR RESISTANCE MEASUREMENT

Due to certain circumstances (e.g. in an ancient town with high historical value), it is not suitable to dig metal rod into earth for resistance measurement. However, as long as "TT" earthing system is used, it is OK to earth 2 wires for resistance measurement. With this method, a relatively precise value can be got.

An auxiliary earth rod is required for such measurement, which should 1) have low resistance; 2) is not connected to any earthing device to be measured.

As shown in Figure 3, the water pipe is used as auxiliary earth rod. In fact, any metal dug into earth and according with above requirements can be used as auxiliary earth rod.

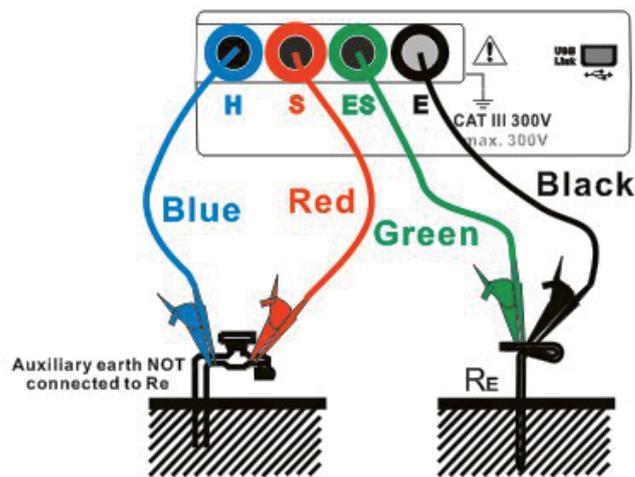
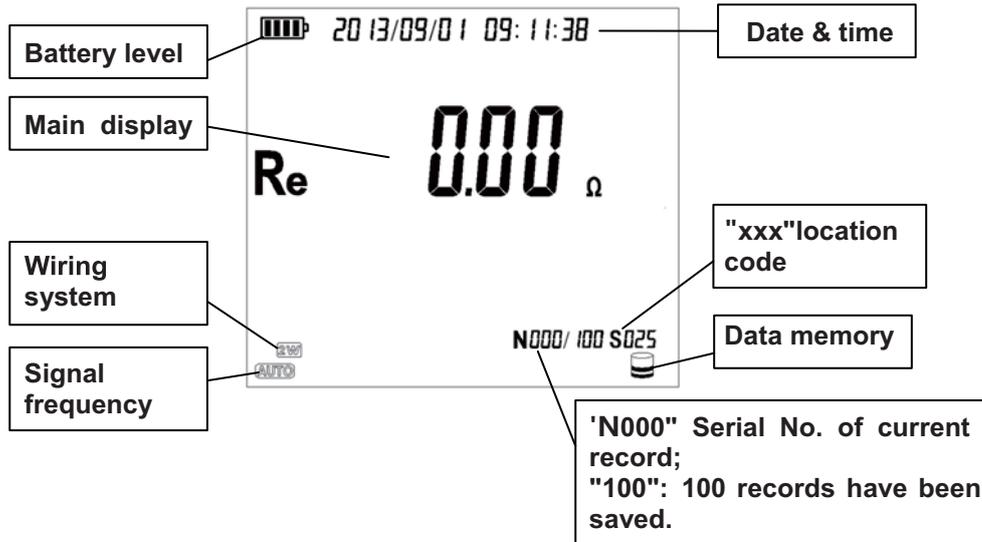


Figure 3. Earthing 2 Wires for Resistance Measurement

Measurement Procedures:

1. Connect the plugs (in black, red, blue and green) of 4 test wires to input port (E, S, H & ES) of this instrument.
2. Connect 4 crocodile clamps according to Figure 3.
3. Turn functional switching knob to "Earth 2 Wires".

The screen will show the following:



START Press "START" to start measuring and reading measured value. After measurement, the screen will show the following:

Warning: "Measuring...." shown on screen indicates this instrument is working, when it is not allowed to contact crocodile clamp (to avoid electric shock).

Note: this measuring method is the same as using voltmeter, which will not be affected by resistance of wires, therefore, there is no need to adjust this instrument due to wires or extensions.

SAVE Press "SAVE" so that measured value will be saved (please refer to section 5).

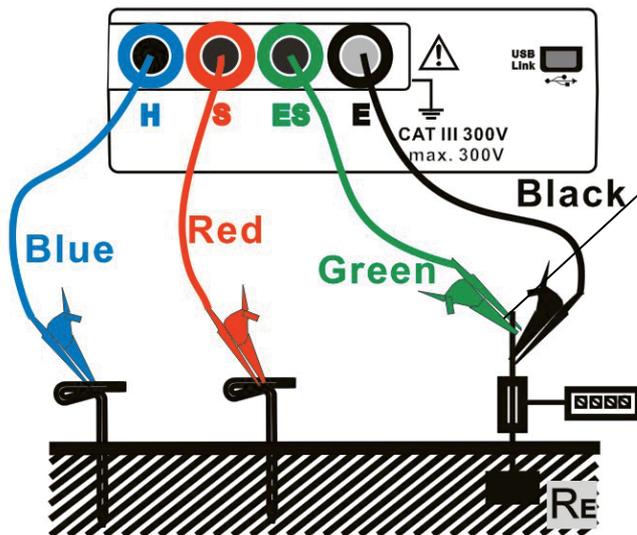
▼ ▲ Press to view other parameters:

- ☞ Series-wound interference voltage "Ust"
- ☞ Series-wound interference frequency "Fst"
- ☞ Auxiliary earth resistance "Rh"
- ☞ Auxiliary earth resistance "Rs"

ENTER Press "ENTER" to set location code (please refer to section 6.3).

4.2. EARTHING 3 WIRES FOR RESISTANCE MEASUREMENT

This measuring method is in compliance with CEI 64.8, IEC781, VDE0413 & EN61557-5 safety standards.



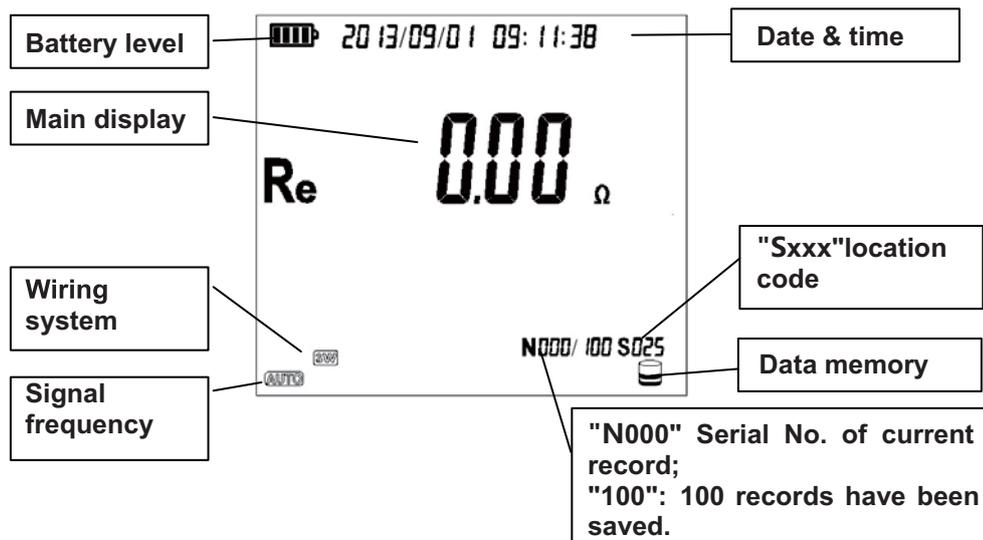
Small-sized power system: current probe should be placed beside earthing device, and the distance between current probe and earthing device should be 5 times the length of diagonal of earthing device (please refer to section 11.1 and Figure 8).

Large-sized power system: current probe should be placed beside earthing device, and the distance between current probe and earthing device should be the length of diagonal of earthing device (please refer to section 11.1 and Figure 8).

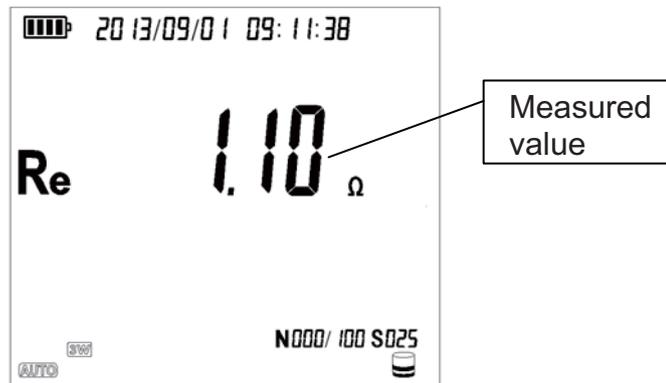
Figure 4. Earthing 3 Wires for Resistance Measurement

Measurement Procedures:

1. Connect the plugs (in black, red, blue and green) of 4 test wires to input port (E, S, H & ES) of this instrument.
2. Connect 4 crocodile clamps according to Figure 4.
3. Rotate function switching knob to "EARTH 3 WIRES" and the screen will show the following:



START Press "START" to start measuring and reading measured value. After measurement, the screen will show the following:



Warning: "Measuring..." shown on screen indicates this instrument is working, when it is not allowed to contact crocodile clamp (to avoid electric shock).

Note: this measuring method is the same as using voltmeter, which will not be affected by resistance of wires, therefore, there is no need to adjust this instrument due to wires or extensions.

SAVE Press "SAVE" so that measured value will be saved (please refer to section 5).

▼ ▲ Press to view other parameters:

- ☞ Series-wound interference voltage "Ust"
- ☞ Series-wound interference frequency "Fst"
- ☞ Auxiliary earth resistance "Rh"
- ☞ Auxiliary earth resistance "Rs"

ENTER Press "ENTER" to set location code (please refer to section 6.3).

4.3. " ρ " : SOIL RESISTANCE COEFFICIENT

This measuring method is in compliance with CEI 64.8, IEC781, VDE0413 & EN61557-5 safety standards.

How to measure soil resistance coefficient:

Calculate potential difference V between potential electrode $S(P)$ and auxiliary earth electrode ES based on alternating current I between earth electrode E and current electrode $H(C)$.

V divided by I results in earth resistance $R_g(\Omega)$. When the gap between electrode is a (m), $\rho = 2 \cdot \pi \cdot a \cdot R_g (\Omega m)$

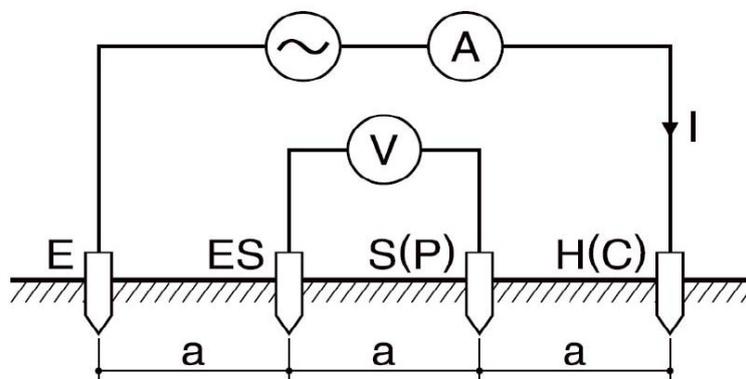


Figure 5. Method of Calculating Soil Resistance Coefficient (ρ)

Measurement Procedures:

- ☞ 1. Dig 4 earth rods, and the distance between two adjacent rods should be equal to "a" i.e. 1~30 meters. The depth of earthing depends on value "a" In order to get the minimum resistance coefficient, it is necessary to measure for several times, and the distance should be changed accordingly. Please make sure earth rod can actually reach such depth.
- ☞ 2. Connect the plugs (in black, red, blue and green) of 4 test wires to input port (E, S, H & ES) of this instrument.
- ☞ 3. Connect 4 crocodile clamps according to Figure 6.

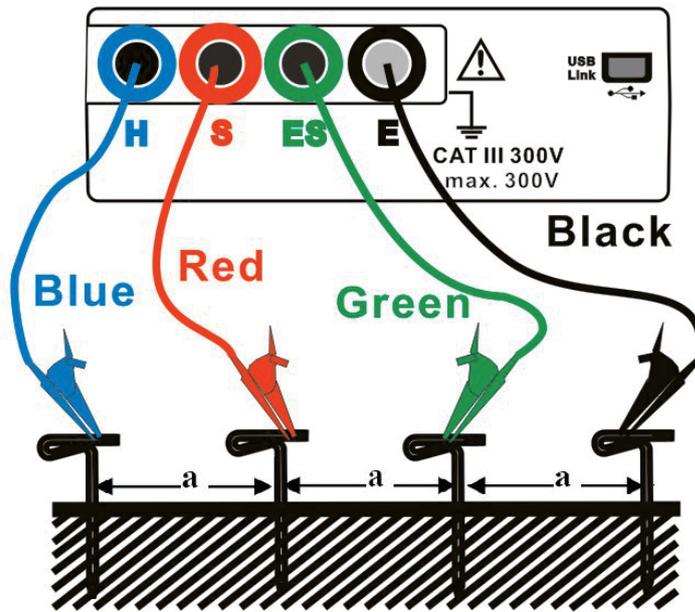


Figure 6. Earthing 4 Wires for Measuring Soil Resistance Coefficient



4. Turn functional switching knob to " ρ " The screen will show the following:

START

Press :START" to start measuring and reading measured value. After measurement, the screen will show the following:

Soil resistance coefficient is indispensable for calculating resistance of earth rod (please refer to section 11.2).

 **Warning: "Measuring..." shown on screen indicates this instrument is working, when it is not allowed to contact crocodile clamp (to avoid electric shock).**

 **Warning: do not disconnect crocodile clamps during measurement.**

SAVE

Press "SAVE" so that measured value will be saved (please refer to section 5).



Press to view other parameters:

-  Series-wound interference voltage "Ust"
-  Series-wound interference frequency "Fst"
-  Auxiliary earth resistance "Rh"
-  Auxiliary earth resistance "Rs"

ENTER

Press "ENTER" to set distance between two adjacent earth rods (please refer to section 6.4).

4.4. ABNORMAL CIRCUMSTANCES DURING MEASUREMENT

☞ Low battery voltage

In case battery icon changed from  to , "LOW BATT" will blink on screen after pressing **START**. In this case, it is suggested to replace with new batteries before operation. (Please refer to section 8.2)

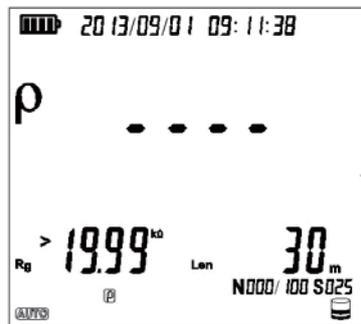


☞ Beyond measuring range

In case actual resistance is out of measuring range of this instrument, the screen will show one of the following after pressing **START**.



Earth resistance beyond measuring range



Earth resistance R_g beyond measuring range during soil resistance coefficient measurement



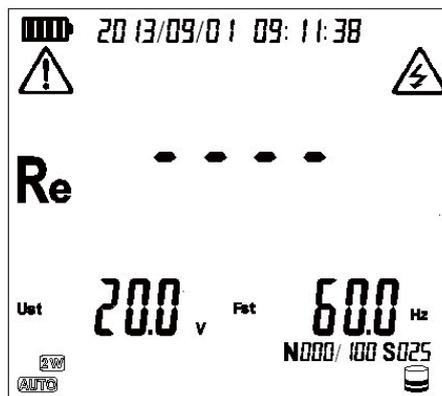
Soil resistance coefficient beyond measuring range during soil resistance coefficient measurement

☞ Auxiliary resistance beyond specified limits

In case auxiliary resistance R_h and (or) R_s exceed specified limits, or in case wires are disconnected during measurement, the screen will give prompt after pressing **START**. Meanwhile, the precision of measured value will be affected. Please check if wires are correctly connected. In case earth rods are dug into stony or low-conductivity soil, it is OK to water around earth rods. For specified limits of auxiliary resistance, please refer to section 9.1.

☞ Interference voltage beyond specified limits

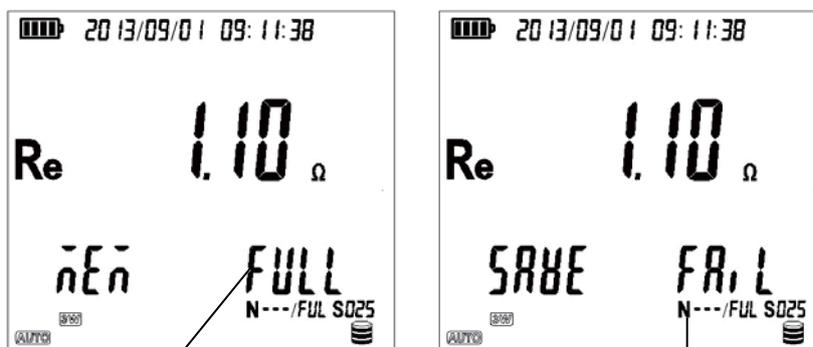
After pressing **START**, in case the interference voltage higher than 15V is detected, this instrument will stop measuring and the following will appear on screen. In this case, please check site condition!



Warning: this instrument is not applicable to test voltage of commercial power supply.

Full memory

In case memory space is full, the following will appear on screen after pressing. In this case, it is necessary to clear out certain space to save new data.



"MEM FULL"
"SAVE FAIL"
Blinks
alternately.

Memory space is
full.

Warning: please export important data as backup before clearing out memory space.

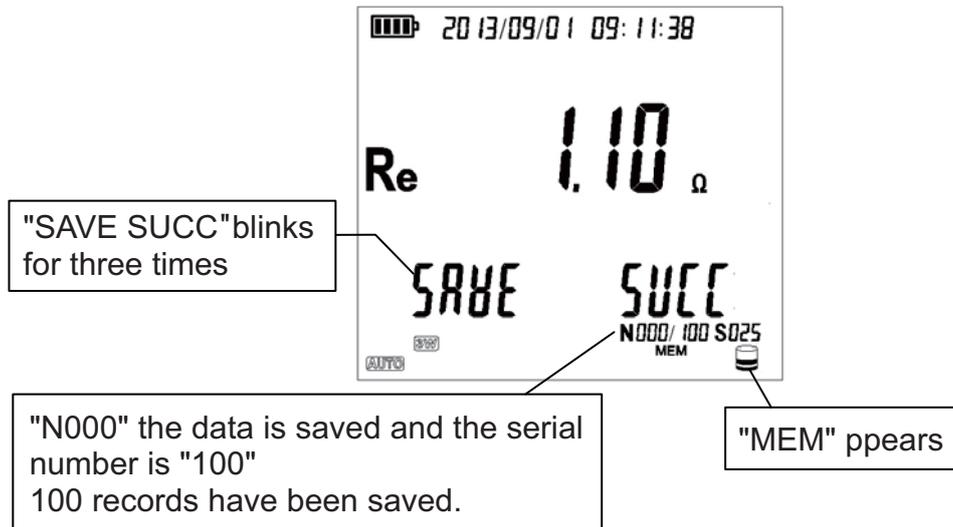
5. HOW TO SAVE, EXPORT AND CLEAR DATA

5.1. SAVE DATA: PRESS "SAVE"

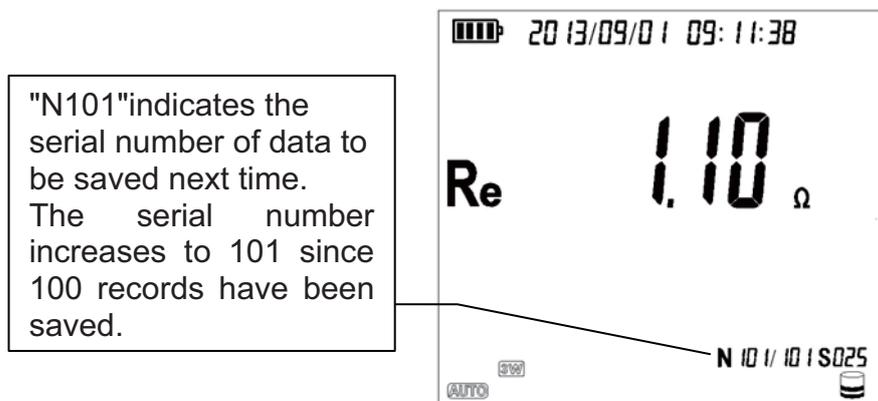
In order to save measured values:

SAVE

Press "SAVE" after measuring and the screen will show the following:



Once data is saved, the screen will show the following:



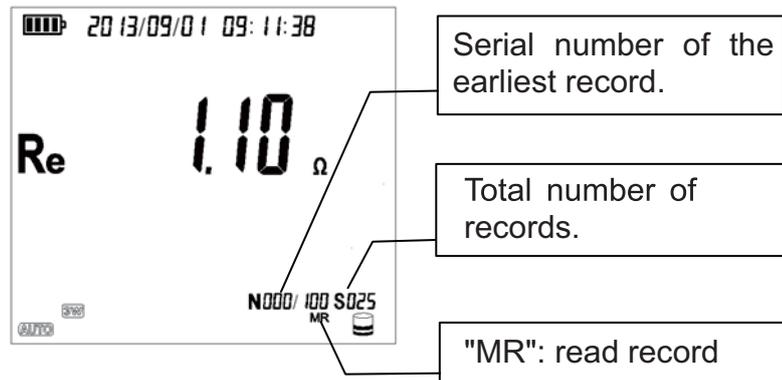
Note: the serial number of records starts from 000 to 999.

5.2. EXPORT DATA: PRESS "RCL"

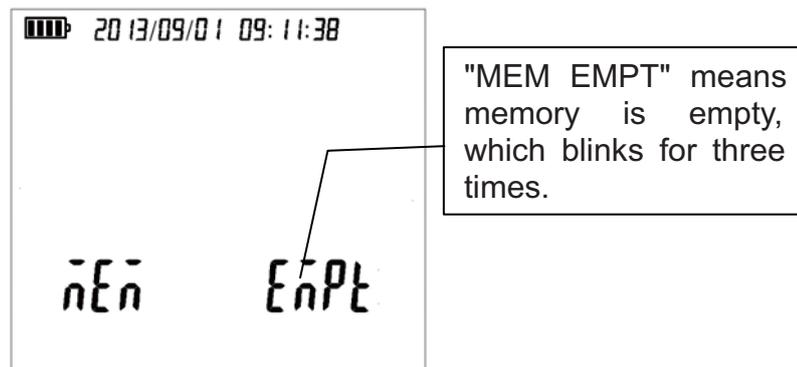
In order to view measured values:

1.  Press "RCL"

In case any record has been saved, the location of the earliest record will be shown on screen.



In case no record has been saved, the screen will show the following.



Press "▲, ▼" to find out the serial number of record that you want to view:



Press "RCL" to view other parameters.

-  Series-wound interference voltage "Ust"
-  Series-wound interference frequency "Fst"
-  Auxiliary earth resistance "Rh"
-  Auxiliary earth resistance "Rs"



Press "ENTER" to clear (current or all) records in memory (please refer to section 5.3).



Press "ESC" to switch to measurement interface.

5.3. CLEAR DATA

In order to clear measured values:

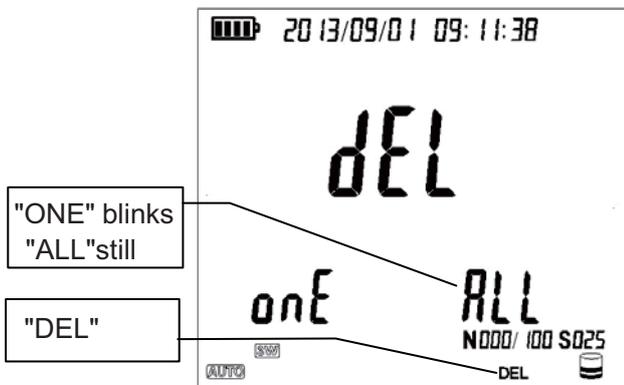
In data reading interface:



1. **ENTER** Press "ENTER" and the screen will show the following:

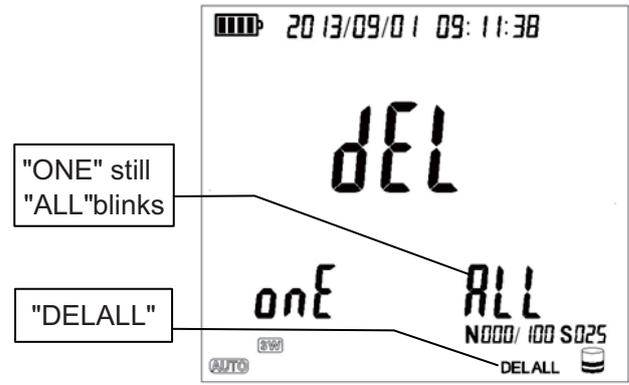
☞ Clear current record:

- ▼** **▲** Press "▲", "▼" to switch to right interface.
- ESC** Press "ESC" to go back to data reading interface.



☞ Clear all records:

- ▼** **▲** Press "▲", "▼" to switch to left interface.
- ESC** Press "ESC" to go back to data reading interface.

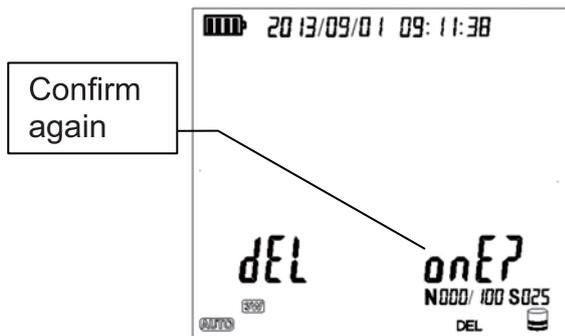


2. **ENTER** Press "ENTER" and the screen will show the following:

☞ Confirm to clear current record:

ENTER Press "ENTER" to confirm.

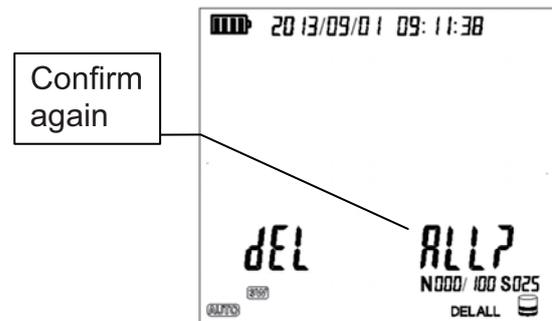
ESC Press "ESC" to go back to data reading interface.



☞ Confirm to clear all records:

ENTER Press "ENTER" to confirm.

ESC Press "ESC" to go back to data reading interface.



- ☞ After clearing current record, in case there is other records in memory, the system will go back to step 1 and ask whether to clear the following record; in case there is no other record in memory, "MEM EMPT" will appear on screen, in this case, press "ESC" to go back to measurement interface.
- ☞ After clearing all records, "MEM EMPT" will appear on screen, in this case, press "ESC" to go back to measurement interface.

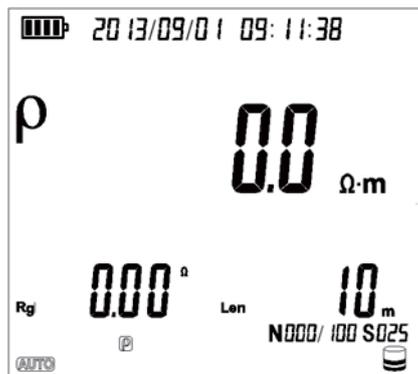
6. PARAMETER SETTINGS

This section tells how to set date, time and parameters.

- ☞ Set measuring frequency
- ☞ Set measuring position
- ☞ Set distance between two adjacent earth rods (" ρ " is valid during soil resistance coefficient measurement)
- ☞ Set date
- ☞ Set time

6.1. BASIC SETTINGS

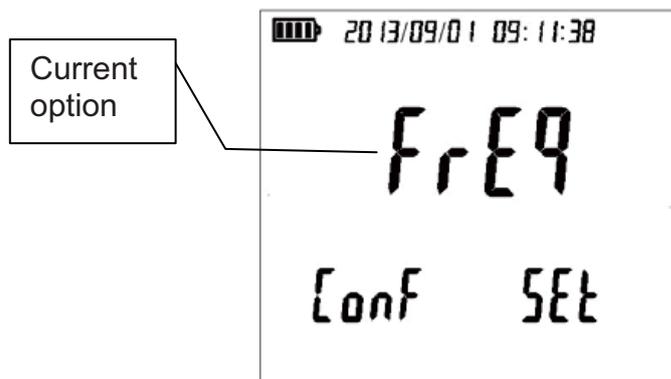
In measurement interface (for measuring soil resistance coefficient), the screen



shows the following:

1. **SET**

Press "SET" to select parameter (frequency is selected in below figure).



2. **SET**

Press "SET" again to cycle among the following options.

- ☞ FREQ: set measuring frequency
- ☞ SITE: set measuring position
- ☞ LEN: set distance between two adjacent earth rods.
- ☞ DATE: set date
- ☞ TIME: set time

ENTER

Press "ENTER" to confirm.

ESC

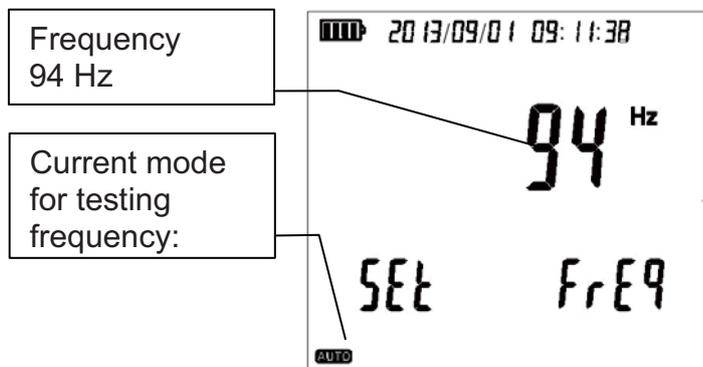
Press "ESC" to go back to measurement interface.

6.2. SET MEASURING FREQUENCY

As per section 6.1, the screen shows the following:



1. **ENTER** Press "ENTER" to start setting measuring frequency, and the screen will show the following:



2. **▼** **▲** Press "▲", "▼" to switch among below options.
Options:

- ☞ AUTO (Correct frequency automatically)
- ☞ 94 Hz
- ☞ 105 Hz
- ☞ 111 Hz
- ☞ 128 Hz

Note: in order to minimize series-wound interference voltage and strengthen resistance against interference, it is necessary to switch among different frequencies during measurement.

ENTER

Press "ENTER" to save current frequency and go back to parameter selecting interface as mentioned in section 6.1.

ESC

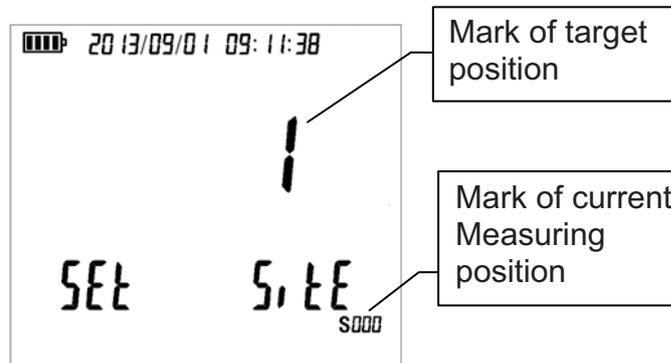
Press "ESC" to give up current selection, and previous measuring frequency will be maintained. Meanwhile, go back to parameter selecting interface as mentioned in section 6.1.

6.3. SET MEASURING POSITION

As per section 6.1, the screen shows the following:



1. **ENTER** Press "ENTER" to start setting measuring position, and the screen will show the following:



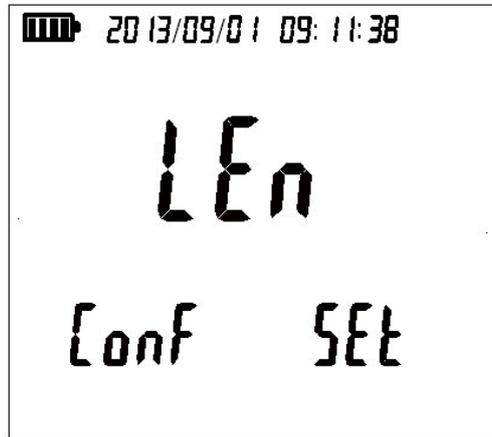
2. **▼** **▲** Press "▲, ▼" to adjust mark of target measuring position, which starts from '000 to 999.

ENTER Press "ENTER" to save target measuring position and go back to parameter selecting interface as mentioned in section 6.1.

ESC Press "ESC" to give up current selection and previous measuring position will be maintained; go back to parameter selecting interface as mentioned in section 6.1.

6.4. SET DISTANCE BETWEEN TWO ADJACENT EARTH RODS ("ρ" IS VALID DURING SOIL RESISTANCE COEFFICIENT MEASUREMENT)

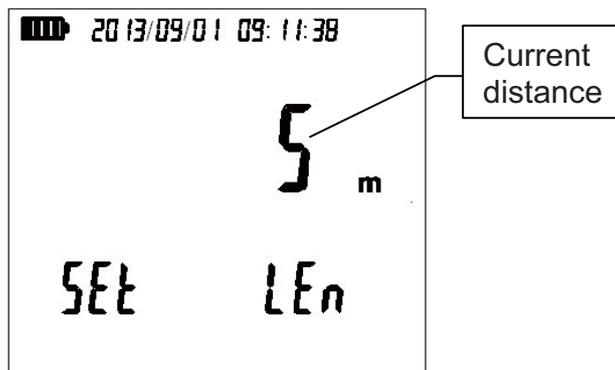
As per section 6.1, the screen shows the following:



1.

ENTER

Press "ENTER" to start setting distance between two adjacent earth rod, and the screen will show the following:



2.



Press "▲, ▼" to adjust distance, which should be within 1~30 meters.

ENTER

Press "ENTER" to save such distance and go back to parameter selecting interface as mentioned in section 6.1.

ESC

Press "ESC" to give up current selection and previous distance will be maintained; go back to parameter selecting interface as mentioned in section 6.1.

6.5. SET DATE

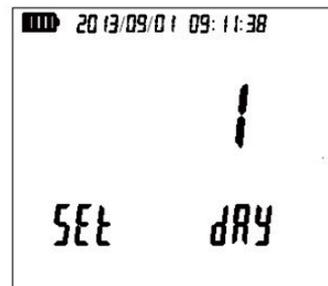
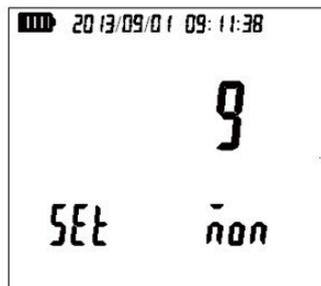
As per section 6.1, the screen shows the following:



1. **ENTER** Press "ENTER" to start setting date, and the screen will show the following:



2. **SET** Press "SET" again to cycle among year, month and date shown in following figures, which will not be saved in such status.



3.



Press "▲, ▼" to adjust value.



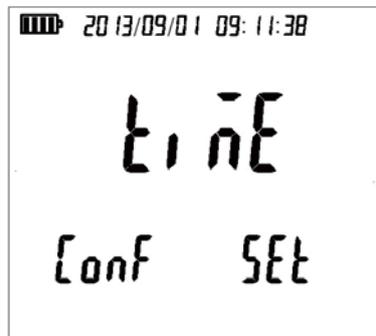
Press "ENTER" to save such value and switch to set another value. For example, after setting "year" press "ENTER" to save and then switch to set "month".



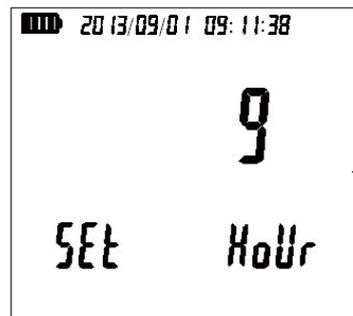
Press "ESC" to go back to parameter selecting interface as mentioned in section 6.1.

6.6. SET TIME

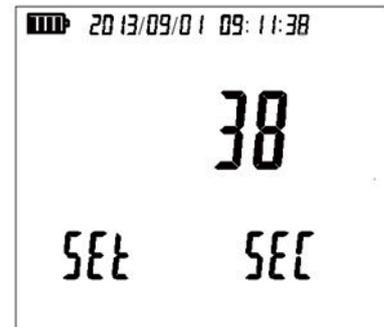
As per section 6.1, the screen shows the following:



1. **ENTER** Press "ENTER " to start setting time, and the screen will show the following:



2. **SET** Press "SET " again to cycle among hour, minute and second shown in following figures, which will not be saved in such status.



- 3.



Press "▲, ▼ " to adjust value.



Press "ENTER" to save such value and switch to set another value. For example, after setting "hour" press "ENTER" to save and then switch to set "minute".



Press "ESC" to go back to parameter selecting interface as mentioned in section 6.1.

7. CONNECTING TO PC

This instrument can be connected to PC via USB cable.

Before connecting, please select input/output and Baud rate of PC. In order to set these parameters, please install application software and refer to online help in advance.

Warning: the port for connecting this instrument shall not be used by other device (such as mouse, modem, etc.)

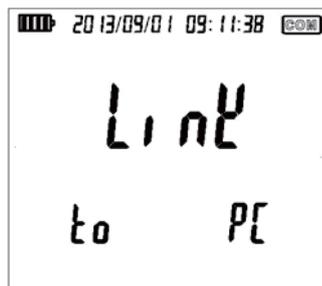
Upload saved data to PC according to below procedures.



Turn function switching knob to .

The screen will show the following:

Please refer to user manual of application software for future operation.



Attention! The transmission speed should be 9600 baud (please refer to user manual of application software). Please connect this instrument to PC according to Figure 7.

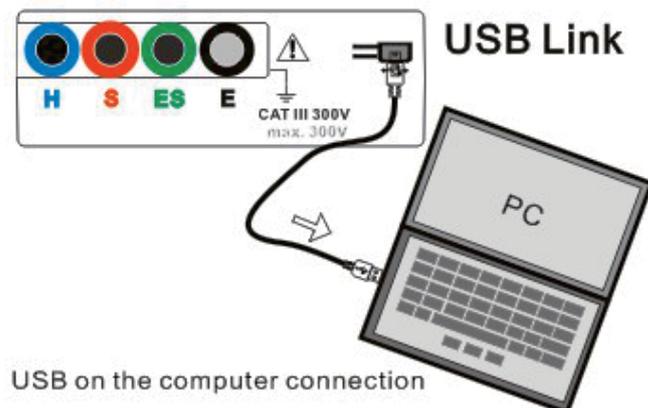


Figure 7. Connecting to PC

Attention! Once  is selected, this instrument will shut down 5 minute after the last instruction sent from PC.

8. MAINTENANCE

8.1. OVERVIEW

This earth resistance tester is a high-precision instrument. Please keep and use it according to operating instructions to avoid any damage or danger.

Do not use this instrument at the places with high temperature or high humidity.

Do not expose this instrument to intense sunlight.

Please turn off this instrument after use (turn function switching knob to "OFF"). In case this instrument will not be used in short term, please take batteries out.

8.2. REPLACE BATTERIES

When battery icon changes from  to , please replace batteries immediately.



Warning: no person other than qualified technicians is allowed to

Replace batteries.

Before replacing batteries, it is required to disconnect crocodile clamp and test circuit to avoid electric shock.

1. Disconnect wires and ports.
2. Turn function switching knob to "OFF"
3. Loosen screws on battery cover and remove it.
4. Replace with 8 pcs batteries (1.5V-R14G-SIZE C).
5. Replace battery cover and tighten screws.

8.3. CLEANING

This instrument should be wiped with clean, dry and soft cloth instead of wet cloth, solvent or water.

9. TECHNICAL SPECIFICATIONS

9.1. TECHNICAL PARAMETERS

Resistance Measurement

Measuring Range (**)	Tolerance	Precision (*)
0.01 ~ 19.99 Ω	0.01 Ω	$\pm(2\% + 3)$
20.0 ~ 199.9 Ω	0.1 Ω	
200 ~ 999 Ω 1	Ω	
1.000 ~ 1.999 K Ω	0.001K Ω	
2.00 ~ 19.99 K Ω	0.01K Ω	

(*) If $R_H > 100R_E$ and/or $R_S > 100R_E$, then $R_H > 50k\Omega$ and/or $R_H > 50k\Omega$. The precision of this instrument should be $\pm(10\% \text{ reading})$

R_S = resistance of voltage circuit

R_H = resistance of current circuit

R_e = earth resistance

R_g = earth resistance (during soil resistance coefficient measurement)

(**) measuring range selected automatically.

Measuring frequency	94Hz / 105Hz/ 111Hz/ 128Hz / AFC ± 1 Hz
Measuring current	≤ 20 mA
Measuring voltage of open-circuit terminal	≤ 48 Vrms
Voltage waveform	Sine wave
Interference voltage	

This instrument will reach above-mentioned precision in case interference voltage is ≤ 5 V; the precision will decrease in case interference voltage is between 5V~15V; this instrument will not measure in case interference voltage is higher than 15V.

Measure Resistance Coefficient " ρ "

Measuring Range (**)	Tolerance	Precision (*)
0.06 ~99.99 Ω m	0.01 Ω m	$\pm(2\% + 3)$
100.0 ~ 999.9 Ω m	0.1 Ω m	
1.000 ~ 9.999 k Ω m	0.001 k Ω m	
10.00 ~ 99.99 k Ω m	0.01 k Ω m	
100.0 ~ 999.9 k Ω m	0.1 k Ω m	
1000 ~ 1999 k Ω m	1 k Ω m	

(*) If $R_P > 100R_E$ and/or $R_C > 100R_E$, then $R_P > 50k\Omega$ and/or $R_C > 50k\Omega$. The precision of this instrument should be $\pm(10\% \text{ reading})$

R_S = resistance of voltage circuit

R_H = resistance of current circuit
 R_e = earth resistance
 R_g = earth resistance (during soil resistance coefficient measurement)
 $\rho = 2 * \pi * D * R_e$ = method of calculating resistance coefficient

(**) measuring range selected automatically.

Measuring frequency	94Hz / 105Hz/ 111Hz/ 128Hz / AFC ± 1 Hz
Measuring current	≤ 20 mA
Measuring voltage of open-circuit terminal	≤ 48 Vrms
Voltage waveform	Sine wave
Interference voltage	

This instrument will reach above-mentioned precision in case interference voltage is ≤ 5 V; the precision will decrease in case interference voltage is between 5V~15V; this instrument will not measure in case interference voltage is higher than 15V.

Resistance of Auxiliary Earth Rod: Within Below Range

Value Range of R_h & R_s

Value Range of R_h & R_s		Precision
$R_e < 1.00\Omega$	2k Ω	$\pm 5\%$ rdg. $\pm 1\%$ fs5
$1.00\Omega \leq R_e < 2.00\Omega$	3.5k Ω	
$2.00\Omega \leq R_e$	= $R_e \times 100 + 5$ k Ω ($R_h, R_s < 100$ k Ω)	

Measure Interference Voltage

Items	Measuring Range	Tolerance	Precision
Interference Voltage (U_{st})	50.0 V	0.1v	$\pm(2\% + 2)$
Frequency of Interference Voltage (F_{st})	16Hz ~500 Hz	0.1Hz	$\pm(1\% + 0.5$ Hz)



Warning: this instrument is not applicable to test voltage of commercial power supply.

9.1.1 Safety Standards

This instrument is in compliance with EN61010, EN61557-1 & EN61557-5 safety standards.

Insulation Level	II, double-insulated
Pollution Level	2
Maximum Altitude	2,000m
Overvoltage Level	CAT III 250V (firewire VS earth wire)

9.1.2 Basic Features

General Features

Dimensions	270 (length) x 190 (width) x 80 (height) mm
Weight (including batteries)	Approximate 1,700g

Power Supply:

Batteries:	8 pcs batteries (1.5 V - R14G - SIZE C)
Low battery:	The battery power is running out when  appears.
Battery life:	Measuring for 1,000 times
Fuse	F100 mA
Auto power-off	This instrument will shut down 5 minutes after the last instruction sent from PC or function selection.

Display:

Features:	102mm * 86mm standard LCD display
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Storage capacity:	999 measured values at maximum
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Connecting port:	USB data cable for connecting to PC (data segregation has been preset)
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9.2. OPERATING ENVIRONMENT

9.2.1. Environmental Requirements

Standard temperature:	23° ± 5°C
Rated temperature:	-10°C~50°C
Relative humidity:	<80%
Storage temperature:	-20°C~60°C
Storage humidity:	<70%

9.2.2. EMC

This instrument is in compliance with EMC standards and has passed the following tests:

Irradiated emissions:	EN55011
Immunity:	EN50140, EN 61000
Electrostatic discharges:	EN61000-4-2
R.F. range:	EN50140
Fast transient:	EN61000-4-4

This instrument is in compliance with 73/23/EEC low voltage directives and 89/336/EEC EMC directives, and has been adjusted according to 93/68/EEC directives.

9.3. ACCESSORIES

9.3.1. Standard and Optional Accessories

Standard Accessories*
- 4 pcs earth rods
- 4 pcs crocodile clamps and wires
Black: 6mm
Red: 15mm
Blue: 30mm
Green: 6mm
User manual
Canvas bag

Optional Accessories
PC software and USB data cable

* Provided together with this instrument

10. AFTER-SALE SERVICE

This instrument sold by authorized distributors is provided with warranty service. We will replace damaged parts for free in case of any problem with production or quality instead of man-made reasons. No one other than the manufacturer is allowed to repair this instrument and replace parts.

In case this instrument does not work as usual, please check if all wires and power supply are well connected, and then check operating procedures according to operating instructions before contacting after-sale service.

In case it is necessary to return this instrument to after-sale service centre or agency, the user shall bear transportation cost and package this instrument on his/her own. The user need provide damage report and account for sending instrument back. It is suggested to use original package when sending instrument back, and the user shall be responsible for any damage due to improper package. The manufacturer will not be liable for any damage due to man-made or external reasons.

We do not offer warranty services in any of the following circumstances.

- This instrument has been repaired, replaced with parts or non-conforming batteries by unauthorized serviceman.
- This instrument breaks down due to improper operation or connected to incompatible devices.
- This instrument is damaged due to improper packaging when sending back.
- This instrument breaks down due to improper repair by unauthorized serviceman.
- This instrument is refitted and has extra/missing units without the authorization of the manufacturer.
- This instrument breaks down due to breach of operating instructions.
-

It is not allowed to modify or copy any information provided herein without the authorization of the manufacturer.

We own patents and registered trademark for all products, of which specifications and technical parameters shall be subject to change without prior notice.

11. ACTUAL MEASUREMENT

11.1. EARTH RESISTANCE MEASUREMENT

Purpose

It is to confirm whether protective device is compatible with that of ground resistance, which cannot be set at random.

Required Device

Earthing device and operating environment. It is required to earth wires during measurement.

Acceptable Value

The resistance value should be calculated according to this formula:

$$R_e < 50 / I_a$$

R_e = Earth resistance, which should be calculated after below tests.

- Measure by earthing 3 wires
- Loop impedance (refer to *)
- Measure by earthing 2 wires (refer to **)
- Measure by earthing 2 wires on socket (refer to **)
- Calculate earth resistance based on earth voltage (refer to **)
- Calculate earth resistance based on operation time of RCDs (A,AC),RCD S (A,AC) (refer to **)

I_a = Action current marked on RCD ($I_a=2 I_{aN}$ in case of optional RCD)

50 = Limited safe voltage (decreased to 25V in special circumstances)

(*) = In case of RCD, it is suggested to measure upstream or downstream circuit. Bypass is suggested to avoid interference.

(**) = Though this method is not adopted by CEI64.8 standards, after comparing with measured values by earthing 3 wires, this method can be used for reference.

Measure Earth Resistance

It is necessary to test RCD with 30mA action current. Please calculate earth resistance with any method mentioned above. In order to check whether the value reaches safety standards, multiply resistance value by 0.03A (30mA), in case the result is no more than 50V (25V in special circumstances), such RCD is qualified.

In case RCD with 30mA action current (mainly for civil use) is used, the maximum of acceptable resistance should be $50/0.03=1666\Omega$. This method can be used to get an approximation (instead of precise value) to check whether the RCD is compatible with earth resistance.

Measure Resistance with Voltmeter-Ammeter

Small-Sized Earth Screen

Set a voltage circuit between earth rod and voltage probe, and current probe should be 5d away from earthing device ($5d=5 \times$ diagonal of earthing device, please refer to Figure 8). Place voltage probe between earth rod and current probe, and measure voltage in between.

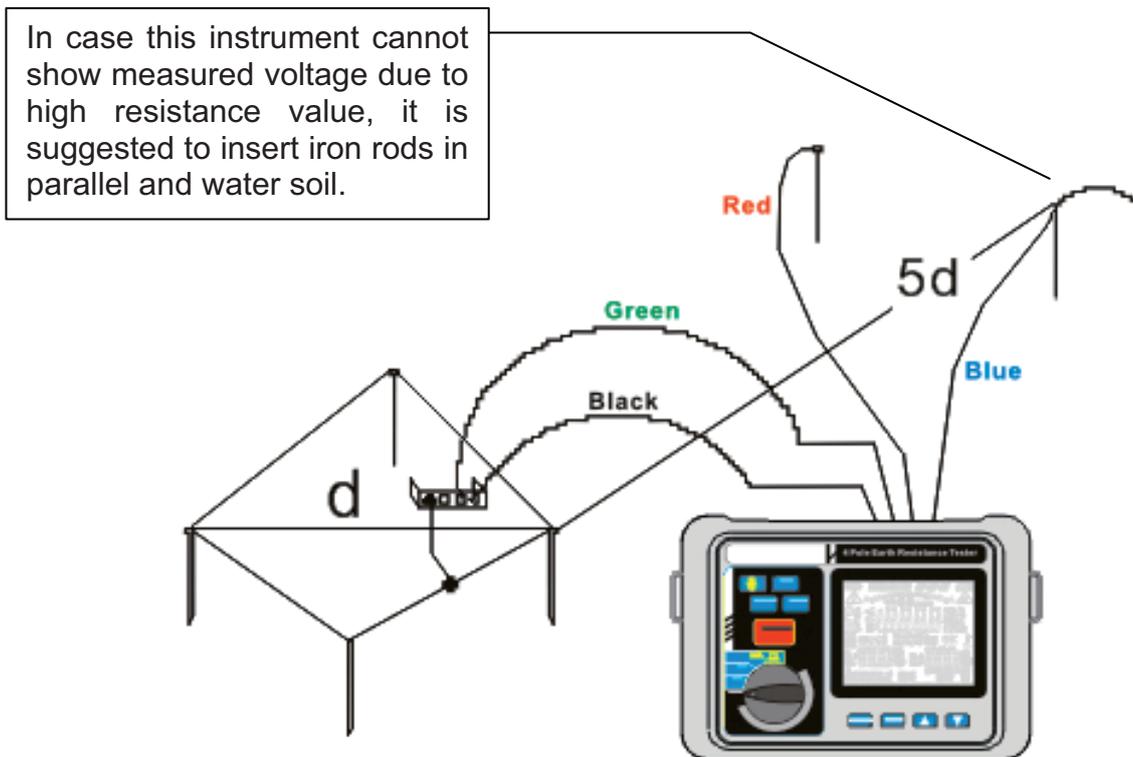


Figure 8. Measure Earth Resistance with Voltmeter-Ammeter (Small-Sized Earth Screen)

Large-Sized Earth Screen

This method also is based on voltmeter and ammeter, and it is mostly used in such circumstances that the distance between auxiliary earth rod and earthing device is not 5 times length of diagonal of earthing device. The current probe should be $1d$ away from earthing device ($1d=1 \times$ diagonal of earthing device, please refer to Figure 9). Place voltage probe out of influence range of earth screen to measure for several times. Firstly, please voltage probe between earth rod and current probe, and then move it towards earth rod or current probe for measurement.

In case this instrument cannot show measured voltage due to high resistance value, it is suggested to insert iron rods in parallel and water soil.

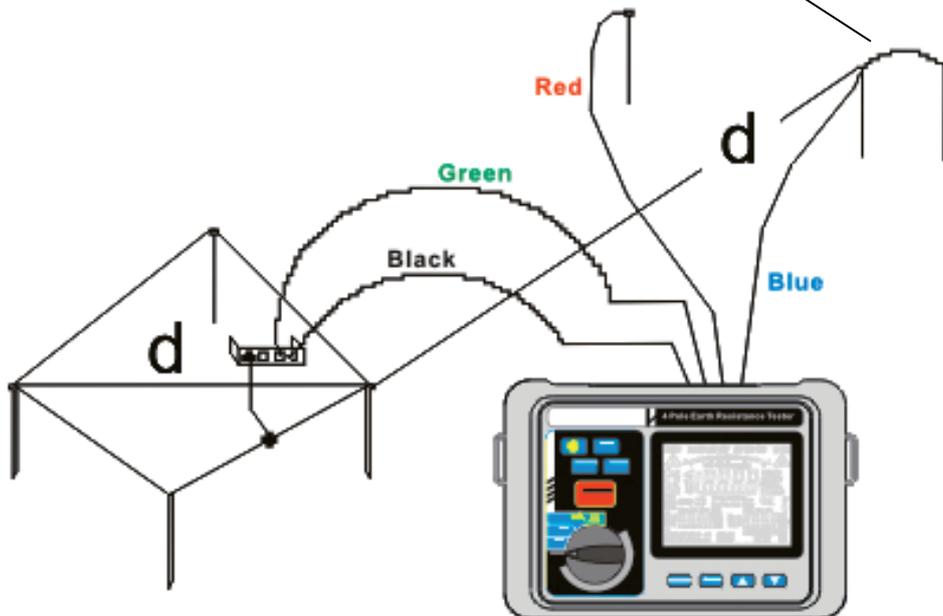


Figure 9. Measure Earth Resistance with Voltmeter-Ammeter (Large-Sized Earth Screen)

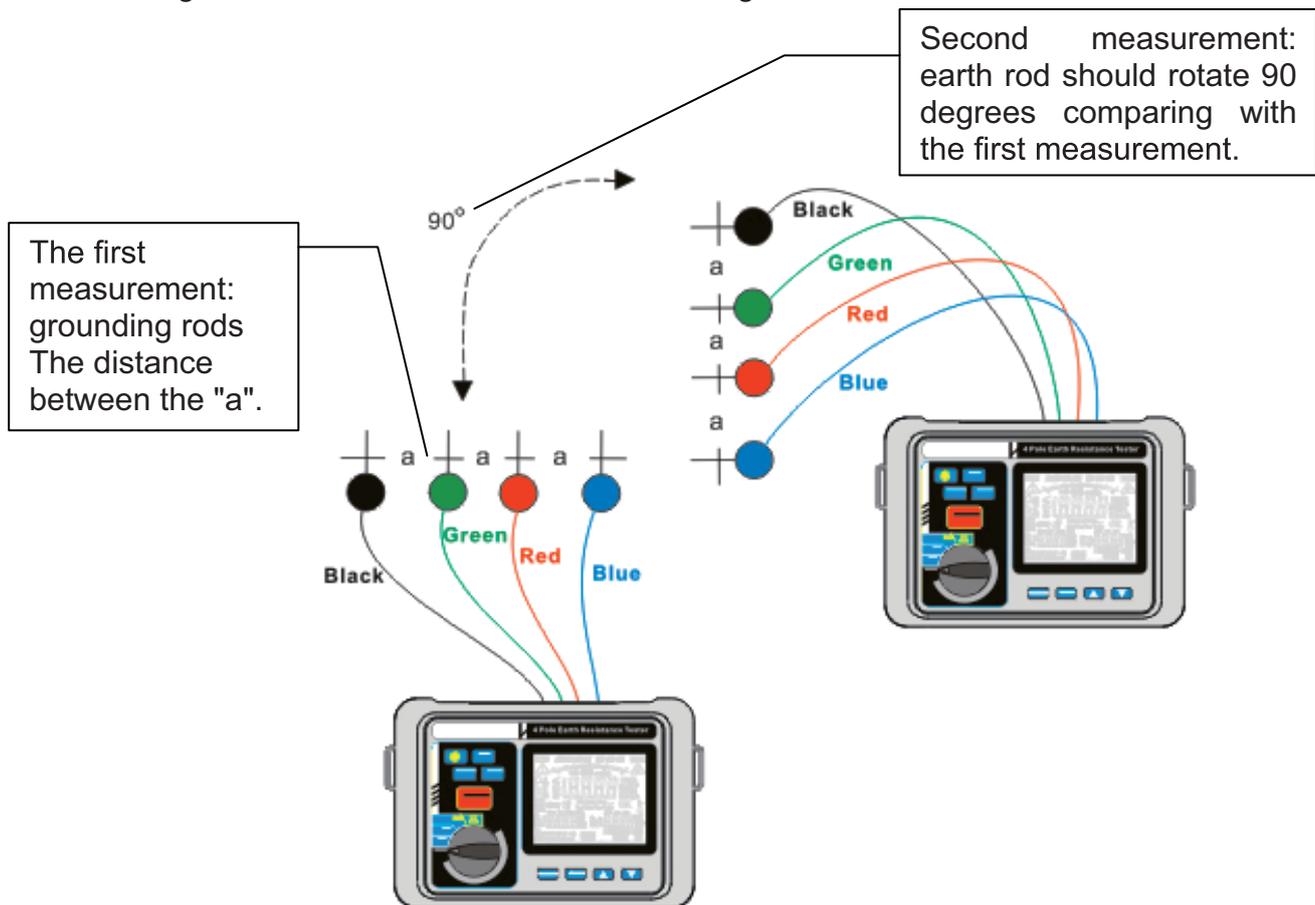
11.2. SOIL RESISTANCE COEFFICIENT MEASUREMENT

Purpose

It is to confirm which type of earth rod is suitable based on soil resistance coefficient.

Required Device

Since there is no specific acceptable value of resistance coefficient, it is suggested to measure for several times and place earth rod according to increasing value "a" (distance between two adjacent earth rods), and make curve chart based on value "a" and measured value of resistance coefficient so as to select suitable earth rod. Considering there might be metal objects (such as water pipe, cable other metal rod) in soil, which will affect measurement precision, therefore, it is OK to measure again. However, earth rod should rotate 90 degrees and value "a" should not be changed.



Soil resistance coefficient should be calculated according to this formula:

$$\rho = 2\pi aR$$

ρ =specified earth resistance

a =distance between two adjacent earth rods (unit: M)

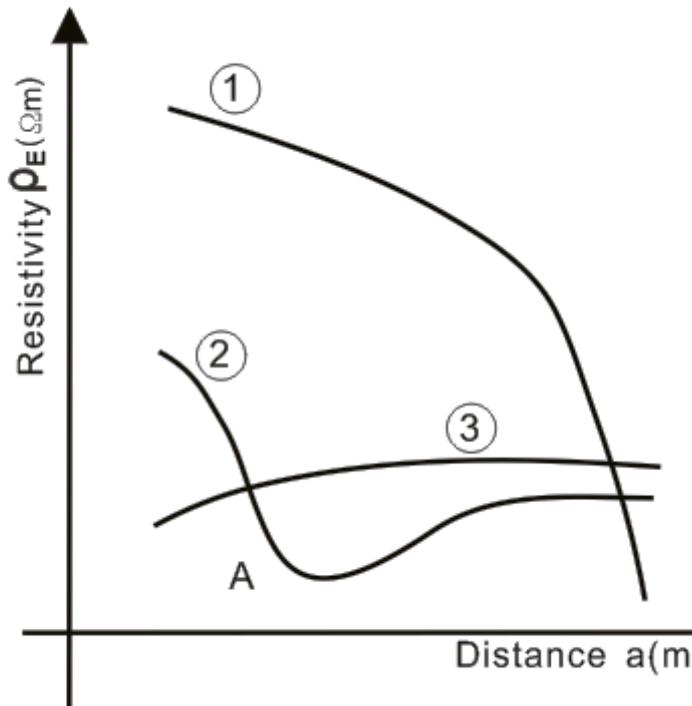
R =resistance measured by this instrument (Ω)

This method can be used to define resistance value based on value "a" and depth of earthing. Depth increases directly with value "a" After measuring " ρ " for several times, you will be able to make the following curve as value "a" increases, based on which you are able to select suitable earth rod.

Curve 1: " ρ " decreases inversely with depth, therefore, earth rod should be long enough.

Curve 2: " ρ " reaches minimum when depth is A.

Curve 3: " ρ " does not decrease though depth increases, therefore, circular earth rod is suggested.



Function of Earth Rod (64-12 2.4.1)

Resistance value of earth rod can be calculated according to the following formulas (ρ = average soil resistance coefficient)

a) Resistance of vertical earth rod

$$R_d = \rho / L$$

L=length of connecting earth

b) Resistance of horizontal earth rod

$$R_d = \frac{\rho}{L}$$

L=length of connecting earth

c) Resistance of connecting system

As for complicated earthing system with earthing rods placed in parallel, the resistance is usually higher than that of simple earthing system, especially those with close distance in between. Due to this reason, the resistance should be calculated according to this formula.

$$R = \frac{\rho}{4r}$$

r=radius of the circle around earthing rods