ENGLISH

User manual

Release EN 4.01 - 13/12/24

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1. SAFETY PRECAUTIONS AND PROCEDURES

This instrument was designed in compliance with the IEC/EN61557-1 and IEC/EN61010-1 guidelines relative to electronic equipment.

CAUTION

For your own safety and to avoid damaging the instrument you are recommended to follow the procedures described in this manual and read carefully all instructions preceded by this symbol ⚠.

Before and during measurements keep to the following instructions:

- Do not take voltage or current measurements in wet places
- Do not take measurements in the presence of explosive gas and combustibles or in dusty places
- Avoid any contact with the circuit under test even though you are not taking any measurement
- Avoid any contact with exposed metal parts, unused measuring terminals, circuits etc.
- Do not take any measurement whenever anomalous conditions occur such as deformations, breaks, leakages, blind display etc
- Pay utmost attention when taking measurements of voltage higher than 25V in special places (building yards, swimming pools, etc.) and higher than 50V in ordinary places due to the risk of electric shock.

The following symbols are used in this manual:

CAUTION: refer to the instruction manual. An improper use may damage the instrument or its components as well as endanger the user.

High voltage danger: risk of electric shock.

AC voltage or current

DC voltage

Double insulation.

1.1. PRELIMINARY INSTRUCTIONS

- This instrument has been designed for use in environments with pollution degree
- It can be used for voltage and current measurements on electrical installations with CAT III 240V to earth and maximum voltage of 415V between inputs
- The instrument can be used on electrical installations type TT, TN and IT industrial, civil, medical, zoo-technical both under ordinary conditions where contact voltage limit is 50V, and under special conditions where contact voltage limit is 25V
- You are recommended to respect the usual safety regulations aimed at protecting you against dangerous currents and protecting the instrument against improper use
- Only the original accessories supplied along with the instrument guarantee compliance with the safety standards in force. They must be in a good conditions and, if necessary, replaced with identical ones
- Do not test nor connect to any circuit exceeding the specified overload protection
- Do not take measurements under environmental conditions exceeding the limits indicated in this manual
- Make sure that batteries are correctly installed.

1.2. DURING USE

You are recommended to read carefully the following instructions::

CAUTION

Failure to comply with warnings and instructions may damage the instrument and/or its components as well as injure the operator.

- When the instrument is connected to circuits never touch any unused terminal
- Do not measure in the presence of external voltages. Although the instrument is protected, an excessive voltage may cause malfunction
- Avoid submitting the instrument to voltage while measuring (i.e. a test lead slipping off the measuring point accidentally touching an energized point).

CAUTION

If the “low battery” symbol “⊟” is displayed during use interrupt testing, switch off the instrument and replace batteries following the procedure described in § 5.2.

1.3. AFTER USE

- Turn off the instrument pressing **ON/OFF** key after using it
- If you expect not to use the instrument for a long time remove batteries.

1.4. DEFINITION OF MEASUREMENT CATEGORY (OVERVOLTAGE)

Standards IEC/EN61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements) define what a measurement category (usually called “overvoltage category”) is. At § 6.7.4: Measuring circuits it quotes:

Circuits are divided into the following measurement categories:

- **Measurement category IV** is for measurements performed at the source of a low-voltage installation.

  Examples are electricity meters and measurements on primary excess current protection devices and ripple control units.
- **Measurement category III** is for measurements performed in the building installations.

  Examples are measurements on distribution boards, circuit breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installations, and equipment for industrial use as well as some other equipment, for example, stationary motors with permanent connection to fixed installations.
- **Measurement category II** is for measurements performed on circuits directly connected to the low voltage installations.

  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 (internally) MAINS-derived circuits. In the latter case, transient stresses are variable; for this reason, the norm requires that the transient withstand capability of the equipment is made known to the user.

2. GENERAL DESCRIPTION

The instrument is capable of performing the following measurements:

EARTH 2W: Two-wire earth resistance measurement .
EARTH 3W: Three-wire earth resistance measurement.

3. PREPARING THE INSTRUMENT

3.1. INITIAL CHECK

This instrument was checked both mechanically and electrically prior to shipment. All possible cares and precautions were taken to let you receive the instrument under perfect conditions. Notwithstanding we suggest you to check it rapidly to check any damage which may have occurred during transport. Should it be the case please contact immediately the manufacturer HT or your local dealer. Make sure that all standard accessories mentioned in the enclosed packing list are included in the packaging. In case of discrepancies contact your dealer. Should you have to return back the instrument for any reason please follow the instructions mentioned in § 7.

3.2. MAINS SUPPLY

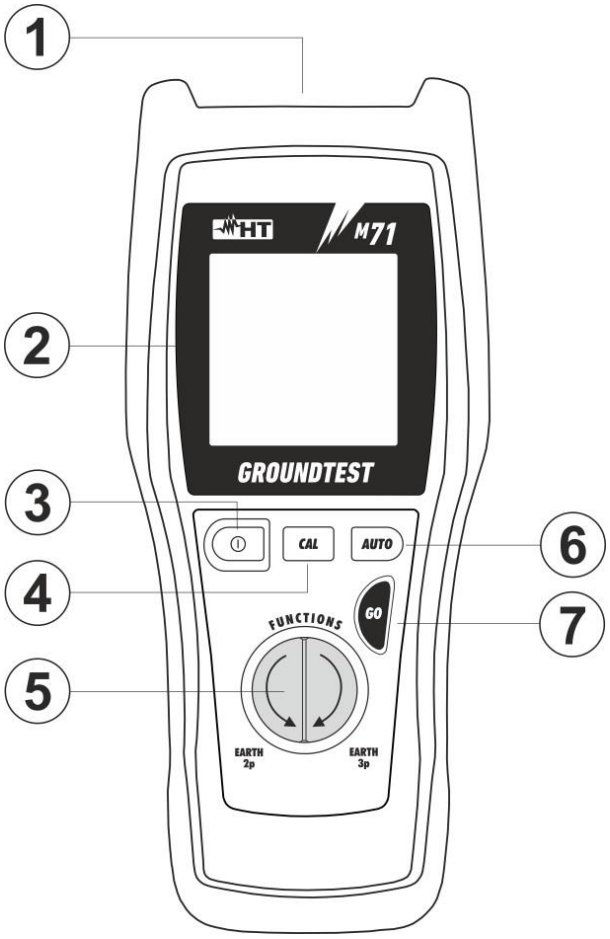
The instrument is powered by batteries (see § 6.1.2). When batteries are low, the low battery indication is displayed. To replace/insert batteries follow the instructions indicated in § 5.2

3.3. STORAGE

After a period of storage under extreme environmental conditions exceeding the limits let the instrument resume normal measuring conditions before using it (see § 6.2.1).

4. WORKING INSTRUCTIONS

4.1. INSTRUMENT DESCRIPTION



CAPTION:
1. Inputs
2. Display
3. **ON/OFF** key
4. **CAL** key
5. Switch of test mode
6. **AUTO** key
7. **GO** key

Fig. 1: Instrument's front panel

4.2. FUNCTION KEYS DESCRIPTION

ON/OFF Key to switch on and off the instrument.

CAL key to effect zero setting of cables under modes EARTH-2W e EARTH-3W.

AUTO key to start/stop the mode detecting critical measuring conditions (high electric noise) with automatic updating of measuring time.

GO key to start measurement.

Switch to select measuring mode.

4.2.1. Switching on

When switching on the instrument a brief tone is audible along with display of all segments for about one second. Subsequently the last firmware version as well as the last selected measuring mode are displayed before switching off.

4.2.2. Auto Power OFF

To save battery life the instrument automatically turns off 5 minutes after last pressure of keys. To resume operation turn on the instrument pressing the start key.

4.3. AUTO MODE

Starting up this mode the instrument will alter the measuring time to fit to the testing conditions detected.

CAUTION

- If the instrument detects an “electrical noise” lower than 0.5Vrms before testing, it will adopt the “standard” test duration (approx. 13 s)
- If the instrument detects an “electrical noise” higher than 0.5Vrms before testing, it will extend the test duration (approx. 25s) to increase the outcome stability even under severe measuring conditions

4.4. EARTH 2W:TWO-WIRE EARTH RESISTANCE MEASUREMENT

4.4.1. EARTH 2W- Zero setting of cables

CAUTION

The instrument can be used for voltage and current measurements on installations with overvoltage category equal to CAT III 240V to earth and maximum voltage of 415V between inputs. Do not connect the instrument to installations whose voltages exceed the limits indicated in this manual. Exceeding such limits may cause electric shock to the user and damage the instrument.

CAUTION

The values for cable zeroing constants under modes EARTH-2W and EARTH-3W are stored into separate and independent cells.

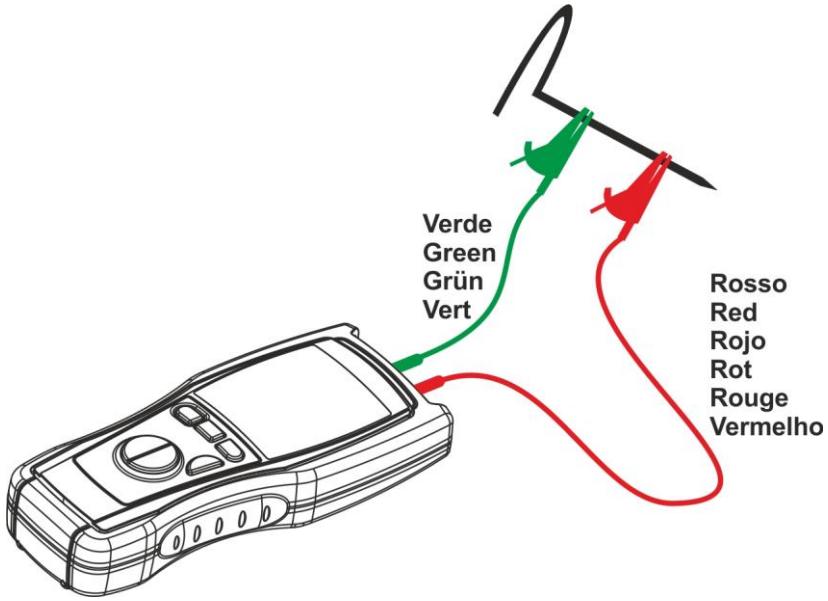


Fig. 2: Instrument's wiring for zero setting of cables under mode EARTH-2W

1. Press the instrument's start key
2. Select function **EARTH 2W** pressing the left arrow key.
3. Connect the red cable, the blue cable and the green cable to the corresponding instrument's input terminals. The instrument shall keep the same operating features during all measurement stages. Any cable extension or replacement as well as additional crocodiles may nullify previous zero setting so requiring to repeat such a setting procedure before effecting further measurements.
4. Connect the crocodiles to the test leads.
5. Short-circuit the measuring cables' ends (see Fig. 2) paying attention that the crocodiles' metal parts make proper contact to each other. To get a safe connection one of the rods provided with the instrument can be used..
6. After pressing the **CAL** key the instrument carries out zero setting of cables' resistance (this procedure takes approx. 30sec). Cables with a resistance up to **2Ω** can be calibrated.

CAUTION

When **"Measuring…"** is displayed the instrument is effecting measurement. During this phase do not disconnect test leads from the instrument.

7. At the end of the test the measured value is stored by the instrument and used as OFFSET (that is to say deduced from all EARTH 2W measurements) for all subsequent measurements till a further zero setting. The instrument emits a double sound tone indicating the positive outcome for zero setting and displays again the initial screen by the symbol **CAL**.

Symbol **CAL**: indicates that the instrument was calibrated; this symbol is displayed for each subsequent measurement even though the instrument is switched off and on again.

8. If during cables' zero setting the value measured is higher than 2Ω the instrument interrupts such setting procedure, removes the previous offset value and does not display the symbol CAL until a cables' zero setting is successfully carried. out The instrument emits a long sound tone indicating the unsuccessful setting outcome and has been displaying a screen similar to the side one for about 2 seconds, then it displays a default screen.
Note: this procedure can be used also to cancel the last value stored for cables' zero setting.

4.4.2. EARTH 2W- Measurement procedure

CAUTION

The instrument can be used for voltage and current measurements on installations with overvoltage category equal to CAT III 240V to earth and maximum voltage of 415V between inputs. Do not connect the instrument to installations whose voltages exceed the limits indicated in this manual. Exceeding such limits may cause electric shock to the user and damage the instrument.

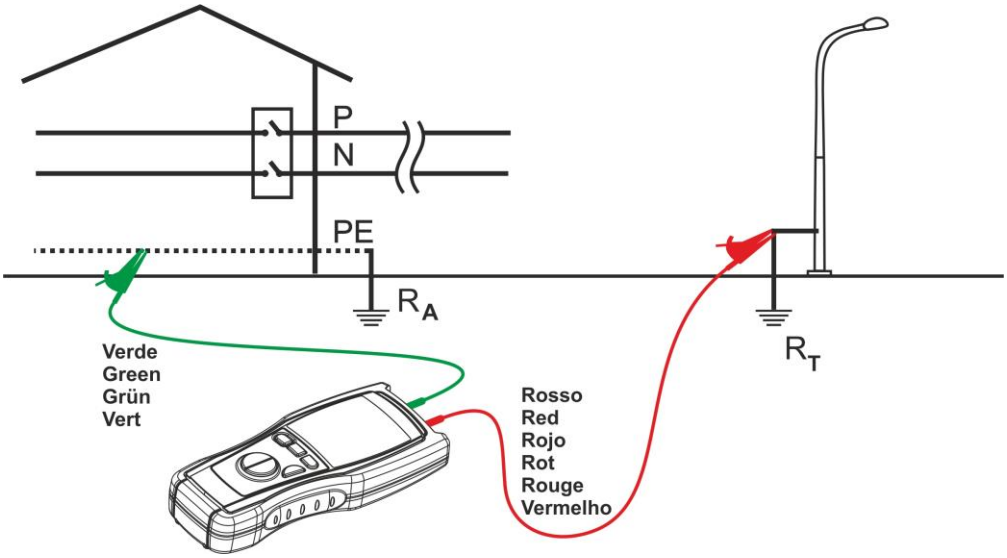


Fig. 3: Example of instrument's wiring for two-wire earth measurement

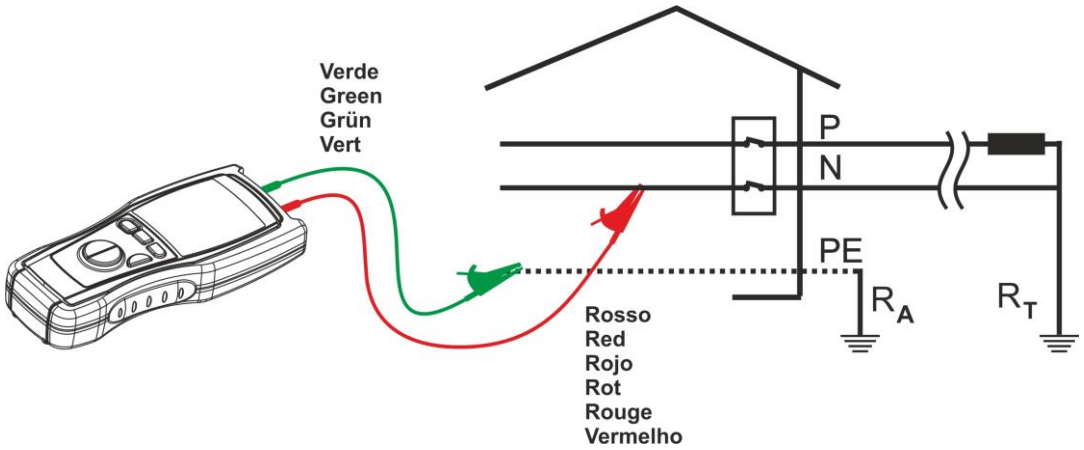


Fig. 4: Example of instrument's wiring for 2-wire earth measurement (only for TT systems).

- Whenever it is not possible to drive rods into the ground to take a three-wire measurement (i.e. In historical centres) it is possible to use the simplified two-wire method which gives an excess value for the sake of safety
- To carry out the test a suitable auxiliary rod is necessary; a rod is defined “suitable” when its earth resistance is negligible and is independent of the earth installation under test
- In Fig. 3 a lamp post is used as auxiliary rod. However a water pipe or any metal body driven into the ground is suitable provided that the above mentions requirements are met
- Only in case of a TT system a neutral conductor can be used as auxiliary earth rod (see Fig. 4).

CAUTION

The instrument displays the sum value of $\mathbf{R_A + R_T}$ as result. Therefore the measurement achieved is:

- The closer to R_A (prospective value) the more negligible the value R_T of the auxiliary earth rod with respect to R_A itself
- Increased "for the sake of safety" by R_T that is to say if the value of $\mathbf{R_A + R_T}$ results to be coordinated with protective conductors, it will be far more coordinated than that thanks to R_A.

1. Press the instrument's start key.
2. Select function **EARTH 2W** pressing the left arrow key.
3. If the circuit under test is assumed to be affected by electric noise press the **AUTO** key to select the corresponding mode.
4. Connect the red cable and the green cable into the corresponding instrument's input terminals.
5. Connect the crocodiles to the test leads.
6. When necessary (symbol CAL missing or use of a new set of cables) carry out zero setting of cable resistance (see § 4.4.1)
7. Connect the instrument's terminals to the circuit under test (see Fig. 4 and Fig. 3).
8. Press **GO** key to start measurement.
9. Display example of earth resistance and disruptive voltage measured values.
   Should disruptive voltage have been higher than 0.5V, it would be advisable to start AUTO mode and repeat measurement.

Value measured for earth resistance $R_A + R_T$

Value measured for disruptive voltage

4.4.3. Message description for EARTH 2W measurement

1. If the following condition is met:

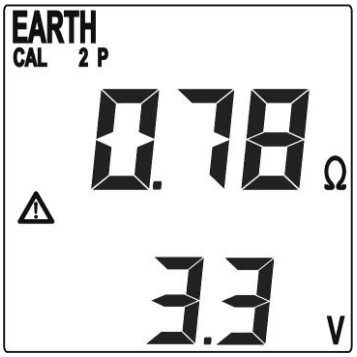
   $R_{DISPLAYED}$ < 0.11Ω

   the instrument displays the symbol ⚠ indicating that the reading may be affected by a relative error higher than 30%.

2. If the following condition is met:

   Disruptive voltage > 3.0V

   the instrument displays the symbol ⚠ indicating that the reading is carried out under critical conditions.



3. If the following condition is met:

   $R_{MEASURED}$ - R_{CABLES} < - 0.03Ω

   the instrument displays the side screen and emits a long sound tone indicating an anomalous condition then displays the initial screen again. This message indicates that the measured resistance is lower than that of measuring cables and that a further zero setting procedure is to be carried out.

4. When measuring, if terminals' voltage is higher than **6V**, the instrument does not effect the test. A long sound tone is emitted indicating an anomalous condition and the side screen is displayed for 5 seconds (S-E indicates between which inputs voltage was detected), then the instrument displays the initial screen.

Value of input voltage

5. Should the resistance value be higher than the full scale, the instrument emits a long sound tone indicating the anomalous condition and displays a screen similar to the side one. The same indication may also highlight that measuring cables are disconnected or open.

4.5. EARTH 3W: THREE WIRE EARTH RESISTANCE MEASUREMENT

4.5.1. EARTH 3W- Zero setting of cables

CAUTION

The instrument can be used for voltage and current measurements on installations with overvoltage category equal to CAT III 240V to earth and maximum voltage of 415V between inputs. Do not connect the instrument to installations whose voltages exceed the limits indicated in this manual. Exceeding such limits may cause electric shock to the user and damage the instrument.

CAUTION

The values for cable zeroing constants under modes EARTH-2W and EARTH-3W are stored into separate and independent cells.

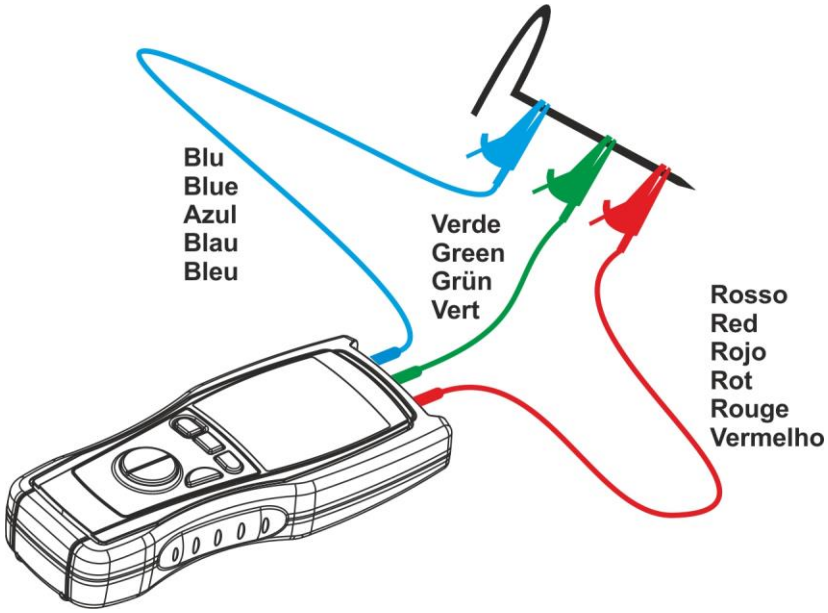


Fig. 5: Instrument's wiring for cables' zero setting under EARTH-3W mode

1. Press the instrument's start key.
2. Select function **EARTH-3W** pressing the right arrow key.
3. Connect the red cable, the blue cable and the green cable to the corresponding instrument's input terminals. The instrument shall keep the same operating features during all measurement stages. Any cable extension or replacement as well as additional crocodiles may nullify previous zero setting so requiring to repeat such a setting procedure before effecting further measurements.
4. Connect the crocodiles to the test leads.
5. Short-circuit the measuring cables' ends (see Fig. 5) paying attention that the crocodiles' metal parts make proper contact to each other. To get a safe connection one of the rods provided with the instrument can be used.
6. After pressing the **CAL** key the instrument carries out zero setting of cables' resistance (this procedure takes approx. 30sec). Cables with a resistance up to **0.3Ω** can be calibrated.

CAUTION

When **"Measuring…"** is displayed the instrument is effecting measurement. During this phase do not disconnect test leads from the instrument.

7. At the end of the test the measured value is stored by the instrument and used as OFFSET (that is to say deduced from all EARTH 3W measurements) for all subsequent measurements till a further zero setting. The instrument emits a double sound tone indicating the positive outcome for zero setting and displays again the initial screen by the symbol **CAL**.

Symbol **CAL**: indicates that the instrument was calibrated; this symbol is displayed for each subsequent measurement even though the instrument is switched off and on again.

8. If during cables' zero setting the value measured is higher than 0.3Ω the instrument interrupts such setting procedure, removes the previous offset value and does not display the symbol CAL until a cables' zero setting is successfully carried. out The instrument emits a long sound tone indicating the unsuccessful setting outcome and has been displaying a screen similar to the side one for about 2 seconds, then it displays a default screen.
   Note: this procedure can be used also to cancel the last value stored for cables' zero setting.

4.5.2. EARTH 3W- Measurement procedure

CAUTION

The instrument can be used for voltage and current measurements on installations with overvoltage category equal to CAT III 240V to earth and maximum voltage of 415V between inputs. Do not connect the instrument to installations whose voltages exceed the limits indicated in this manual. Exceeding such limits may cause electric shock to the user and damage the instrument.

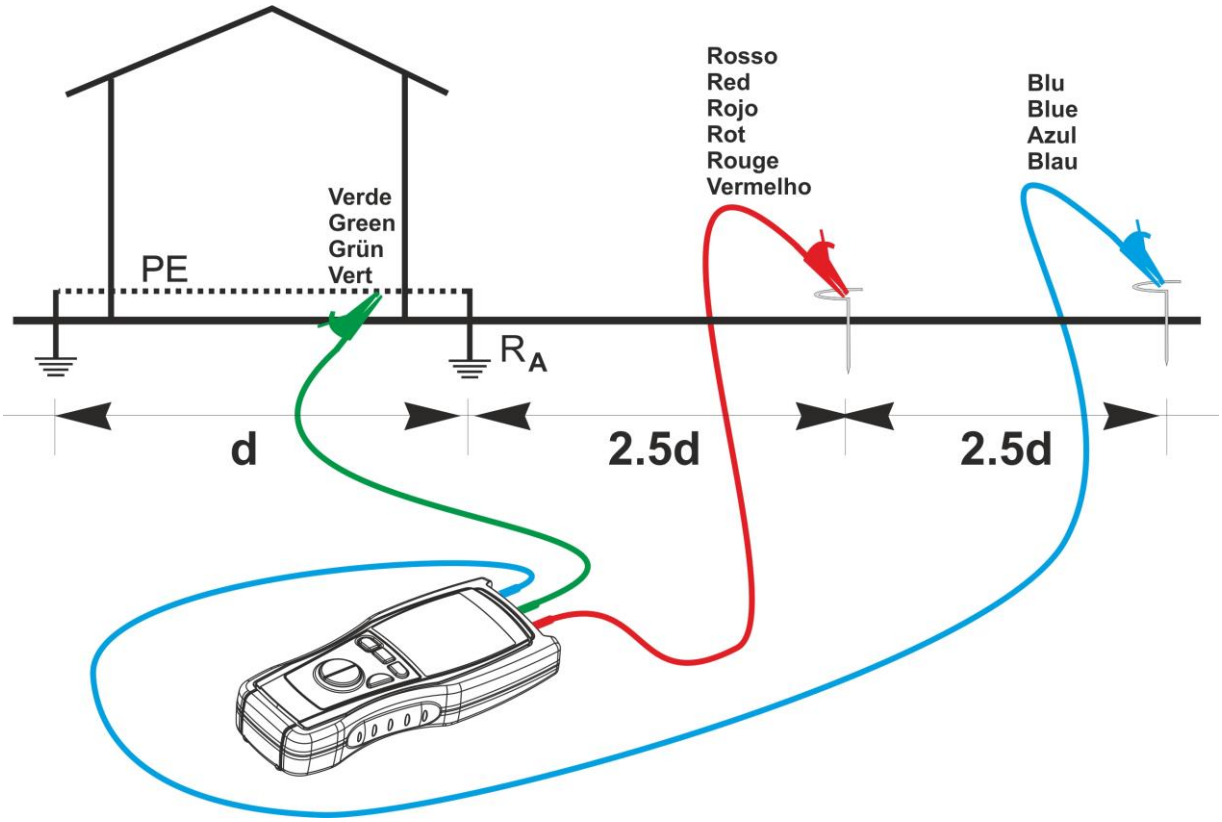


Fig. 6: Instrument's wiring for three-wire earth measurement

- For small sized installations, place the ampere metric probe (terminal H, blue wire) at a distance equal to five times the diagonal of the earth installation and the volt metric probe (terminal S, red wire) at a distance equal to about 2.5 times the diagonal of the earth installation

- For large sized installations, place the ampere metric probe (terminal H, blue wire) at a distance equal to the diagonal of the earth installation and the volt metric probe (terminal S, red wire) at a distance equal to about 0.5 times the diagonal of the earth installation

- In the latter case several measurements shall be carried out moving the volt metric probe back and forth (along the measurement direction) with respect to the middle point and checking that the result is nearly constant.

1. Press the instrument's start key.
2. Select function **EARTH 3W** pressing the right arrow key.
3. If the circuit under test is assumed to be affected by electric noise press the **AUTO** key to select the corresponding mode.
4. Connect the red cable and the green cable into the corresponding instrument's input terminals.
5. Connect the crocodiles to the test leads.
6. When necessary (symbol CAL missing or use of a new set of cables) carry out zero setting of cable resistance (see § 4.5.1)
7. Connect the instrument's terminals to the circuit under test (see Fig. 6).
8. Press **GO** key to start measurement.
9. Display example of earth resistance and disruptive voltage measured values.
   Should disruptive voltage have been higher than 0.5V, it would be advisable to start AUTO mode and repeat measurement.

Value measured for earth resistance

Value measured for disruptive voltage

4.5.3. Message description for EARTH 3W measurement

1. If the following condition is met:

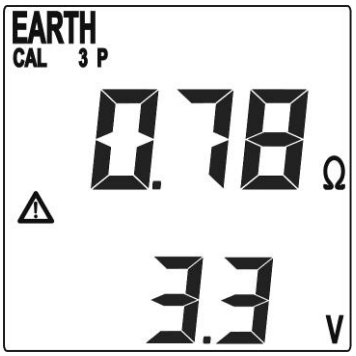
   $R_{DISPLAYED}$ < 0.11Ω

   the instrument displays the symbol ⚠ indicating that the reading may be affected by a relative error higher than 30%.

2. If the following condition is met:

   Disruptive voltage > 3.0V

   the instrument displays the symbol ⚠ indicating that the reading is carried out under critical conditions.



3. If the following condition is met:

   $R_{MEASURED}$ - R_{CABLES} < - 0.03Ω

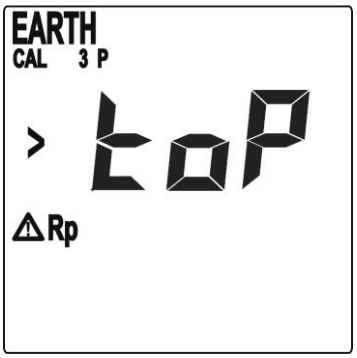
   the instrument displays the side screen and emits a long sound tone indicating an anomalous condition then displays the initial screen again. This message indicates that the measured resistance is lower than that of measuring cables and that a further zero setting procedure is to be carried out.

4. When measuring, if terminals' voltage is higher than **6V**, the instrument does not performs the test. A long sound tone is emitted indicating an anomalous condition and the side screen is displayed for 5 seconds (S-E indicates between which inputs voltage was detected), then the instrument displays the initial screen.

Value of input voltage

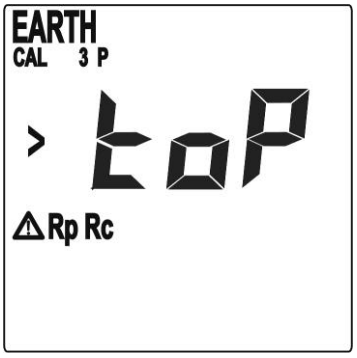
5. Should the resistance value be higher than the full scale, the instrument emits a long sound tone indicating the anomalous condition and displays a screen similar to the side one. The same indication may also highlight that measuring cables are disconnected or open.

6. If the volt metric circuit (terminal S) shows a too high resistance value the side message is displayed.
   Check connection of red and green wires as well as their integrity.
   If the problem still exists connect two or more auxiliary rods in parallel and pour some water around the rods in order to make a better volt metric probe (that is the ground rod connected to the red wire).



7. If the ampere metric circuit (terminal H) shows a too high resistance value the side message is displayed.
   Check connection of blue and green wires as well as their integrity.
   If the problem still exists connect two or more auxiliary rods in parallel and pour some water around the rods in order to make a better ampere metric probe (that is the ground rod connected to the blue wire).

8. If the ampere- and volt-metric circuits (terminal S and H) show a too high resistance value the side message is displayed.
   Check connection of blue, red and green wires as well as their integrity.
   If the problem still exists connect two or more auxiliary rods in parallel and pour some water around the rods in order to make a better ampere metric probe (that is the ground rod connected to the blue wire).repeating the procedure for the volt metric probe (that is the ground rod connected to the red wire).



5. MAINTENANCE

5.1. GENERAL

1. This instrument is a precision meter. During its use and storage you are recommended to keep the instructions listed in this manual to avoid any harm or danger
2. Do not use the instrument in excessively wet environments and under high temperatures. Do not expose it to direct sunlight
3. Always switch the instrument off after use. If you expect not to use the instrument for a long period remove batteries to avoid any acid leakage which may damage the instrument's inner circuits.

5.2. BATTERY REPLACEMENT

The display of the symbol "  " indicates that batteries shall be replaced.

CAUTION

Such an operation shall be carried out by qualified people only. Before replacing batteries disconnect test leads from the circuit under test to avoid electric shock.

1. Disconnect all cables from input terminals
2. Turn off the meter pressing **ON/OFF** key
3. Remove battery compartment cover
4. Remove all batteries and replace them with 4 units. having the same features (see § 6.1.2) keeping to the indicated polarity signs
5. Replace battery compartment cover
6. Use the appropriate battery disposal methods for Yr area

5.3. CLEANING

Clean the meter exclusively using a soft and dry cloth. Never use wet clothes, solvents, water, etc.

5.4. END OF LIFE

Caution: the barred symbol of the rubbish bin shown on the equipment indicates that, at the end of its useful life, both the products and its accessories shall be collected separately from other waste and correctly disposed.

6. TECHNICAL SPECIFICATIONS

6.1. TECHNICAL FEATURES

Accuracy is calculated as ±[%rdg + (dgt number) * resolution] at 23°C ± 5°C,< 80%RH

CAUTION

Under modes EARTH-2W and EARTH-3W the instrument displays the symbol of warning ⚠ whenever:

- It is working under critical conditions, such as in the presence of input voltages
- It cannot grant the uncertainty of measurement lower than 30% of reading, according to IEC/EN61557-1

EARTH RESISTANCE MEASUREMENT

Range (Ω)	Resolution (Ω)	Accuracy	
		Disturbance ≤ 3Vrms	3Vrms<Disturbance<6Vrms AUTO mode triggered
0.01 ÷ 19.99	0.01	±(2%rdg + 3dgt)	±(4%rdg + 10dgt)
20.0 ÷ 199.9	0.1		
200 ÷ 1999	1		
2.00 ÷ 19.99k	0.01k		
20.0 ÷ 49.9k	0.1k	±(3rdg + 3dgt)	±(6%rdg + 10dgt)

Measurement frequency: 110Hz ± 1Hz
Test current: ≤12mA AC
Open circuit voltage: ≤ 25Vrms
Resistance values of the voltmetric (Rp) and ampermetric probes (Rc) always meet the following conditions:

- If $R_A \leq 10\Omega$ → Rc, Rp ≤ 1kΩ
- If $10\Omega < R_A \leq 500\Omega$ → Rc, Rp ≤ 100 * R_A
- If $R_A > 500\Omega$ → Rc, Rp ≤ 50kΩ

DISTURBANCE VOLTAGE MEASUREMENT

Range (V)	Resolution (V)	Accuracy
0.0 ÷ 99.9	0.1	±(2%rdg + 2dgt)
100 ÷ 299	1	

6.1.1. Reference guidelines

Safety:	IEC/EN61010-1, IEC/EN61557-1
EMC :	IEC/EN61326-1
Technical literature:	IEC/EN61187
Accessory safety:	IEC/EN61010-031, IEC/EN61010-2-032
Insulation:	double insulation
Pollution degree:	2
Maximum height of use:	2000m (6561ft)
Measurement category:	CAT III 240V, maximum 415V between inputs
Earth resistance :	IEC/EN61557-5

6.1.2. General features

Mechanical features

Dimensions (L x W x H):	240x100x45mm ; (9x4x2inches)
Weight (including batteries):	630g (22 ounces)
Mechanical protection:	IPXX

Power supply

Battery type:	4x1.5 V alkaline batteries type AA LR6
Low battery indication:	symbol “⊡” is displayed
Battery life:	approx. 500 measurements
Auto Power OFF:	after 5 minutes of idleness

Display:

LCD	53mm x 53mm ; (2x2inches)

6.2. ENVIRONMENT

6.2.1. Environmental conditions

Reference temperature:	23°C ± 5°C ; (73°F ± 41°F)
Operating temperature:	0°C ÷ 40°C ; (32°F ÷ 104 °F)
Operating humidity:	<80%RH
Storage temperature:	-10°C ÷ 60°C ; (14°F ÷ 140 °F)
Storage humidity:	<80%RH

This instrument satisfies the requirements of Low Voltage Directive 2014/35/EU (LVD) and of EMC Directive 2014/30/EU
This instrument complies the requirements of 2011/65/EU (RoHS) directive and 2012/19/EU (WEEE) directive

6.3. ACCESSORIES

See enclosed packing list

7. SERVICE

7.1. WARRANTY TERMS

This instrument is guaranteed against material and manufacturing defects, in compliance with our general sales terms. During the warranty period all defective parts may be replaced, but the manufacturer reserves the right to decide either to repair or replace the product. Should you need to return the instrument back for repair or replacement take prior agreements with your dealer as transport expenses must be borne by the customer. A report must always be enclosed to the returned product, stating the faults detected. For shipping use exclusively original packaging; any damage that may be caused by no-original packing shall be charged to the customer. The manufacturer disclaims any responsibility for damages caused to people and/or objects.

Warranty is not applied in the following cases:

- Any repair and/or replacement of accessories and batteries (not covered by warranty)
- Any repair that might be necessary as a consequence of a misuse of the instrument or improper combination with no compatible devices
- Any repair that might be necessary as a consequence of improper packaging
- Any repair that might be necessary as a consequence of service actions carried out by unauthorised personnel
- Any change to the instrument carried out without the explicit authorisation of the manufacturer
- Use not provided by the instrument specifications or in the instruction manual.

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.

7.2. AFTER SALES SERVICE

If the instrument does not operate properly, before contacting the after-sale service check the cables and the test leads and replace them, if necessary. Should the instrument still operate improperly, check that the operation procedure is correct and corresponds to the instructions provided in this manual. If the instrument is to be returned to the after-sale service or to a dealer, transport costs will be up to the customer. Return shipment shall be always agreed upon. A report must always be attached to the returned product, stating the reasons of its return. When shipping the instrument exclusively use the original packaging; any damage that may be occur due to no-original packing shall be charged to the customer.

8. PRACTICAL REPORTS FOR ELECTRICAL TESTS

8.1. EARTH RESISTANCE MEASUREMENT IN TT SYSTEMS

PURPOSE OF THE TEST
Make sure that the RCD is coordinated with the earth resistance value. It is not possible to take an earth resistance value as reference limit when controlling the measurement result, while it is always necessary to check that the coordination complies with the standards' requirements.

INSTALLATIOIN PARTS TO BE CHECKED
The earth installation under working conditions. The check is to be effected without disconnecting the earth rods.

ALLOWABLE VALUES
The earth resistance value measured shall meet the following relation:

$$R_A < 50 / I_a$$

where:

R_A= Resistance of the earth installation, the value can be set with the following measurements:
- Earth resistance with three-wire volt-ampere method
- Fault loop impedance (see (*))
- Two-wire earth resistance (see (**))
- Two-wire earth resistance in the socket (see (**))
- Earth resistance achieved by measurement of contact voltage U_t (see (**)).
- Earth resistance achieved by measurement of tripping time test of the RCDs (A, AC),RCDs S (A, AC) (see (**)).

I_a= Tripping current in 5s of the RCD, rated tripping current of the RCD (in case of RCD S 2 $I_{\Delta n}$).

50=Safety limit voltage (reduced down to 25V in special environments).

(*) If the installation is protected by an RCD the measurement shall be effected upstream or downstream the RCD short-circuiting it to avoid its tripping.

(**) These methods, even though not presently provided for by standards, provide values, which compared with numberless reference tests resulted to be reliable for earth resistance.

EXAMPLE OF EARTH RESISTANCE TEST
Let's assume an installation protected by a 30 mA RCD. Let's measure the earth resistance using one of the methods quoted above. To evaluate whether the installation resistance is complying with the standards in force multiply the result by 0.03A (30 mA). If the result is lower than 50V (or 25V for special environments) the installation can be considered as coordinated as it meets the above said relation.

In case of 30 mA RCDs (most civil installations) the maximum earth resistance allowed is 50/0.03=1666Ω permitting to use even simplified methods which though do not provide extremely accurate values, give values approximate enough to calculate the coordination.

8.2. EARTH RESISTANCE MEASUREMENT, VOLT AMPERE METRIC METHOD

Method for small sized earth rods

Let current stream between the earth rod and a current probe placed at a distance equal to fivefold the diagonal of the area limiting the earth installation. Place the voltage probe at approximately half way between the earth rod and the current probe, finally measure voltage between both of them.

Use several rods in parallel and moisten the surrounding ground if the instrument does not manage to supply the current necessary to perform the test due to a

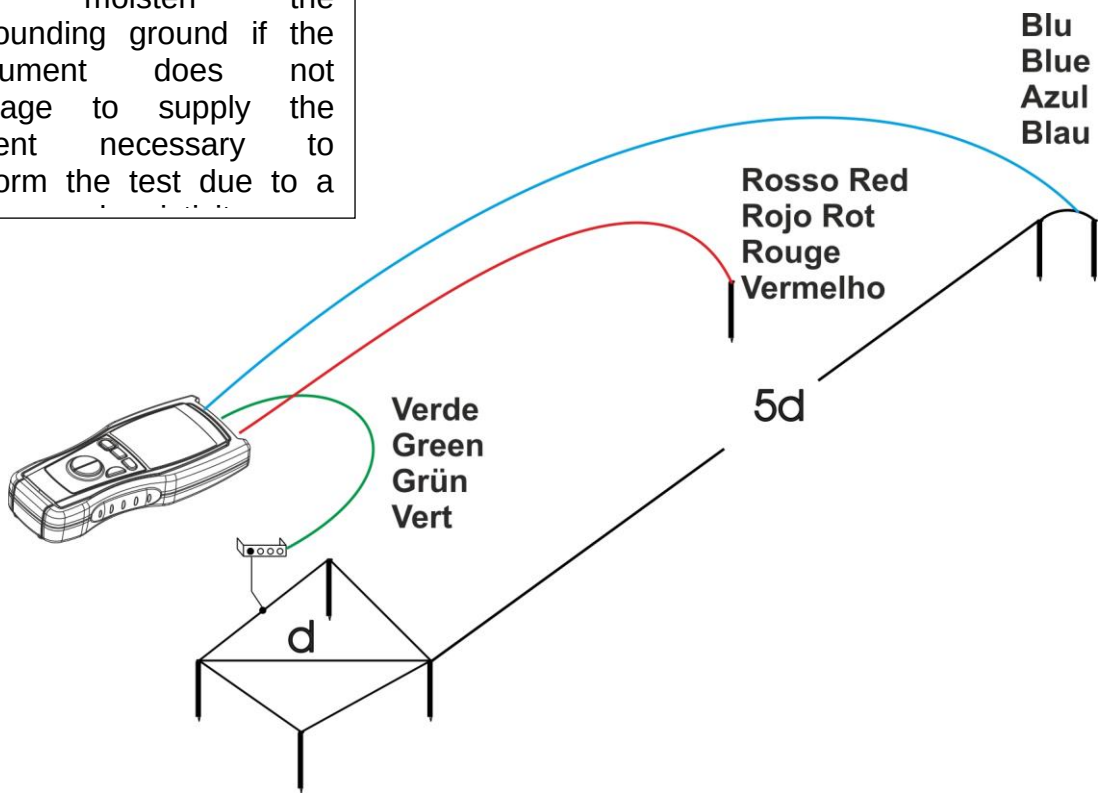


Fig. 7: Measurement of earth resistance for small sized earth rods

Method for medium and large sized earth rods

This procedure is based on the volt ampere metric method as well, however it is mainly used whenever it is difficult to place an auxiliary current rod at a distance equal to fivefold the diagonal of the area limiting the earth installation. Place the current probe at a distance equal to the diagonal of the earth installation. To make sure that the voltage probe is placed outside the area affected by the rod under test, take several measurements, firstly placing the voltage probe at half way between the rod and the current probe, later moving the probe to both the earth rod and the current probe.

Use several rods in parallel and moisten the surrounding ground if the instrument does not manage to supply the current necessary to perform the test due to a high ground resistivity.

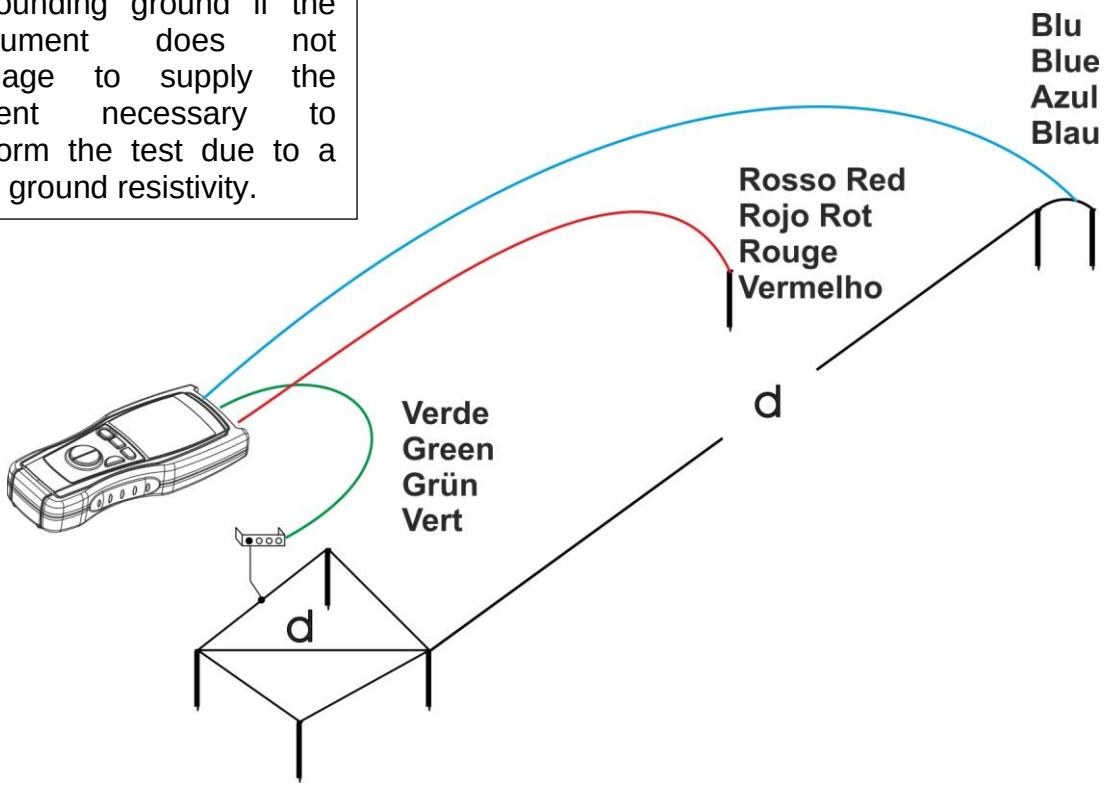


Fig. 8: Earth resistance measurement for medium and large sized earth rods

The measuring method allows to define the specific resistance till the depth corresponding approximately to the distance "**a**" between two rods. If you increase the distance "**a**" you can detect deeper ground layers and check the ground homogeneity. After several ρ measurements, at growing distances "**a**", you can trace a profile like the following ones, according to which the most suitable rod is selected.

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