

پتروفرهان گستر جنوب

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PRT-36

4-TERMINALEARTHRESISTANCETESTER
ANDSOILRESISTIVITYTESTER

MANUAL



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SAFETY WARNINGS

This instrument has been designed, manufactured and tested according to IEC 61010: Safety requirements for Electronic Measuring apparatus, and delivered in the best condition after passing quality control tests.

This instrument manual contains warnings and safety rules which have to be observed by the user to ensure safe operation of the instrument and to maintain it in safe condition. Therefore, read through these operating instructions before using the instrument.

CAT.IV	The circuit from the service drop the service entrance, and to the power meter and primary overcurrent protection device(distribution panel)
CAT.III	Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets.
	Instrument with double or reinforced insulation.
	User must refer to the explanations in the instruction manual.

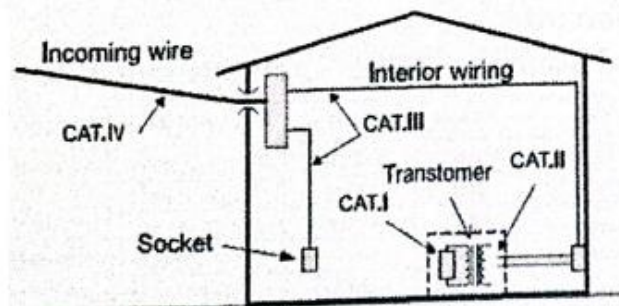
This instrument meets CAT.III 300V/CAT.IV 150V. To ensure safe operation of measuring instruments, IEC 61010 established safety standards for various electrical environments, categorized as CAT.I to CAT.IV, and called measurement categories. Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measuring instrument designed for CAT.III environments can endure greater momentary energy than one designed for CAT.II.

CAT.I: Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.

CAT.II: Primary electrical circuits of equipment connected to an AC electrical outlet by a power cord.

CAT.III: See above table

CAT.IV: See above table



FEATURES

PRT-36 is a 2/ 3/ 4-Wire Digital Earth Resistance/ Earth Resistivity Tester equipped with a microcomputer and can measure earth resistances and calculate earth resistivities (ρ). The instrument can measure earth resistances on power distribution lines, in-house wiring system and electrical appliances etc. due to the low output voltage: approx 10Vrms or less.

- Designed to meet following safety standards.
IEC 61010-1 (CAT. III 300V, CAT. IV 150V, Pollution degree 2)
IEC 61010-031 (Requirements for hand-held Probes)
IEC 61557-1, 5 (Earth Resistance Tester)
- Stable measurement results can be obtained under a noisy environment by introducing the FFT (Fast Fourier Transform) technology.
- Dot-matrix 192x64, Monochrome LCD.
- Backlight function to view the test results in dimly areas.
- Can switch frequencies of measuring signal 4-kind of frequencies : 94 / 105 / 111 / 128Hz, are selectable by hand or automatically.
- Rk Function is available to cancel the residual resistance on the Test Leads.
- Battery Check Function
- Can measure Series Interference Voltage/ Frequency Voltage values and frequencies are displayed when Series Interference voltage (AC) exist.
- Auxiliary Earth Resistance Measurement Function.
- Auxiliary earth resistances are measured and displayed.
- Warning for Auxiliary Earth Resistance Measurements Warnings are displayed on the LCD when auxiliary earth resistances are too high and may result in inaccurate measurements.
- Auto-Power-Off Function.
- The instrument is automatically powered off when 5 min passes without any Key operation.
- Memory Function. Can save 800 measured results.

3. Specification

Applicable Standards

- IEC 61010-1 Measurement CAT. III 300V, CAT. IV 150V Pollution degree 2
- IEC 61010-031 Standard for hand-held Probes
- IEC 61557-1, 5 Earth Resistance Tester
- IEC 61326-1 EMC Standard

Measuring range and accuracy (23°C 5°C, relative humidity 45~75%RH)

Function	Range	Resolution	Measuring Range	Accuracy
Earth Resistance Re(Rg at ρ measurement)	2Ω	0.001Ω	0.05~2.099Ω	±3%rdg±0.05W
	20Ω	0.01Ω	0.05~20.99Ω	±3%rdg±5rdg
	200Ω	0.1Ω	0.5~209.9Ω	
	2000Ω	1Ω	5~2099Ω	
	20kΩ	10Ω	50~20.99KΩ	
	200kΩ	100Ω	500~209.9KΩ	
Auxiliary Earth Resistance Rh, Rs				8% of Re + Rh + Rs
Earth Resistivity ρ	2Ω	0.1Ωm~1Ωm Auto ranging	0.3~395.6Ωm	ρ=2×l×a×Rg
	20Ω		0.3~3956Ωm	
	200Ω		0.3~39.56kΩm	
	2000Ω		0.3~395.6kΩm	
	20kΩ		0.3~1999kΩm	
	200kΩ			
Series Interference Voltage Ust(AC only)	50V	0.1V	0~50.9Vrms	±2%rdg, ±2dgt (50~60Hz)
Frequency Fst	Auto- ranging	0.5Hz	40Hz~500Hz	

- LCD Dot-matrix 192X64, monochrome Backlight.
- Earth resistance: max 209.9kW. Earth resistivity Interference Voltage: max 50.9V.
- Low Battery Warning: Battery mark appears.
- Continuous Measurement: 400 times or more with manganese batteries; repeating measurements at every 30 sec with a load of 1W at 2W range.
- Over-range Indication :OL
- Auto-Power-Off: automatically powered off when 5 min passes without any Key operation.
- Location for use: Indoor/ Outdoor use (Not completely waterproof), altitude 2000m or less.
- Applicable range: Testing earth resistance on power distribution lines, in-house wiring system and electrical appliances.
- Temperature & Humidity range (guaranteed accuracy) :23°C~5°C , relative humidity 85% or less (no condensation)
- Operating Temperature & Humidity range :-10°C ~ 50°C , relative humidity75% or less (no condensation).
- * Supplied Test leads cannot be used at 0°C or less.**
- Storage Temperature & Humidity range:-20°C~-60°C , relative humidity 75% or less (no condensation).
- Overload Protection : between E-S(P) and between E-H(C) terminals AC280V / 10 sec

- Withstand Voltage : between the electrical circuit and enclosure. AC3540V(50/60Hz) / 5 sec
- Insulation Resistance : between the electrical circuit and enclosure 50MΩ or more / DC1000V.
- Dimension:167*185*89mm.
- Weight:900g(including batteries)
- Power source: DC12v:size AA manganese dry battery((R6P)*8

**** In a use of this instrument under low temperature below 0°C, a use of alkaline batteries with low temperature spec is recommended.**

Range to keep the maximum operating error

Measurement range within which the maximum operating error(±30%)applies.

2W Range:0.5W~2.099W
 20gRange:2W~20.99W
 200W Range:20W~209.9W
 2000W Range:2kW~20.99kW
 20kW Range:2kW~20.99kW
 200kW Range:20kW~209.9kW

Variation of Supply Voltage : until the Battery Warning mark appears

Temperature Variation : -10°C ~ 50°C

Series Interference Voltage: 16 ~ 2/3Hz, 50Hz, 60Hz, 400Hz and DC3V.

No need to consider DC Series interference voltages at 2Ω .

Auxiliary earth electrode resistance: within following range or 50kW or less whichever smaller.(At r measurements, "Re" in this formula is replaced with "Rg".)

Rh, Rs limit	Accuracy	Accuracy
$Re < 0.40\Omega$	1k Ω	$\pm 5\% \text{rdg} \pm 1\% \text{fs}$
$0.4\Omega \leq Re < 1.00W$	2k Ω	
$1.00\Omega \leq Re < 2.00W$	3.5k Ω	
$2.0\Omega \leq Re$	$= Re \times 100 + 5k\Omega$ (Rh, Rs < 50k Ω)	

MARKS AND MESSAGE DISPLAYED ON THE LCD

Only 2w/3w/4w	Setting for Rk can be made only at 2w,3w,4w measurements.
Voltage Hightl	Ust is Regulated value or more.
Rh>limit Rs>limit	Rh and rs values exceed the allowable range. Correct results might not be obtained.
No Saved data	No saved data exists.
Memory Full	Memory is full. No more data can saved.
Delete This Item?	A confirmation message before deleting the selected.
Delete All Item?	A confirmation message before deleting all selected.
Data Succed Delete	All items have been deleted.
NO03/095	Nxxx is a memory no., and the left message saying 95 data have been stored.(Displayed at the Data Review Screen.)
No03	Indicating the measured result is saved with Memory NO. 003.

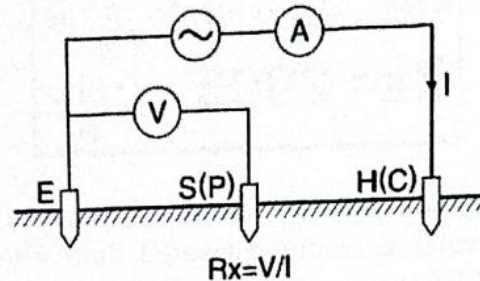
Marks and Message	Details
BATT Batt Error	Battery voltage is low. Replace the batteries.
Measuring...	This mark is being displayed during a measurment.
OL	Measuring range for the selected Range is exceeded. In case of Ust measurments, 50V or more is detected.
---	Failed to make successful measurements
Rh>limit	Rk is exceeded the limit value;exceeding 2W at 2 Range and exceeding 9W at 20 or lower.
Range<=20	Setting for Rk can be made at 20W or lower.

No03	Indicating the measured result is saved with Memory NO. 003.
S005	The character S stands for Site. Selectable from 000 to 999.
Saved	Data is successfully saved.

5. Measurement Principle

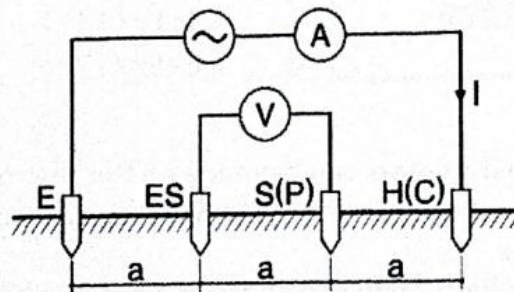
5-1 Principle of Earth Resistance Measurements

This instrument makes earth resistance measurement with fall-of-potential method, which is a method to obtain earth resistance value R_x by applying AC constant current I between the measurement object E (earth electrode) and $H(C)$ (current electrode), and finding out the potential difference V between E (earth electrode) and $S(P)$ (potential electrode).



5-2 Principle of Earth Resistivity (ρ) Measurement

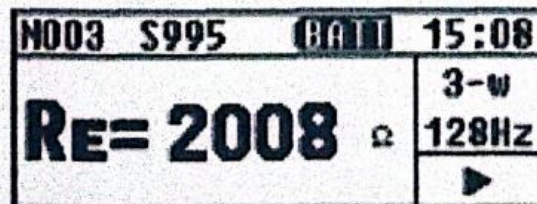
According to the Wenner 4-pole method, apply AC current I between the E (earth electrode) and $H(C)$ (current electrode) to find out the potential difference V between the potential electrode $S(P)$ and auxiliary earth electrodes ES . To Obtain the earth resistance R_{gW} , divide the potential difference V by AC current I ; where the interval between electrodes is $a(m)$. Then use a formula: $\rho = 2 \times \pi \times a \times R_{gW} (W \times m)$



6. Preparation for Measurement

6-1 Battery Voltage Check

Power on the instrument. If the display is clear without the Low battery mark "BATT" showing, battery voltage is sufficient. If the display blanks or the Low battery mark is indicated, replace the batteries according to 11. for Battery and Fuse Replacement.



Note) Measurements cannot be made, even the Test Button is pressed, while the Low Battery Mark is displayed on the LCD. Measurements are halt when the Low Battery Mark appears on the LCD.

6-2 Settings

6-2-1 Setting Items

This instrument starts with Measurement mode when it is powered on while the Range Switch has been set to the position other than OFF.

N003 S995 02/26 15:08			
Re= 2008 Ω		3-w	
		128Hz	▶

Measurement conditions should be set before starting measurements. Setting the date and time enables a saving measured data with time Information. Press the MENU Key and enter into the SYSTEM_MENU. Then select CONFIG_SETTING with Cursor Keys, and press the ENTER/SAVE Key to enter into the CONFIG_SETTING mode. Pressing the ESC Key twice exits from the CONFIG_SETTING mode and returns to Measurement mode.

SYSTEM_MENU 02/26 15:08
Review Data
Config Setting

CONFIG_SETTING	
Wire(ρ)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	Rk(0.005)

Settings of following parameters can be made on this instrument.

Wire: Measurement method (Wiring System) Freq: Measurement frequency

Site: Site (location) No

Lh: Interval of the auxiliary earth spikes at Earth resistivity (ρ) measurement

Date/Time: Year/ Month/ Day, Time (24-hour display)

Rk : Residual resistance on the Test Leads

6-2-2 Setting for Measurement Method

Measurement method is selectable from: 2-wire (2-wire system), 3-wire (3 wire system), 4-wire (4-wire system) and ρ (earth resistivity).

Select Wire with the Cursor Key on the CONFIG_SETTING Screen and press the ENTER/SAVE Key to proceed to the Wiring Setting Screen.

Wiring: ρ -wire			
2-wire	3-wire	4-wire	ρ

Select the appropriate Wiring System with the Cursor Key and press the ENTER/SAVE Key. Then the CONFIG_SETTING Screen with the selected Wiring System will be displayed .

CONFIG_SETTING	
Wire(3)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	Rk(0.005)

6-2-3 Setting for Measurement Frequency

Measurement signal frequencies can be selected from following four frequency bands with this instrument in order to minimize the influence of the series interference voltage (earth voltage).

*Auto *94Hz *105Hz *111Hz *128Hz

The instrument automatically select the best suitable frequency when selecting Auto and output the frequency signal. Select Freq with the Cursor Key on the CONFIG_SETTING Screen and press the ENTER/SAVE Key to display the Frequency Setting Screen.

CONFIG_SETTING	
Wire(3)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	Rk(0.005)

Selecting a desirable frequency with the Cursor Key, and pressing the ENTER/SAVE key return to the CONFIG-SETTING screen with the selected frequency.

CONFIG_SETTING	
Wire(ρ)	Freq(AUTO)
Site(111)	Lh(14.5)
Date/Time	Rk(0.005)

6-2-4 Site (location) no. setting

The site (location) where measurements done can be saved with numbers. Select site with the Cursor Key on the CONFIG_SETTING screen, and press the ENTER/SAVE key to display the site number setting screen.

Site_Number
S123

Select any digit to be changed with the Cursor Key, and press the ENTER/SAVE Key. Then the selected digit is highted and ready to be changed.

Site_Number
S123

Press the Right cursor Key ► to increase number and the left Cursor Key ◀ to reduce numbers. Keep the cursor Key pressed down to change numbers quickly. Press the ENTER/SAVE key to confirm a number. Repeat this procedure to change the other digits. Press the ESC key when settings are done. Then the CONFIG-SETTING Screen with the selected site No. will be displayed.

CONFIG_SETTING	
Wire(ρ)	Freq(94)
Site(123)	Lh(14.5)
Date/Time	Rk(0.005)

Note) Site No. is selectable from 000 to 999.

6-2-5 Setting for the interval between Auxiliary Earth Spikes at Earth Resistivity (ρ)

Making setting of the intervals between auxiliary earth spikes is necessary to measure earth resistivity (ρ)

Select Lh with the Cursor Key on the CONFIG-SETTING Screen, and press the ENTER/SAVE key to display the length Setting Screen.

Length(m)
L= 12.3m

Select any digits to be changed with the Cursor Key, and press the ENTER/SAVE Key. Then the selected digits is highlighted and ready to be changed.

Length(m)
L= 12.3m

Press the Right Cursor Key ► to increase numbers and the Left Cursor Key ◀ to reduce numbers. Keep the Cursor Key pressed down to change numbers quickly. Press the ENTER/SAVE Key to confirm a number. Repeat this procedure to change the other digits. Press the ESC Key when settings are done. Then the CONFIG-SETTING Screen with a new interval will be displayed.

CONFIG_SETTING	
Wire(ρ)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	Rk(0.005)

Note) Intervals can be set within a range of 1.0 to 30.0m. If a longer interval out of this range is entered at the Setting Screen, it automatically changed to 30.0m when pressing the ENTER/SAVE key.

Note) Intervals up to 20m can be selected with the supplied Test Leads.

6-2-6 Date and Time Setting

This instrument has a clock function and can save the measured data with time and date information. The clock will not be reset once it has been set even after powering off the instrument. A manual adjustment is required to keep the clock time always right.

Time setting can be done in following procedure.

Select Date/Time with the Cursor Key on the CONFIG-SETTING Screen, and press the ENTER/SAVE Key to display the Time and Date Setting Screen.

Time: 11:59:02
Date: 02/29/08

(1) Time Setting

Put the cursor in Time and press the ENTER/SAVE Key, and display the time Setting Screen.

Time: 11:59:02
Date: 02/29/08

Select a parameter to be changed with the Cursor Key, and press the ENTER/SAVE Key. Then the selected digit is highlighted and ready to be changed. The clock is 24-hour display.

Time: 11:59:02
Date: 02/29/08

Put the Right Cursor Key ► to increase numbers and the Left Cursor Key ◀ to reduce numbers. Keep the cursor Key pressed down to change numbers quickly. Press the ENTER/SAVE Key to confirm a number. Repeat this procedure to change the other digits. Pressing the ESC when settings are done return to the Time/Date Setting Screen.

Time: 11:59:02
Date: 02/29/08

To change the date, proceed to Step (2). Press the ESC Key again to exit from the setting mode and return to the CONFIG-SETTING Screen. Then the clock starts.

(2) Date Setting

Date is displayed in the following order: Month/ Day/ Year.

Put the cursor on Date and press the ENTER/SAVE Key to display the Date Setting Screen .

Time: 11:59:02
Date: 02/29/08

Select a parameter to be changed with the Cursor Key, and press the ENTER/SAVE Key. Then the selected digit is highlighted and ready to be changed.

Time: 11:59:02
Date: 02/29/08

Press the Right Cursor Key ► to increase numbers and the Left Cursor Key ◀ to reduce numbers. Keep the Cursor Key pressed down to change numbers quickly. Press the ENTER/SAVE Key to confirm a number.

Repeat this procedure to change the other digits. Pressing the ESC Key when settings are done returns to the Time/Date Setting Screen .

Time: 11:59:02
Date: 02/29/08

Press the ESC Key again to exit from the setting mode and return to the CONFIG_SETTING Screen. Then the clock starts.

Note) The second is not displayed on the Main Screen; only hours and minutes are displayed.

Note) The backup battery may be exhausted when clock becomes wrong after powering on/off the Instrument. In this case, please contact our local distributor. The life time of the backup battery is approx 5 years.

6-2-7 Setting for the residual resistance (Rk) on the Test Leads

This instrument can store the residual resistance (Rk) of the Test Leads before starting Re measurements on 2/ 3/ 4-wire system, and can deduct the resistance from the measured result. The setting of Rk can be done in following procedure.

Note) Connections of Test leads vary by measurement methods. See the corresponding pages for further details.

Note) Rk cannot be saved while the Low Battery Mark BATT or Batt Error is displayed on the LCD.

Select the 2W or 20W.

Select Rk with the Cursor Key on the CONFIG_SETTING Screen, and press the ENTER/SAVE Key to display the Rk Setting Screen.

Rk=0.000 Ω	Save Clear
--------------------------	---------------

Press the Test Button to measure Rk. The measured results will not be saved until the ENTER/SAVE Button is pressed. The CONFIG_SETTING Screen is displayed when the Button is pressed down and the data is saved.

CONFIG_SETTING	
Wire(ρ)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	RR(0.005)

The Rk value is being kept even powering off the instrument. To clear the saved Rk values, select Clear on the Rk Setting Screen and press the ENTER/SAVE Key. Then the value restores to 0.000 Ω .

Rk=0.005 Ω	Save Clear
--------------------------	---------------

Then CONFIG_SETTING Screen) is displayed again.

CONFIG_SETTING	
Wire(ρ)	Freq(94)
Site(111)	Lh(14.5)
Date/Time	RR(0.000)

Note) Rk values exceeding following values cannot be saved.

2 Ω Range: max 2 Ω , 20 Ω Range: max9 Ω

A message shown in Fig.30 is displayed when the measured Rk is exceeding above values.

Note) The message shown in is also displayed when a fuse blows.

Rk= OL Ω	Save Clear
------------------------	---------------

Following message appears and shows that the data cannot be saved when the ENTER/SAVE Key is pressed with above display.

Rk=0.000 Ω	Save Clear
Rk limit	



Note) Following message appears and shows that the data cannot be saved when trying to save Rk at 200k Ω or upper Ranges. The Rk values saved at 2 Ω and 20 Ω Ranges are kept effective at 200k Ω or upper Ranges.

Rk=0.000 Ω Range <= 20	Save Clear
--	-----------------------------

Note) Following message appears and shows that the data cannot be saved when trying to save Rk at Wire (ρ) measurement.

Rk=0.000 Ω Only 2w/3w/4w	Save Clear
--	-----------------------------

6-3 Backlight

To facilitate working in dimly lit situations or in night time, a backlight function is provided which illuminates the LCD. Press the  Key to operate this function. The backlight will light up for about 30 sec and turned off automatically. Pressing the  Key while the backlight is on can turn it off by manual.

6-4 Auto-Power-Off

This instrument is automatically powered off about 5 min after the last switch operation. To exit from the auto-power-off mode, set the Range Switch to OFF position once, and re-set it the Range at which a measurement to be conducted.

6-5 Series Interference Voltage (Earth Voltage) Measurement

Measurements are automatically started during a measurement of earth resistances and earth resistivities, and the results can be checked on the Result display screen.

Warning message **Voltage High!** is displayed on the Main display when the earth voltage (U_{st}) is high.

2 Ω /20 Ω Range: **Voltage High!** warning appears when the voltage is 12V or higher. Earth resistance measurement cannot be made when the voltage exceeds 15V.

2 Ω /20 Ω Range: **Voltage High!** warning appears when the voltage is 15V or higher. Earth resistance measurement cannot be made when the voltage exceeds 20V.

Note) DC series interference voltages cannot be measured.

6-6 Auxiliary Earth Resistance Measurement

This instrument can measure and display the auxiliary earth resistances (R_h , R_s).

When the Rh or Rs value is more than Regulated value or 50W, a warning message **Rh>limit** or **Rs>limit** appear. The LCD shows **Rh=OL Ω** or **Rs=OL**, when the Rh or Rs values exceed 50kΩ. These parameters are measured automatically at auxiliary earth resistance measurements, and can be checked on the Result Display Screen. **Note) Rh and Rs stand for Auxiliary Earth Pole H(C) and the Auxiliary Earth Resistance of S(P) respectively.**

6-7 Connection of Earth Test Leads and Simplified Measurement Probes

Connect the Earth Test Leads and Simplified Measurement Probes to the connectors on the instrument firmly. Otherwise, a contact failure occurs and wrong results may be read out on the LCD.

Note) Some numbers other than OL may be displayed on the LCD when making measurement without connecting any cord or probe at 200Ω or upper Ranges. This is not a malfunction.

7. Measurement Method

7-1 Earth Resistance Measurement

7-1-1 Precise Measurement (3-Wire) * with Earth Test Leads

This is a standard method to measure earth resistances. The measured earth resistances are free of auxiliary earth resistances but the resistances on the E terminal are contained.

terminal are contained.

Terminals to be used: E, S(P), H(C) Terminals

Test Leads: connect to the E, S(P), H(C) Terminals

Auxiliary Earth Spike: 2 pcs, connect to the S(P) and H(C) terminal

(1) Setting of Wiring System

Select Wire (4) with reference to 6-2-2 Setting for Measurement Method in this manual.

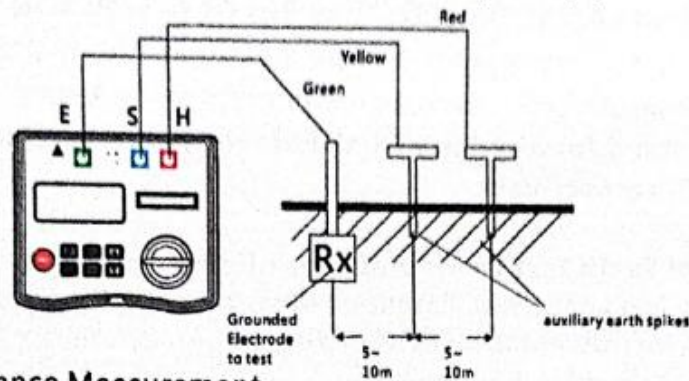
(2) Setting of Rk

1. Firmly insert each plug of 3 test leads (green, yellow, red) to the corresponding connectors on the instrument.
2. Select the 2Ω or 20Ω Range
3. Engage 3 Alligator clips to short-circuit all of them.
4. Save the Rk values with reference to 8-2-7 Setting for the residual resistance (Rk) on the Test Leads.

Note) A break in Test Leads or burnout of Fuse is suspected when the LCD shows Rk=OL Ω while 3 Test Leads are being shorted.

(3) Connection of Auxiliary Earth Spikes and Test Leads Stick the Auxiliary Earth Spikes S(P) and H(C) into the ground deeply. They should be aligned at an interval of 5-10m from the earthed equipment under test. Connect the green Test Lead to the earthed equipment under test, the yellow Test Lead to the Auxiliary Earth Spike

S(P) and the red Test Lead to the Auxiliary Earth Spike H(C).



(4) Earth Resistance Measurement

Select a Range (any Range is ok) when the connection is done, and press the TEST Button. A message Measuring..... Is displayed at the upper right on the LCD. The measured earth resistance R_e are displayed on the LCD. The operation procedure is same to that for 3-wire measurements.

N003 S995 02/26 15:08			
$R_E = 2008$		3-w	128Hz
		▶	

Pressing the Cursor Key displays the Result Display Screen to view each parameter.

N003 S995 02/26 15:08			
Rh=	128	Fst=	50.0Hz
Rs=	2.64k	Ust=	19.2V
Rk=	0.072	◀	

Note) The readings may not correct when the auxiliary earth resistance is too high. Stick the Auxiliary Earth Spikes S(P) and H(C) in the moist part of the soil. If a message $R_h > \text{limit}$ or $R_s > \text{limit}$ appear on the LCD, auxiliary earth resistance is too high to make measurements. Recheck the connection of Test Leads.

Give enough water where the spikes have to be stuck into the dry stony or sandy or sandy part of the earth so that it may become moist. In case of concrete, lay the Auxiliary Earth Spike down and water it, or put a wet cloth etc. On the spike when making measurements.

7-1-2 Precise Measurement (4-wire)* with earth Test Leads

The ES terminal is also used with the other terminals used at the 3-wire Precise measurements. In this case, more precise results can be obtained because auxiliary earth resistances of the measured earth resistances are excluded, moreover, resistance of the Test Leads connected to the E Terminal can be canceled.

Terminals to be used: E, ES, S(P), H(C) Terminals

Test Leads: Connect to the E, ES, S(P), H(C) Terminals (the ES Test Lead should be connected to the earthed equipment under test where the E Test Lead is connected)

Auxiliary Earth Spike: 2 pcs

(1) Setting of wiring System

Select Wire(4) with reference to 6-2-2 Setting for Measurement Method in the manul.

(2) Setting of Rk

The measured results obtained at 4-Wire system are not be influenced by the Test Leads Connected to the E Terminal, but setting of Rk can be made on this instrument.

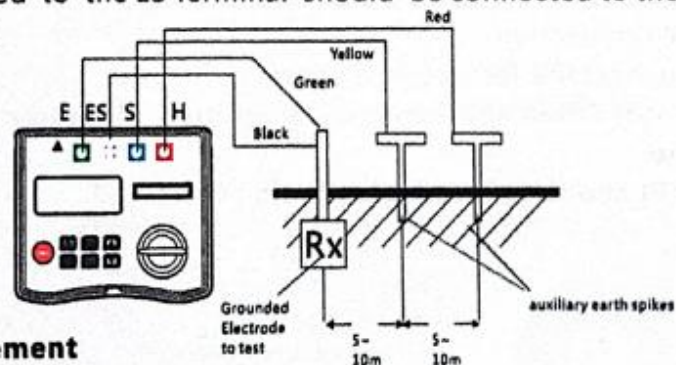
1. Firmly insert each plug of 4 Test Leads (green, black, yellow, red), to the corresponding connectors on the instrument.
2. Select the 2Ω or 20Ω Range.
3. Engage 4 Alligator clips to short-circuit all of them.
4. Save the Rk values with reference to 6-2-7 Setting for the residual resistance (Rk) on the Test Leads.

Note) A break in Test Leads or burnout of Fuse is suspected when the LCD shows $R_k = OL\Omega$ while 4 Test Leads are being shorted.

(3) Connection of Auxiliary Earth Spikes and Test Leads

Stick the Auxiliary Earth Spikes S(P) and H(C) into the ground deeply. They should be aligned at an interval of 5-10m from the earthed equipment under test. Connect the green Test Lead to the earthed equipment under test, the yellow Test Lead to the Auxiliary Earth Spike S(P) and the red Test Lead to the Auxiliary Earth Spike H(C).

The black Test Lead connected to the ES Terminal should be connected to the earthed equipment under test.



(4) Earth Resistance Measurement

Select a Range (any Range is ok) when the connection is done, and press the TEST Button. The measured earth resistances R_e are displayed on the LCD.

The operation procedure is same to that for 3-Wire measurements.

Note) If a message $R_h > \text{limit}$ or $R_s > \text{limit}$ appear on the LCD, auxiliary earth resistance is too high to make measurements. Recheck the connection of Test Leads.

7-1-3 Simplified Measurement (2-Wire) *with Simplified Test Probes

Use this method when the Auxiliary Earth Spike cannot be stuck. In this method,

pipe, a common earth of a commercial power supply and an earth terminal of a building, can be used with the 2-Wire method.

However, the measured earth resistances contain the auxiliary earth resistance and the resistance of the E Test Lead.

This instrument is supplied with a set of Simplified Measurement Test Leads for which both of Alligator Clips and Flat Test Bar can be replaced and used if necessary.

Terminals to be used: E, S(P), H(C) Terminals

Test Leads: one to the E Terminal, Simplified Measurement Probes to the S and H Terminals and short-circuit these Terminals.

Auxiliary Earth Spike: None is used

(1) Setting of Wiring System

Select Wire(2) with reference to 8-2-2 Setting for Measurement Method in this manual.

(2) Setting of Rk

1. Put the Alligator Clips to the 2 Test Leads (green, red), and connect the green Plug to the E Terminal and the two red Plugs to the S(P) and H(C) Terminals respectively.

2. Select the 2Ω or 20Ω Range

3. Engage 2 Alligator clips to short-circuit both of them.

4. Save the Rk values with reference to 6-2-7 Setting for the residual resistance (Rk) on the Test Leads.

Note) A break in Test Leads or burnout of Fuse is suspected when the LCD shows Rk=OLW 4 Test Leads are being shorted.

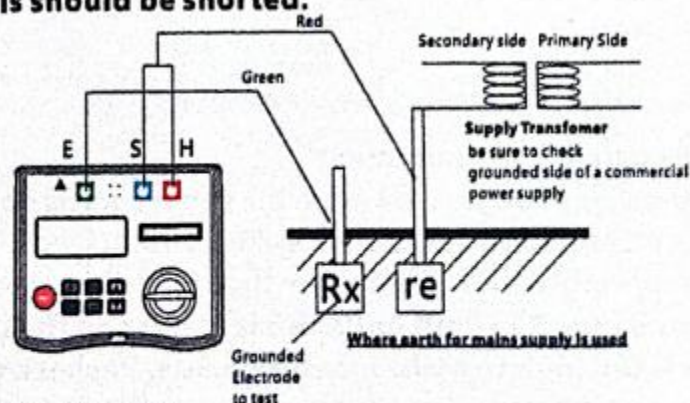
(3) Connection

Connect the Test Leads as shown in.

Note) When the supplied Simplified Measurement Probes are not used,

the

S(P) and H(C) Terminals should be shorted.



(4) Earth Resistance Measurement

Select a high resistance Range when the connection is done, and press the TEST Button. Then the earth resistance values Re are displayed on the LCD. Select a lower Range for the low earth resistances.

(5) Measured resistances at simplified measurements

Two-Wire method is used for the simplified measurements. In this method, earth resistance of the earthed electrode (re) connected to the S(P) Terminal is added to the true earth resistance Rx and shown as an indicated value Re.

$$Re \text{ (indicated value)} = Rx + re$$

If the Re is known beforehand, true earth resistance value Rx is calculated as follows.

$$Rx = Re - re$$

Note) The re cannot be canceled by the setting of Rk.

7-2 Earth Resistivity (ρ)

Making a setting of the interval between Auxiliary Earth Spikes first and measuring the earth resistances with the 4 Auxiliary Earth Spikes stuck into the ground at even intervals. Then the instrument can calculate and display earth resistivity on the LCD automatically.

Terminals to be used: E, ES, S(P), H(C) Terminals

Test Leads : connect to the E, ES, S(P) and H(C) Terminals

Auxiliary Earth Spike : 4 pcs

(1) Setting of Wiring System

Select Wire(ρ) with reference to 6-2-2 Setting for Measurement Method in this manual.

Note) The instrument doesn't accept any setting change on Rk while measuring earth resistivity(ρ)

(2) Connection of Auxiliary Earth Spikes and Test Leads

Stick the four Auxiliary Earth Spikes into the ground deeply. They should be aligned at an interval of 1-30m. The depth should be 5% or less of the interval between the spikes.

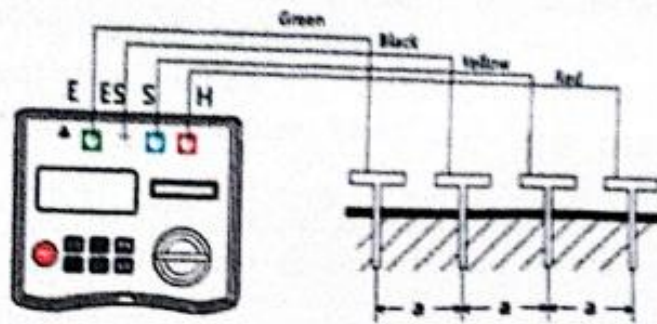
(e.g. The spike should be stuck in the depth of 25cm or less when the interval of the Auxiliary Earth Spikes is 5m.)

If the Spikes stuck too deep, it may result in inaccurate earth resistivity measurement.

Note) The supplied Test Leads can be used for the Spikes stuck at the interval of max 20m.

Note) The length of the supplied Auxiliary Earth Spike is 20cm.

Connect the green, black, yellow Test Leads connected to the E, ES, S(P) and H(C) Terminals on the instrument to the Auxiliary Earth Spikes from the closest to the farthest in this order.



(4) Earth Resistivity (ρ)

Select a Range (any Range is ok) when the connection is done, and press the TEST Button. Then the measured earth resistivity (ρ) and the earth resistance R_g between the ES-S Terminals are displayed.

N003 S995 02/26 15:08			
$\rho=369.4 \Omega m$		$\rho-u$	
$R_g=5.88 \Omega$		AUTO	
		◀ ▶	

Pressing the Cursor Key displays parameters like shown.

N003 S995 02/26 15:08			
$R_g=5.88 \Omega$	$F_{st}=0.0Hz$		
$R_h=204 \Omega$	$U_{st}=0.0V$		
$R_s=99 \Omega$	$L=10.0m$		◀

Press the Key to return to the Main Screen.

If the R_g value is too large, the display reads as shown. In this case, rotate the Range Switch and select an upper Range.

N003 S995 02/26 15:08			
$P=OL$		$\rho-u$	
$R_g=OL k\Omega$		128Hz	
		◀ ▶	

Pressing the Key while the measured result of ρ is being displayed switches the display as indicated. Then setting of interval between auxiliary earth spikes (L_h) can be made. Clause 6-2-5 describes the detailed setting procedure.

Length(m)	
$L=12.3m$	