# AD INSTRUMENTS

# AD6650 Multifunction Tester

## User Manual

**Contents** **Page**

**Warning!**

You must read and completely understand the Safety Considerations part of this manual before using the instrument.

## 1-Safety Considerations

This manual contains instructions regarding the safe use and the proper functioning of the instrument. If not complied with, the user could be exposed to danger and the instrument to possible damage.

### 1.1-International Symbols

| | |
|---|---|
|  | WARNING! |
|  | CAUTION! Voltage present |
|  | Earth |
|  | Double Insulation (Class II insulation) |
|  | Fuse |
|  | Prohibited to use for the Electrical System which uses the voltage above 550V |
|  | Conformity to European Standards |

### 1.2-Terminology

The term **WARNING** as used in this manual defines a condition or a procedure which could lead to a serious injury or accident. The term **CAUTION** defines a condition or action which could lead to the instrument being rendered defective during the testing process.

### 1.3-Warnings

- Make sure to read and fully understand the instruction contained within this manual prior to use.
- This instrument is not intrinsically safe therefore do not use the instrument in hazardous environments.
- In order to prevent fire and/or electrical shock, do not use the instrument in wet, damp or highly humid environments.
- Prior to use, check if the instrument functions correctly. If any symptoms/symbols of malfunction or abnormalities are indicated, do not use and inform MTi Instruments.
- Users who could be exposed to voltages in excess of the extra low band (50V ac or 120V dc) should be competent and be aware of the requirements of GS 38 regarding the use of the instrument and the associated leads and probes etc.
- Make sure your fingers holding the test probes are positioned behind the safety lines of the test probes.
- DO NOT OPEN THE INSTRUMENT.
- If the internal fuse (protective device) operates, replace with a device of the same type and rating. If it operates again seek professional advice. DO NOT REPLACE FUSE AND TRY AGAIN.
- When carrying out the “dead tests” ensure prior to connection of the instrument leads the circuit under test has been confirmed “dead” and secured in the OFF position using appropriate methods.
- Battery condition is indicated by a beep. Check and replace if necessary.
- Do not test an electrical circuit or systems where the voltage is in excess of 550V.
- Ensure at all times the leads are in compliance with GS 38 (as supplied) and not damaged.

**1.4-Caution**

Do not change functions on the test instrument with the test leads in place, i.e. changing from a "dead test" to a test where the supply is required could damage the instrument.

**1.5-Declaration of Conformity**

This instrument has been tested according to the below regulations:

EN 61326: Electrical equipment for measurement, control and laboratory use.

EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use –Part 1: General requirements.

BS EN61557: Electrical safety in low voltage distribution systems up to 1000V a.c. and 1500V d.c. Equipment for testing, measuring or monitoring of protective measures.

- Part 1 General requirements
- Part 2 Insulation resistance
- Part 3 Loop resistance
- Part 4 Resistance of earth connection and equipotential bonding
- Part 6 Residual current devices (RCDs) in TT and TN systems
- Part 7 Phase sequence
- Part 10 Combined measuring equipment

**1.6-Error Codes**

Various error conditions are detected by the tester and are indicated with the icon, "Err", and an error number on the primary display. See Table 1. These error conditions disable testing and, if necessary, stop a running test.

Table 1. Error Codes

| Error Condition Code | Code | Solution |
|---|---|---|
| Solution Fault Voltage | 1 | Check the installation, in particular, the voltage between N and PE. |
| Over Temp | 2 | Wait while the tester cools down. |
| Excessive Noise | 3 | Switch off all appliances (Loop, RCD measurements) and move the earth stakes (earth measurement). |
| Excessive Probe Resistance | 4 | Put the stakes deeper into the soil. Tamp down the soil directly around the stakes. Pour water around the stakes but not at the earth ground under test. |
| Self Test Fails | 5 | Return the tester to a Service Center. |

## 2-Specification

**LOOP Resistance**

**L- PE (Hi-Amp)**

| Range(Ω) | Resolution(Ω) | Accuracy |
|---|---|---|
| 0.23～9.99 | 0.01 | ±(4% of reading+6digits) |
| 10.0～99.9 | 0.1 | |
| 100～999 | 1 | |

Measuring Current: 8.0 A～25.0 A

Range of the Voltage Used: 195V a.c. – 260V a.c. (50,60Hz)

***Notes***

[1] Valid for resistance of neutral circuit <20Ω and up to a system phase angle of 30°. Test leads must be zeroed before testing.

[2] Valid for mains voltage >200V.

**L- PE (No Trip)**

| Range(Ω) | Resolution(Ω) | Accuracy |
|---|---|---|
| 0.23~9.99 | 0.01 | ±(5% of reading+6 digits) |
| 10.0~99.9 | 0.1 | |
| 100~999 | 1 | |

Measuring Current: < 15mA

Range of the Voltage Used: 195V a.c – 260V a.c (50,60Hz)(50,60Hz)

***Notes***

[1] Valid for resistance of neutral circuit <20Ω and up to a system phase angle of 30°. Test leads must be zeroed before testing.

[2] Valid for mains voltage >200V.

**LINE Resistance**

**L- N**

| Range(Ω) | Resolution(Ω) | Accuracy |
|---|---|---|
| 0.23 – 9.99 | 0.01 | ±(4% of reading+4digits) |
| 10.0 – 99.9 | 0.1 | |
| 100 – 999 | 1 | |

Measuring Current: 4.0 A

Range of the Voltage Used: 195V a.c. – 260V a.c. (50,60Hz)

***Notes***

[1] Valid for resistance of neutral circuit <20Ω and up to a system phase angle of 30°. Test leads must be zeroed before testing.

[2] Valid for mains voltage >200V.

**RCD (BSEN 61557-6)**

Rcd Rating (I_n): 10mA, 30mA, 100mA, 300mA, 500mA, 650mA and 1A.

Test current: x1/2, x1, x2 and x5

**Accuracy at applied test current**

| Current Multiplier | Trip Time Accuracy |
|---|---|
| x1/2 | ±(1% of reading+1ms) |
| x1 | ±(1% of reading+1ms) |
| x2 | ±(1% of reading+1ms) |
| X5 | ±(1% of reading+1ms) |

Form of the Test Current: Sine wave form (ac), Pulse wave form (dc)

RCD Form: General (G - non-delayed), Selective (S - time-delayed)

Initial Polarity of the Test Current: 0°, 180°.

Voltage Range: 195V a.c. - 260V a.c. (50Hz,60Hz)

Accuracy of the Current of the RCD: ± (5% of reading + 1digits)
Resolution of the RCD Timing: 0.1ms

**Voltage and Frequency**

| Measurement Range (V)/AC-DC | Resolution(V) | Accuracy |
|---|---|---|
| 80～500 | 1 | ±(2% of reading +2digits) |

| Measurement Range (Hz) | Resolution(Hz) | Accuracy |
|---|---|---|
| 45～65 | 1 | ±2Hz |

**Insulation**

| Terminal Voltage | Range | Resolution | Accuracy | Test Current | Short circuit current |
|---|---|---|---|---|---|
| 125V(0%～+10%) | 0.125～4.000 MΩ | 0.001MΩ | ±(3%+10) | 1mA @load125kΩ | ≤1mA |
| | 4.001～40.00 MΩ | 0.01MΩ | ±(2%+10) | | |
| | 40.01～400.0 MΩ | 0.1MΩ | ±(4%+5) | | |
| | 400.1～1000 MΩ | 1MΩ | ±(5%+5) | | |
| 250V(0%～+10%) | 0.250～4.000 MΩ | 0.001MΩ | ±(3%+10) | 1mA @load250kΩ | ≤1mA |
| | 4.001～40.00 MΩ | 0.01MΩ | ±(2%+10) | | |
| | 40.01～400.0 MΩ | 0.1MΩ | ±(3%+2) | | |
| | 400.1～1000 MΩ | 1MΩ | ±(3%+2) | | |
| 500V(0%～+10%) | 0.500～4.000 MΩ | 0.001MΩ | ±(3%+10) | 1mA @load500kΩ | ≤1mA |
| | 4.001～40.00 MΩ | 0.01MΩ | ±(2%+10) | | |
| | 40.01～400.0 MΩ | 0.1MΩ | ±(3%+2) | | |
| | 400.1～1000 MΩ | 1MΩ | ±(4%+5) | | |
| 1000V(0%～+10%) | 1.000～4.000 MΩ | 0.001MΩ | ±(3%+10) | 1mA @load1MΩ | ≤1mA |
| | 4.001～40.00 MΩ | 0.01MΩ | ±(2%+10) | | |
| | 40.01～400.0 MΩ | 0.1MΩ | ±(3%+2) | | |
| | 400.1～1000 MΩ | 1MΩ | ±(4%+5) | | |

**Low Ohm**

| Range | Resolution | Accuracy | Max. Open Circuit Voltage | Overload Protection |
|---|---|---|---|---|
| 0.000～2.000Ω | 0.001Ω | ±(1.5%+30) | 5.0V±1VDC | 250Vrms |
| 2.00～20.00Ω | 0.01Ω | ±(1.5%+3) | | |
| 20.0～200.0Ω | 0.1Ω | | | |
| 200～2000Ω | 1Ω | ±(1.5%+5) | | |

**Earth Resistance**

| Range | Resolution | Accuracy |
|---|---|---|
| 0.00～99.99Ω | 0.01Ω | ±(2%+30d) |
| 100.0～999.9Ω | 0.1Ω | ±(2%+6d) |
| 1000～2000Ω | 1Ω | |

## 3-General Specification

| | |
|---|---|
| **Power Source** | 8 x 1.5V AA Size Alkaline batteries<br>or 8 x 1.2V AA Size rechargeable Ni-MH batteries |
| **Battery Life** | Average of 15hours |
| **CAT Rating** | CAT III 600V |
| **Protection Classification** | Double Insulation |
| **Protection Rating** | IP65 |
| **LCD Screen Type** | 3.5"TFT |
| **Pixels** | 320x240 |
| **Operating Temp** | 0°C～ 45°C<br>95% 10°C～ 30°C: Non-condensing |
| **Relative Humidity** | 75% 30°C～ 40°C |
| **Storing Temp** | -10°C～ 60°C |
| **Operating Altitude** | 2000m |
| **Protective device** | 500mA Fast response BS 88 Fuse |
| **Dimensions** | 24.2cm(L) x 10.5cm(W) x 14.5cm(H) |
| **Weight** | 1.56kg |

## 4-Instrument Overview

### 4.1-Front View

*1*-Starts the selected test. The T key is surrounded by a "touch pad". The touch pad measures the potential between the operator and the tester's PE terminal. If you exceed a 100 V threshold, the D symbol above the touch pad is illuminated.

*2*-Warning lamp

*3*-320X(RGB)X240 color active matrix

*4*-Press and hold Turns the tester on and off. Short Press return the latest status.

*5*-Function selector switch.

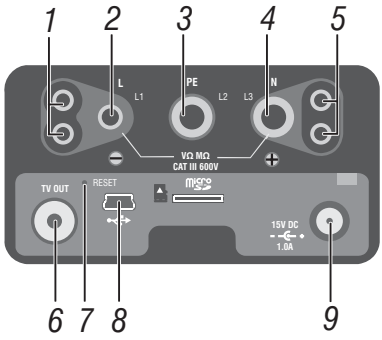
*6*-Navigation keys:
Enter, Up, Down, Left/Save, Right

*7*-Selects the sub-menus from the Test Mode selected by the rotary switch:
F1, F2, F3, F4

*8*-Accesses help menus and delete files .

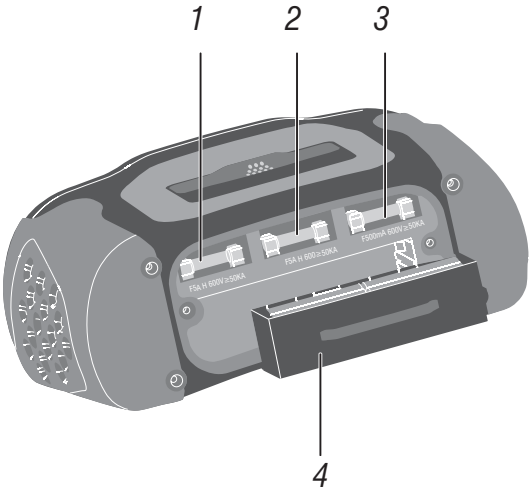
**4.2-Connector Panel**

*1*-Input Terminal to operate the switched probe
*2*-L - Line Input
*3*-PE - Protective Earth Input
*4*-N - Neutral Input
*5*-Input Terminal to operate the switched probe
*6*-TV OUT
*7*-System Reset
*8*-USB Connector
*9*-Power Supply Socket

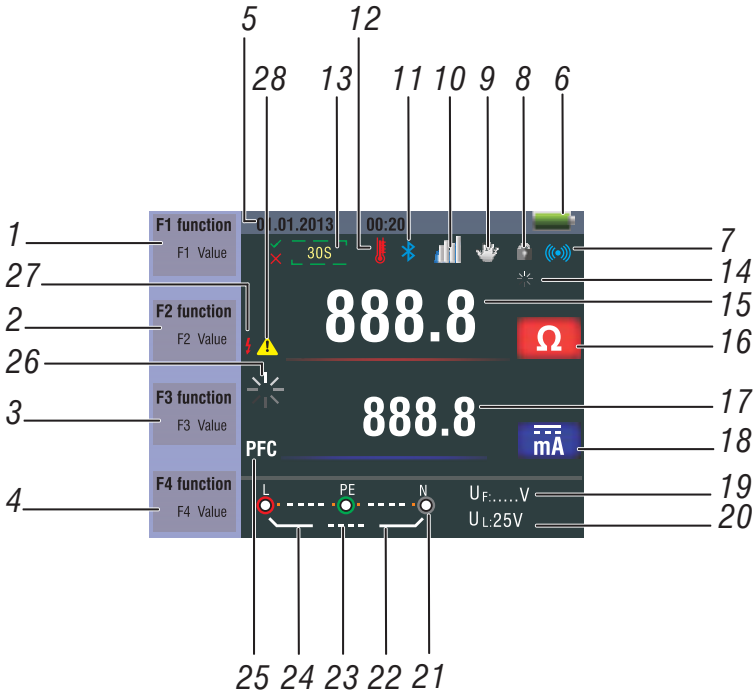



**4.3-Battery & Fuse**

*1*-Fuse 5A 600V
*2*-Fuse 5A 600V
*3*-Fuse 500mA 600V
*4*-Battery cells (size AA).

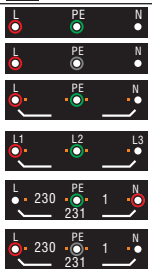


### 4.4-Understanding the Display




| No. | Annunctator | | |
|---|---|---|---|
| | Function | Value | |
| 1 | RCD | | AUTO |
| | | | X1/2 |
| | | | X1 |
| | | | X2 |
| | | | X5 |
| | | | RAMP |
| | Loop/PFC | L-PE | |
| | | L-L | |
| | | L-N | |
| | V/Phase | L-PE | |
| | | | |
| | Continuity | 0.5Ω | |
| | | 1.0Ω | |
| | | 2.0Ω | |
| | | 5.0Ω | |

| No. | Annunctator | |
|---|---|---|
| | Function | |
| 1 | Continuity | 10.0Ω |
| | | 20.0Ω |
| | | 50.0Ω |
| | | 50.0Ω |
| | Terminal Voltage | 125V |
| | | 250V |
| | | 500V |
| | | 1000V |
| 2 | Trip Current | 30mA |
| | | 100mA |
| | | 300mA |
| | | 500mA |
| | | 650mA |
| | | 1000mA |
| | | 10mA |
| | Current | NO Trip |
| | | Hi Amp |
| | Beeper | OFF |
| | | ON |
| 3 | Type of RCD | G |
| | | S |
| | | G |
| | | S |
| | Lock | OFF |
| | | ON |
| 4 | 0°/180° | 0° |
| | | 180° |
| | ZERO | Ø |
| | Reference | 0.125MΩ |
| | | 0.25MΩ |
| | | 0.5MΩ |
| | | 1MΩ |
| | | 2MΩ |
| | | 5MΩ |
| | | 10MΩ |
| | | 20MΩ |
| | | 50MΩ |
| | | 100MΩ |
| | | 200MΩ |
| 5 | Date Time | |

| No. | Annunctator | Meaning |
|---|---|---|
| 6 |  | Low battery icon. See<br>  :Indicates the battery status.<br>  :100%<br>  :80%<br>  :50%<br>  :20%<br>  :Low Battery<br>for additional information on batteries and power management. |
| 7 |  | Beeper |
| 8 |  | Lock |
| 9 |  | Hold |
| 10 |  | Datalog |
| 11 |  | Bluetooth |
| 12 |  | Appears when the instrument is overheated. |
| 13 |  | Display 30 seconds (time-delayed) |
| 14 |  | Being tested |
| 15<br>16 |  | Primary display and measurement units. |
| 17<br>18 |  | Primary display and measurement units. |
| 19 | $U_{F:}$ | Fault voltage. Measures neutral to earth. |
| 20 | $U_{L:}$ | Indicates the preset falut voltage limit. |
| 21 |  | Arrows above or below the terminal indicator symbol indicate reversed polarity. Check the connection or check the wiring to correct. |
| 22 | N-PE | N-PE Value |
| 23 | L-N | L-N Value |
| 24 | L-PE | L-PE Value |
| 25 | PFC | Prospective Earth Fault Current.<br>Calculated from voltage and loop impedance which is measured line to protective earth. |
| | PSC | Prospective Short Circuit. Calculated from measured voltage and impedance when reading line to neutral. |
| 26 |  | Being tested |
| 27 |  | High Voltage Warning |
| 28 |  | Warning |

## 5-How to Use the Tester

### 5.1-Important Symbols and Messages during the measurement

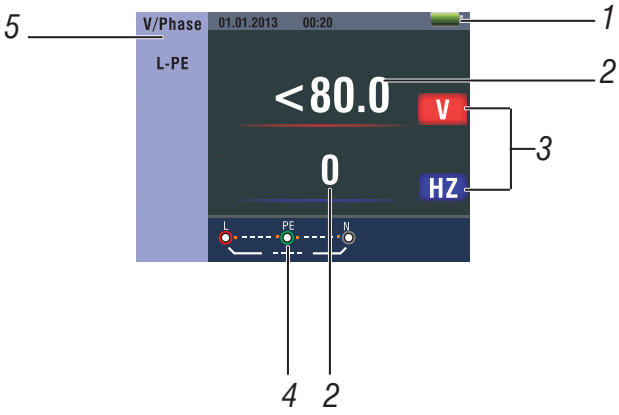



Figure 1 Screen

**Description**

*1*-Battery status
*2*-Displayed measured value
*3*-The measurement unit of the measured value
*4*-The indication of the correct input terminal connection
*5*-Displayed menu

5.1.1-Displayed icons (symbols) and messages in VOLTAGE function


:Indicates the correct input terminal connectivity . The user should connect the test leads to the appropriate terminals.


:Indicates L connection is connected on the N input terminal and vice-versa


:Indicates no connection on the PE input terminal

If the wiring condition is other than normal, the Tester is limited on its measurements that can be performed.

***Notes:***

- Will not detect two hot wires in a circuit.
- Will not detect a combination of defects.
- Will not detect reversal of grounded and grounding conductors.


:Indicates the battery status.


:100%


:80%


:50%


:20%


:Low Battery

5.1.2-Displayed icons (symbols) and messages in LOOP/PFC function

:Indicates the correct input terminal connectivity . The user should connect the test leads to the appropriate terminals.

:Indicates L connection is connected on the N input terminal and vice-versa

:Indicates no connection on the PE input terminal

If the wiring condition is other than normal, the Tester is limited on its measurements that can be performed.

***Notes:***

- Will not detect two hot wires in a circuit.
- Will not detect a combination of defects.
- Will not detect reversal of grounded and grounding conductors.


:Indicates the battery status.


:100%


:80%


:50%


:20%


:Low Battery


:Indicates high temperature and therefore cannot make any measurements

***Message:***

Measuring : Function in use - measurement being carried out

RCD Trip: During the measurement, the RCD has tripped therefore no test result obtained

-Noise-: Appears during the No Trip Loop Measurement, and indicates that the displayed value may not be accurate due to “mains” interference - test to be repeated

5.1.3-Displayed icons (symbols) and messages in RCD function

: Indicates the correct input terminal connectivity . The user should connect the test leads to the appropriate terminals.

: Indicates L connection is connected on the N input terminal and vice-versa

: Indicates no connection on the PE input terminal

If the wiring condition is other than normal, the Tester is limited on its measurements that can be performed.

***Notes:***

- Will not detect two hot wires in a circuit.
- Will not detect a combination of defects.
- Will not detect reversal of grounded and grounding conductors.


: Indicates the battery status.


: 100%


: 80%


: 50%


: 20%

: Low Battery
: Indicates high temperature and therefore cannot make any measurements

***Message:***
Half: Appears during the auto test when rcd has operated on the x ½ test
Half Trip: Appears during the manual test when rcd has operated on the x ½ test
UL OVER: Appears when UF voltage exceeds the previously set UL voltage. (UL voltage can be set to 25V or 50V) The user must check the impedance between L-PE

5.1.4-Displayed icons (symbols) and messages when using the LOW OHM and CONTINUITY functions
***Symbol:***


: Indicates correct input terminal connectivity. The user should connectthe test leads to the appropriate terminals indicated by color coding.
: Low Battery (The icon will be flashing along with the beep sound).
ZERO : The resistance of the test leads are included in the test measurement
ZERO : The resistance of the test leads are not included in the test measurement

5.1.5-Displayed icons (symbols) and messages when using the RE functions


: Indicates correct input terminal connectivity. The user should connect the test leads to the appropriate terminals indicated by color coding.
: Low Battery (The icon will be flashing along with the beep sound).
ZERO : The resistance of the test leads are included in the test measurement
ZERO : The resistance of the test leads are not included in the test measurement

5.1.6-Displayed icons(symbols) and messages in INSULATION function


: Indicates correct input terminal connectivity. The user should connect the test leads to the appropriate terminals indicated by color coding.
: Low Battery (The icon will be flashing along with the beep sound).
: Indicates high voltage (125V, 250V,500V or 1000V) at probe terminals, Use caution

**5.2-Using the LOOP/PFC Function**
*1*-Before you do a loop impedance test, use the zero adapter to zero the test leads or the mains cord. Press and hold F4 button for more than two seconds until the annunciator appears. The tester measures the lead resistance, stores the reading in memory, and subtracts it from readings. The resistance value is saved even when the power is turned off so it is unnecessary to repeat the operation each time you use the tester with the same test leads or mains cord.
***Note***: Be sure the batteries are in good charge condition before you zero the test leads.

*2*-You can select UL Voltage by Pressing and hold F3 button for more than two seconds (25V or 50V).

5.2.1-Using the No Trip LOOP Measurement to be selected where the circuit is protected by an RCD whose rating is 30mA or above

*1*-Turn the rotary switch to the LOOP/PFC position
*2*-Connect the test leads as Figure Figure *4*
*3*-If voltage of the L- PE on the lower left appears, the unit is ready to TEST
*4*-Press the TEST button when ready

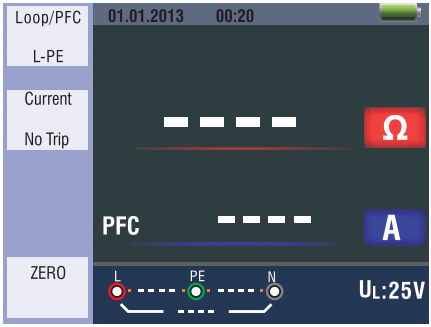



Figure 2-No Trip LOOP-Standby Screen

*5*-If NOISE appears during the No Trip Loop Measurement, the displayed value may not be accurate due to “mains” interference and the test should be repeated

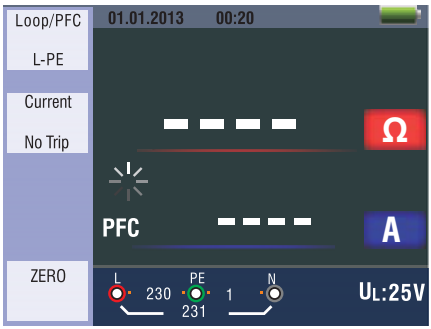



Figure 3-No Trip LOOP

When carrying out the test from a 13A socket the points of contact are automatically selected by the plug top connection

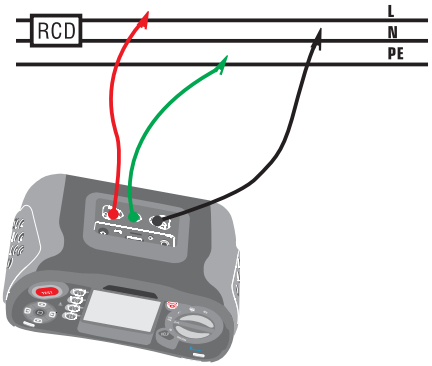
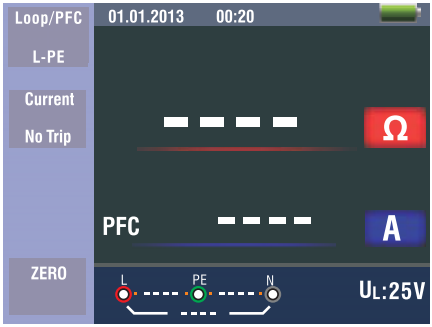
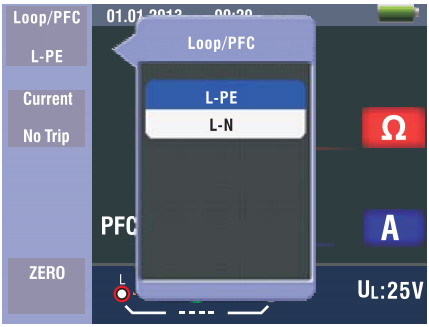


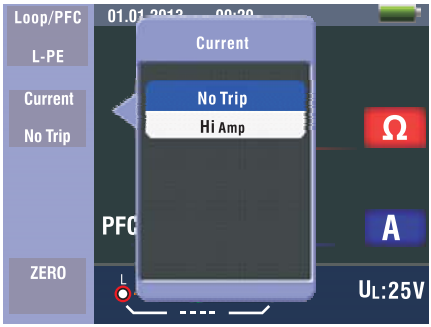

Figure 4 No Trip LOOP-Test lead connection

5.2.2-LOOP / PFC Function Menu Operation
Main Display




Menu Display




**F1 Button:** Pop-up and shutdown Loop/PFC menu , Shutdown mode is activated when the user selects.
**F2 Button:** Pop-up and shutdown Current menu , Shutdown mode is activated when the user selects
**F3 Button:** None
**F4 Button:** Press the F4 button 3S, triggering zero function.
**Up Button:** Up menu to select the current active sub-options.
**Down Button:** Down menu to select the current active sub-options.
**Enter Button:** Confirm the user select mode.

*1*-When measuring is completed, impedance of L- PE and PFC (If) value appears on the screen
*2*-Press TEST button if re-test is necessary.
When symbol from 

, 

,  appears lower left corner, and if the voltage exceeds 260V, the measurement will not take place

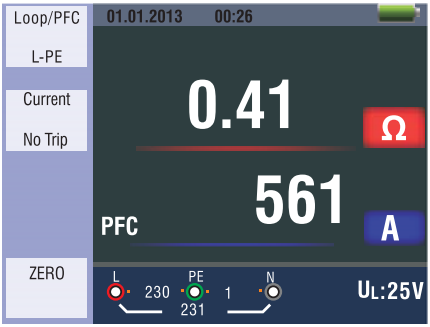



Figure 5 No Trip-Measurement completed

5.2.3-Using the Hi Amp LOOP Measurement to be selected where the circuit is NOT protected by the inclusion of an RCD
*1*-Turn the rotary switch to the LOOP / PFC position
*2*-Press F2 button to change from No Trip to Hi Amp
*3*-Connect the test leads as shown in the *Figure 8*
*4*-If voltage of the L- PE on the lower left appears, the unit is ready to TEST
*5*-Press the TEST button when ready

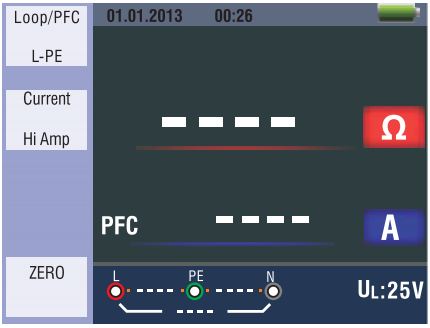



Figure 6 Hi Amp Loop-Standby screen

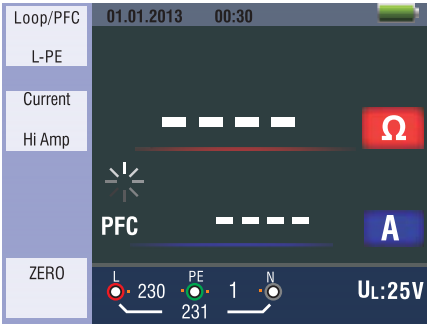



Figure 7 Hi Amp LOOP-To be used where NO RCD is present

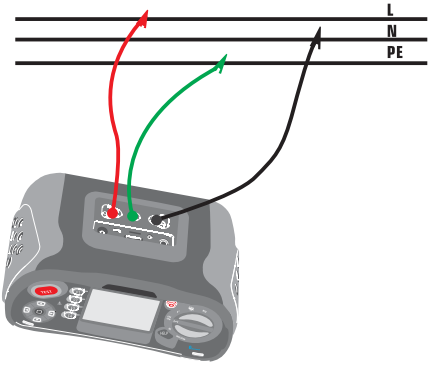



Figure 8 Hi Amp LOOP-Test lead connection

*6*-When the measuring is complete the impedance of L-PE and PFC (If) value appears on the screen
*7*-Press TEST button if re-test is necessary
When symbol from 

, 

,  appears lower left corner, and if the voltage exceeds 260V, the measurement will not take place

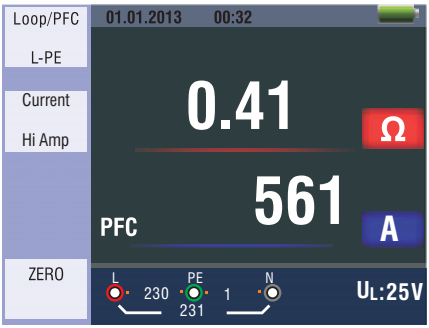



Figure 9 Hi Amp LOOP-Measurement finished

5.2.4-Using the L- N Line Impedance Measurement
*1*-Turn the rotary switch to the LOOP / Psc position
2-Press F1 button to change from L - PE to L - N
*3*-Connect the test leads as shown in *Figure 12*
*4*-If voltage of the L- PE on the lower left appears, the unit is ready to TEST
*5*-Press the TEST button when ready

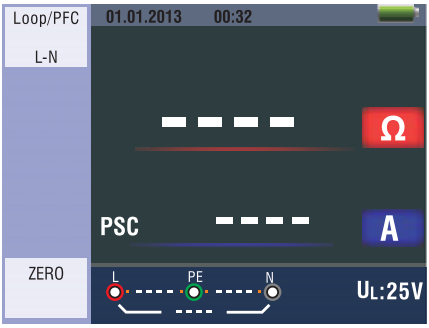



Figure 10 L-N Line-Standby screen

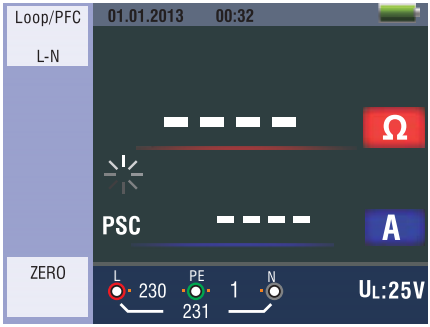



Figure 11 N Line Impedance-When measuring

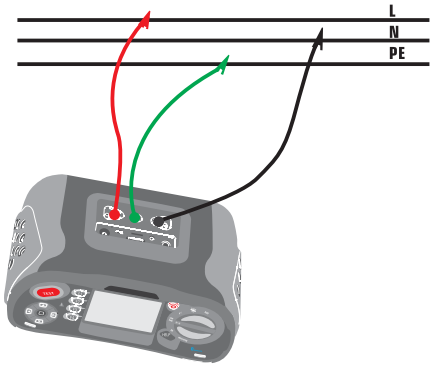



Figure 12 L-N Line Impedance-Test leads connection

*6*-When measuring is completed, impedance of L - N and PSC value appears on the screen

*7*-Press TEST button if re-test is necessary

When symbol from 

, 

,  appears lower left corner, and if the voltage exceeds 260V, the measurement will not take place

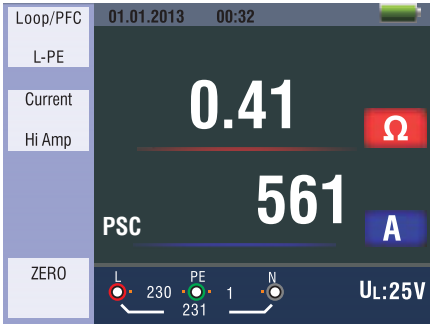



Figure 13 L-N Line Impedance -Measurement completed

5.2.5-Using The RCD Function

You can select UL Voltage by Pressing and hold F3 button for more than two seconds (25V or 50V).

Uf value appears is the contact voltage on the screen.

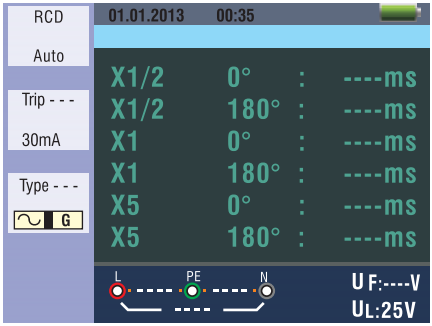



Figure 14 RCD-Standby screen

**Function Button Description**

| BUTTON | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| F1 | AUTO | RCD tΔ | RCD IΔN | | | | |
| F2 | 30mA | 100mA | 300mA | 500mA | 650mA | 1A | 10mA |
| F3 | AC G | AC S | DC G | DC S | | | |
| F4 | 0 | 180 | | | | | |

G: General (non-delayed) RCDs
S: Selective (time-delayed) RCDs

**Possible setup ratios depending on the RCD Trip Current**

| | 10mA | 30mA | 100mA | 300mA | 500mA | 650mA | 1A |
|---|---|---|---|---|---|---|---|
| X1/2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| X1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| X2 | 0 | 0 | 0 | 0 | 0 | X | X |
| X5 | 0 | 0 | 0 | X | X | X | X |
| AUTO | 0 | 0 | 0 | X | X | X | X |
| RAMP | 0 | 0 | 0 | 0 | 0 | 0 | X |

**Maximum measurement Trip Time of the RCD (Complying to BS 61008 and 61009)**

| | ½XIΔN | IΔN | 2xIΔN | 5xIΔN |
|---|---|---|---|---|
| General (non-delayed) RCD | tΔ= Max.1999mS | tΔ= Max.500mS | tΔ= Max.150mS | tΔ= Max.40mS |
| Selective (time-delayed) RCDs | tΔ= Max.1999mS | tΔ= Max.500mS | tΔ= Max.150mS | tΔ= Max.40mS |

IΔN: Trip-Out Current
tΔ: Trip-Out Time
: Indicates that the thermal protection device has operated and therefore cannot make any measurements. Instrument must be allowed to cool for a period before tests can continue.

Using the Functions activated by F1 button

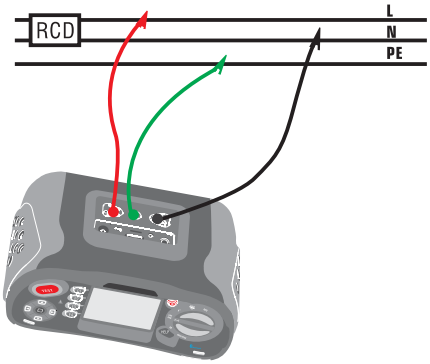



Figure 15 RCD Measurement-Test lead connection

**Using the AUTO Mode**

*1*-Turn the rotary switch to the RCD position
*2*-Initial screen is setup to the AUTO
*3*-Using the F2 and F3 button, select the rating and the type of the RCD
*4*-Connect test leads as shown in the *Figure 15*
*5*-If --- from the lower right corner disappears and voltage of the L- PE on the lower left appears, the unit is ready to TEST (If N and PE test leads are reversed, the instrument will still carry out the test)
*6*-Press the TEST button when ready
*7*-Test will proceed it should not trip from x ½ mode but will trip from the x 1 0° mode, and indicate the trip time
*8*-Reset RCD the unit will measure the Trip Time from the x 1 180° mode
*9*-Repeat for both x 5 0° and x 5 180° resetting RCD after each test
*10*-Tests now complete - see display for results

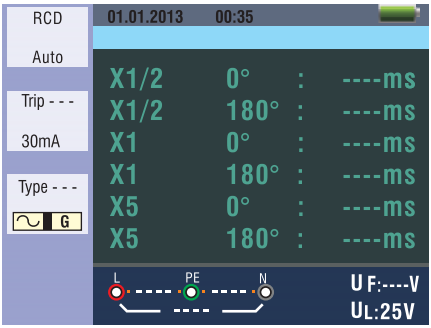



Figure 16 RCD Auto Function Screen

**Using the x1/2, x1 and x5 manual selection**

*1*-Turn the rotary switch to the RCD position
*2*-Press F1 and aspect button from the AUTO to select x1/2, x1 and x5
3-Using the F2 and F3 button, select the RCD's trip current and type of the RCD. (General/Selective)
*4*-Connect the test leads as shown in *Figure 15*
*5*-If --- from the lower right corner disappears and voltage of the L- PE on the lower left appears, the unit is ready to TEST
(If N and PE test leads are reversed, the instrument will still carry out the test)

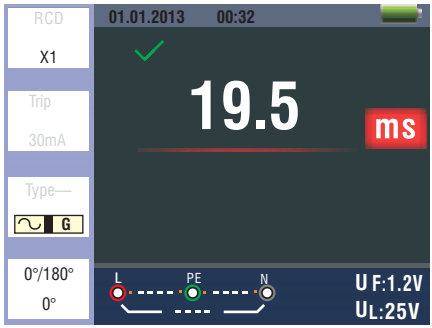



Figure 17 x1 Mode-Measuring screen

*6*-Using the Selective RCDs with F3 button
S : Selective (time-delayed) RCDs
S (Selective (time-delayed)) RCDs will measure by delaying 30 seconds and then stream the current. (will display 30 seconds during the time of the delay)
AC RCD streams current in r.m.s. value which has the sine wave form.
DC RCD streams current in r.m.s. value which has the pulse wave form.
*7*-Using the Selective 0°and 180° with F4 button
*8*-Press the TEST button when ready
*9*-Record slowest time

**Using the RAMP Function**

*1*-Turn the rotary switch to the RCD position
*2*-By pushing the F1 button select RAMP from AUTO
*3*-Using the F2 and F3 button, select the RCD's trip current and type of the RCD
*4*-Using the Selective 0°and 180° with F4 button
*5*-Press test button-the test current "ramps up from 3mA to 33mA in 3mA stages
*6*-The RCD should operate approximately 21mA for it to be in Compliance

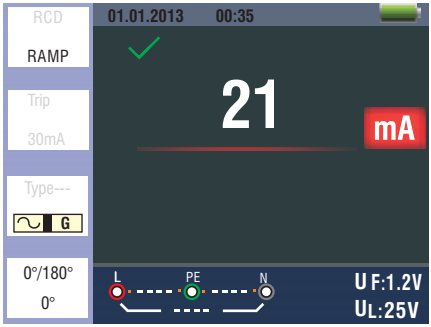
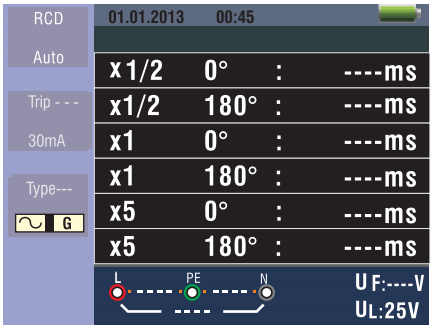



Figure 18 RCD Ramp-Measuring screen

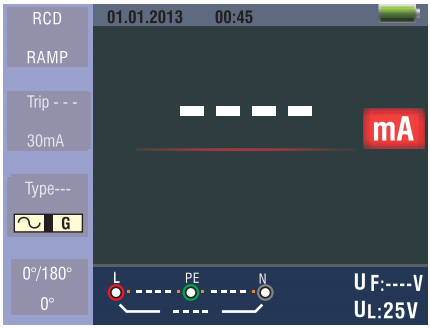
5.2.6-RCD Function Menu Operation

Main Display

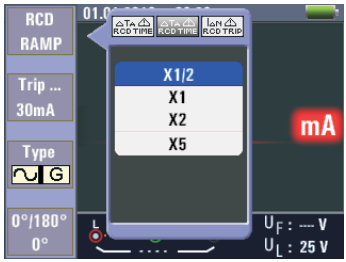
RCD AUTO

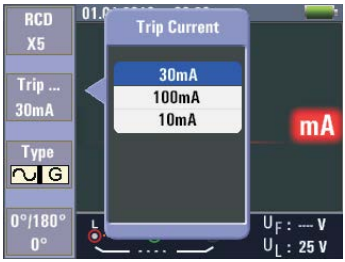


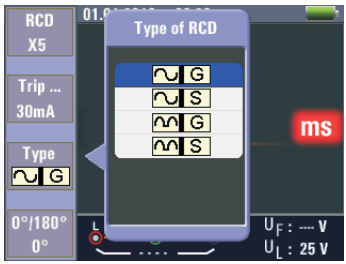

Other

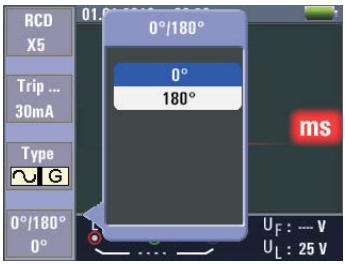



Menu Display




**F1 Button:** Pop-up and shutdown RCD menu , Shutdown mode is activated when the user selects.
**F2 Button:** Pop-up and shutdown Trip Current menu , Shutdown mode is activated when the user selects
**F3 Button:** Pop-up and shutdown Type of RCD menu , Shutdown mode is activated when the user selects
**F4 Button:** Pop-up and shutdown Type of 0°/180° menu , Shutdown mode is activated when the user selects
**Up Button:** Up menu to select the current active sub-options.
**Down Button:** Down menu to select the current active sub-options.
**Enter Button:** Confirm the user select mode.

5.2.7-Using the VOLTAGE Function

**WARNING!**

Do not use on a circuit whose voltage either L-L or L-N exceeds 550V Measuring the Voltage and Frequency


Figuire 19 Standby screen for the Voltage and Frequency

*1*-Connect the test lead input terminal
*2*-Turn the rotary switch to the VOLTAGE position

Do not attempt to measure when the input voltage is above 500V a.c.

Value at the top right hand corner represents the Voltage, and the value in the right hand center represents the frequency.

The display will appear without the TEST button operated.


Figure 20 Screen while measuring Voltage and Frequency

5.2.8-Using the Phase Sequence Function

Determining the Phase Sequence

*1*-Turn the rotary switch to the VOLTAGE position
*2*-Press F1 to make symbol is displayed
3-Connect the test leads L1, L2, L3 as shown on the *Figure 22*
-When the instrument is energized the sequence will be displayed automatically

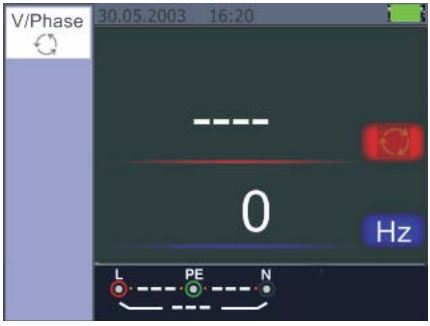



Figure 21 Initial screen of the Phase Sequence Measurement

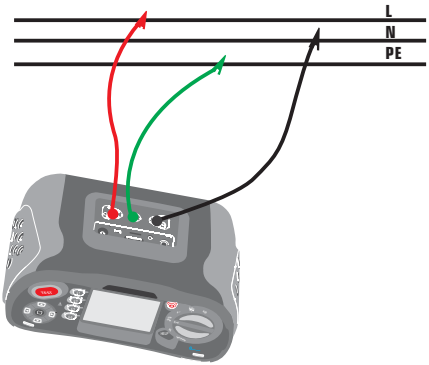



Figure 22 Phase Sequence-Test lead connection

When the line conductors are connected in the correct sequence 1.2.3 and the symbol will appear as the *Figure 23*

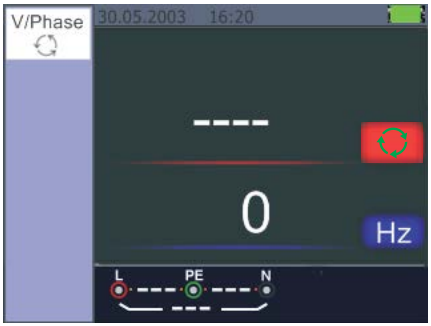
However, connected in the wrong sequence, 2.1.3 and the circle symbol will change to the symbol displayed below


Figure 23 Phase Sequence screen-when connected in clockwise direction.

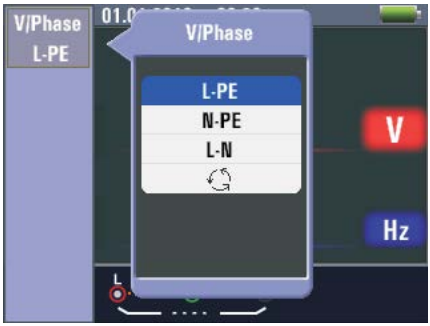

Figure 24 Phase Sequence-When connected in counter-clockwise manner

5.2.9-Voltage/Phase Function Menu Operation

Main Display




Menu Display

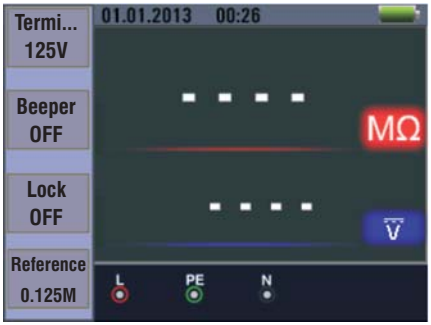



**F1 Button:** Pop-up and shutdown Voltage/Phase menu , Shutdown mode is activated when the user selects.
**F2 Button:** None
**F3 Button:** None
**F4 Button:** None
**Up Button:** Up menu to select the current active sub-options.
**Down Button:** Down menu to select the current active sub-options.
**Enter Button:** Confirm the user select mode.

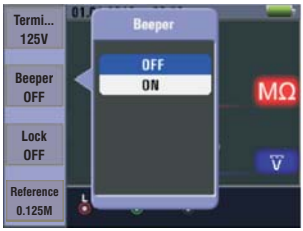
## 6-Using the Insulation Function

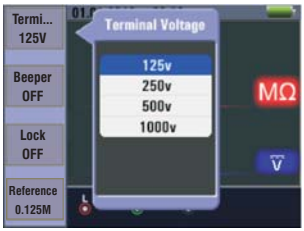

### 6.1-Insulation Function/Menu Operation

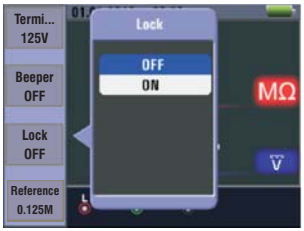
Main Display



Menu Display




**F1 Button:** Pop-up and shutdown Insulation menu , Shutdown mode is activated when the user selects.
**F2 Button:** Pop-up and shutdown Insulation menu , Shutdown mode is activated when the user selects.
**F3 Button:** Pop-up and shutdown Insulation menu , Shutdown mode is activated when the user selects.
**F4 Button:** Pop-up and shutdown Insulation menu , Shutdown mode is activated when the user selects.
**Up Button:** Up menu to select the current active sub-options.
**Down Button:** Down menu to select the current active sub-options.
**Enter Button:** Confirm the user select mode.

### 6.2-Insulation Resistance Display/Switch and Terminal Settings

⚠ ⚠ **WARNING!**

**Measurements should only be performed on de-energized circuits.**
**To measure insulation resistance**

*1*-Turn the rotary switch to the **INSULATION** position.
2-Use the L and N (red and black) terminals for this test.
*3*-Press F4 and set limit value (optional).
4-Use the F1 to select the test voltage. Most insulation testing is performed at 500 V, but observe local test requirements.
5-Press and hold TEST button until the reading settles and the tester beeps.

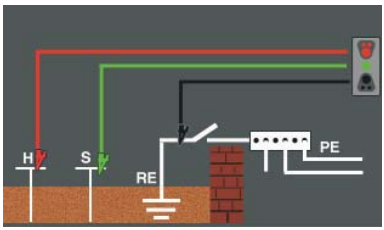
***Note***

Testing is inhibited if voltage is detected in the line.
The primary (upper) display shows the insulation resistance.
The secondary (lower) display shows the actual test voltage.

***Note***

For normal insulation with high resistance, the actual test voltage (UN) should always be equal to or higher than the programmed voltage. If insulation resistance is bad, the test voltage is automatically reduced to limit the test current to safe ranges.

### 6.3-Using the RE Function

### 6.4-Earth Resistance Display/Switch and Terminal Settings

The earth resistance test is a 3-wire test consisting of two test stakes and the earth electrode under test. This test requires an accessory stake kit. Connect as shown in right figure .

Best accuracy is achieved with the middle stake at 62 % of the distance to the far stake. The stakes should be in a straight line and wires separated to avoid mutual coupling.

The earth electrode under test should be disconnected from the electrical system when conducting the test. Earth resistance testing should not be performed on a live system.

### 6.5-To Measure Earth Resistance

*1*-Turn the rotary switch to the RE position.

*2*-Press and release TEST button. Wait for the test to complete.

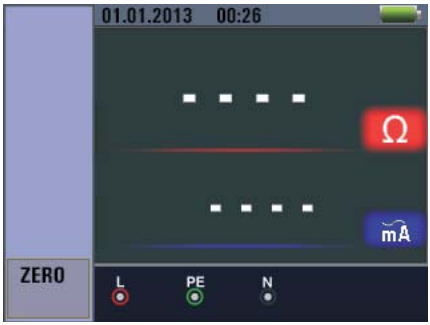
The primary (upper) display shows the eart resistance reading.

The Test Current will be displayed in the secondary display.

If Voltage detected between the test rods greater than 10V, the test is inhibited.

### 6.6-RE Function Menu Operation

Main Display



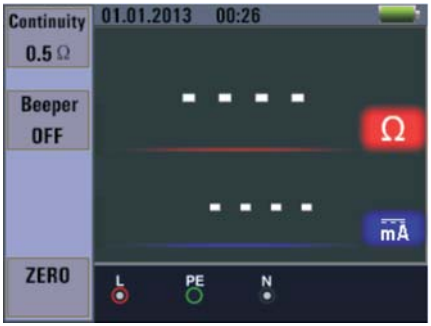

**F1 Button:** None
**F2 Button:** None
**F3 Button:** None
**F4 Button:** Short the F4 button 3S, triggering zero function.
**Up Button:** None
**Down Button:** None
**Enter Button:** None

### 6.7-Using the LOW OHM Function

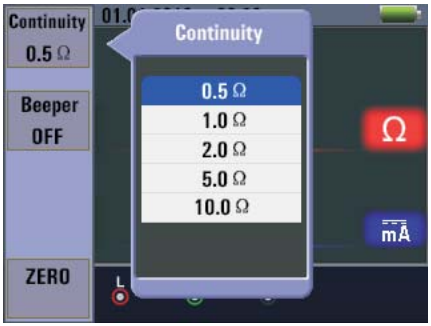
A continuity test is used to verify the integrity of connections by making a high resolution resistance measurement. This is especially important for checking Protective Earth connections.

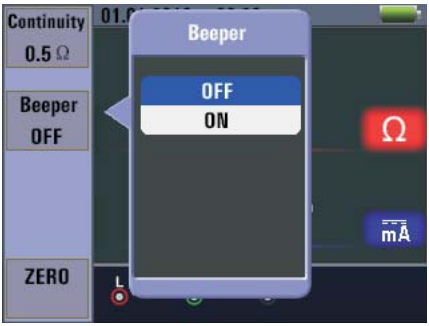
**6.8-LOW OHM Function Menu Operation**

Main Display




Menu Display




**F1 Button:** Pop-up and shutdown LOW OHM menu , Shutdown mode is activated when the user selects.
**F2 Button:** Pop-up and shutdown LOW OHM menu , Shutdown mode is activated when the user selects.
**F3 Button:** None
**F4 Button:** Short the F4 button 3S, triggering zero function.
**Up Button:** Up menu to select the current active sub-options.
**Down Button:** Down menu to select the current active sub-options.
**Enter Button:** Confirm the user select mode.

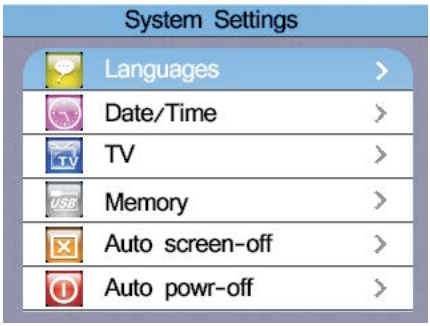
## 7-Menu

| Items | Menu |
|---|---|
| | System Settings |
| | Data Record |
| | Run Settings |

Press the ◄ and ► button to select the System Settings, Data Record or Run Settings. Then press the ▢ button to enter.

## 8-System Settings

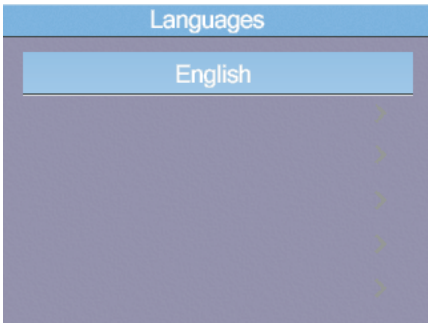
| Items | Menu |
|---|---|
| | Languages |
| | Date/Time |
| | TV |
| | Memory |
| | Auto screen-off |
| | Auto power-off |
| | System default settings |
| | System upgrade |




Press the ▲and▼ button to select the Items, Then press the ▢ button to enter

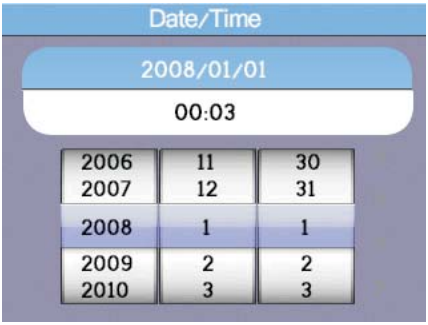
### 8.1-Languages

Press the ▲and▼ button to select the language, press ESC button to esc and save the select the language.



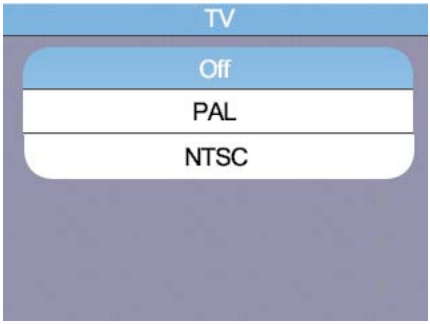
**8.2-Date/Time**

Press the ▲ and ▼ button to select the date or time, Then press the ▢ button to enter, Press the ▲ and ▼ button to adjust the value, Press the ◄ and ► button to select the Items ,press the ESC button to esc and save.



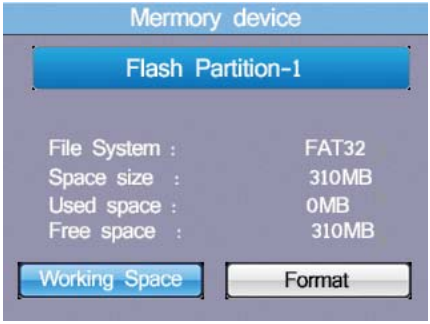

**8.3-TV**

Press the ▲ and ▼ button to select the output time, Then press the ▢ button to enter.



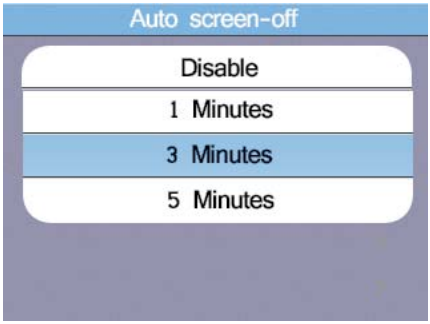

**8.4-Memory**

Press the ▲ and ▼ button to select the Working Space or Format , Then press the ▢ button to enter, press the ESC button to esc and save.



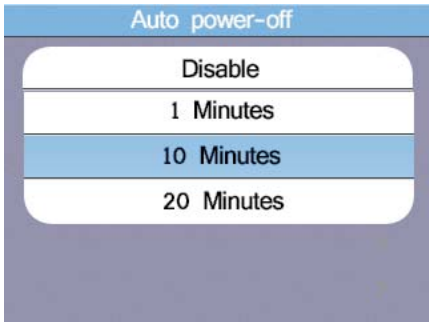
**8.5-Auto Screen-off**

Default 3 Minutes, Press the ▲ and ▼ button to select the Auto screen-off time, press ESC button to esc and save the select the time.




**8.6-Auto Power-off**

Default 10 Minutes, Press the ▲ and ▼ button to select the Auto power-off time, press ESC button to esc and save the select the time.




**8.7-System Default Settings**

Then press the ▢ button to enter, Then press the ▲ and ▼ button to select whether Reset.

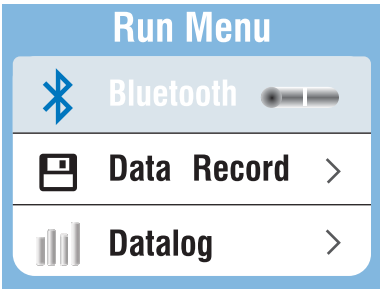
### 8.8-System Upgrade

Then press the ▢ button to enter.


### 9-Run Settings

| Items | Menu |
|---|---|
| | On or off the Bluetooth |
| | Data Record |
| | Datalog |

Press the ▲ and ▼ button to select the Items, then press the ▢ button to enter.




### 9.1-Bluetooth

Off the Bluetooth


On the Bluetooth


Press the ◄ and ► button to select the on or off bluetooth , press the ESC button to esc and save.

### 9.2-Data Record

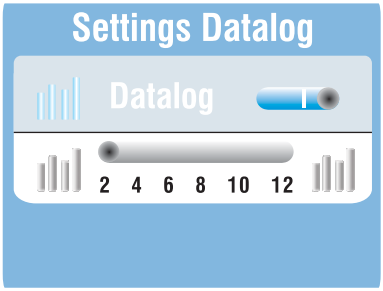
| Items | Menu |
|---|---|
| F1 button | Backspa |
| F2 button | Enter Data Record |
| ▢ | Enter characters |

Press the ◄ ► ▲ ▼ button to select the characters , press the ▢ button to Enter characters.
**NOTE:** Data recording shortcuts, press the left button.


### 9.3-Datalog

| Items | Menu |
|---|---|
| | On or off the Datalog |
| / | / Set Datalog time(Unit : second) |

Press the ▲ and ▼ button to select the Items, Pressthe ◄ and ► button to set.




### 10-Data Record

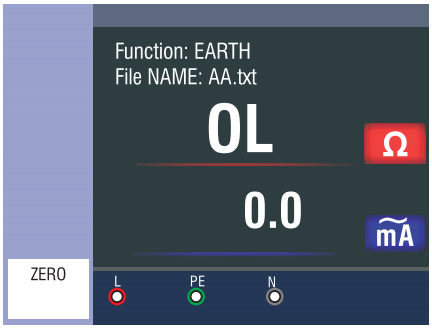
Press the ▲ and ▼ button to select the data record file, press ▢ button to to enter.

**10.1-Delete Files**

Press Help/Delete button to menu, Press the ▲ and ▼ button to select the Yes or No , press ▢ button to execute.


**10.2-Data Record Preview**

Main Display

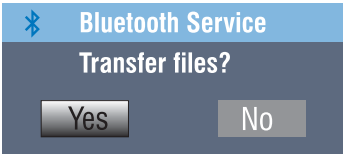



**F1 Button:** None
**F2 Button:** None
**F3 Button:** None
**F4 Button:** None
**Up Button:** Turned up view log data
**Down Button:** Turned down view log data
**Left Button**
**Right Button**
**Enter Button:** Menu

Press the ▲ and ▼ button to select the view log data, Press the ◄ and ► button to select the files ,press ▢ button to menu, press the ESC button to esc data record preview.

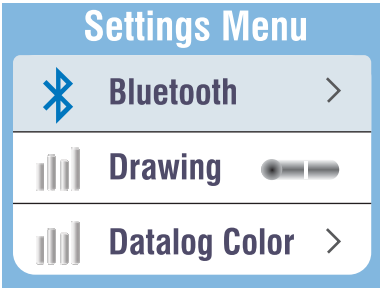
**10.3-Menu**

10.3.1-Data record




10.3.2-Datalog

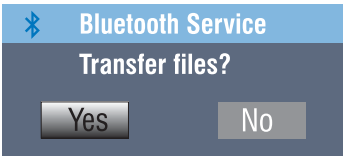
Settings Menu Display



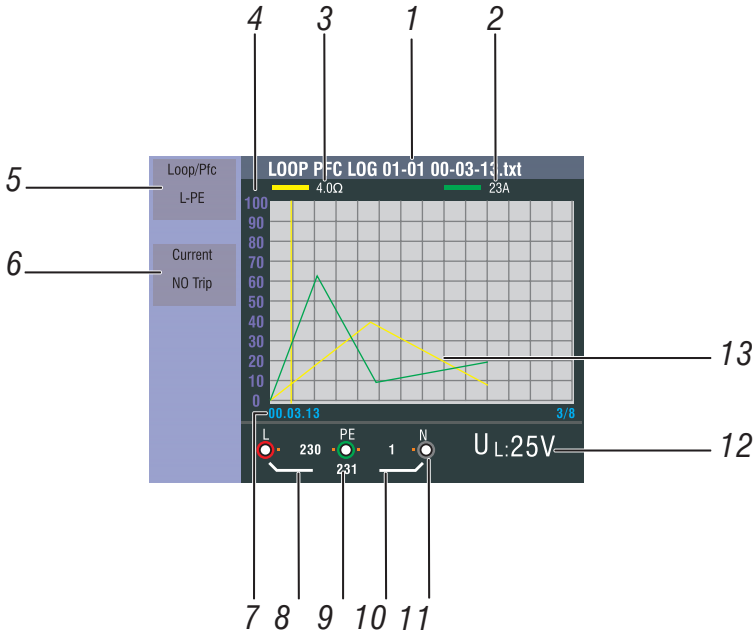

**F1 Button:** None
**F2 Button:** None
**F3 Button:** None
**F4 Button:** None
**Up Button:** Select up
**Down Button:** Select down
**Left Button:** None
**Right Button:** None
**Enter Button:** Confirm the user select mode

Press the ▲ and ▼ button to select the Items, Then press the ▢ button to enter

10.3.3-Bluetooth

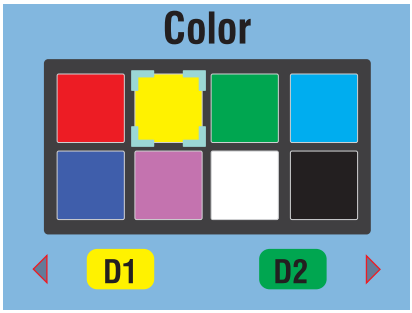


## 10.4-Drawing




| No. | Annunctator | Meaning |
|---|---|---|
| 1 | File Name | File named:<br>Month/day File type<br>LOOP PFC LOG 01-01 00-03-13.txt<br>Function Hours/minutes/seconds |
| 2 | Primary display and measurement units. | |
| 3 | Primary display and measurement units. | |
| 4 | Coordinate | |
| 5 | Function | |
| 6 | Function | |
| 7 | hours/minutes/seconds | Record time |
| 8 | L-FE Value | |
| 9 | L-N Value | |
| 10 | FE-N Value | |
| 11 | Arrows above or below the terminal indicator symbol indicate reversed polarity. Check the connection or check the wiring to correct. | |
| 12 | UF Value | |
| 13 | Main display curve | |

**10.5-Datalog Color**




⚠ ⚠ **WARNING!**

- Measurements should only be performed on de-energized circuits.
- Measurements may be adversely affected by impedances or parallel circuits or transient currents.

**To Measure Continuity**

*1*-Turn the rotary switch to the RLO position.
*2*-Use the L and N (red and black) terminals for this test.
*3*-Before making a continuity test, short the ends of the probes together and press the ZERO button. After performing test leads compensation compensated test leads indicator is displayed.
*4*-Press and hold TEST until the reading settles.
*5*-If the continuity beeper is enabled,press the F1 to set high limit resistance value. the tester beeps continuously for measured values less than high limit resistance and there is no stable reading beep for measured values greater than high limit resistance.


*Rev. 140123*