

Terra EZ Res™ Pro 2/3/4 Probes

Earth R/P Analyzer

Technical User's Guide



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Warning



Thanks for your purchase of Terra EZ Res Pro Digital Earth Analyzer. For best results, thoroughly read and completely understand this User's Guide.

- ◆ The tester conforms to IEC61010 in design, production and testing.
- ◆ Under all circumstances, pay special attention to the safe use of this device.
- ◆ Avoid nearby use of high-frequency signal generators like mobile phones to avoid electrical interference errors during device operation.
 - ◆ Pay attention to warnings and symbols shown on the device.
- ◆ Make sure that device and accessories are in good working order before use. Do not use if there are broken parts or exposed areas of test wires. Do not touch probes while measurement is in progress---**risk of electrical shock!!!!**
- ◆ **During measurement**, do not touch bare conductors or circuits under measurement.
- ◆ Before measurement, please set rotary **FUNCTION** switch to desired measuring position.
- ◆ Confirm that connector plug of leads have been completely inserted into device interface.
- ◆ Do not expose to Earth Voltage exceeding 600V A.C. or D.C. between probes and interface as this may seriously damage the device.

- ◆ Do not operate device in the presence of flammables, as a spark could initiate an explosion or fire.
- ◆ Do not use device if test wires are damaged with uninsulated wire exposed.
- ◆ Do not expose the device to high temperatures, high humidity or condensation.
- ◆ Do not leave device exposed to direct sunlight for extended periods to avoid excessive heating of electronics.
- ◆ For battery replacement, remove testing wire from device interface, and make sure that rotary **FUNCTION** switch is in "**OFF**" position.
- ◆ Dispose of used batteries in an appropriate manner.
- ◆ When the meter displays battery low voltage symbol, replace batteries.
- ◆ The Tester has no auto shut-off function. Uof Testing complete, turn rotary **FUNCTION** switch to "**Off**"
- ◆ If the Tester is not going to be used for a long period, remove batteries to prevent battery corrosion and damage to the device.
- ◆ This measuring device is only to be disassembled, adjusted and/or and repaired by distributor-authorized personnel---all other use will void warranty.
- ◆  Risk of severe electrical shock exists through improper use of this device. Device users must perform all operations as instructed in this user's guide.

I. Introduction

The **Terra EZ Res Pro** is specially designed and manufactured for measuring earth resistance, soil resistivity and AC voltage. Utilizing state-of-the-art digital and micro-processing technology precise earth resistance and soil resistivity measurements can utilize 2, 3 or 4 probe arrays. The **EZ Res Pro** possesses an unique function of wire resistance verification, anti-interference capability and the ability to adapt to the environment---all to ensure high precision, high stability and reliability for prolonged and complicated measurements. The **EZ Res Pro** is very effective in locating caves and tunnels as well as underground water and mineral veins through the use of electrical resistance tomography to accurately locate desired subterranean anomalies. The **EZ Res Pro** is also widely used in commercial power, telecommunications, oil field applications and general construction.

The **Terra EZ Res Pro** is composed of a host device, monitoring software, testing wires, communication wires, probes and a carrying case. The large LCD display of device offers blue back-light for dark conditions and a digital bar graph for ease of viewing. The **Terra EZ Res Pro** can store sets of data of 300 individual readings, allowing post-analysis via the included **Data Collection and Analysis Software**, showing the maximum, minimum, and average resistivity values. Included are alarm settings and an alarm indicator as well as historical data access, reading, preservation, report forms and printing.

The **Terra EZ Res Pro Earth Analyzer** may also be called: Precise Earth Resistance Tester, 4-pole Earth Resistance Tester, 2/3/4-pole Earth Resistance Tester and/or Soil Resistivity Tester.


II. Technical Specifications

1. Working Conditions

Influence Description	Working Conditions
Ambient Temp	15F-105F
Ambient Humidity	< 80%
Working Voltage	9V ± 1.5V
Auxiliary Earth Resistance	< 30k Ω
Interference Voltage	< 20V
Interference Current	< 2A
Electrode Distance when measuring R	a > 5d
Electrode Distance when measuring ρ	a > 20h

2. General Specification

Function	Measurement of 2/3/4-pole earth resistance, soil resistivity, earth voltage, AC voltage
Power Supply	DC 9V(6 High Quality Alkaline C Cells 1.5V continuous standby for 300 hours)
Measurement Range	Earth Resistance: 0.00Ω-30.00kΩ Soil Resistivity: 0.00Ωm-9000kΩm
Measuring Modes	Precise 4-probe measurement, 3-probe measurement and simple 2-probe measurement
Measuring Methods	Earth Resistance: rated current change-pole method, measurement current 20mA Max Soil Resistivity: 4-pole measurement (Wenner or Schlumberger Arrays) Earth Voltage: average rectification(between P(s)-ES)
Test Frequency	128Hz/111Hz/105Hz/94Hz(AFC)
Short-circuit Test Current	AC 20mA max
Open-circuit Test Current	AC 40V max
Test Voltage Wave	Sine wave
Electrode Distance Range	Outside probes can be set up to 330' apart .
Shift	Earth resistance: 0.00Ω-30.00kΩ, automatic shift

	Soil Resistivity: 0.00Ωm-9000kΩm, automatic shift
Backlight	Blue screen backlight, suitable for dim light use
Display Mode	4-digital super-large LCD display, blue screen backlight
Measuring Indicator	During measurement, LED flash indicator, LCD count down display, progress bar indicator
LCD Frame Dimension	5"x3"mm
LCD Window Dimension	4.9"x2.6"
Dimension	LxWxH: 8.5"x7.5"x3.75"
Standard Test Wire	4 wires: red 200 feet, black 200 feet, yellow 100 feet, and green 100 feet
Simple Test Wire	2 wires: red and black 5.2 feet each
Landscape Spikes	4 probes: 3/8" x 12"
Measuring Rate	Voltage to ground: about 3 times/second Earth resistance, soil resistivity: about 5 seconds/time
Measuring Times	Over 5000 times (Short-circuit test, interval time should be at least 30 seconds)
Circuit Voltage	Below AC 600V
RS232 Interface	RS232 interface, software supervision, storage data can be uploaded to computer, saved or printed.
Communication Wire	One RS 232 Cable
Data Storage	300 measurements, "MEM" icon storage indicator, flash display "FULL" icon to indicate storage is full
Data Hold	Data hold function: "HOLD" icon display
Data Read	Data read function: "READ" icon display
Overflow Display	Exceeding measuring range overflow function: "OL" icon display
Interference Test	Recognize interference signal automatically, "NOISE" icon display when interference voltage exceed 5V
Auxiliary Earthing Test	Can measure auxiliary earth resistance, 0.00KΩ-30kΩ(100R+rC<50kΩ, 100R+rP<50kΩ)
Alarm Function	When measuring value exceeds alarm setting value, an alarm will sound.
Battery Voltage	When battery voltage decreases to about 7.5V, low battery voltage icon  will display, indicating battery replacement is necessary.

Power Consumption	Standby: about 20mA (Backlight shut off)
	Boot-up and with backlight: about 45mA (25mA without backlight)
	Measurement: about 100mA (Backlight shut off)
Weight	Total weight: 12 lbs. (including package)
	Tester: 3.2 lbs (including batteries)
	Testing wires: 5.3 lbs
	Copper-clad probes (4pcs) 5 lbs
Working Temperature & Humidity	15°F-115°F, below 80%rh
Storage temperature & humidity	-4°F-140°F, below 70%rh
Overload Protection	Measuring earth resistance: between interfaces of C(H)-E 、 P(S)-ES , AC 280V/3 seconds
Insulation Resistance	Over 20MΩ (between circuit and enclosure it is 500V)
Withstanding Voltage	AC 3700V/rms (Between circuit and enclosure)
Electromagnetic Features	IEC61326(EMC)
Protection Type	IEC61010-1 (CAT III 300V、CAT IV 150V、Pollution 2), IEC61010-031, IEC61557-1 (Earth resistance), IEC61557-5 (Soil resistivity), JJJ 366-2004

3. Intrinsic error and performance indicators under base conditions

Category	Measurement Range	Intrinsic Error	Resolution
Earth Resistance (R)	0.00Ω-30.00Ω	±2%rdg±3dgt	0.01Ω
	30.0Ω-300.0Ω	±2%rdg±3dgt	0.1Ω
	300Ω-3000Ω	±2%rdg±3dgt	1Ω
	3.00kΩ-30.00kΩ	±4%rdg±3dgt	10Ω
Soil Resistivity (ρ)	0.00Ωm-99.99Ωm	According to the precision of R R (ρ=2πaR)	0.01Ωm
	100.0Ωm-999.9Ωm		0.1Ωm
	1000Ωm-9999Ωm		1Ωm
	10.00kΩm-99.99kΩm		10Ωm

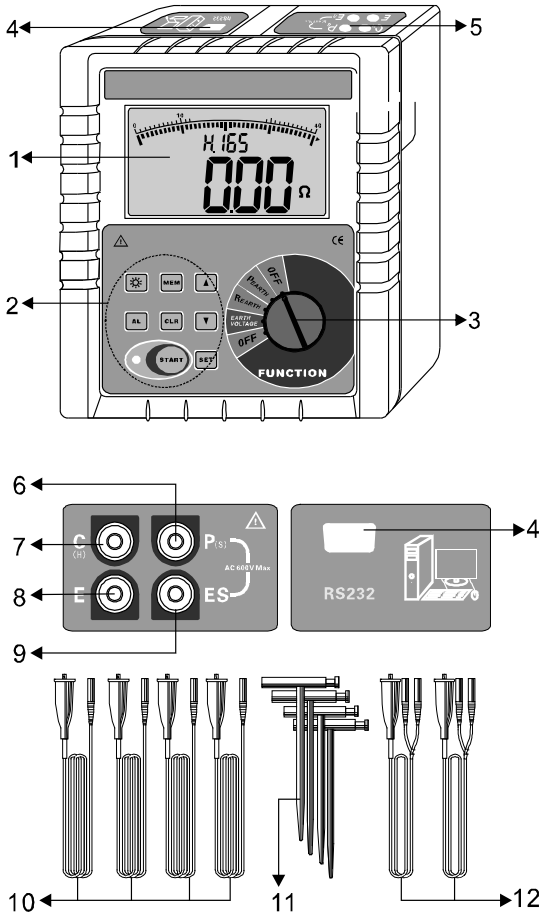
	100.0kΩm-999.9kΩm	a:1 m-100m, π=3.14)	100Ωm
	1000kΩm-9000kΩm		1kΩm
Earth Voltage	AC 0.0-600V	±2%rdg±3dgt	0.1V

Note: 1. When rC max or rP max, additional errors±3%rdg±5dgt.

(rC max: 4kΩ+100R<50kΩ, rP max: 4kΩ+100R<50kΩ)

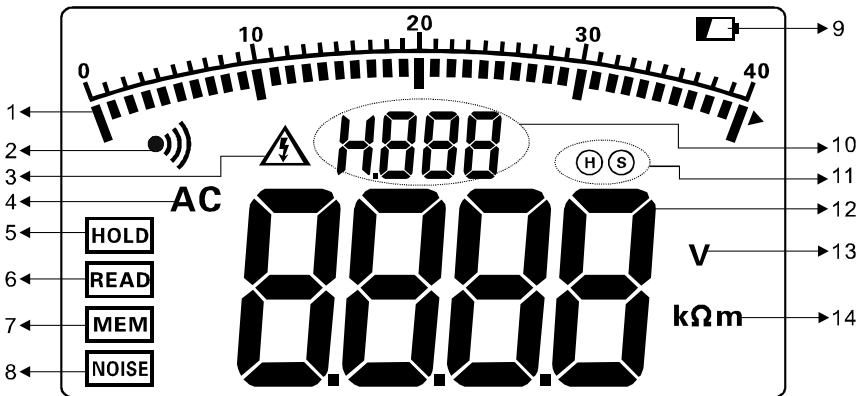
2. When 5V interference voltage, additional error≤±5%rdg±5dgt.

III. Tester Structure



1. LCD 2. Button area
3. Rotary switch for function selection 4. RS232 interface
5. Interface for testing wires 6. P(S) interface: Voltage probe
7. C(H) interface: Current probe 8. E interface: Earth probe
9. ES interface: Auxiliary earth probe 10. Standard test wires
11. Auxiliary earthing probes 12. Simple test wires

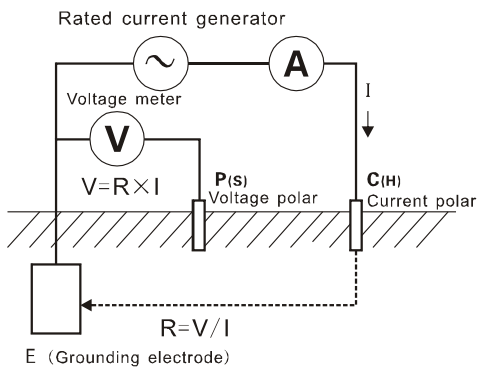
IV. LCD Display



1. Progress bar (Dynamic display of testing progress)
2. Alarm symbol (Displays with open alarm function, flashes when alarm value is met)
3. Exceed voltage symbol (Displays when measured voltage exceeds 30V---use caution and maintain safety)
4. AC symbol
5. Data hold symbol (Press **MEM** to hold data)
6. Data access symbol (Press **MEM** for at least 3 seconds to access data)
7. Data storage symbol (Press **MEM** to store data)
8. Interference signal symbol (Displays when interference voltage exceeds 5V)
9. Low battery symbol (Displays when battery voltage falls to 7.5V or less)
10. Displays the group number of stored data and countdown.
11. Interference electrode symbol (Displays when interference exceeds 5v)
12. Measured data
13. Voltage unit symbol
14. Resistance, soil resistivity, length unit symbol (Ω , k Ω , Ω m, k Ω m, m)

V. Measuring Principle

1. Voltage to ground measurement utilizes average value rectification method.
2. Earth resistance measurement uses fall-of-potential method. AC constant current I is applied between the measurement object E earth probe and $C(H)$ current probe, and calculating the potential difference V between E earth probe and $P(S)$ voltage probe, calculating the earth ground R according to formula $R=V/I$. To ensure test accuracy, the 4-wires method was developed. To use **4-wires method**, clip ES and E to the same probe during testing. The 4-wires method can eliminate the influence of contact resistance (usually caused by dirty probes) between measured earthing body, auxiliary earthing probes, test clips and/or meter's input interface. The 4-wires method can also eliminate influence of line resistance.



3. Maximum Operating Error: Operating error(B) is an error obtained within the rated operating conditions, and calculated with the intrinsic error(A), which is an error of the instrument used, and the error(E) due to variations.

$$B = \pm (|A| + 1.15 \times \sqrt{E_2^2 + E_3^2 + E_4^2 + E_5^2})$$

A: Intrinsic error

E2: Variation due to power supply voltage

E3: Variation due to temperature change

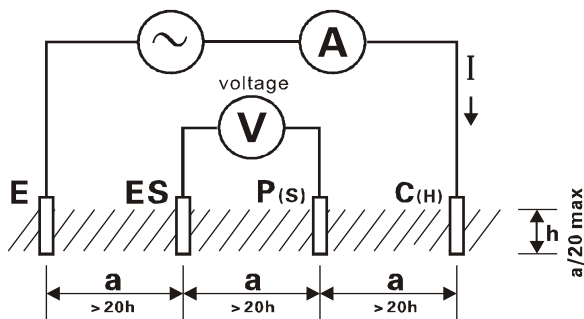
E4: Variation due to interference voltage change

E5: Variation due to contact electrode resistance

4. Soil resistivity (ρ) is measured by 4-probe method (ex: Wenner method):

An AC current I runs between **E** earthing probe and **C(H)** current electrode. The potential difference V between **P(s)** voltage

electrode and **ES** auxiliary earthing probe, the potential difference V is divided by AC current I to give earth resistance R . With probe separation distance a , soil resistivity can be determined according to formula $\rho=2\pi aR(\Omega m)$. The probe distance of **C(H)-P(s)** is equal to **P(s)-ES** (both = a) for Wenner method. In order to simplify the calculation, make electrode distance a much more than probe embedding depth h (generally, $a>20h$, as shown below).



VI. Operation Methods

1 . Switch On/Off

Rotate **FUNCTION** rotary switch to switch on and off. The rotary switch button is in position “OFF” for shut-off. The Tester has no auto shut-off function---shut it off after usage to prevent unwanted battery drainage.

2 . Battery Voltage Check

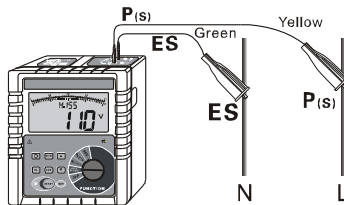
After switch on, if LCD displays low battery voltage icon " ", which indicates that battery voltage is low, replace batteries in accordance with instructions. Adequate battery power can ensure accuracy of measurement.

3 . AC Voltage Measurement

Ac line voltage measurement cannot exceed 600 V.
Connect P(s) and ES interface to test commercial AC
voltage, no need to connect C(H) and E interface.

AC voltage measurement refers to general commercial AC voltage measurement. By determining the difference between earthing voltage, the meter can be used for testing below 600V AC line voltage.

As shown below: First, connect test wires **P(S)** with **ES** interface. Second, connect test wires with tested line, then rotate **FUNCTION** rotary switch to **“EARTH VOLTAGE”** and start testing, LCD will display the test results.



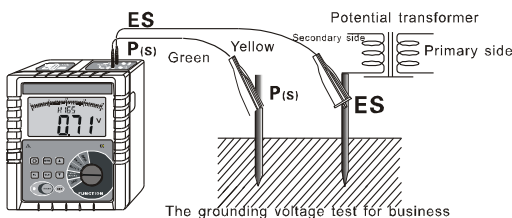
4 . Earth Voltage Measurement

Earth voltage measurement uses only 2 probes (ES + P).

The meter connects with the earth by using only testing wires and 2 probes. Other testing wires of meter's interface cannot be used to connect with commercial power line L, N, as breakers may be tripped and serious damage to tester will result.

Earth voltage measurement cannot exceed 600 V.

As shown below: once meter, probes and testing wires are all connected, rotate **FUNCTION** rotary switch to **“EARTH VOLTAGE”** and start testing, LCD will display test results.



5 . 4-wires Precise Earth Resistance Measurement

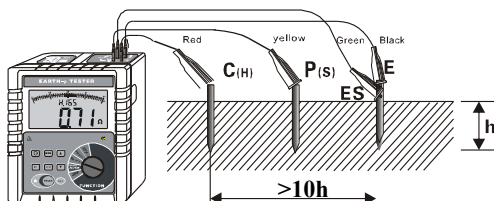
For testing earth resistance, first confirm the earth voltage i.e. the voltage between C(H) and E or P(s) and ES must under 20V. The meter NOISE symbol shows when the earth voltage exceeds 5V, which may produce resistivity measurement error. If high earth voltage is found, interrupt power supply causing earth voltage. Confirm the earth voltage decrease, then test earth resistivity again.

4-wires measurement: The 4-wires method can eliminate the influence of contact resistance (usually caused by rust) between probes, test clips, and/or meter's input interface. The 4-wires method can also eliminate influence of line resistance. It is much better than 3-wires measurement.

As shown below: Start from probe E, interval 10-30', respectively insert P(S), C(H) probes deep into the earth in a straight line, and then connect testing wires (black, green, yellow, red) from E, ES, P(S), C(H) interfaces corresponding to measured earth electrode E, auxiliary voltage electrode P(S), auxiliary current electrode C(H).

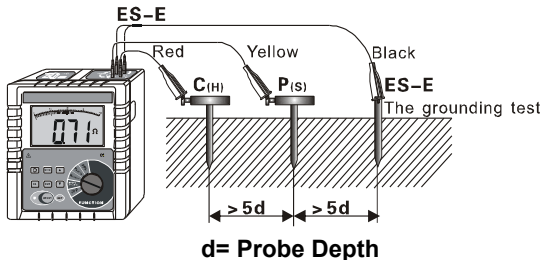
The distance from probe E to current electrode C(H), should at least ten times farther than the embedded depth probe depth (h)

Testing wires cannot be wound together as this will affect measuring accuracy.



6 . 3-Wires Earth Resistance Measurement

3-wires measurement: As shown below, short-circuit **ES** and **E** interface. The operation of meter is the same with 4 wires measurement but, the 3-wires method cannot eliminate the influence of line resistance, or the influence of contact resistance between meter and testing wires or between testing wires and probes. Oxidation layers on probes must be removed when measuring.

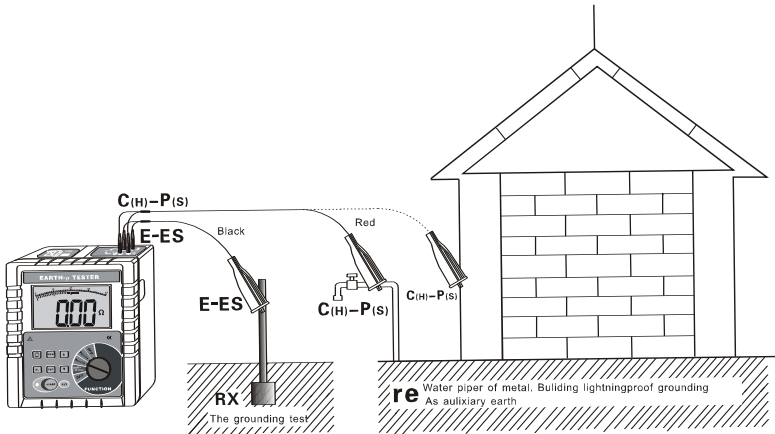
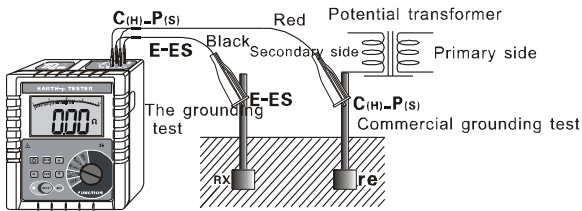


7 . 2-Wires Simple Measurement

Using simple 2-wires method for measuring earth resistance, choose a earthing body which has a small **re** value as auxiliary earthing probe, so that the reading value is more close to the actual value. Buried metal pipes or metal fire hydrant would be priority auxiliary earthing probes.

2-wires method: This method is a simple method for measurement that does not use an auxiliary earthing probe. Use the earth electrode with the minimal existing earth ground resistance value as auxiliary earth electrode and connect two simple testing wires (in which **C(H)-P(S)**, **E-ES** interfaces are in short circuit). It can make use of metal pipes, fire hydrants and other metal buried objects, common earthing of commercial electric power system or lightning protection earth ground electrode and others to replace auxiliary earthing rods **C(H),P(S)**---remove oxide layer on the connection point of the selected metal auxiliary earthing object when making measurement.

Wire connection is as shown in following figure, and refer to 4-wires measurement for other operations.



2-wires simple method for measurement of earth ground resistance, its reading on tester is the total value of earth ground resistance value of

measured earthing object and that of commercial earthing object, that is:

$$R = R_X + r_e$$

In which:

R is the tester reading value;

R_X is the earth ground resistance value of measured earthing object;

r_e is the earth ground resistance value of common earthing object like commercial use power system.

Then, the earth ground resistance value of measured earthing object is: **R_X = R - r_e**

8 . Soil Resistivity Measurement

Soil resistivity **ρ** is a determining factor of earthing resistance of earthing body. In different types of soil, there is a different soil resistivity. Even the same kind of soil, due to different temperatures and water content and so on, the soil resistivity will correspondingly show a significant change.

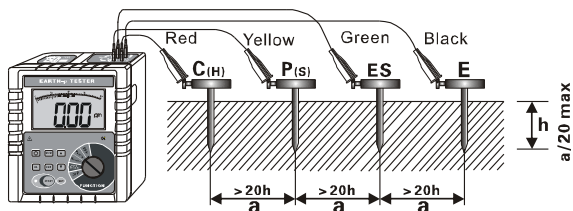
Soil resistivity is measured by 4-pole method (ex: Wenner method)

According to formula $\rho = 2\pi a R(\Omega m)$ calculating soil resistivity **ρ**, its unit is **Ωm**, in which:

a—probe separation distance

R—soil resistivity between electrode **P(S)**-**ES**

4-pole method (Wenner method): Connect testing wires as shown below, pay attention to the distance between auxiliary earthing probes, and the embedding depth. Respectively insert **C(H)**, **P(S)**, **ES**, **E** auxiliary earthing rods deep into the earth in a straight line, and then connect testing wires (red, yellow, green, black) corresponding to **C(H)**, **P(S)**, **ES**, **E** of interfaces and measured auxiliary earthing probe.



After completing wire connections, rotate **FUNCTION** rotary switch to “**ρEARTH**”, long press “**SET**” button (about 3 seconds) to enter setting, quickly



press “**SET**” button to move the cursor, press “**←**” or “**→**” button to change current data value (a range:1m-100m), then press and hold “**! T**” button to save the set **a** value, and return to soil resistivity testing mode. After setting **a** value, in soil resistivity testing mode, press the “**START**” button to start testing. A countdown display testing process and soil resistivity value is shown when testing cycle is completed. As shown below, the measured soil resistivity is 53.38Ωm and there are 157 sets of data stored. Press “**SET**” button, the earth resistance **rC** of auxiliary current electrode **C(H)** and earth resistance **rP** of auxiliary voltage probe **P(S)** will be displayed, then automatically, display will return to measured soil resistivity **ρ**.



9 . Backlight Control

After startup, press "Light" button to turn backlight on or off. The backlight function is helpful in dark situations---power consumption of backlight is about 25mA. It will default to backlight turned off after each startup.

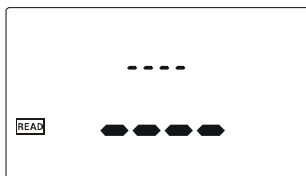
10 . Alarm Settings

After startup, rotate **FUNCTION** rotary switch to select function, press “**AL**” button for a brief time to open or shut off alarm function; hold for about 3 seconds to enter alarm critical value settings, press “**▲**” or “**▼**” to change current value. Press “**AL**” button to store and exit. When measurement value is surpassed, the alarm function will open --- the icon will flash and an alarm will sound.

11. Data Lock Storage

In test mode, press “**MEM**” button for a brief time to lock current displayed data, showing “**HOLD**”, “**MEM**” icon and automatically store with serial numbers. If storage is full, the tester will display “**FULL**” icon, and then press “**MEM**” button to remove lock.

As shown in the left figure below: the lock measurement data of soil resistivity is 53.38Ωm, as the 28th group of data storage.



12 . Data Reading/Deletion

In test mode, press “MEM” button for more than 3 seconds to enter data reading, press “▲” or “▼” button to select reading data number by step value 1, press“▲” or“▼” button continually to select data reading group number by step value 10. When the current data is earth resistance or soil resistivity, press “SET” button to read data value **rC** and **rP** and “MEM”button to exit from reading.

If there is no storage data, LCD will display “- - -”, see the above figure on right side.

Under data reading status, press “CLR” button to enter data deletion, press“▲” or“▼” to select “NO” or “YES”, selecting “NO and then pressing “CLR” button for not deleting and return data reading status, selecting “YES” and then pressing “CLR” button for deleting stored data---it will show as above right figure after deletion.

Notice: Operating data deletion will delete all the stored data one-time and cannot be restored. Be sure you want to delete stored data.

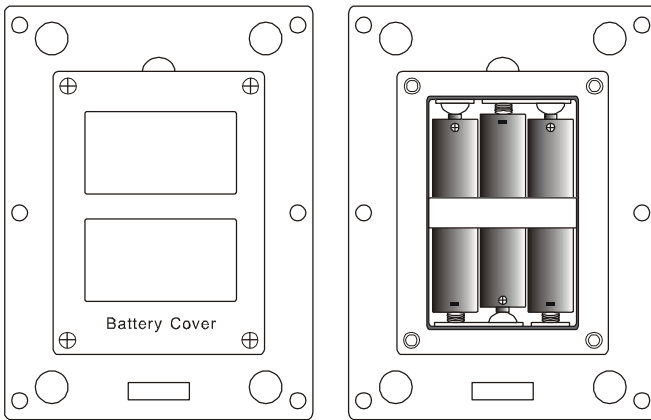
13 . Data Upload

Stored data can be retrieved via functions explained above and easily transferred to an optional **Interpolated Data Transfer Spreadsheet** supplied by Terra Exploration Group. The **Interpolated Data Transfer Spreadsheet** feeds seamlessly into the optional **Voxler Earth Imaging Software**. The **Interpolated Data Transfer Spreadsheet** and **Voxler Earth Imaging Software** are available as a package from **Terra Exploration Group**. The **Interpolated Data Transfer Spreadsheet** provides the ability to view **Voxler** information in 2D or 3D modes.

VII. Battery Replacement

	Do not replace batteries around flammable products.
	Do not replace batteries during measurement
	Pay attention to battery polarity and specification. do not mix use of new and used batteries to avoid damage to Tester
	When the enclosure of Tester is wet, do not open battery cover
	Dispose of used batteries in an appropriate manner.

1. Switch off; make sure that the Tester is in switched-off state.
2. Loosen the four screws on battery cover at the bottom of the Tester, and remove battery cover.
3. Install new batteries, paying attention to battery polarity and specification, close battery cover, and re-fasten screws.
4. Switch on Tester for verification and operate normally.



VIII. Accessories

1. Main electronics unit in protective waterproof case.
2. Black barrel zipper bag containing: red/black wires on reels 50m each, green/yellow wires on reels 25 m each, two jumper wires--red/yellow and black/green, two 50m measuring tapes, five steel probes in canvas zippered bag, ten probe-marking flags, Easy Resistivity User's Guide, Technical User's Guide and Warranty Information sheet.