



# EQUITEST 5071






User manual

CE





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## 1. PRECAUTIONS AND SAFETY MEASURES

The instrument has been designed in compliance with Standards IEC/EN61557 and IEC/EN 61010-1 relevant to electronic measuring instruments.



### CAUTION

For your safety and in order to prevent damaging the instrument, please carefully follow the procedures described in this manual and read all notes preceded by the symbol  with the utmost attention.

Before and after carrying out the measurements, carefully observe the following instructions:

- Do not carry out any voltage or current measurement in humid environments
- Do not carry out any measurements in case gas, explosive materials or flammables are present, or in dusty environments
- Avoid contact with the circuit being measured if no measurements are being carried out
- Avoid contact with exposed metal parts, unused measuring probes, circuits, etc.
- Do not carry out any measurement in case you find anomalies in the instrument such as deformation, substance leaks, absence of display on the screen, etc.
- Pay special attention when measuring voltages higher than 25V in special environments (such as construction sites, swimming pools, etc.) and 50V in normal environments, since a risk of electrical shock exists.
- Only use original accessories.

In this manual, and on the instrument, the following symbols are used:



CAUTION: observe the instructions given in this manual; improper use could damage the instrument, its components and create dangerous situations for the operator.



Presence of dangerous voltage ( $\geq 30V$ ): electrical shock hazard



Double-insulated meter



AC voltage or current



Connection to earth

### 1.1. PRELIMINARY INSTRUCTIONS

- This instrument has been designed for use in environments of pollution degree 2.
- The instrument may be used for measuring and verifying the safety of electrical systems of overvoltage category CAT III 300V (to earth) or CAT II 350V (to earth).
- We recommend following the normal safety rules devised to protect the user against dangerous currents and the instrument against incorrect use.
- Only the accessories provided together with the instrument will guarantee safety standards. If necessary, replace them with identical models.
- Do not test circuits exceeding the specified current and voltage limits. Do not perform any test under environmental conditions exceeding the limits indicated in § 10.3.
- Check that the batteries are correctly inserted.
- Before connecting the test leads to the circuit to be tested, make sure that the switch is correctly set.

## 1.2. DURING USE

Please carefully read the following recommendations and instructions:



### CAUTION

Failure to comply with the caution notes and/or instructions may damage the instrument and/or its components or be a source of danger for the operator.

- Before activating the rotary switch, disconnect the test leads from the circuit under test.
- When the instrument is connected to the circuit under test, never touch any terminal, even if unused.
- Avoid measuring resistance if external voltages are present. Even if the instrument is protected, excessive voltage could cause damage.

## 1.3. AFTER USE

- When measurements are complete, turn off the instrument by pressing and holding the **ON/OFF** key for some seconds.
- If the instrument is not to be used for a long time, remove the batteries and follow the instructions given in § 9.2.

## DEFINITION OF MEASUREMENT (OVERVOLTAGE) CATEGORY


Standard "IEC/EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements" defines what measurement category, commonly called overvoltage category, is. § 6.7.4: Measured circuits, reads:

Circuits are divided into the following measurement categories:

- **Measurement category IV** is for measurements performed at the source of the low-voltage installation  
*Examples are electricity meters and measurements on primary overcurrent protection devices and ripple control units.*
- **Measurement category III** is for measurements performed inside buildings.  
*Examples are measurements on distribution boards, circuit breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to fixed installation.*
- **Measurement category II** is for measurements performed on circuits directly connected to the low-voltage installation  
*Examples are measurements on household appliances, portable tools and similar equipment*
- **Measurement category I** is for measurements performed on circuits not directly connected to MAINS.  
*Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS-derived circuits. In the latter case, transient stresses are variable; for that reason, the standard requires that the transient withstand capability of the equipment is made known to the user.*

## 2. GENERAL DESCRIPTION

Instrument EQUITEST 5071 carries out the following measurements:

- **LOW $\Omega$ :** Continuity test of protective conductors with test current of 200mA in compliance with standard IEC/EN61557-4
- **LOW $\Omega$ 10A:** Continuity test of protective conductors with test current of 10A in compliance with standard IEC/EN60439-1
- **LOW $\Omega$ 10AE60204:** Continuity test of protective conductors with test current of 10A in compliance with standard IEC/EN60204-1:2006.
- **LOOP/Ra** : measurement of line impedance and fault loop impedance with calculation of the assumed short-circuit current, also with high resolution (0.1m $\Omega$ ) with optional accessory IMP57 / measurement of overall earth resistance without causing the differential protections' tripping (function  $R_{A\pm}$ ) / phase rotation.

## 3. PREPARATION FOR USE

### 3.1. INITIAL CHECKS

Before shipping, the instrument has been checked from an electric as well as mechanical point of view. All possible precautions have been taken so that the instrument is delivered undamaged.

However, we recommend rapidly checking it to detect any damage possibly suffered during transport. In case anomalies are found, immediately contact the Dealer.

We also recommend checking that the packaging contains all components indicated in § 10.4. In case of discrepancy, please contact the Dealer. In case the instrument should be returned, please follow the instructions given in § 11.

### 3.2. INSTRUMENT POWER SUPPLY

The instrument is supplied by six 1.5V alkaline batteries type LR6 AA AM3 MN 1500, not included in the package. For battery installation, follow the instructions given in § 9.2.

#### CAUTION



- The instrument AUTOMATICALLY turns OFF display backlight after approximately 5 seconds.
- In order to extend the battery life, in case battery voltage is too low, the instrument deactivates display backlighting.

### 3.3. CALIBRATION

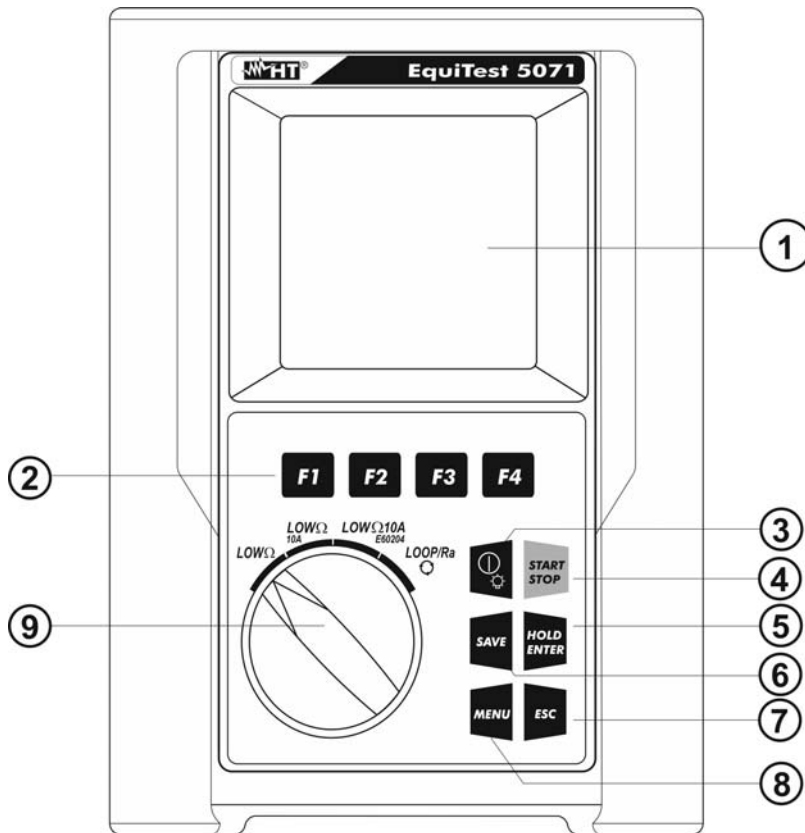
The instrument has the technical specifications described in this manual. Its performance is guaranteed for 12 months from the date of purchase.

### 3.4. STORAGE

In order to guarantee precise measurement, after a long storage time under extreme environmental conditions, wait for the instrument to come back to normal condition (see § 10.3)

## 4. INSTRUMENT DESCRIPTION

### 4.1. FRONT PANEL

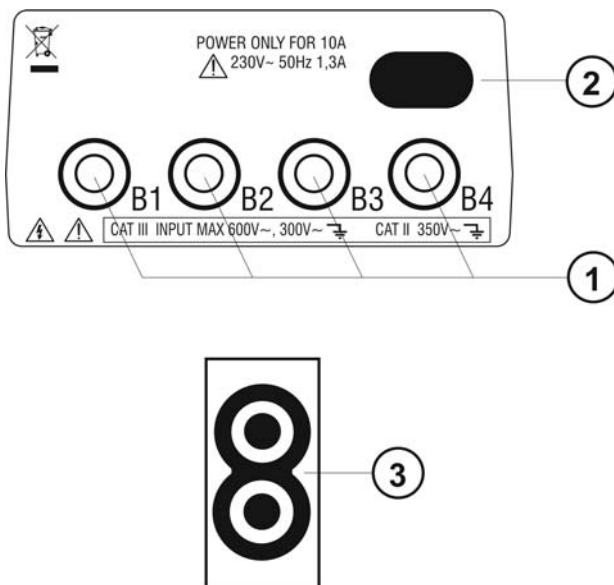


#### CAPTION:

1. LCD display
2. **F1, F2, F3, F4** keys
3. key
4. **START/STOP** key
5. **HOLD/ENTER** key
6. **SAVE** key
7. **ESC** key
8. **MENU** key
9. Rotary selector switch

Fig. 1: Description of the instrument's front panel

### 4.2. INPUT AND OUTPUT LEADS




#### CAPTION:

1. **B1, B2, B3, B4** inputs
2. Input for external 230V/50Hz power supply for functions **LOWΩ10A** and **LOWΩ10AE60204**
3. Optical serial output for PC connection

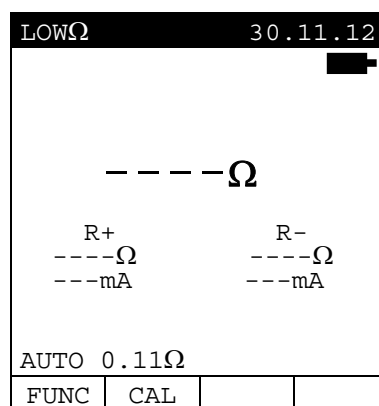
Fig. 2: Description of the instrument's inputs and outputs

### 4.3. DESCRIPTION OF FUNCTION KEYS

Key	Description
	Key to switch on/off the instrument. Press and hold the key for some seconds to turn off the instrument. Shortly press this key to activate display backlighting.
F1, F2, F3, F4	Keys for programming the internal parameters associated with the functions of the instrument.
START/STOP	Key for starting measuring. STOP function not enabled.
SAVE	Key for saving measurement results.
HOLD/ENTER	ENTER key to confirm the parameters set within the general menu of the instrument. HOLD function not enabled.
MENU	Key to access the instrument's general menu.
ESC	Key to quit the selected mode shown on the display.


### 4.4. DISPLAY DESCRIPTION

The display is a graphic module with a resolution of 128 x 128 dots. The first line of the display shows the instrument's date and time. In the top right-hand corner of the display there is the battery charge indicator.



For the sake of brevity, these symbols will be omitted in the following screenshots of this manual.

### 4.5. INITIAL SCREEN

When turning on the instrument with the  key, the following screen appears for a few seconds:




It contains (further to the name of the Manufacturer and to the instrument model):

- The serial number (SN:) of the instrument.
- The firmware version (V:) in the instrument's memory.
- The date of the last instrument calibration (CALIBRATION DATE).
- The serial transmission speed (Baud Rate).

Press **ESC** to exit this screen.

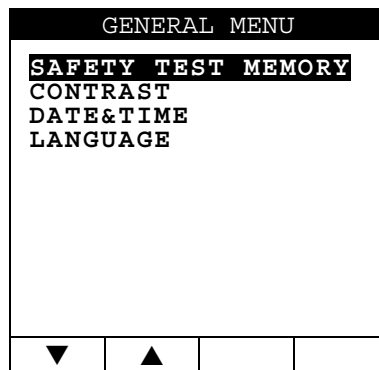


#### 4.6. BACKLIGHT

During instrument operation, a further short pressing of the  key turns on the display's backlighting. In order to save battery efficiency, backlighting automatically turns off after approx. 5 seconds. A frequent use of backlighting reduces the batteries' life.

### 5. INITIAL SETTINGS

When pressing the **MENU** key, the display shows the following screen, which allows accessing the General Menu:



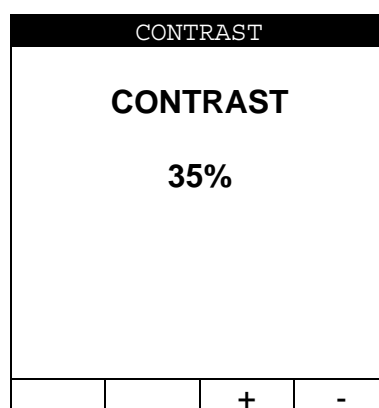
The following items are available:

- Safety Test Memory → memory area for saving measuring results.
- Contrast → function to adjust display contrast.
- Date&Time → function to adjust system date/time.
- Language → function to select system language.

#### 5.1. ADJUSTING DISPLAY CONTRAST

Proceed as follows:

1. Press the **MENU** key with the selector switch in any position to enter the General Menu.
2. Use the **F1** key to move the cursor to "CONTRAST". Confirm with **ENTER**. The following screen appears on the display:

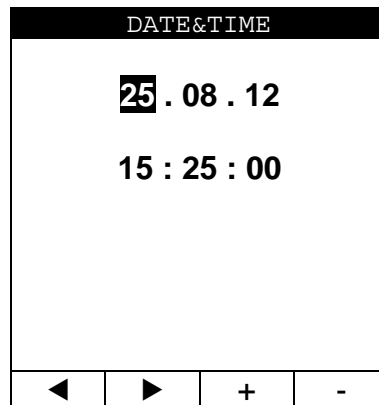


3. Use the **F3** and **F4** keys to set the desired percentage value.
4. Press the **ENTER** key to confirm. The settings made shall remain valid also after switching off the instrument.
5. Press the **ESC** key to exit without saving.

## 5.2. ADJUSTING DATE AND TIME

Proceed as follows:

1. Press the **MENU** key with the selector switch in any position to enter the General Menu.
2. Use the **F1** key to move the cursor to "DATE&TIME". Confirm with **ENTER**. The following screen appears on the display:



3. Use the **F1** and **F2** keys to alternately select the date and time fields. The selected field appears with a black background. The date is expressed with format: "**gg.mm.aa**" while time is expressed in format: "**hh:mm:ss**".
4. Use the **F3** and **F4** keys to increase or decrease the value of date/time.
5. Press the **ENTER** key to confirm. The settings made shall remain valid also after switching off the instrument.
6. Press the **ESC** key to exit without saving.

## 5.3. LANGUAGE SETTING

Proceed as follows:

1. Press the **MENU** key with the selector switch in any position to enter the General Menu.
2. Use the **F1** key to move the cursor to "LANGUAGE". Confirm with **ENTER**. The following screen appears on the display:



3. Use the **F1** and **F2** keys to select the desired language among those available.
4. Press the **ENTER** key to confirm. The settings made shall remain valid also after switching off the instrument.
5. Press the **ESC** key to exit without saving.

## 6. OPERATING INSTRUCTIONS

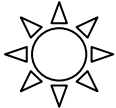
### 6.1. LOW $\Omega$ : CONTINUITY OF PROTECTIVE CONDUCTORS WITH 200mA

Measurement is carried out in compliance with standard IEC/EN61557-4.

#### CAUTION



Before carrying out the continuity test, make sure there is no voltage at the ends of the conductor to be analyzed.



Turn the **rotary switch** to **LOW $\Omega$** .

#### F1

With the **F1** key it is possible to select one of the following measuring modes (which cyclically appear when pressing the key):

- ☞ **“AUTO”** mode (the instrument carries out two measurements with inverted polarity and displays their average value). Recommended mode for continuity test
- ☞ **“RT+”** mode (measurement with positive polarity and with the possibility of setting a duration time for testing). In this case, the operator may set a sufficiently long measuring time to be able to move the protective conductors while the instrument is carrying out the test, in order to find out a possible bad connection.
- ☞ **“RT-”** mode (measurement with negative polarity and with the possibility of setting a duration time for testing). In this case, the operator may set a sufficiently long measuring time to be able to move the protective conductors while the instrument is carrying out the test, in order to find out a possible bad connection.

#### F2

With the **F2** key it is possible to select the **“CAL”** mode (compensation of the resistance of the cables used for measuring).

#### CAUTION



Continuity test is carried out by applying a current higher than 200mA in case resistance does not exceed **5 $\Omega$**  (including the measuring cables' resistance saved as offset value in the instrument after carrying out the calibration procedure). For higher resistance values, the instrument carries out the test with a current lower than 200mA.

### 6.1.1. Calibration of measuring cables

1. Insert the black cable and the blue cable into the relevant input terminals **B1** and **B4** of the instrument.

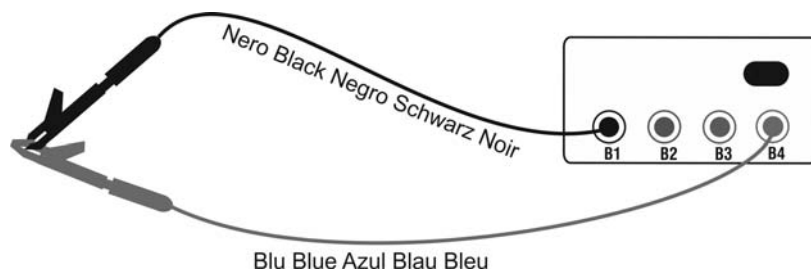


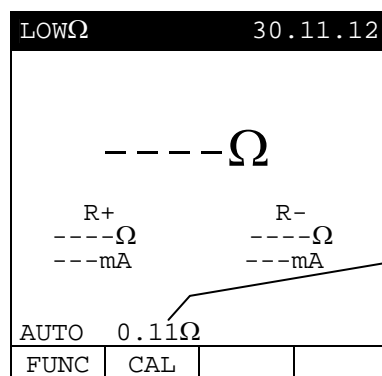
Fig. 3: Terminal connection during calibration procedure

2. If, for the measurement to be carried out, the length of the cables provided should be insufficient, extend the blue cable.
3. Insert two alligator clips into the cable terminals.
4. Short-circuit the measuring cables' ends, taking care that the conductive parts of the alligator clips have good contact (see Fig. 3)
5. Press the **F2** key. The instrument calibrates.



#### CAUTION

Never disconnect the terminals from the measuring points when the instrument shows the message "**MEASURING...**".



This numerical value indicates that calibration has been carried out

6. At measurement end, the instrument gives out a double sound, to indicate that calibration has been correctly carried out. The value of calibration is updated and displayed above the **F2** key. This value shall remain saved also after the instrument has been switched off.



#### CAUTION

- The instrument calibrates the measuring cables only if their resistance is lower than **5Ω**
- Before carrying out any measurement, always make sure that calibration is referred to the cables currently used. In a continuity test, if the purified resistance value (i.e. the value of resistance minus the calibration offset value) is **negative**, the symbol "CAL" flashes on the display.

7. To delete the calibration parameter it is necessary to carry out a **calibration procedure with a lead resistance higher than 5Ω** (e.g. with open leads). When carrying out a deletion, the symbol "- -" is shown on the display above the **F2** key.

### 6.1.2. Measuring

1. Select the desired mode using the **F1** key.
2. Insert the black cable and the blue cable into the relevant input terminals **B1** and **B4** of the instrument:

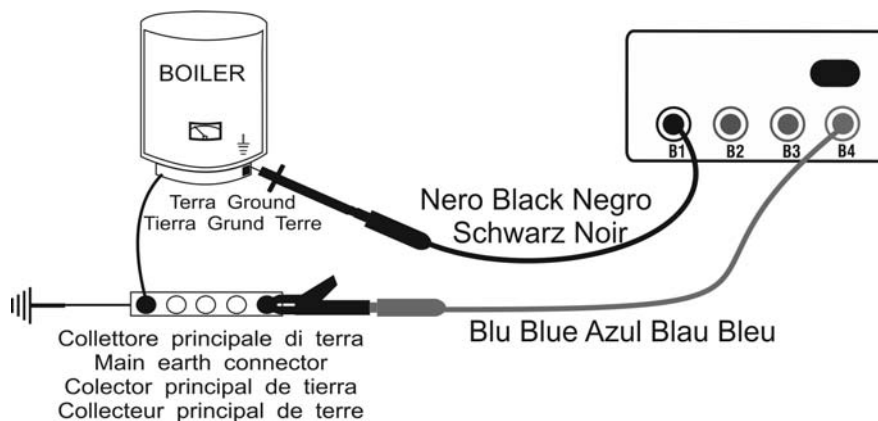


Fig. 4: Instrument connection for LOWΩ test

3. If, for the measurement to be carried out, the length of the cables provided should be insufficient, extend the blue cable.
4. Insert two alligator clips into the cable terminals.
5. Short-circuit the measuring cables' ends, taking care that the conductive parts of the alligator clips have good contact. Press the **START/STOP** key. **If the instrument shows a resistance value different from 0,00 repeat the calibration operation** (see § 6.1.1)
6. Connect the instrument terminals to the ends of the conductor whose continuity you want to test (see Fig. 4)
7. If mode "RT+" or "RT-" is selected, use the **F3**, **F4** keys to set the test time.
8. Press the **START/STOP** key. The instrument carries out the measurement. In "RT+" or "RT-" mode, press the **START/STOP** key again to stop the test.

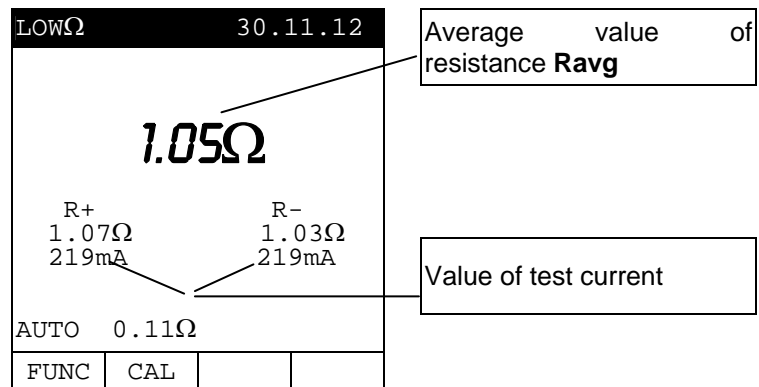
### CAUTION



When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

### "AUTO" mode results

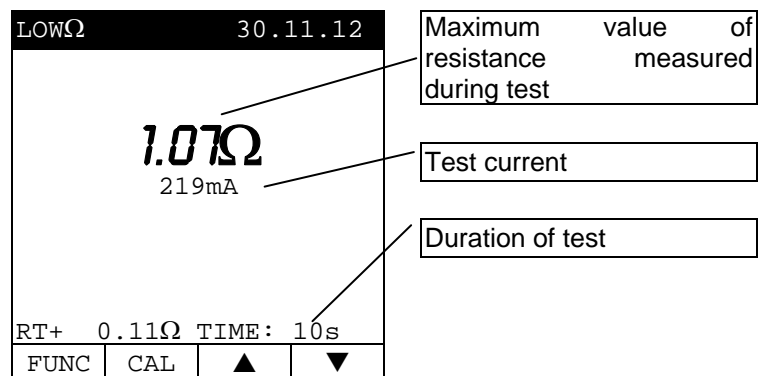
☞ At the end of the test, in case the **average value of resistance  $R_{avg}$**  measured is **lower than  $5\Omega$** , the instrument gives out a **double sound to signal the positive result of the test**. The following screen appears on the display:



The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### "RT+" or "RT-" mode results

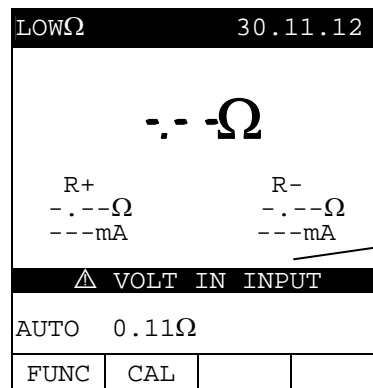
☞ During the test, an audible beep sounds in case the measured resistance value exceeds 99.9. If, at the end of the test, the maximum **RT+ or RT-** resistance value measured is **lower than  $5\Omega$** , the instrument gives out a **double sound to signal the positive result of the test**. The following screen appears on the display:



The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### 6.1.2.1. Anomalous situations in "AUTO", "RT+", "RT-" mode

☞ If the instrument detects a voltage higher than approx. 15V at the input terminals, the message to the side appears on the display.

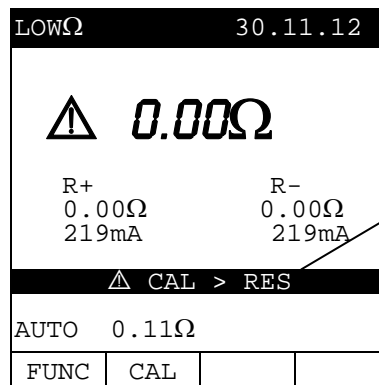


The test cannot be carried out because voltage has been detected at the instrument's inputs

☞ If the instrument detects that:

$$R_{\text{CALIBRATION}} > R_{\text{MEASURED}}$$

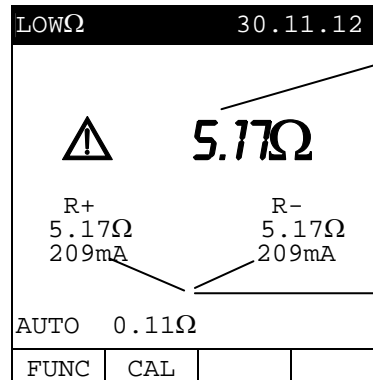
the message to the side appears on the display.



CAUTION:  
 $R_{\text{CALIBRATION}} > R_{\text{MEASURED}}$

#### PREVIOUS RESULTS CANNOT BE SAVED.

☞ In case a **resistance higher or equal to 5Ω but lower than 99,9Ω** is detected, at the end of the test the instrument gives out a long sound and the following screen appears on the display.

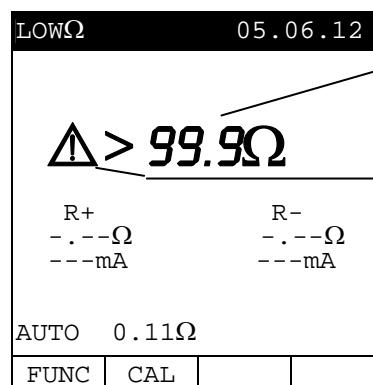


Resistance higher than 5Ω

Test current

The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

☞ In case a **resistance higher than 99,9Ω** is detected, at the end of the test the instrument gives out a long sound and the following screen appears on the display.



Resistance with a value higher than 99.9Ω

CAUTION: Resistance value out of range

The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

## 6.2. LOW $\Omega$ 10A: CONTINUITY OF PROTECTIVE CONDUCTORS WITH 10A

Measurement is carried out in compliance with standards IEC/EN60439-1.

Measurement is carried out by voltammetric method with 4 wires. Therefore, the calculated value is not influenced by the value of resistance of the measuring cables, so it is not necessary to carry out any preventive calibration of the cables used for measuring (unlike with function LOW $\Omega$ ).

### CAUTION



- Before carrying out the continuity test, make sure there is no voltage at the ends of the conductor to be analyzed.
- Measurement may be influenced by parallel impedance of additional circuits or by transient currents. Make sure none of these parasite elements is present before measuring and **always keep test cables outstretched in order to prevent “coil effects”**.

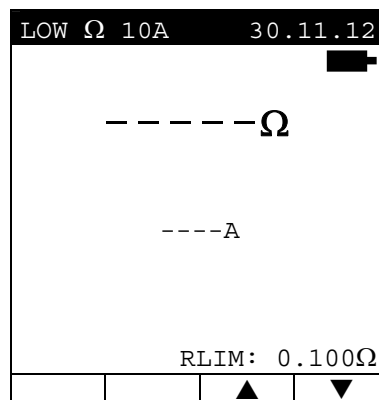
### CAUTION



The instrument performs the test with a current  $\geq 10A$  only if resistance is lower than approx.  $0.45\Omega$ .

### 6.2.1. Measuring

1. Turn the rotary switch to **LOW $\Omega$ 10A**. The following screen appears on the display:



2. Use the **F3** and **F4** keys to set the maximum limit threshold RLIM for measurement in range **0.001 $\Omega$  ÷ 0.999 $\Omega$** . Keep the function keys pressed for a quick setting of the desired value
3. Supply the instrument by connecting it to the 230V/50Hz electric mains (see Fig. 2 – position 2) by means of the cable provided.
4. Connect the connectors of the measuring cables C7000 provided to the instrument's input terminals **B1** (Black), **B2** (Red), **B3** (Red), **B4** (Black) and the alligator clips to the item to be tested as indicated in Fig. 5



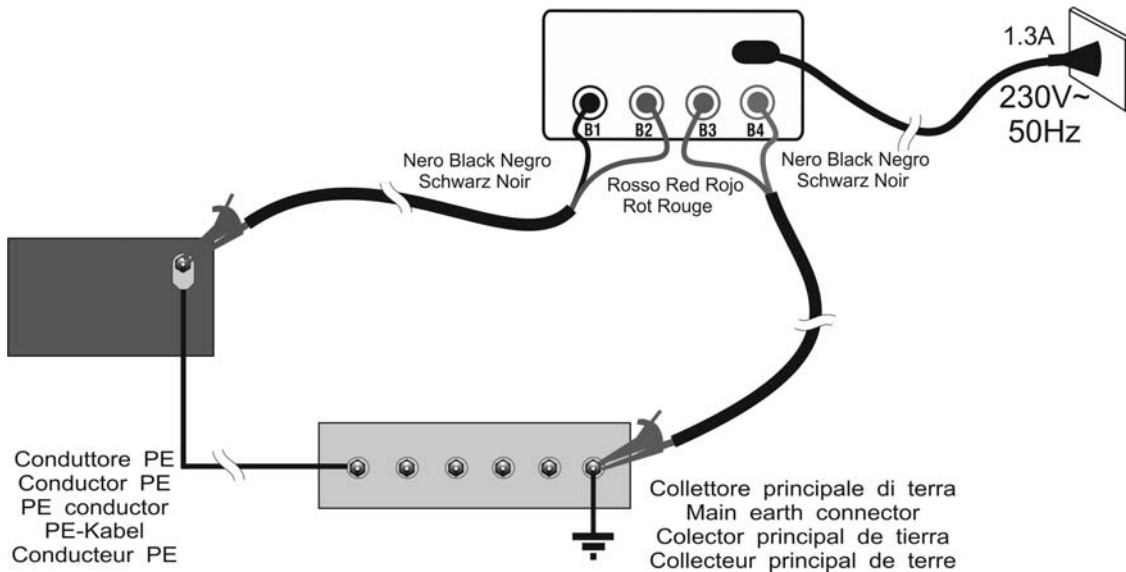


Fig. 5: Instrument connection for LOWΩ10A test

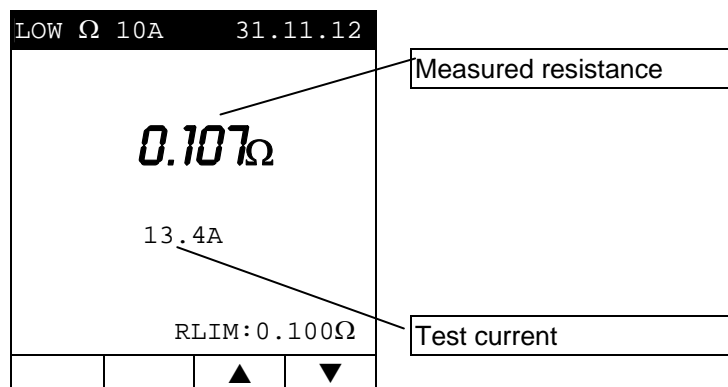
- Press the **START** key. The instrument starts testing.

### CAUTION



When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

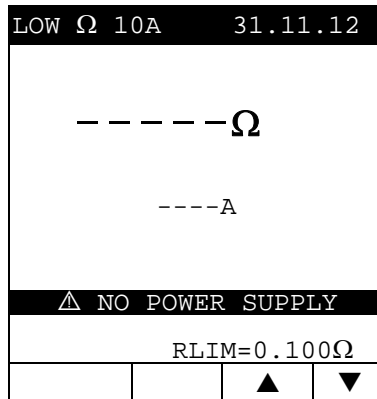
At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.



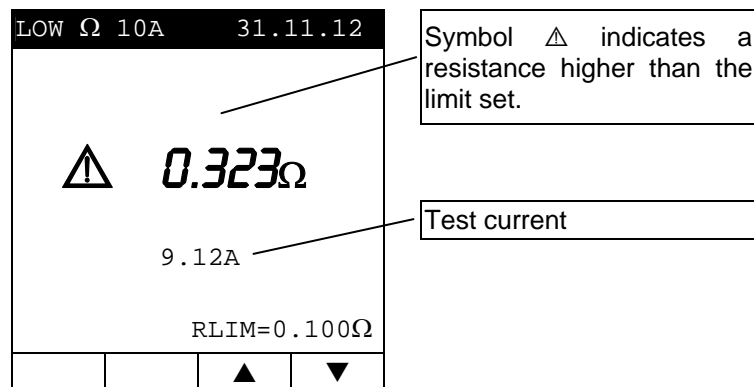
- The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### 6.2.2. Anomalous situations

If the instrument does not detect any power supply at connector "230V 50Hz", it displays the message reported to the side.

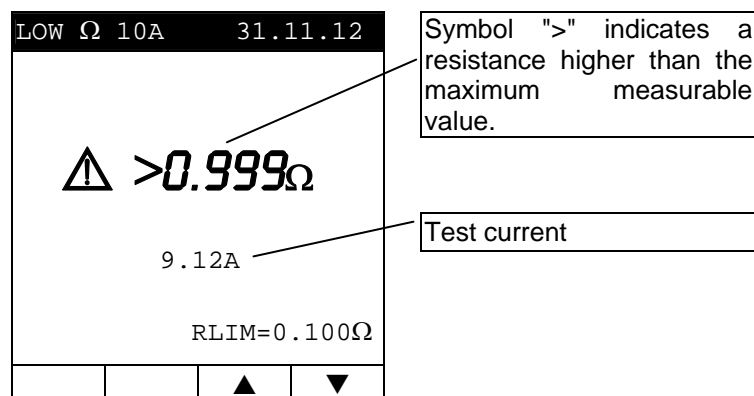


If the instrument detects a resistance higher than the limit set, it gives out a long sound and the following screen appears on the display.



The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

If the instrument detects a resistance higher than the maximum measurable value, it gives out a long sound and the following screen appears on the display.



The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1)

### 6.3. LOW $\Omega$ 10AE204: CONTINUITY 10A IN COMPLIANCE WITH IEC/EN60204-1:2006

Measurement is carried out in compliance with standard IEC/EN60204-1:2006, which states that measurement result must be compatible with the protective conductor's length, section and material.

The instrument evaluates the limit threshold of measured resistance according to the following formula:

$$R_{\text{lim}} = \rho \frac{L}{S}$$

in which:

- L = length in **m** of the protective conductors being tested, decided by the user according to design calculations;
- S= section in **mm<sup>2</sup>** of the protective conductor being tested;
- $\rho$  = resistivity of copper set to the standard average value of **0.017 $\Omega$ mm<sup>2</sup>/m**.

Measurement is carried out by voltammetric method with 4 wires. Therefore, the calculated value is not influenced by the value of resistance of the measuring cables, so it is not necessary to carry out any preventive calibration of the cables used for measuring (unlike with function LOW $\Omega$ ).

#### CAUTION



- Before carrying out the continuity test, make sure there is no voltage at the ends of the conductor to be analyzed.
- Measurement may be influenced by parallel impedance of additional circuits or by transient currents. Make sure none of these parasite elements is present before measuring and **always keep test cables outstretched in order to prevent "coil effects"**.

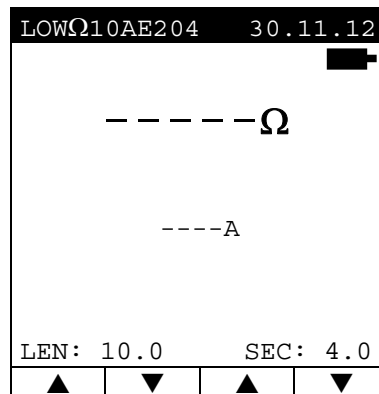
#### CAUTION



The instrument performs the test with a current  $\geq 10\text{A}$  only if resistance is lower than approx.  $0.45\Omega$ .

### 6.3.1. Measuring

1. Turn the rotary switch to **LOW $\Omega$ 10AE204**. The following screen appears on the display:



2. Use the **F1** and **F2** keys to set the length in range **0.1m ÷ 999.9m** and keys **F3** and **F4** to set the section of the protective conductor being tested, selecting the values **0.5, 1, 1.5, 2.5, 4, 6, 10, 16mm<sup>2</sup>**. Keep the function keys pressed for a quick setting of the desired values
3. Supply the instrument by connecting it to the 230V/50Hz electric mains (see Fig. 2 – position 2) by means of the cable supplied.
4. Connect the connectors of the measuring cables C7000 provided to the instrument's input terminals **B1** (Black), **B2** (Red), **B3** (Red), **B4** (Black) and the alligator clips to the item to be tested as indicated in Fig. 6

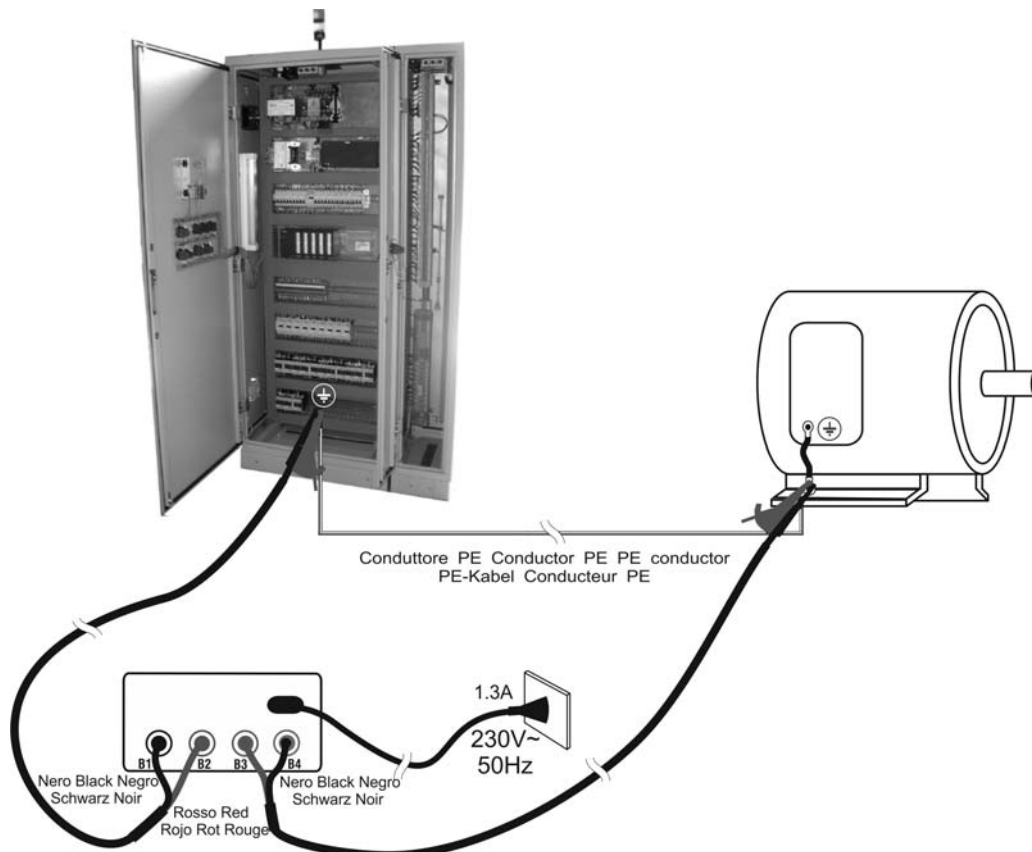


Fig. 6: Instrument connection for LOW $\Omega$ 10AE204 test

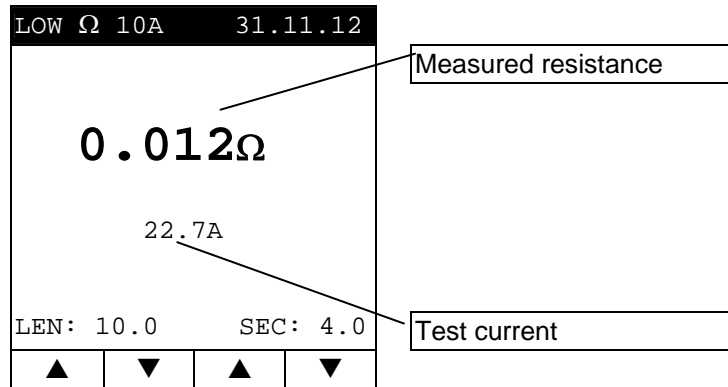
5. Press the **START** key. The instrument starts testing.



### CAUTION

When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

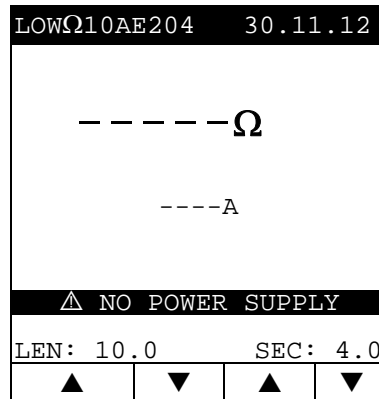
At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.



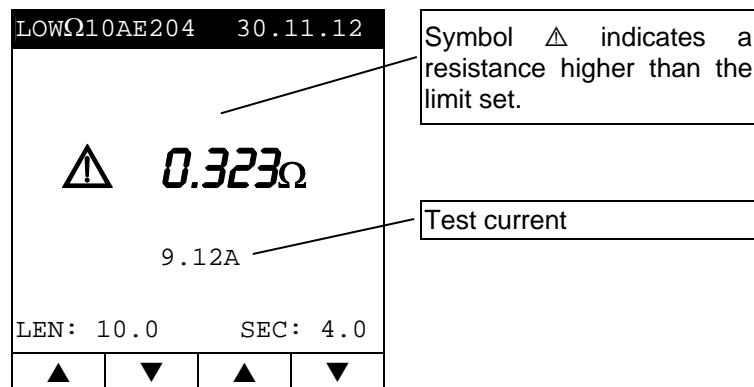
6. The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### 6.3.2. Anomalous situations

If the instrument does not detect any power supply at connector "230V 50Hz", it displays the message reported to the side.

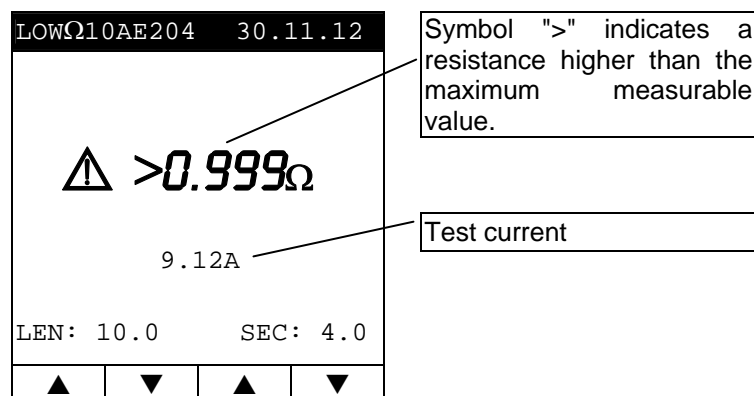


If the instrument detects a resistance higher than the limit set, it gives out a long sound and the following screen appears on the display.



The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

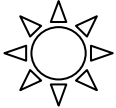
If the instrument detects a resistance higher than the maximum measurable value, it gives out a long sound and the following screen appears on the display.



The displayed results can be saved by pressing the **SAVE** key **twice** (see § 7.1)

#### 6.4. LOOP/RA : LOOP IMPEDANCE, OVERALL EARTH RESISTANCE AND PHASE SEQUENCE


Measurement is carried out in compliance with standards IEC/EN61557-3 and IEC/EN60204-1:2006.



Turn the **rotary switch** to **LOOP/Ra** .

#### **F1**

With the **F1** key it is possible to select one of the following measuring modes (which cyclically appear when pressing the key):

- ☞ **“P-N”** mode (the instrument measures impedance between Phase conductor and Neutral conductor and calculates the assumed Phase-Neutral short-circuit current. This test is usually carried out to evaluate if the breaking power of switches is higher than short-circuit current in the installation point).
- ☞ **“P-P”** mode (the instrument measures impedance between two Phase conductors and calculates the assumed Phase-Phase short-circuit current. This test is usually carried out to evaluate if the breaking power of switches is higher than short-circuit current in the installation point).
- ☞ **“P-PE”** mode (the instrument measures the overall earth resistance and calculates the assumed Phase-Earth short-circuit current. This test is usually carried out to evaluate the coordination of the protections against indirect contact by means of an automatic interruption of power supply and to measure the value of Earth resistance).
- ☞ **“R<sub>A</sub>≡”** mode (the instrument measures the overall earth resistance and calculates the assumed Phase-Earth short-circuit current. This test is usually carried out to evaluate the coordination of the protections against indirect contact by means of an automatic interruption of power supply and to measure the value of Earth resistance. This test has a lower resolution than **“P-PE”** test, but has the advantage that it can be carried out without making a possible residual current protection, installed upstreams of the measuring point, trip).
- ☞ **“”** mode (the instrument detects phase sequence).

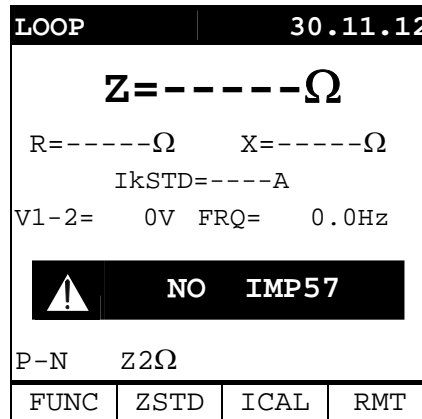
#### CAUTION



When message **“MEASURING...”** is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

### 6.4.1. High-resolution impedance measurement (0.1 mΩ)

The instrument allows measuring impedance with a high resolution next to a MT/BT transformer by using the optional accessory **IMP57**. Measurement is selectable in modes **LOOP P-P**, **P-N**, **P-PE** by means of the **F2** key (**Z2Ω**). In case high-resolution impedance measurement is selected with no connection of the accessory **IMP57**, the instrument shows a screen similar to the following one (e.g.: Loop P-N):



For any detail regarding the use and the technical specifications of accessory **IMP57**, please refer to the relevant user manual or visit the website [www.ht-instruments.com](http://www.ht-instruments.com).

### 6.4.2. "P-N" mode: measurement procedure and results

1. Select the **P-N** mode using the **F1** key.
2. Insert the 3 Black, Green, Blue connectors of the three-pin shuko cable or of the separate cables into the relevant instrument input terminals **B1**, **B3**, **B4** (see Fig. 7, Fig. 8). In case separate cables are used, insert alligator clips on the free cable ends.

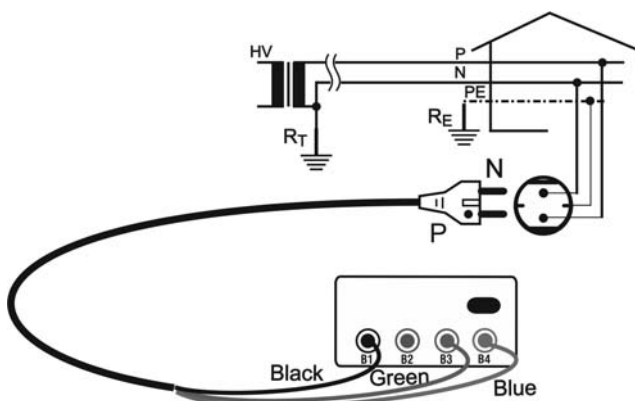


Fig. 7: Connection for measuring Loop impedance of single-phase/two-phase 230V system

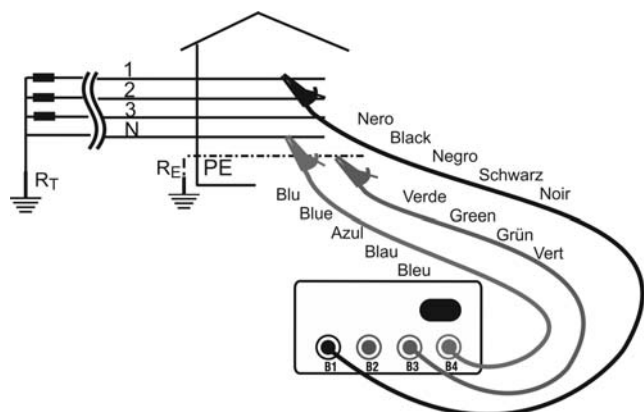


Fig. 8: Connection for measuring Loop impedance of three-phase 400V system

3. Insert the Shuko plug into a 230V 50Hz socket or the alligator clips onto the conductors of the three-phase system (see Fig. 7, Fig. 8)
4. When possible, disconnect all loads connected downstreams of the measuring point since the impedance of these users may alter test results.
5. Press the **START** key. The instrument carries out the test.





### 6.4.3. "P-P" mode: measurement procedure and results

1. Select the **P-P** mode using the **F1** key.
2. Insert the 3 Black, Green, Blue connectors of the separate cables into the relevant instrument input terminals **B1**, **B3**, **B4**.

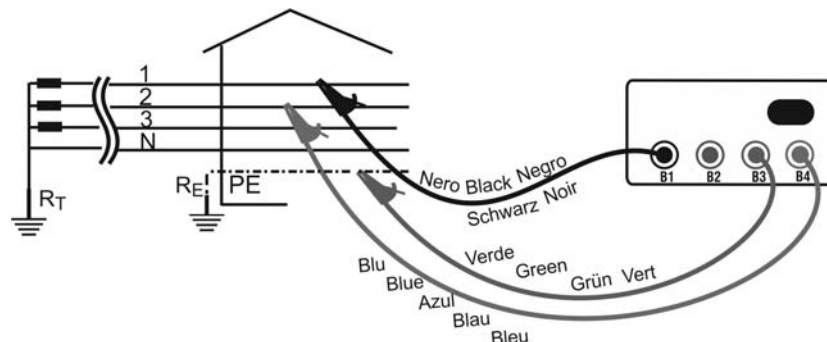


Fig. 9: Instrument connection for measuring Phase-Phase impedance

3. Insert the alligator clips onto the conductors of the three-phase system (see Fig. 9)
4. When possible, disconnect all loads connected downstreams of the measuring point since the impedance of these users may alter test results
5. Press the **START** key. The instrument carries out the test.

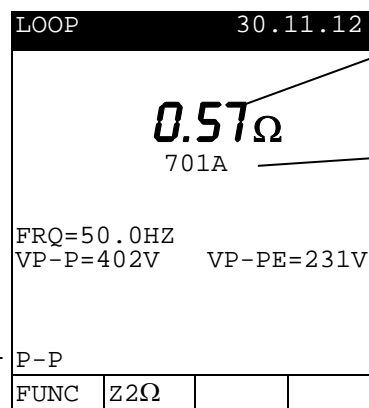
#### CAUTION



- The following test entails the circulation of a maximum current of approx. 12A (400V) between phase and phase. This could cause the tripping of possible magnetothermal protections with lower tripping currents. In this case, carry out the measurement upstreams of the protections.
- When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.

Operating mode



Value of Phase-Phase Line impedance expressed in Ohm

Value of the assumed Phase-Phase short-circuit current calculated using the formula reported below

Formula used for calculating the assumed short-circuit current:  $I_{CC} = \frac{U_N}{Z_{PP}}$

where  $U_N$  = Phase-Phase voltage

127 if $V_{mis} \leq 150$
230 if $150V < V_{mis} \leq 260$
400 if $V_{mis} > 260$

$Z_{PP}$  = measured Phase-Phase impedance

3. The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

#### 6.4.4. "P-PE" mode: measurement procedure and results

1. Select the **P-PE** mode using the **F1** key.
2. Insert the 3 Black, Green, Blue connectors of the shuko cable or of the separate cables into the relevant instrument input terminals **B1**, **B3**, **B4** (see Fig. 10, Fig. 11, Fig. 12). In case separate cables are used, insert alligator clips on the free cable ends.

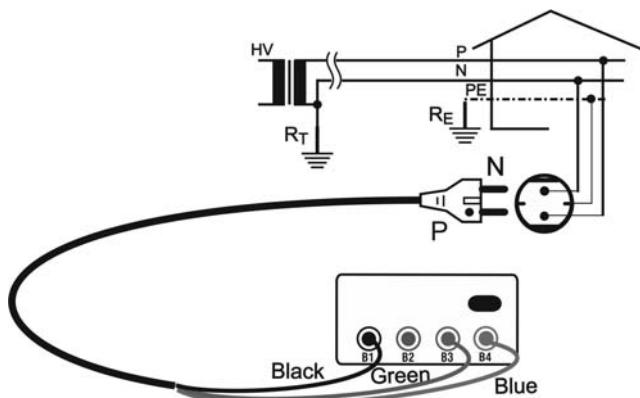


Fig. 10: Connection for measuring P-PE impedance of single-phase/two-phase 230V system

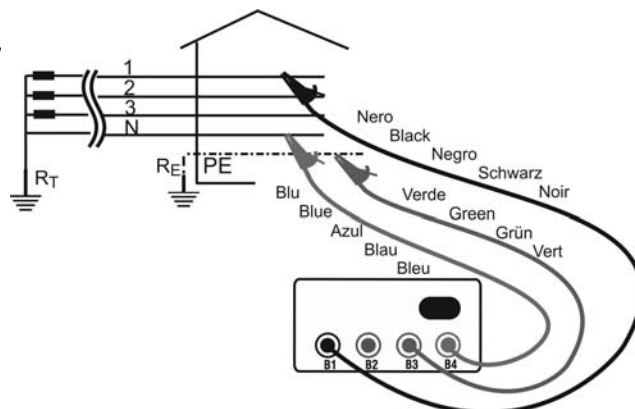


Fig. 11: Connection for measuring P-PE impedance of three-phase 400V + N system

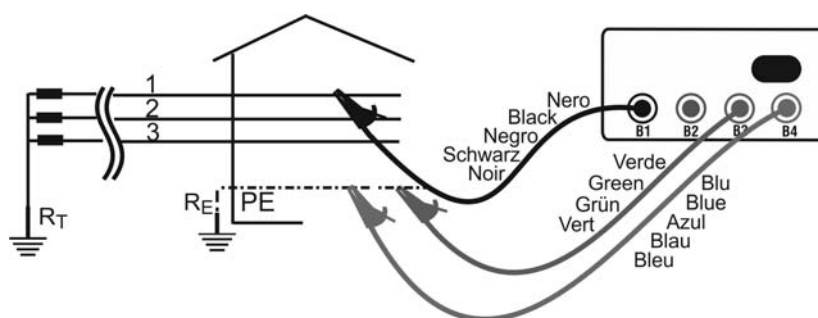


Fig. 12: Connection for P-PE impedance of three-phase 230V or 400V system without N

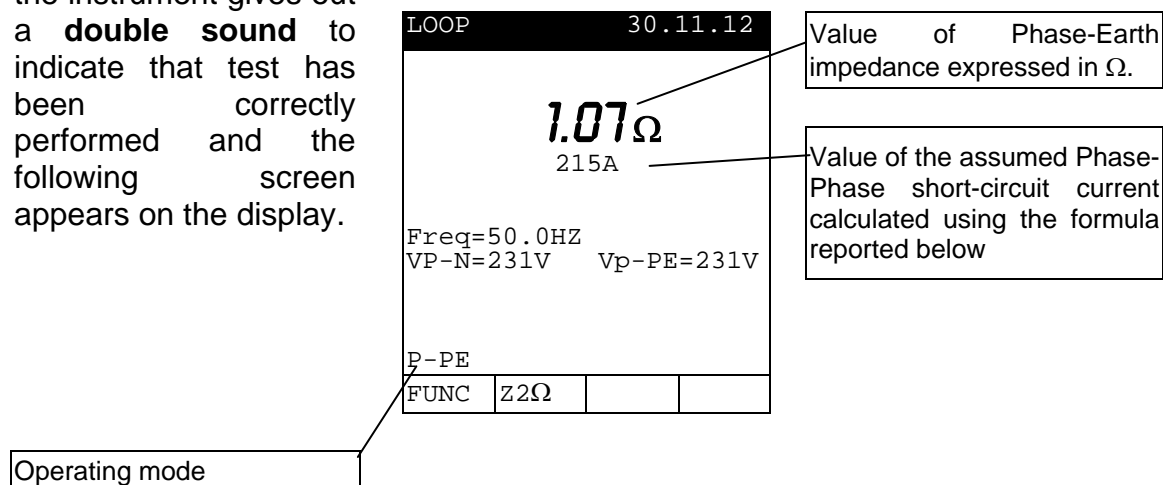
3. Insert the Shuko plug into a 230V 50Hz socket or the alligator clips onto the conductors of the three-phase system (see Fig. 10, Fig. 11, Fig. 12)
4. The **F4** key allows setting the limit value for contact voltage. The instrument carries out the test, checking that the contact voltage found on the system masses, with regard to the actual current applied, does not exceed the limit value set. You may select one of the two possible values: 50V (default), 25V
5. Press the **START** key **once**. The instrument carries out the test by circulating a current of type "0°". Otherwise, press the **START** key **twice** before the dashes disappear. The instrument carries out the test by circulating a current of type "180°".

### CAUTION



- The following test entails the circulation of a current of approx. 6A between phase and earth. This could cause the tripping of possible magnetothermal or residual current protections. In this case, carry out the measurement upstreams of the protection. In case of AC residual current protections you may try and detect what kind of waveform (type 0° or type 180°) does not cause the protection's tripping.
- When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.



**N.B.:** In **TT** systems, the value of impedance measured by the instrument may only be attributed to the value of overall earth resistance. Therefore, in compliance with standard CEI 64-8, the measured value may be taken as the value of the system's earth resistance.

Formula used for calculating the assumed short-circuit current:  $I_{CC} = \frac{U_N}{Z_{PE}}$

where:  $U_N$  = Phase-Earth voltage 127 if

100 <  $V_{mis} \leq 150$

230 if  $150V < V_{mis} \leq 260$

$Z_{PE}$  = measured Phase-Earth impedance

6. The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### 6.4.5. " $R_A \perp$ " mode: measurement procedure and results

1. Select the  $R_A \perp$  mode using the **F1** key.
2. Insert the 3 Black, Green, Blue connectors of the shuko cable or of the separate cables into the relevant instrument input terminals **B1**, **B3**, **B4** (see Fig. 13, Fig. 14, Fig. 15). In case separate cables are used, insert alligator clips on the free cable ends.

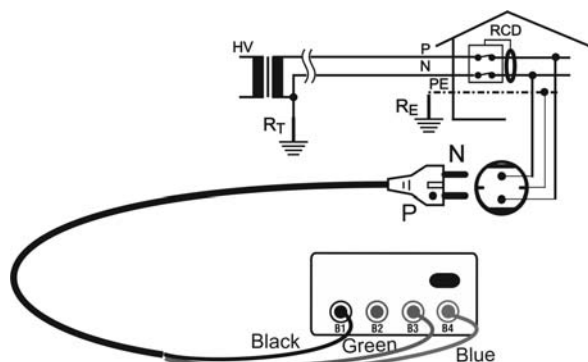


Fig. 13: Connection for  $R_A$  measuring of single-phase/two-phase 230V system

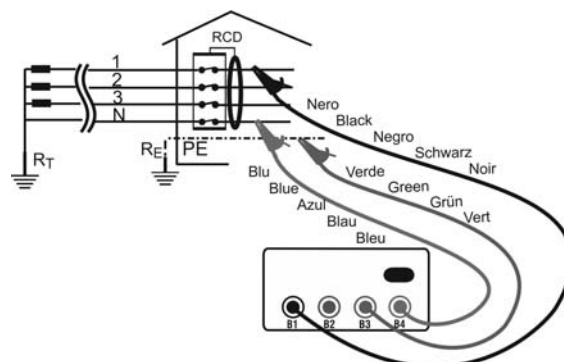


Fig. 14: Connection for  $R_A$  measuring of three-phase 400V + N system

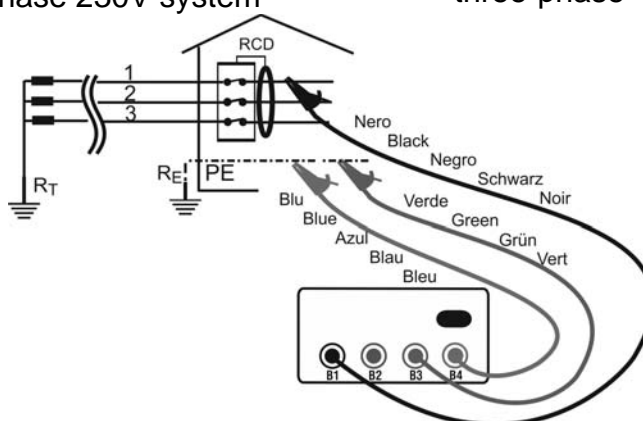


Fig. 15: Connection for  $R_A$  measuring of three-phase 230V or 400V system without N

3. Insert the Shuko plug into a 230V 50Hz socket or the alligator clips onto the conductors of the three-phase system (see Fig. 13, Fig. 14, Fig. 15)
4. The **F4** key allows setting the limit value for contact voltage. The instrument carries out the test, checking that the contact voltage found on the system masses, with regard to the actual current applied by the instrument, does not exceed the limit value set for contact voltage. You may select one of the two possible values: 50V (default), 25V
5. Press the **START/STOP** key **once**. The instrument carries out the test by circulating a current of type "**0°**". Otherwise, press the **START/STOP** key **twice** before the dashes disappear. The instrument carries out the test by circulating a current of type "**180°**".

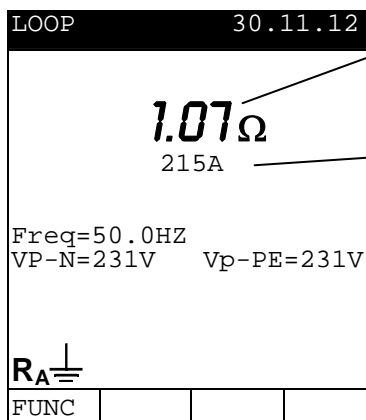
### CAUTION



- The following test entails the circulation of a current of approx. 15mA between phase and earth. This could cause the tripping of possible residual current protections with rated current of 10mA. In this case, carry out the measurement upstreams of the protection.
- When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.

Operating mode



Value of Phase-Earth resistance expressed in Ω

Value of the assumed Phase-Earth short-circuit current calculated using the formula reported below

**N.B.** In **TT** systems, the value of overall earth resistance may be considered similar to the value of Phase-Earth fault loop impedance, measured by the instrument. Therefore, in compliance with standards, the measured value may be taken as the value of the system's earth resistance.

Formula used for calculating the assumed short-circuit current:

$$I_{CC} = \frac{U_N}{Z_{PE}}$$

where:

$$100 < V_{mis} \leq 150$$

$U_N$  = Phase-Earth voltage 127 if

230 if  $150V < V_{mis} \leq 260$

$Z_{PE}$  = measured Phase-Earth impedance

6. The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

### 6.4.6. "∞" mode: measurement procedure and results

1. Select the "∞" mode using the **F1** key.
2. Insert the 3 Black, Blue, Green connectors of the separate cables into the relevant instrument input terminals **B1**, **B2**, **B3**.

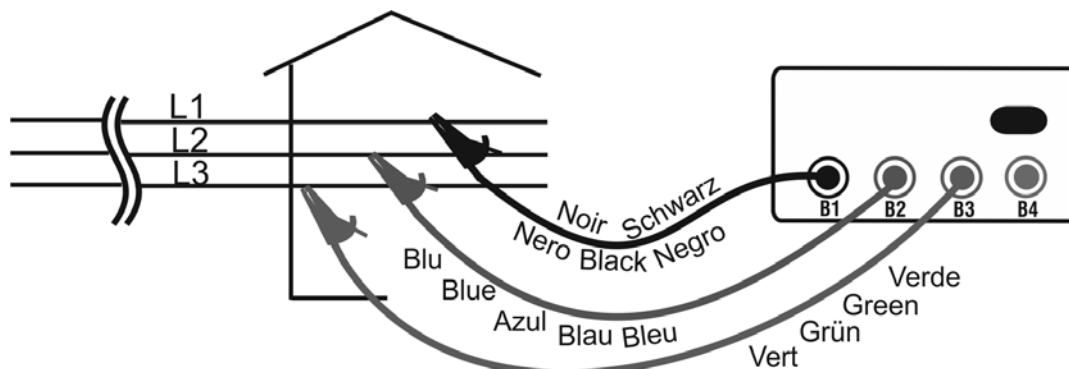


Fig. 16: Instrument connection for phase sequence test

3. Insert the alligator clips onto the conductors of the three-phase system (see Fig. 16)
4. Press the **START** key. The instrument carries out the test.

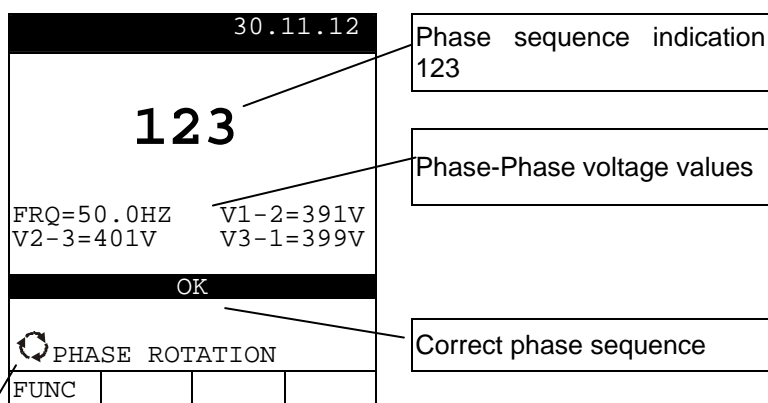
#### CAUTION



When message "**MEASURING...**" is displayed, this indicates that the instrument is carrying out the test. Never disconnect the instrument's leads during this phase.

At the end of the test, the instrument gives out a **double sound** to indicate that test has been correctly performed and the following screen appears on the display.

Operating mode



Phase sequence indication  
123

Phase-Phase voltage values

Correct phase sequence

5. The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

#### CAUTION



Message "123" **DOES NOT** mean that Input **B1** is connected to phase L1, Input **B2** is connected to phase L2 and Input **B3** is connected to phase L3, but it only indicates that the phases of the electric system being tested respect the correct sequence.

### 6.4.6.1. Anomalous situations in "P-P", "P-N", "P-PE", "R<sub>A</sub>⊥", "⊙" mode

If the instrument detects a Phase-Neutral voltage and a Phase-Earth voltage lower than 100V, the following message appears on the display. Check that the system being tested is supplied.

LOOP				30.11.12			
--- Ω ---A							
FRQ=50.0HZ							
VP-N= 1V VP-PE= 0V							
▲ LOW VOLTAGE							
P-PE				50V			
FUNC	Z2Ω			UL			

Insufficient voltage

If the instrument detects a Phase-Neutral voltage and a Phase-Earth voltage higher than 250V, or a Phase-Phase voltage higher than 440V, the following message appears on the display. Check that the instrument is not connected phase to phase.

LOOP				30.11.12			
--- Ω ---A							
Freq=50.0HZ							
VP-N=401V VP-PE=230V							
▲ HIGH VOLTAGE							
P-PE				50V			
FUNC	Z2Ω			UL			

Voltage too high

If the instrument detects that the Phase and Neutral terminals have been exchanged, the following message appears on the display. Rotate the Shuko plug or check the connection of the separate cables.

LOOP				30.11.12			
--- Ω ---A							
FRQ=50.0HZ							
VP-N=231V VP-PE= 0V							
CHANGE P-N							
P-PE				50V			
FUNC	Z2Ω			UL			

Phase and Neutral conductors have been exchanged.

If the instrument detects that the Phase and Earth terminals have been exchanged, the following message appears on the display. Rotate the Shuko plug or check the connection of the separate cables.

LOOP				30.11.12			
--- Ω ---A							
FRQ=50.0HZ							
VP-N= 1V VP-PE= 230V							
CHANGE P-PE							
P-N							
FUNC	Z2Ω						

Phase and Earth conductors have been exchanged.



If in a 230V system, the instrument detects that terminals B3 and B4 have been exchanged, the following message appears on the display. Check the connection of the separate cables.

LOOP		30.11.12	
--- Ω ---A			
FRQ=50.0HZ			
VP-N=131V VP-PE= 227V			
CHANGE N-PE			
P-N			
FUNC	Z2Ω		

Phase and Earth conductors have been exchanged.

If the instrument detects that, in case test is carried out, a Contact Voltage higher than the limit value set would be found in the system being tested, it does not perform the test and the following message appears on the display. Check for the efficiency of the PE conductor and of the grounding system.

LOOP		30.11.12	
--- Ω ---A			
FRQ=50.0HZ			
VP-N= 1V Vp-PE= 0V			
Ut DANGEROUS			
$R_A \downarrow$			50V
FUNC			UL

The instrument detects a dangerous Contact Voltage

If the instrument detects an Earth resistance so high that the Earth conductor of the grounding system itself may be considered missing, the following message appears on the display. Check for the efficiency of the PE conductor and of the grounding system.

LOOP		30.11.12	
--- Ω ---A			
FRQ=50.0HZ			
VP-N=231V Vp-PE= 40V			
NO PE			
P-PE			50V
FUNC	Z2Ω		UL

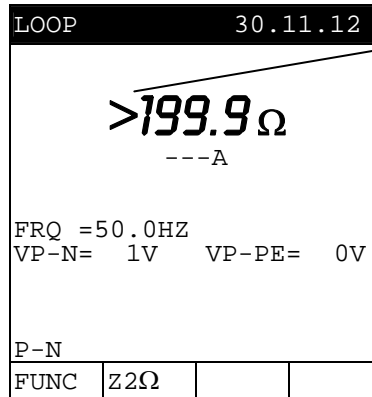
Inefficient grounding system

If, after repeated tests, the instrument has overheated, the following message appears on the display. Wait for the message to disappear before carrying out other tests.

LOOP		30.11.12	
--- Ω ---A			
FRQ=50.0HZ			
VP-N=231V Vp-PE= 40V			
HIGH TEMP			
P-PE			50V
FUNC	Z2Ω		UL

The instrument has overheated

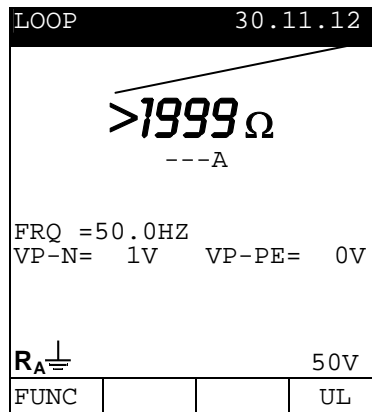
Using modes "P-P", "P-N", if the instrument detects an impedance higher than  $199.9\Omega$ , the following screen appears on the display.



Symbol ">" indicates that the value of impedance is higher than the maximum measurable value

The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

Using modes "P-PE", " $R_A \perp$ ", if the instrument detects an impedance higher than  $1999\Omega$ , the following screen appears on the display.

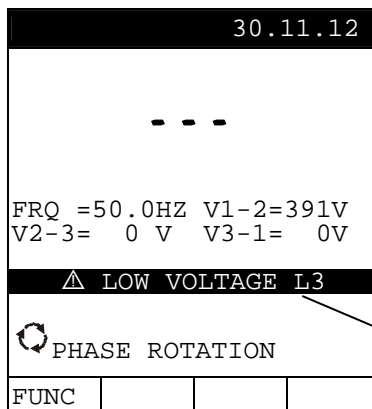


Symbol ">" indicates that the value of impedance is higher than the maximum measurable value

The results can be saved by pressing the **SAVE** key **twice** (see § 7.1).

In "⊙" mode, if one of the Phase-Phase voltages does not reach the minimum threshold value of 100V, the instrument does not perform any test and displays the following screen.

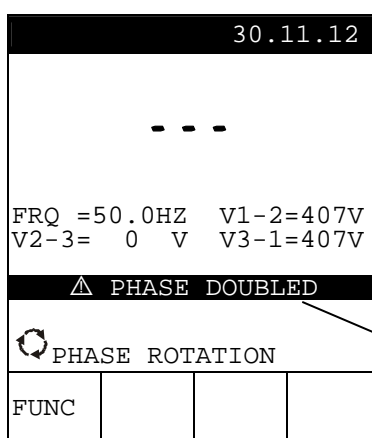
Check that all phases of the electric system being tested have voltage.



Phase "L3" does not reach the minimum voltage value

Using the "⊙" mode, if two phases of the electric system coincide, the instrument does not perform any test and displays the following screen.

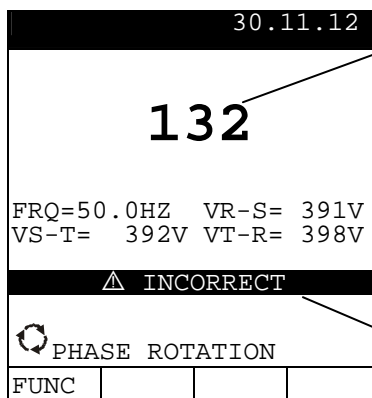
Check that all phases of the electric system being tested have voltage.



Two phases of the three-phase system being tested are connected to each other

Using mode "⊙", if phase sequence is incorrect, the symbol "132" is displayed.

Exchange two phases of the electric system being tested and repeat the test.



This symbol **DOES NOT** indicate that input B1 is connected to phase L1, input B2 is connected to phase L3, input B3 is connected to Phase L2. It **ONLY** indicates that **the detected phase sequence is incorrect**

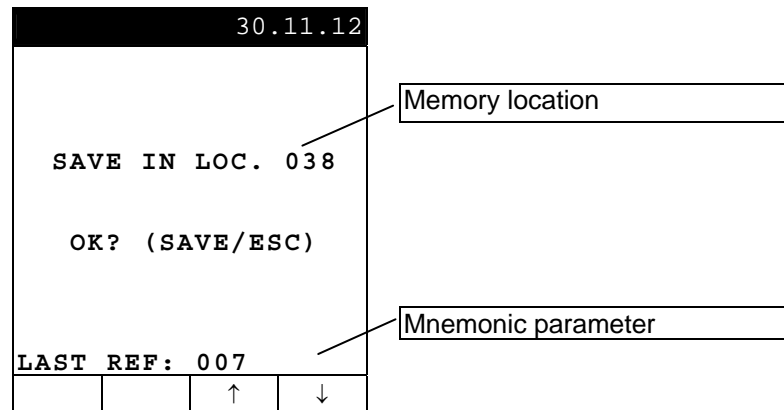
Incorrect sequence

## 7. OPERATIONS WITH THE MEMORY

### 7.1. STORAGE OF MEASUREMENT RESULTS

1. With displayed result, press the **SAVE** key. The following screen appears on the display:

The parameter "LAST REF" (numerical marker) may be used to help the operator find out the point in which a measurement has been carried out. The value of this parameter can be freely modified and is not bound to the memory location in which the results shall be saved, which progressively increases. There are up to **255 markers** available.



2. Use the **F3** or **F4** keys to set the mnemonic reference marker.
3. Press the **SAVE** key again to save the result in the indicated memory location, associating the displayed value of parameter "REF". The message "OK" immediately appears on the display to confirm operation.
4. Press the **ESC** key to exit without saving.

### 7.2. RECALLING AND DELETING DATA FROM THE MEMORY

1. Press the **MENU** key to access the instrument's general menu. Select item "SAFETY TEST MEMORY" and confirm with **ENTER**. The following screen appears on the display:

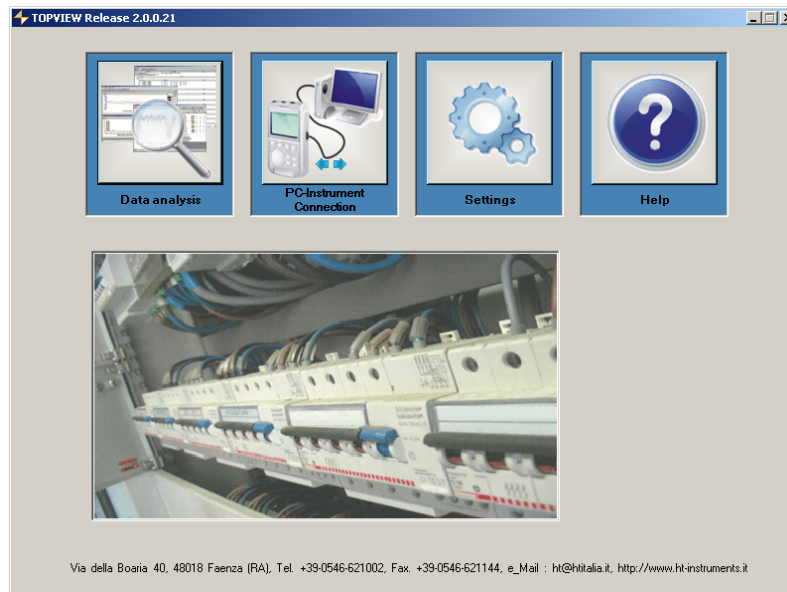
SAFETY TEST MEMORY		
MEM	TYPE	REF
001	LOW $\Omega$	001
002	LOW $\Omega$ 10A	001
003	LOW $\Omega$ E204	002
004	LOOP	003
TOT:004 FREE:995		
▼	▲	LAST
		TOT.

2. Use the **F1** or **F2** keys to select the desired measurement among those available in the list. Press the **ENTER** key to recall the measurement on the display and the **ESC** key to go back to the list of measurements.
3. Press the **F3** key to delete the last measuring result saved in the memory. The instrument shows the message "CLEAR LAST? (Enter)". Confirm the operation with **ENTER** or press **ESC** to go back to the list of measurements.
4. Press the **F4** key to delete the whole memory content. The instrument shows the message "CLEAR ALL? (Enter)". Confirm the operation with **ENTER** or press **ESC** to go back to the list of measurements

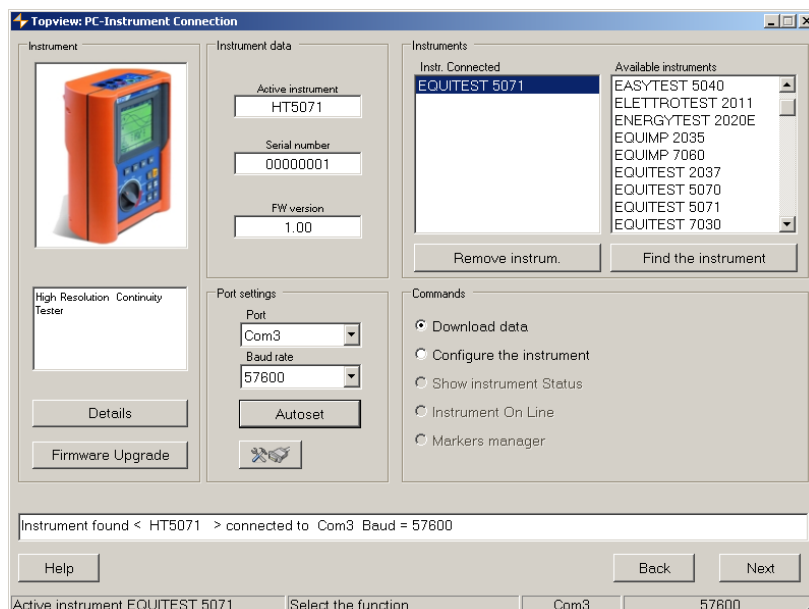
## 8. CONNECTING THE INSTRUMENT TO THE PC

To transfer data to the PC, follow this procedure:

1. Install the **TopView** software found in the provided CD-ROM.
2. Install the C2006 cable driver found in the provided CD-ROM.
3. Launch **TopView** software. The following initial screen appears on the PC screen:



4. Switch on the instrument and leave it in any reading screen.
5. Connect the optical connector of the C2006 cable to the instrument (side in the shape of an “8”) and the other end to a USB port of the PC.
6. Click on key “**PC-InstrumentConnection**” of the TopView software. The following screen appears on the display:



7. Use the keys “**Detect instrument**” and “**Autoset**” until the instrument is detected.
8. Click on key “**Forward**” and follow the guided procedure of the software.

**For any detail regarding the analysis of the results, please refer to TopView ON-LINE HELP**

## 9. MAINTENANCE

### 9.1. GENERAL INFORMATION

1. The instrument you purchased is a precision instrument. While using and storing the instrument, carefully observe the recommendations listed in this manual in order to prevent possible damage or danger during use.
2. Do not use the instrument in environments with high humidity levels or high temperatures. Do not expose to direct sunlight.
3. Always switch off the instrument after use. For long-term storage, remove the batteries to avoid leakage of battery fluid that can damage the internal components.

### 9.2. BATTERY REPLACEMENT

The symbol "■" indicates a full charge level of the batteries. The symbol "□" indicates that the batteries are almost flat. In this case, stop testing and replace the batteries.



#### CAUTION

- The instrument is capable of keeping data stored even without batteries. **The date/time settings remain unchanged only if replacement is carried out within 24 hours.**
- Only expert and trained technicians should perform this operation. Before carrying out this operation, make sure you have disconnected all cables from the input terminals.

1. Switch off the instrument using the **ON/OFF** key.
2. Remove all the cables from the input terminals.
3. Loosen the battery compartment cover fastening screw and remove the cover.
4. Remove all batteries and replace them with six new batteries of the same type (see § 10.2), respecting the indicated polarity.
5. Position the battery cover back over the compartment and fasten it with the relevant screw.
6. Do not scatter old batteries into the environment. Use the relevant containers for battery disposal.

### 9.3. CLEANING THE INSTRUMENT

Use a soft and dry cloth to clean the instrument. Never use wet cloths, solvents, water, etc.

### 9.4. END OF LIFE



**CAUTION:** the symbol on the instrument indicates that the appliance and its accessories must be collected separately and correctly disposed of.

## 10. TECHNICAL SPECIFICATIONS

Accuracy indicated as [%reading + (number of digits)\* resolution] at 23°C±5°C, <60%RH

### Continuity of protective conductors with 200mA (LOWΩ)

Mode	Measuring range (Ω)	Resolution (Ω)	Accuracy (*)
AUTO, R+TIMER, R-TIMER	0.01 ÷ 9.99	0.01	±(2%rdg + 2digits)
	10.0 ÷ 99.9	0.1	

(\*) Considering the calibration of measuring cables

Test current >200mA DC up to 5Ω (including calibration value)

Current measurement resolution 1mA ; Open-circuit voltage: 4V < V<sub>o</sub> < 12V

### Continuity of protective conductors with 10A (LOWΩ10A)

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.001 ÷ 0.999	0.01	±(1%rdg + 2digits)

Test current > 10A AC up to 0.45Ω

Current measurement resolution 0.1A

Open-circuit voltage < 12V AC

Measuring mode 4 terminals

Power supply 230V AC / 50/60Hz

### Continuity of PE conductors in compliance with IEC/EN60204-1:2006 (LOWΩ10AE204)

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.001 ÷ 0.999	0.01	±(1%rdg + 2digits)

Test current > 10A AC up to 0.45Ω ; Current measure resolution: 0.1A ; Open-circuit voltage < 12V AC

Length measuring range 0.1m ÷ 999.9m ;

Selectable section 0.5, 1, 1.5, 2.5, 4, 6, 10, 16mm<sup>2</sup> ; Copper resistivity 0.017 Ωmm<sup>2</sup>/m

Measuring mode 4 terminals

Power supply 230V AC / 50/60Hz

### Contact voltage (U<sub>t</sub>)

Range (V)	Resolution (V)	Accuracy
0 ÷ 2U <sub>t lim</sub>	0.1	-0%, +(10%rdg + 3digits)

U<sub>t lim</sub> (U<sub>t</sub>): 25V or 50V

### Frequency

Range (Hz)	Resolution (Hz)	Accuracy
47.0 ÷ 63.6	0.1	±(0.1%reading+1digit)

LOOP measurement is only active for 50Hz ±0.5Hz

### AC voltage measurement (LOOP, )

Measuring range (V)	Resolution (V)	Accuracy
15 ÷ 460	1	±(3%rdg + 2digits)

### Line impedance (Phase – Phase / Phase - Neutral)

Range (Ω)	Resolution (Ω) (*)	Accuracy
0.01 ÷ 9.99	0.01	±(5%rdg + 3digits)
10.0 ÷ 199.9	0.1	

(\*) 0.1mΩ in range 0.0 ÷ 199.9 mΩ (with IMP57)

Maximum peak current at test voltage: 3.65A (127V) ; 6.64A (230V) ; 11.5A (400V)

Phase – Phase test voltage: 100 ÷ 460V 50Hz ±0.5Hz ; Phase – Neutral test voltage: 100 ÷ 265V 50Hz ±0.5Hz

### Fault ring impedance (Phase – Earth)

Range (Ω)	Resolution (Ω) (*)	Accuracy
0.01 ÷ 9.99	0.01	±(5%rdg + 3digits)
10.0 ÷ 199.9	0.1	
200 ÷ 1999	1	

(\*) 0.1 mΩ in range 0.0 ÷ 199.9 mΩ (with IMP57)

Maximum peak current at test voltage: 3.65A (127V) ; 6.64A (230V)

Phase – Earth test voltage 100 ÷ 265V 50Hz ±0.5Hz

### Global earth resistance (R<sub>a</sub>) without RCD tripping

Range (Ω)	Resolution (Ω)	Accuracy
1 ÷ 1999	1	± (5%rdg + 3digits)

Test current: 15mA ; Phase – Earth test voltage : 100 ÷ 265V 50Hz ±0.5Hz

### 10.1. REFERENCE STANDARDS

Safety:	IEC/EN61010-1, IEC/EN61557-1, -3, -4, -7
Insulation:	double insulation
Pollution level:	2
Measurement category:	CAT II 600VAC (inputs) / 350VAC to earth CAT III 600VAC (inputs) / 300VAC to earth
LOW $\Omega$ (200mA):	IEC/EN61557-4
LOW $\Omega$ 10A:	IEC/EN60439-1
LOW $\Omega$ 10AE60204:	IEC/EN60204-1:2006
LOOP P-P, P-N, P-PE, Ra:	IEC/EN61557-3
PHASE SEQUENCE:	IEC/EN61557-7

### 10.2. GENERAL CHARACTERISTICS

#### Mechanical characteristics

Size (L x W x H):	225 x 165 x 105mm ; (9 x 6 x 4in)
Weight (batteries included):	1.7kg (35lv)

#### Power supply

Internal power supply:	6x1.5V alkaline batteries type AA LR6 AM3
Battery life:	LOW $\Omega$ : >80 test; LOOP:>1000test; Ra $\frac{1}{\equiv}$ :>1000 test; PHASE SEQUENCE: > 1000 test
External power supply:	230V / 50/60Hz (only for continuity test with 10A)

#### Display

Characteristics:	Dot matrix graphic module, backlit
Resolution	128x128pxl
Visible area	73mmx73mm ; (3 x 3in)

#### Memory:

Memory	2MByte (non-expandable)
Verification tests	max 999 measurements

#### Interface:

Serial port RS232, opto-isolated

### 10.3. ENVIRONMENTAL CONDITIONS

Reference temperature	23° ± 5°C ; (73° ± 41°C)
Operating temperature	0° ÷ 40°C ; (32° ÷ 104°F)
Operating relative humidity	< 80%RH
Storage temperature	-10 ÷ 60°C; (14° ÷ 140°F)
Storage humidity	< 80%RH
Max operating altitude:	2000m (6562ft)

### 10.4. ACCESSORIES

See the attached packing list.



## 11. SERVICE

### 11.1. WARRANTY CONDITIONS

This instrument is warranted against any material or manufacturing defect, in compliance with the general sales conditions. During the warranty period, defective parts may be replaced. However, the manufacturer reserves the right to repair or replace the product.

Should the instrument be returned to the After-sales Service or to a Dealer, transport will be at the Customer's charge. However, shipment will be agreed in advance.

A report will always be enclosed to a shipment, stating the reasons for the product's return. Only use original packaging for shipment; any damage due to the use of non-original packaging material will be charged to the Customer.

The manufacturer declines any responsibility for injury to people or damage to property.

The warranty shall not apply in the following cases:

- Repairs that may become necessary as a consequence of an incorrect use of the instrument or due to its use together with non-compatible appliances.
- Repairs that may become necessary as a consequence of improper packaging.
- Repairs which may become necessary as a consequence of interventions performed by unauthorized personnel.
- Modifications to the instrument performed without the manufacturer's explicit authorization.
- Use not provided for in the instrument's specifications or in the instruction manual.

The content of this manual cannot be reproduced in any form without the manufacturer's authorization.

**Our products are patented and our trademarks are registered. The manufacturer reserves the right to make changes in the specifications and prices if this is due to improvements in technology.**

### 11.2. SERVICE

If the instrument does not operate properly, before contacting the After-sales Service, please check the conditions of batteries and cables and replace them, if necessary.

Should the instrument still operate improperly, check that the product is operated according to the instructions given in this manual.

Should the instrument be returned to the After-sales Service or to a Dealer, transport will be at the Customer's charge. However, shipment will be agreed in advance.

A report will always be enclosed to a shipment, stating the reasons for the product's return. Only use original packaging for shipment; any damage due to the use of non-original packaging material will be charged to the Customer.







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