
# EurotestAT

MI 3101

# Instruction manual

*Version 5.4, HW 5; Code no. 20 751 834*

METREL®

*Distributor:*

*Manufacturer:*

METREL d.d.
Ljubljanska cesta 77
1354 Horjul
Slovenia
web site: http://www.metrel.si
e-mail: metrel@metrel.si

CE Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) concerning safety and electromagnetic compatibility regulations

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# 1 Preface

Congratulations on your purchase of the instrument and its accessories from METREL. The instrument was designed on basis of rich experience, acquired through many years of dealing with electric installation test equipment.

The multifunctional hand-held installation tester EurotestAT is intended for all tests and measurements required for total inspection of electrical installations in buildings. In general the following measurements and tests can be performed:

- True rms voltage and frequency, phase sequence,
- Insulation resistance,
- Resistance to earth connection and equipotential bonding plus continuous resistance measurement,
- Line impedance / Voltage drop,
- Loop impedance,
- 2 Ω line/loop impedance
- RCD protection,
- Resistance to earth,
- Tracing the installation,
- Overvoltage protection devices,
- Specific earth resistance measurement.

Tests can be performed on the following supply systems:

- TN / TT,
- IT,
- 110 V reduced low voltage (2 x 55 V), and
- 110 V reduced low voltage (3 x 63 V).

The high-resolution graphic display with backlight offers easy reading of results, indications, measurement parameters and messages. Operation is simple and clear – operator does not need any special training (except reading this instruction manual) to operate the instrument.

In order for operator to be familiar enough with measurements in general and their typical applications it is advisable to read Metrel handbook *Measurements on electric installations in theory and practice*.

The instrument is equipped with all accessories necessary for comfortable testing. It is kept in a soft carrying bag together with all accessories.

# 2 Safety and operational considerations

## 2.1 Warnings and notes

In order to reach high level of operator's safety while carrying out various tests and measurements using EurotestAT, as well as to keep the test equipment undamaged, it is necessary to consider the following general warnings:

- ⚠ **Warning on the instrument means »Read the Instruction manual with special care to safety operation«. The symbol requires an action!**
- **If the test equipment is used in a manner not specified in this user manual the protection provided by the equipment might be impaired!**
- **Read this user manual carefully, otherwise use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!**
- **Do not use the instrument and accessories if any damage is noticed!**
- **In case a fuse has blown follow the instructions in this manual to replace it!**
- **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- **Do not use the instrument in supply systems with voltages higher than 550 V!**
- **Service intervention or adjustment and calibration procedure is allowed to be carried out only by a competent authorized person!**
- **Use only standard or optional test accessories supplied by your distributor!**
- **Test tips and Tip commander have removable caps. If they are removed the protection falls to CAT II. Check markings on accessories!**
  **Cap off, 18 mm tip…CAT II up to 600 V (Altitude: <2000 m)**
  **Cap on, 4 mm tip…CAT II 600 V / CAT III 600 V / CAT IV 300 V, (Altitude: <2000 m)**
- **Consider that older and some of new optional test accessories compatible with this instrument meet overvoltage category CAT II 300 V for altitudes up to 4500 m max! It means that maximum allowed voltage between test terminals and ground is 300 V!**
- **Instrument contains rechargeable NiCd or NiMh battery cells. The cells should only be replaced with the same type as defined on the battery placement label or in this manual. Do not use standard alkaline battery cells while power supply adapter is connected, otherwise they may explode!**
- **Hazardous voltages exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before removing battery compartment cover.**
- **All normal safety precautions have to be taken in order to avoid risk of electric shock when working on electrical installations!**

⚠ **Warnings related to measurement functions:**

**Insulation resistance**

- **Do not touch the test object during the measurement or before it is fully discharged! Risk of electric shock!**
- **Automatic discharge of capacitive object will take some time after the finished insulation resistance measurement. Warning message ⊠ and actual voltage is displayed during discharging until voltage drops below 10 V. <u>In no case you should disconnect test leads until tested object is completely discharged!</u>**

**Notes related to measurement functions:**

**General**

- Indicator means that the selected measurement can't be performed because of irregular conditions on input terminals.
- **Insulation resistance, varistor test**, **continuity** functions and **earth resistance** measurements shall be performed on de-energized objects, i.e. voltage between test terminals should be lower than 10 V!
- PASS / FAIL indication is enabled when limit is set to ON. Apply appropriate limit value for evaluation of measurement results.
- In case that only two of three wires are connected to test electrical installation, only voltage indication between these two wires is valid.

**Insulation resistance**

- When measuring insulation resistance between installation conductors all loads must be disconnected and all switches closed!
- The instrument automatically discharge tested object after finished measurement.
- Keep the TEST key pressed for continuous measurement.

**Continuity functions**

- Parallel resistance paths and interfering currents in measured circuit will influence the test result!
- If necessary compensate test lead resistance before performing continuity measurement, see *5.2.3.*
- Measuring the resistance of wire wound components like transformer or motor windings is possible only in continuous function (**R7mA**) due to great influence of the winding inductance.

**RCD functions**

- Parameters set in one function are also kept for other RCD functions.
- The measurement of contact voltage will not trip-out RCD of tested installation if selected rated test current is the same as rated $I_{\Delta N}$ of observed RCD. However, the RCD trip-out may occur and Uc measurement is affected as a result of PE leakage currents caused by appliances that are connected to the tested installation.
- The RCD trip-out current test and Uc measurement could be affected as a result of potential fields of other earthing installations.
- RCD trip-out current and time will be measured only if pretest of those functions gives contact voltage lower than the selected conventional limit contact voltage.
- L and N test terminals are reversed automatically according to detected terminal voltage.
- In case the RCD trips-out during safety pretests it is possible to continue measurements just by recovering the RCD. Possible reasons for trip-out are incorrect RCD sensitivity ($I_{\Delta N}$) selected, relatively high leakage currents in tested installations or defective RCD.

**Z-LOOP**

- Fault loop impedance measurement (protection: FUSE or no protection ---) trips-out the RCD. Use the **Z-LOOP Impedance, Protection: RCD** option to prevent the trip-out.
- **Fault loop impedance** function with selected RCD protection takes longer time to complete but offers much better accuracy then $R_L$ sub-result in **RCD**: **Uc** function.
- Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement and no additional operating circuits are connected in parallel.
- L and N test terminals are reversed automatically according to detected terminal voltage.

**Z-LINE / Voltage drop**

- Measurement of $Z_{Line-Line}$ with the instrument test leads PE and N connected together will generate warning of dangerous PE voltage when the **TEST** key is touched but measurement is not prohibited.
- Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement and no additional operating circuits are connected in parallel.
- L and N test terminals are reversed automatically according to detected terminal voltage.

**Earth resistance**

- High currents and voltages in earthing could influence the measurement results.
- High resistance of S and H probes could influence the measurement results. In this case, indications Rp and Rc appear in the message field. There is no pass / fail indication in this case.
- Resistance of E measuring wire is added to the measurement result of resistance to earth. Use only standard test accessory without extension lead for E probe.

**Line tracer**

- Receiver R10K should always be in IND mode when working with the MI 3101 instrument.
- When dealing with complex installations (long conductors or more current loops connected in parallel), it is advisable to disconnect parts of the installation that are not of interest at that moment. Otherwise the test signal will spread all over the installation and the selectivity can fall to an unacceptable level.

## 2.2 Battery and charging

The instrument uses six AA size alkaline or rechargeable Ni-Cd or Ni-MH battery cells. Nominal operating time is declared for cells with nominal capacity of 2100 mAh.
Battery condition is always present on the display when the instrument is turned on.
In case the battery is weak the instrument indicates this as shown in figure 2.1. This indication appears for a few seconds and then the instrument is turned off.

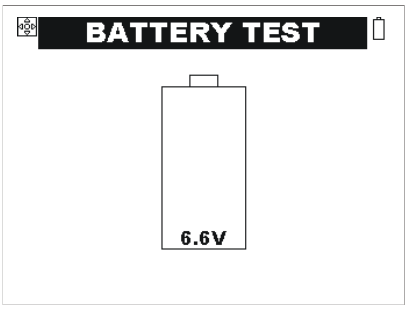



*Figure 2.1: Discharged battery indication*

The battery is charged whenever the power supply adapter is connected to the instrument. Internal circuit controls charging assuring maximum battery lifetime. Power supply socket polarity is shown in figure 2.2.

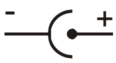
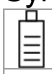



*Figure 2.2: Power supply socket polarity*

The instrument automatically recognizes connected power supply adapter and controls charging.

Symbols:

| | |
|---|---|
|  | Indication of battery charging |
| 7.2 | Battery voltage |

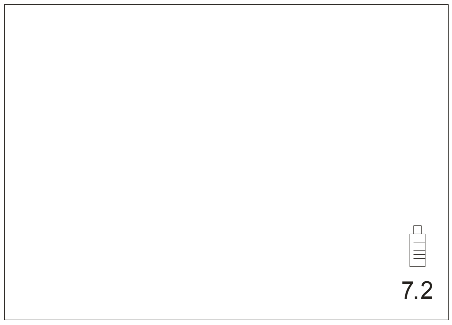



*Figure 2.3: Charging indication*

- ⚠ Before opening battery / fuse compartment cover disconnect all measuring accessories connected to the instrument and power off the instrument.
- Insert cells correctly, otherwise the instrument will not operate and the batteries could be discharged.
- If the instrument is not used for longer period remove all battery cells from the battery compartment.
- Do not charge alkaline battery cells!

- Take into account handling, maintenance and recycling requirements that are defined by related regulatives and manufacturer of alkaline or rechargeable batteries!
- Use only power supply adapter delivered from manufacturer or distributor of the test equipment to avoid possible fire or electric shock!

### 2.2.1 New battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during charging of new battery cells or cells that were unused for a longer period (more than 3 months). Ni-MH and Ni-Cd battery cells are affected to capacity degradation (sometimes called as memory effect). As a result the instrument operation time can be significantly reduced.

Recommended procedure for recovering battery cells:

| **Procedure** | ***Notes*** |
|---|---|
| ➢ Completely **charge** the battery. | *At least 14h with in-built charger.* |
| ➢ Completely **discharge** the battery. | *Can be performed with normal work with the instrument.* |
| ➢ **Repeat** the charge / discharge cycle for at least **two times**. | *Four cycles are recommended.* |

Complete discharge / charge cycle is performed automatically for each cell using external intelligent battery charger.

**Notes:**

- The charger in the instrument is a pack cell charger. This means that the battery cells are connected in series during the charging. The battery cells have to be equivalent (same charge condition, same type and age).
- One different battery cell can cause an improper charging and incorrect discharging during normal usage of the entire battery pack (it results in heating of the battery pack, significantly decreased operation time, reversed polarity of defective cell,…).
- If no improvement is achieved after several charge / discharge cycles, then each battery cell should be checked (by comparing battery voltages, testing them in a cell charger, etc). It is very likely that only some of the battery cells are deteriorated.
- The effects described above should not be mixed with normal decrease of battery capacity over time. Battery also loses some capacity when it is repeatedly charged / discharged. The actual decrease of capacity versus number of charging cycles depends on battery type and is provided in the technical specification from battery manufacturer.

## 2.3 Standards applied

The MI 3101 EurotestAT instrument is manufactured and tested according to the following regulations, listed below.

*Electromagnetic compatibility (EMC)*

| | |
|---|---|
| EN 61326 | Electrical equipment for measurement, control and laboratory use – EMC requirements<br>Class B (Hand held equipment used in controlled EM environments) |

*Safety (LVD)*

| | |
|---|---|
| EN 61010 - 1 | Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements |
| EN 61010 - 031 | Safety requirements for hand-held probe assemblies for electrical measurement and test |

*Functionality*

| | | |
|---|---|---|
| EN 61557 | Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures | |
| | Part 1 | General requirements |
| | Part 2 | Insulation resistance |
| | Part 3 | Loop resistance |
| | Part 4 | Resistance of earth connection and equipotential bonding |
| | Part 5 | Resistance to earth |
| | Part 6 | Residual current devices (RCDs) in TT and TN systems |
| | Part 7 | Phase sequence |
| | Part 10 | Combined measuring equipment |

*Other reference standards for testing RCDs*

| | |
|---|---|
| EN 61008 | Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses |
| EN 61009 | Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses |
| EN 60755 | General requirements for residual current operated protective devices |
| IEC 60364-4-41 | Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock |
| IEC 60364-5-52 | Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems |
| IEC 62423 | Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar use |
| BS 7671 | IEE Wiring Regulations |
| AS / NZ 3760 | In-service safety inspection and testing of electrical equipment |

**Note about EN and IEC standards:**
Text of this manual contains references to European standards. All standards of EN 6xxxx (e.g. EN 61010) series are equivalent to IEC standards with the same number (e.g. IEC 61010) and differ only in amended parts required by European harmonization procedure.

# 3 Instrument description

## 3.1 Front panel

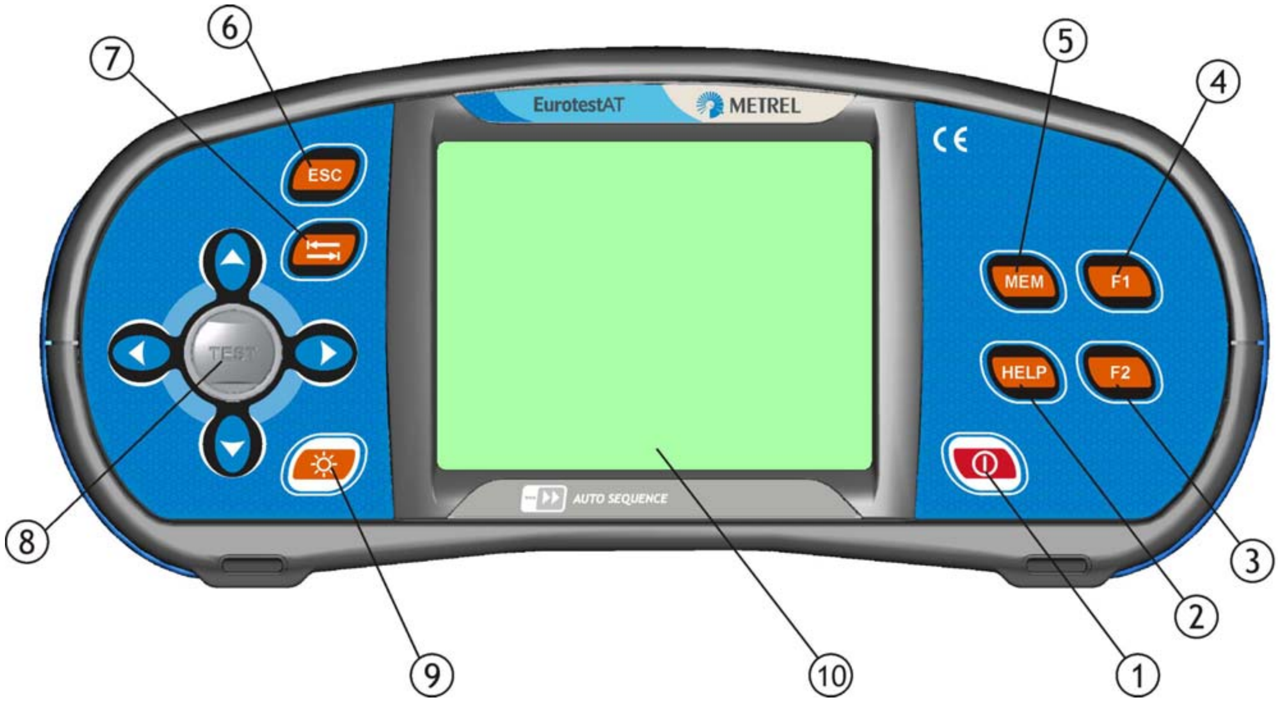



*Figure 3.1: Front panel*

Legend:

| | | | |
|---|---|---|---|
| 1 | ON / OFF | | Switches the instrument power on or off.<br>*The instrument automatically turns off 15 minutes after the last key was pressed.* |
| 2 | HELP | | Accesses help menus. |
| 3 | F2 | | Adds new memory location.<br>Confirmation of name entered in edit mode. |
| 4 | F1 | | Enters memory editing mode.<br>Deletes character on the left in edit mode. |
| 5 | MEM | | Handling with memory. |
| 6 | ESC | | Exits selected and displayed option. |
| 7 | TAB | | Jumps between display windows. |
| 8 | Cursor keypad with TEST key | Cursors | Selection of tested function and its working parameters. |
| | | TEST | Initiates measurements.<br>Acts also as the PE touching electrode. |
| 9 | BACKLIGHT, CONTRAST | | Changes backlight level and contrast. |
| 10 | LCD | | 320 x 240 dots matrix display with backlight. |

## 3.2 Connector panel

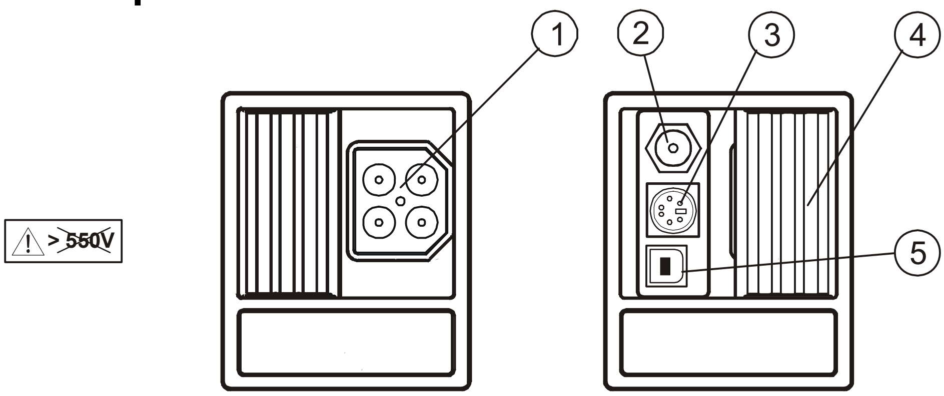



*Figure 3.2: Connector panel*

Legend:

| | | |
|---|---|---|
| 1 | Test connector | Measuring inputs / outputs, connection of measuring cables. |
| 2 | Charger socket | Connection of power supply adapter. |
| 3 | PS/2 connector | Communication with PC serial port and Bluetooth dongle and connection to optional measuring adapters. |
| 4 | Protection cover | Protects from simultaneous access to test connector and power supply adapter socket plus communication connectors. |
| 5 | USB connector | Communication with PC USB (1.1) port. |

**Warnings!**

- **Maximum allowed voltage between any test terminal and ground is 600 V!**
- **Maximum allowed voltage between test terminals is 550 V!**
- **Maximum short-term voltage of external power supply adapter is 14 V!**

## 3.3 Back panel

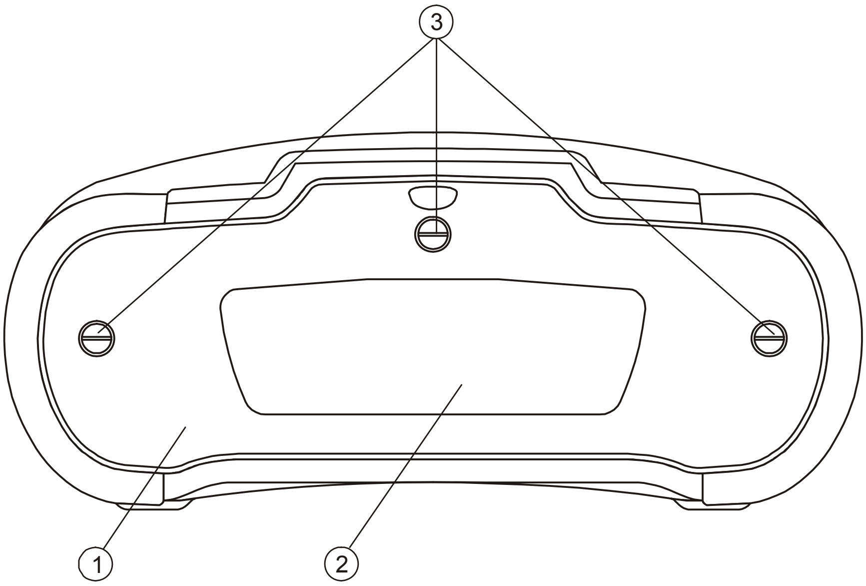



*Figure 3.3: Back panel*

Legend:

| | |
|---|---|
| 1 | Battery / fuse compartment cover |
| 2 | Back panel information label |
| 3 | Fixing screws for battery / fuse compartment cover |

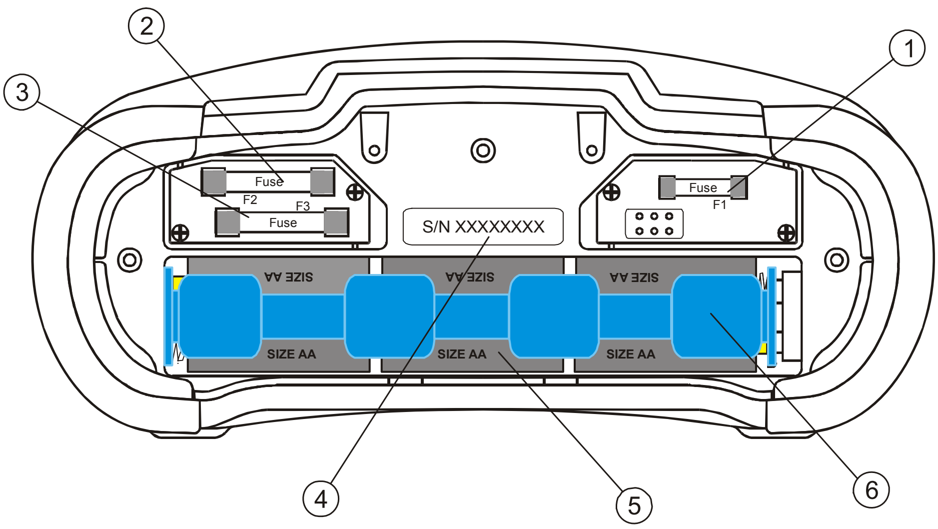



*Figure 3.4: Battery and fuse compartmentLegend:*

| | | |
|---|---|---|
| 1 | Fuse F1 | T 315 mA / 250 V |
| 2 | Fuse F2 | T 4 A / 500 V |
| 3 | Fuse F3 | T 4 A / 500 V |
| 4 | Serial number label | |
| 5 | Battery cells | Size AA, alkaline / rechargeable NiMH or NiCd |
| 6 | Battery holder | Can be removed from the instrument |

## 3.4 Bottom

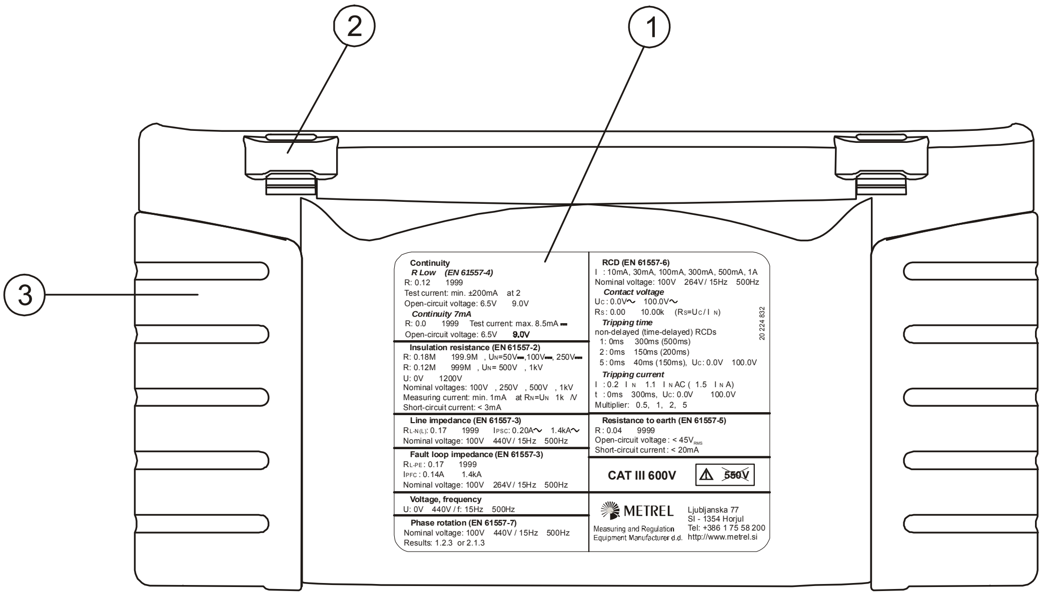



*Figure 3.5: Bottom*

Legend:

| | |
|---|---|
| 1 | Bottom information label |
| 2 | Neck belt openings |
| 3 | Handling side covers |

## 3.5 Display organization

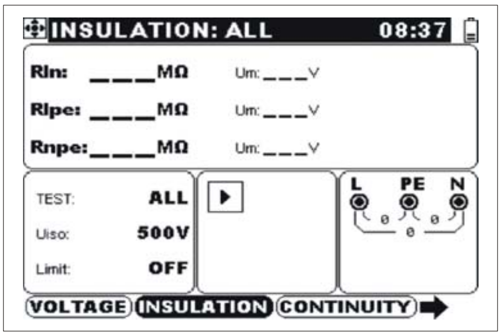
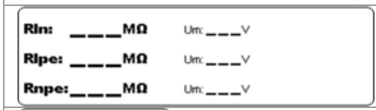
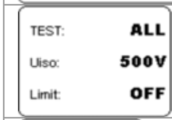
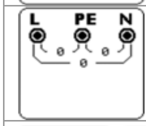
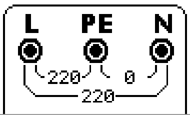
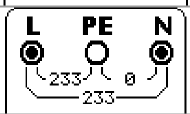
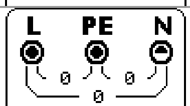
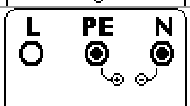
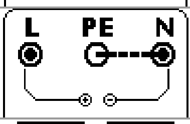
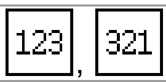
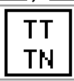
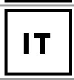
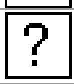
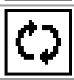
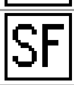



*Figure 3.6: Typical single test display*

| | |
|---|---|
|  | Menu line |
|  | Result field |
|  | Test parameter field |
|  | Message field |
|  | Terminal voltage monitor |
|  | Function tabs |

### 3.5.1 Terminal voltage monitor

The terminal voltage monitor displays current voltages present on the test terminals. In its lower part messages are displayed regarding the measured voltages and selected voltage system (see *4.4.2 Supply system*).

| | |
|---|---|
|  | Online voltage is displayed together with test terminal indication. |
|  | L and N test terminals are used for selected measurement. |
|  | L and PE are test terminals; N terminal should also be connected for reference in measuring circuit. |
|  | Polarity of test voltage applied to the output terminals. |
|  | Insulation test: two measuring terminals should be shorted. |
|  | Three-phase connection indicator. |
|  | TT / TN supply system. |
|  | IT supply system. |
|  | Reduced low voltage supply system. |
|  | Unknown supply system (atypical voltage at input terminals for selected supply system). |
|  | L – N polarity changed. |
|  | First fault in IT supply system.<br>Check monitored voltages to fix the problem. |

| | |
|---|---|
| | **Warning!** Phase voltage on the PE terminal! Stop the activity immediately and eliminate the fault / connection problem before proceeding with any activity! |

### 3.5.2 Menu line

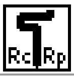
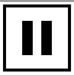
In the menu line the name of the selected function is displayed. Additional informations about active cursor / TEST keys and battery condition are shown.

| | |
|---|---|
| INSULATION: ALL | Function name. |
| 08:37 | Time. |
| | Active keys on cursor / **TEST** keypad (↓ and **TEST** in this example). |
| | Battery capacity indication. |
| | Low battery.<br>Battery is too weak to guarantee correct result. Replace or recharge the battery cells. |
| | Recharging in progress (if power supply adapter is connected). |

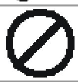
### 3.5.3 Message field

In the message field different warnings and messages are displayed.

| | |
|---|---|
| | **Warning!** High voltage is applied to the test terminals. |
| | Measurement is running, consider displayed warnings. |
| | Conditions on the input terminals allow starting the measurement (**TEST** key), consider other displayed warnings and messages. |
| | Conditions on the input terminals do not allow starting the measurement (**TEST** key), consider displayed warnings and messages. |
| F1 CAL | Test leads resistance in CONTINUITY tests is not compensated, see *Chapter 5.2.3* for compensation procedure. |
| F1 CAL | Test leads resistance in CONTINUITY tests is compensated. |
| F1 Zref | Possibility to perform reference measurement (Zref) in ΔU sub-function. |
| | RCD tripped-out during the measurement (in RCD functions). |
| | Instrument is overheated, the temperature inside the instrument is higher than the safety limit, and measurement is prohibited until the temperature decreases under the allowed limit. |
| | Fuse F1 has blown or not inserted (CONTINUITY and EARTH functions). |
| | It is possible to store result(s). |
| | High electrical noise during measurement. Results may be impaired. |

| | |
|---|---|
|  | Probe resistances Rc or Rp could influence earth resistance result. |
|  | Pause activated in auto sequence test. Follow required activity for paused test function. |

### 3.5.4 Result field

| | |
|---|---|
|  | Measurement result is inside pre-set limits (PASS). |
|  | Measurement result is out of pre-set limits (FAIL). |
|  | Measurement is aborted. Consider displayed warnings and messages. |

### 3.5.5 Other messages

| | |
|---|---|
| **Hard Reset** | Instrument settings and measurement parameters/limits are set to initial (factory) values, for more information refer to chapter 4.8.5. *Recalling original settings.* |
| **CAL ERROR!** | Service intervention required. |

### 3.5.6 Sound warnings

| | |
|---|---|
| Periodic sound | **Warning!** Dangerous voltage on the PE terminal is detected. Refer to chapter *5.8* for more information. |

### 3.5.7 Help

Key:

| | |
|---|---|
| **HELP** | Opens help screen. |

The help menu contains some basic schematic / connection diagrams to illustrate recommended connection of the instrument to the electrical installation and information about the instrument.
Pressing the **HELP** key in single test generates help screen for selected single test function, while in other working menus the voltage system help is displayed first.

Keys in help menu:

| | |
|---|---|
| ← / → | Select neighbour help screen. |
| **HELP** | Rotates through help screens. |
| **ESC** | Exits help menu. |

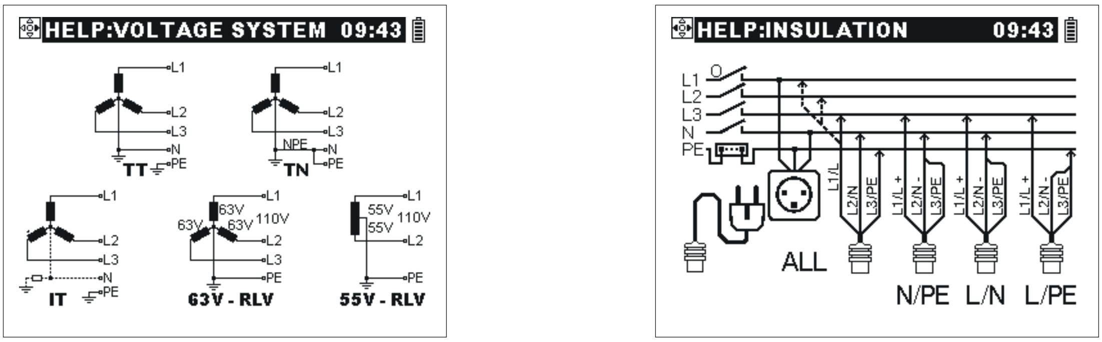



*Figure 3.7: Examples of help screen*

### 3.5.8 Backlight and contrast adjustments

With the **BACKLIGHT** key backlight and contrast can be adjusted.

| | |
|---|---|
| **Click** | Toggle backlight intensity level. |
| Keep pressed for **1 s** | Lock high intensity backlight level until power is turned off or the key is pressed again. |
| Keep pressed for **2 s** | Bargraph for LCD contrast adjustment is displayed. |

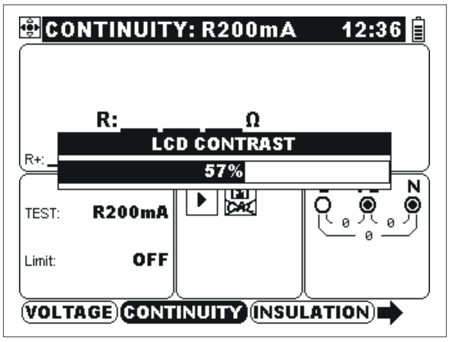



*Figure 3.8: Contrast adjustment menu*

Keys for contrast adjustment:

| | |
|---|---|
| ← | Reduces contrast. |
| → | Increases contrast. |
| **TEST** | Accepts new contrast. |
| **ESC** | Exits without changes. |

## 3.6 Carrying the instrument

With the neck-carrying belt supplied in standard set, various possibilities of carrying the instrument are available. Operator can choose appropriate one on basis of his operation, see the following examples:


The instrument hangs around operators neck only - quick placing and displacing.

The instrument can be used even when placed in soft carrying bag – test cable connected to the instrument through the front aperture.

## 3.7 Instrument set and accessories

### 3.7.1 Standard set

- Instrument
- Soft carrying bag
- Short instruction manual
- Product verification data
- Warranty declaration
- Declaration of conformity
- Universal test cable
- Three test tips
- Schuko plug commander
- Three alligator clips
- Power supply adapter
- CD with instruction manual, handbook *Measurements on electric installations in theory and practice*, PC software
- USB interface cable
- RS232 interface cable

### 3.7.2 Optional accessories

See the attached sheet for a list of optional accessories that are available on request from your distributor.

# 4 Instrument operation

## 4.1 Main menu

From the **Main** menu different instrument operation modes can be set.

- Single test menu (see *4.2*),
- Auto sequence menu (see *4.3*),
- Miscellaneous (see *4.4*).

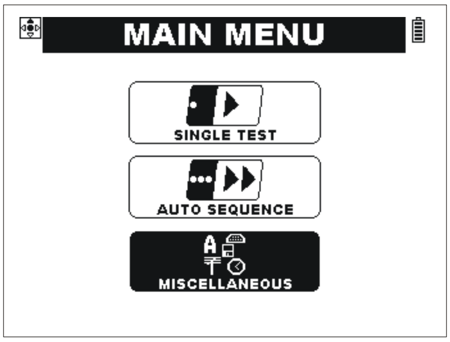



*Figure 4.1: Main menu*

Keys:

| | |
|---|---|
| ↓ / ↑ | Select the mode. |
| **TEST** | Enters selected mode. |

## 4.2 Single test


is intended to run individual test / measurement functions.

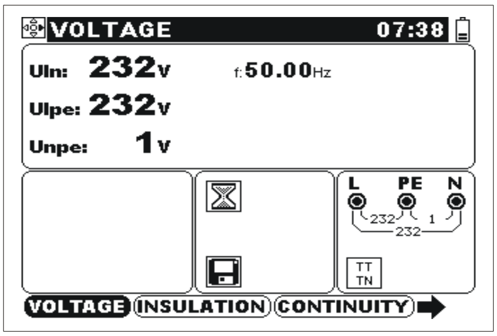



*Figure 4.2: Example of typical Single test screen*

Keys in main **single test** screen:

| | |
|---|---|
| ← / → | Select test / measurement function:<br>❑ <**VOLTAGE**> Voltage and frequency plus phase sequence.<br>❑ <**INSULATION**> Insulation resistance.<br>❑ <**CONTINUITY**> Resistance to earth connection and equipotential bonding.<br>❑ <**Z-LINE**> Line impedance.<br>❑ <**Z-LOOP**> Fault loop impedance.<br>❑ <**RCD**> RCD testing.<br>❑ <**EARTH**> Resistance to earth.<br>❑ <**VARISTOR TEST**> Transient suppressor test. |
| ↓ / ↑ | Select sub-function in selected measurement function. |
| **TEST** | Runs selected test / measurement function. |
| **TAB** | Enters test parameters field. |
| **ESC** | Exits single test operation mode. |
| **MEM** | Stores measured results / recalls stored results. |

Keys in **test parameter** field:

| | |
|---|---|
| ↓ / ↑ | Select measuring parameter. |
| ← / → | Change the selected parameter. |
| **TEST, TAB, ESC** | Exit back to main single test screen. |

General rule for enabling **limits** for evaluation of measurement / test result:

| | | |
|---|---|---|
| Limit | **OFF** | No limit comparison |
| | **ON** | Limit **ON** – enabled comparison |
| | | Limit **Value** – minimum / maximum limit value * |

* Type of limit value depends on particular function.

See *Chapter 5* for more information about operation of the instrument in single test functions.

## 4.3 Automatic testing

is intended for automatic executing of predefined measurement sequences.

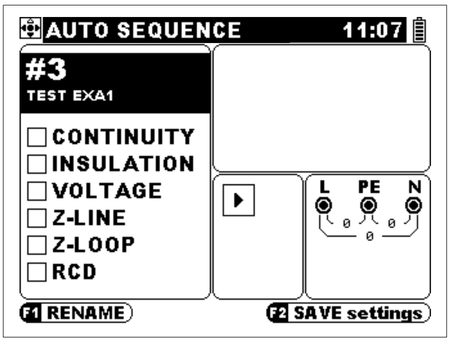



*Figure 4.3: Typical auto sequence screen*

| | |
|---|---|
| AUTO SEQUENCE | Auto sequence menu. |
| #3 TEST EXA1 | Selected sequence number and (optional) name. |
| ☐ CONTINUITY<br>☐ INSULATION<br>☐ VOLTAGE<br>☐ Z-LINE<br>☐ Z-LOOP<br>☐ RCD | Sequence field. |
|  | Test parameter / auto sequence description field. |
| F1 RENAME F2 SAVE settings | Saving and renaming options. |

**Running auto sequence:**

- Select auto sequence (see *4.3.2*).
- Connect the instrument to tested object as required for the first measurement in the sequence.
- Press TEST key.
- The sequence will pause at the functions marked with pause flag ⏸. Comments regarding the paused function will be displayed (optional).
  - Press the TAB key to toggle between comments menu and auto sequence main menu.
  - If the conditions at input terminals are valid, the test will proceed after pressing the TEST key.
  - Press the F1 key to skip the paused function. The test will continue with the next test (if any) or will end.
  - Press the ESC key to skip the remaining functions and finish the auto sequence.
- The set of measurements will be performed in sequential manner until the conditions at input terminals are valid for each individual test. If not, the instrument will stop (the buzzer sounds). The auto sequence will proceed:
  - After correct conditions are restored at the input terminal (e.g. by reconnecting, switching on the RCD).
  - If pressing the F1 key this function will be skipped.
  - By pressing the ESC key to skip the remaining functions and finish the auto sequence.
- Results of a finished auto sequence can be viewed and stored. See chapter *6.* for more information.

Measurements are marked with one of the following symbol after finished test.

| | |
|---|---|
| ☒ CONTINUITY | Measurement is finished and has failed. |
| ☑ INSULATION | Measurement is finished and has passed. |
| ⊡ VOLTAGE | Measurement is finished. No comparison limit was applied. |
| ☐ Z-LINE | Measurement is not performed yet (during test) or was skipped. |
| ✓ | Overall PASS result is reported if all performed tests passed. |
| ✗ | Overall FAIL result is reported if one or more performed tests failed. |

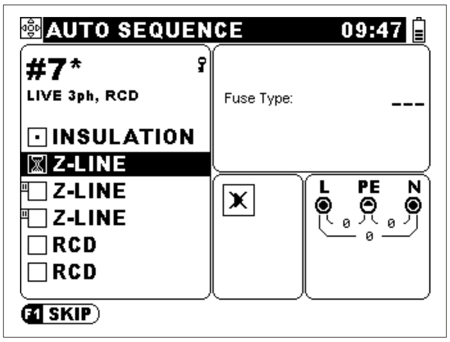



*Figure 4.4: Waiting for right input condition to proceed*

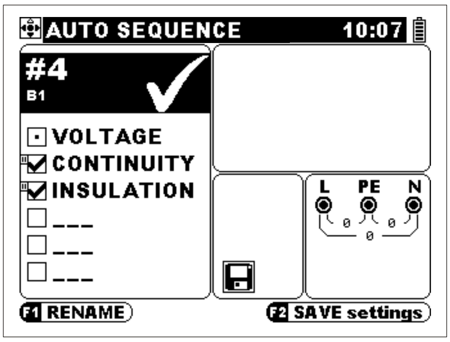



*Figure 4.5: Overall PASS example*

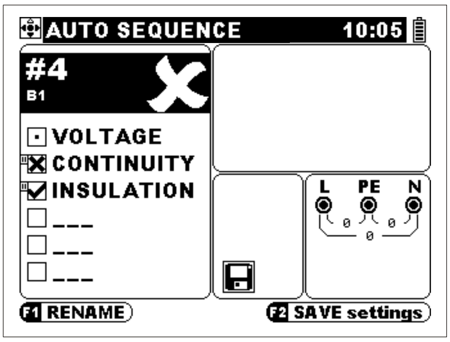



*Figure 4.6: Overall FAIL example*

**Viewing auto sequence particular results:**

- After finished auto sequence press the key ↓ to move focus into sequence field.
  - Press TEST key.
  - Result of selected function is displayed.
  - Press the key ↓ (or ↑) to select the next function of the sequence.
  - Repeat this part until all results are observed.
- Viewing of the results is finished by pressing the key ↑ until selected sequence number is focused or by pressing the ESC key.

### 4.3.1 Auto sequence number main menu

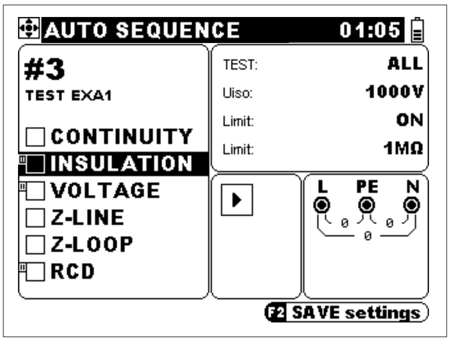
In the instrument up to 99 automatic sequences can be stored.


| | |
|---|---|
| #3 | Auto sequence number. |
| * | Indicator that the preset sequence was changed and is not stored yet, the auto sequence can be performed anyway. |
| TEST EXA1 | Optional sequence name (see *4.3.4*). |
| | Indication of locked sequence (see 4.3.2). |

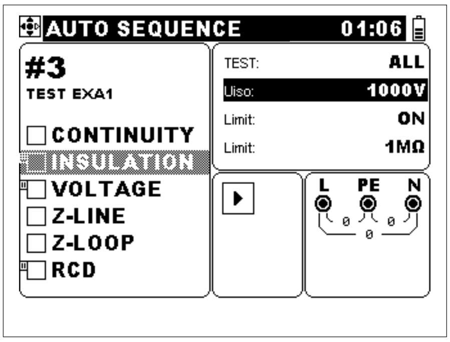
### 4.3.2 Auto sequence set

Keys in main auto sequence menu:

| | |
|---|---|
| **TEST** | Starts the selected test sequence.<br>Enters / clears pause ⏸ before test. |
| ← / → | Select the test sequence number or measuring function (see *4.3.1).* |
| ↓ / ↑ | Select individual sequence step / measuring function. |
| **TAB** | Enters test parameter field (see *4.3.3).* |
| **ESC** | Exits auto sequence menu without changes. |
| **F1** | Enters editor to rename selected test sequence and enter its description (see *4.3.4).*<br>Enters menu for setting pause flag and comments (see *4.3.7*). |
| **F2** | Saves entered test sequence (see *4.3.5).* |
| **MEM** | Stores / recalls AUTO SEQUENCE results. |




*Function selection*




*Parameter selection*

*Figure 4.7: Example of setting auto sequence sequence*

For each of 6 predefined sequence steps any of the following measurement function can be selected: voltage, continuity, insulation, Zline, Zloop, RCD and earth. The field can also be left empty (- - -).

Test parameters are applied to individual measurements as in the single test. The test parameter menu of selected measurement is available on the right side of the display.

The **pause** ⏸ flag holds the auto sequence until prosecution is confirmed with the **TEST** key. It is recommended to use it if additional checks or reconnections have to be performed before performing the next measurement.

The key is indication of locked sequence. This indication appears at predefined sequences that were loaded into the instrument from PC. It is possible to modify locked auto sequences and run them. However, the modified sequence cannot be stored by overwriting.

**Note:**
- It is recommended to save current auto sequence if modified or new prepared, to keep it during manipulation.

## 4.3.3 Test parameters in auto sequence

Keys in test parameter menu (in auto sequence):

| | |
|---|---|
| ← / → | Select test parameter value or enable / disable parameter. |
| ↓ / ↑ | Select test parameter. |
| **TEST, TAB, ESC** | Return to auto sequence main screen. |

Whenever a new function is selected for auto sequence its test parameters should be verified and changed to appropriate values / states.

**Test parameter merging**

When the prepared sequence from *section 4.3.2* contains selected at least two of Zline, Zloop, or RCD, is possible to merge test parameters of one function to others of mentioned in the same sequence.
Merged parameters are related to:
- fuse data, and
- RCD data, except start polarity of test current.

Additional Key in main auto sequence menu with selected Zline, Zloop, or RCD:

| | |
|---|---|
| **F2** | Merges test parameters. |

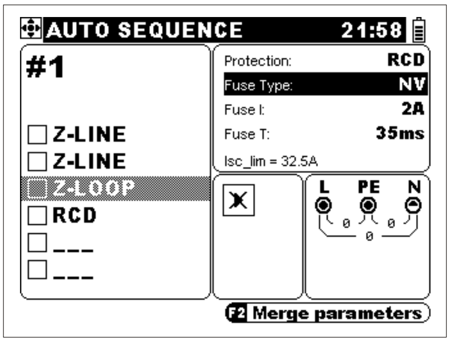



*Figure 4.8: Parameter merging possibility*

### 4.3.4 Name and description of auto sequence

| | |
|---|---|
| **F1** | Enters test sequence name menu from auto sequence main menu. |

Name and description for the selected auto sequence can be added or changed (optional) in this two level menu.

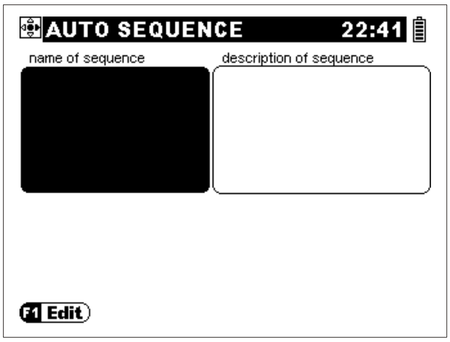



*Figure 4.9: Auto sequence name menu*

Keys for 1st level:

| | |
|---|---|
| **←** / **→** | Select between name and description field. |
| **TEST** | Returns to auto sequence main menu. |
| **F1** | Enters editing of selected field (2nd level). |
| **ESC** | Returns to auto sequence main menu without changes. |

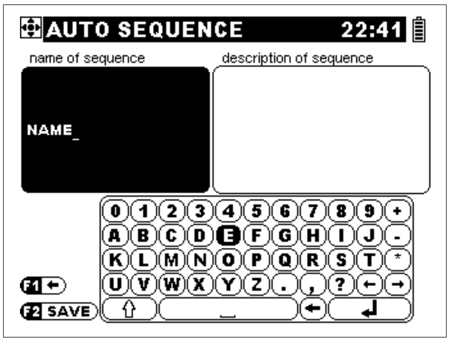



*Figure 4.10: Auto sequence name edit menu*

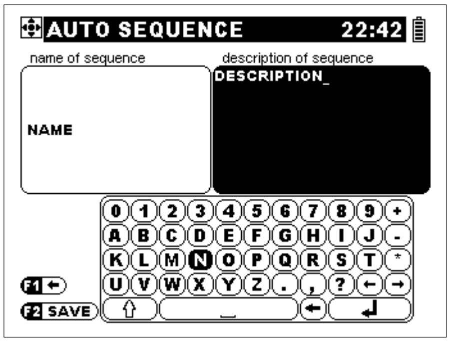



*Figure 4.11: Auto sequence description edit menu*

Keys for 2nd level:

| | |
|---|---|
| **Highlighted key** | Selected symbol or activity. |
| **←** / **→** / **↓** / **↑** | Select symbol or activity. |
| **TEST** | Enters selected symbol or performs selected activity. |
| **F1** | Deletes last entered symbol in the name line. |
| **F2** | Confirms name and returns to 1st level of auto sequence name menu. |
| **ESC** | Returns to 1st level of auto sequence name menu without changes. |

20 characters is the maximum length of the auto sequence name.
100 characters is the maximum length of the auto sequence description.

### 4.3.5 Storing auto sequence settings (sequence, number, name)

| | |
|---|---|
| **F2** | Opens dialog for storing auto sequence settings in auto sequence main menu. |

The dialog enables storing existing auto sequence settings into different location or overwriting existing.

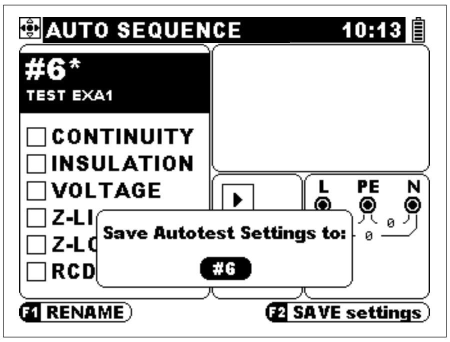



*Figure 4.12: Store dialog*

Keys:

| | |
|---|---|
| **← / →** | Select the auto sequence number. |
| **TEST** | Confirms the storing. |
| **ESC** | Returns to auto sequence main menu without changes. |

Auto sequence settings are stored in nonvolatile memory. Stored auto sequence procedures remain in memory until the user changes them.

It is not possible to store any auto sequence in locked location. Locked auto sequence can be copied in an unlocked location. Stored sequence is unlocked in this case.

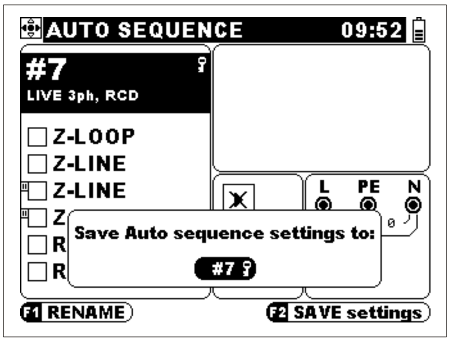



*Figure 4.13: Store dialog for locked sequence*

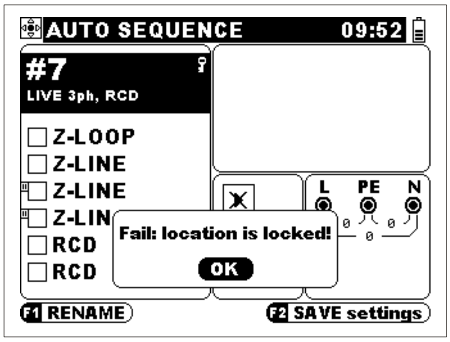
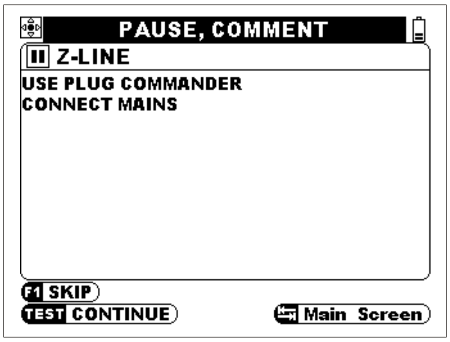



*Figure 4.14: Failed storing*

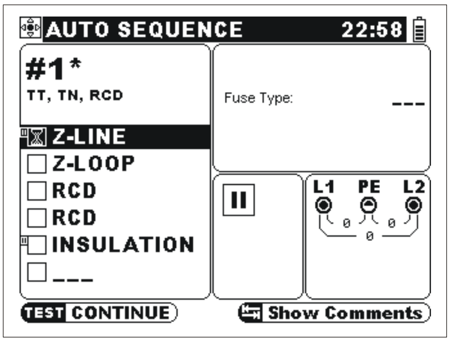
It is possible to unlock all locked sequences (see *4.4.5* for more information) if necessary.

### 4.3.6 Pause flag and comments in auto sequence

The auto sequence holds if a pause flag is associated with the measurement and the pre-defined comment is displayed. When the input conditions are regular, the auto sequence can be continued by pressing the **TEST** key.




*Comment appears with the pause*




*Blinking pause flag in main screen*

*Figure 4.15: Examples of screens during the pause in auto sequence*

Keys:

| | |
|---|---|
| **TAB** | Toggles between comment screen and auto sequence main screen. |
| **TEST** | Continues with the paused test. |
| **F1** | Skip paused test. |
| **ESC** | Skip all tests and ends auto sequence. |

### 4.3.7 Setting pause flag and comments

Operator of the instrument can prepare comments regarding the measurements. Warnings, reconnection hints or other useful remarks related to the test sequence can be applied this way.

| | |
|---|---|
| **F1** | Enters pause set-up and comments menu for selected function in auto sequence main menu. |

Set-up of comments is enabled if pause flag is set to ON.

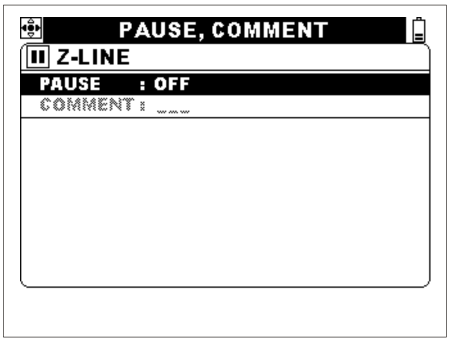



*Figure 4.16: Pause set-up menu*

Keys:

| | |
|---|---|
| **← / →** | Enable (ON) / disable (OFF) pause flag. |
| **↓** / **↑** | Select between pause flag and comments fields. |
| **TEST** | Confirms pause and comment selection, and returns to auto sequence main menu. |
| **ESC** | Returns to auto sequence main menu without changes. |

Comments set-up menu enables selection and editing of the pause comment.

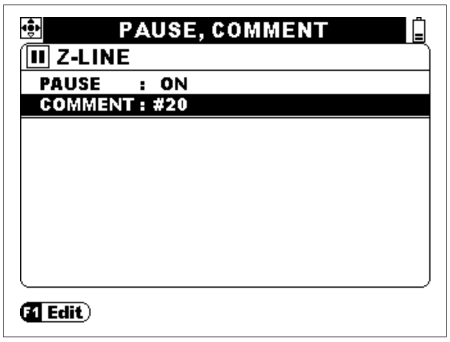



*Figure 4.17: Comments set-up menu*

Keys:

| | |
|---|---|
| **↓** / **↑** | Select between setup of pause and comment. |
| **← / →** | Select comment [--- (no comment), #1 ÷ #99]. |
| **F1** | Enters edit comments menu for selected comment number. |
| **TEST** | Confirms pause and comment selection and returns to auto sequence main menu. |
| **ESC** | Returns to auto sequence main menu without changes. |

Comments can be entered and edited in the Edit comments menu.

Maximum comment length: 250 characters (including space and new line characters).

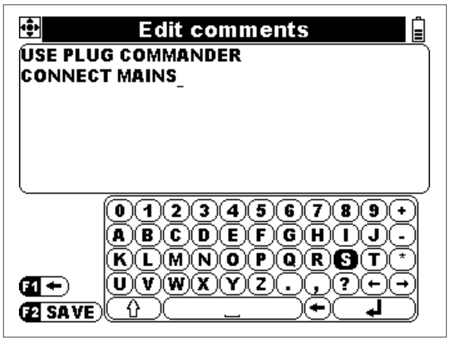



*Figure 4.18: Comments edit menu*

Keys:

| | |
|---|---|
| **Highlighted key** | Selected symbol or activity. |
| **←** / **→** / **↓** / **↑** | Select symbol or activity. |
| **TEST** | Enters selected symbol or performs selected activity. |
| **F1** | Deletes last entered symbol in the name line. |
| **F2** | Opens dialog for comment storing. |
| **ESC** | Deletes comment (immediately after entering the editor).<br>Returns to auto sequence main menu without changes. |

Storing comment opens dialog for storing into selected location.

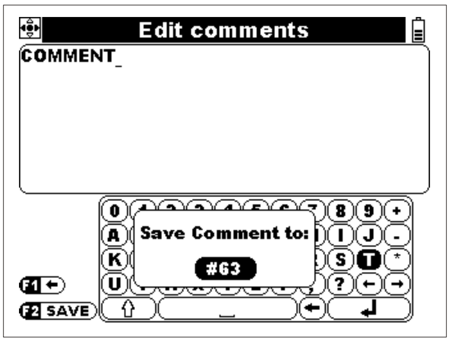



*Figure 4.19: Store dialog for comment*

Keys:

| | |
|---|---|
| ← / → | Select comment number. |
| **TEST** | Confirms storing the comment and returns. |
| **ESC** | Returns to Edit comments menu. |

**Note:**

- It is not possible to overwrite comments associated to locked auto sequences.

## 4.3.8 Building an auto sequence

The instrument supports up to 99 auto sequences, each consisting of up to 6 steps. It is not necessary that all steps are enabled.
The auto sequence can be prepared in the following way:

- By storing the existing auto sequence under another auto sequence number (see *4.3.5*),
- By changing an existing auto sequence and saving it under the same auto sequence number (not possible for locked auto sequence),
- By building a new auto sequence.

**Building a new auto sequence**

- In the main menu (see *4.1*) select **auto sequence.**
- Press the **TEST** key.
- Select **auto sequence number** (see *4.3.2*).
- Repeat until finished (maximum 6 steps):
  - Select **auto sequence step** (see *4.3.2*).
  - Select auto sequence **function** (see *4.3.2*).
  - Select auto sequence **test parameters** of the function (see *4.3.3*).
  - Set / reset pause flag ⏸ and select or create new comment if necessary (see *4.3.7*).
- Name (or **rename**) the auto sequence and enter its description (see *4.3.4*).
- Save prepared auto sequence (see *4.3.5*).

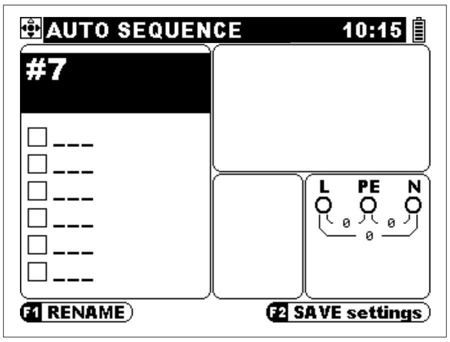



*Figure 4.20: Blank auto sequence*

**Example of building an auto sequence**

A house installation wall socket protected with fuse (type gG, In = 6 A, td = 5 s) and RCD (type AC, $I_{\Delta N}$ = 30 mA) shall be tested.
The following measurements must be performed:

- Equipotential bonding resistance of PE terminal to main PE collector (R ≤ 0.1 Ω),
- Insulation resistances between L – N, L – PE and N – PE (U = 500 V, R ≥ 1 MΩ),
- Voltages on the socket,
- Line impedance with fuse verification,
- RCD trip-out time at nominal current,
- RCD trip-out time at increased current (5 x $I_{\Delta N}$).

The name of test sequence number 10 is "Sock. 6A / 30mA(AC)". Description of the test sequence is: "Verification of wall socket, protected with fuse and RCD".

For the measurement the following conditions shall apply:

- Equipotential bonding resistance and insulation resistance measurement has to be performed on de-energized socket;
- Equipotential bonding resistance test (see figure *5.6*) should be performed with the universal test cable and extension lead;
- Insulation resistance test should be performed with the plug cable or commander (see figures *5.2* and *5.3*);
- Other tests have to be applied on energized test socket with the plug cable or commander (see figures *5.13, 5.22* and *5.26*).

Example:

| **Item/keys** | **Chapter reference** | **Comment** |
|---|---|---|
| **Auto sequence, TEST** | 4.1 | Selection of auto sequence operation in main menu. |
| ← / → | 4.3.1 | Selection of test sequence number **10.** |
| **F1** | 4.3.4 | Enter into sequence name editing menu. |
| **F1** | 4.3.4 | Enter the sequence name editor. |
| **Sock. 6A / 30mA(AC)** | 4.3.4 | Enter the name of auto sequence. |
| **F2** | 4.3.4 | Accept name and exit into sequence name editing menu. |
| → | 4.3.4 | Select description of test field. |
| **F1** | 4.3.4 | Enter the description of test editor. |
| **Verification of wall socket, protected with fuse and RCD** | 4.3.4 | Enter the description. |
| **F2** | | Accept description and exit into sequence name editing menu. |
| **TEST** | 4.3.4 | Exit sequence name editing menu. |
| ↓ | 4.3 | Enter into sequence field. |
| ← / → | 4.3.2 | Select **CONTINUITY.** |
| **TAB** | 4.3.2 | Enter test parameter selection mode. |
| TEST **R200mA**<br>Limit **ON**<br>Limit **0.1Ω** | 5.2 | Set test parameters for equipotential bonding resistance. |
| **TAB** | 4.3.2 | Exit parameter mode. |
| **F1** | 4.3.2 | Set **PAUSE** (wait to prepare for measurement). |
| ← / → | 4.3.7 | Set PAUSE: **ON.** |
| ↓ | 4.3.7 | Select **COMMENT.** |
| → | 4.3.7 | Select COMMENT: **#1.** |
| **F1** | 4.3.7 | Enter **Edit comment** menu. |
| **Disconnect mains, univ. cable + ext.** | 4.3.7 | Enter the comment. |
| **F2** | 4.3.7 | Save the comment. |
| **TEST** | 4.3.7 | Store the comment to location #1. |
| → | 4.3.7 | Select COMMENT: **#2.** |
| **F1** | 4.3.7 | Enter **Edit comment** menu. |
| **Commander** | 4.3.7 | Enter the comment. |
| **F2** | 4.3.7 | Save the comment. |
| **TEST** | 4.3.7 | Store the comment to location #2. |
| → | 4.3.7 | Select COMMENT: **#3.** |
| **F1** | 4.3.7 | Enter **Edit comment** menu. |
| **Connect mains** | 4.3.7 | Enter the comment. |
| **F2** | 4.3.7 | Save the comment. |
| **TEST** | 4.3.7 | Store the comment to location #3. |
| → | 4.3.7 | Select COMMENT: **#4.** |
| **F1** | 4.3.7 | Enter **Edit comment** menu. |
| **Turn ON RCD** | 4.3.7 | Enter the comment. |
| **F2** | 4.3.7 | Save the comment. |
| **TEST** | 4.3.7 | Store the comment to location #4. |

| | | |
|---|---|---|
| ← (3 x) | 4.3.7 | Select COMMENT: **#1.** |
| **TEST** | 4.3.7 | Confirm selected pause and its comment. |
| ↓ | 4.3 | Next step. |
| ← / → | 4.3.2 | Select **INSULATION.** |
| **TAB** | 4.3.2 | Enter test parameter selection mode. |
| TEST **ALL**<br>UISO **500 V**<br>Limit **ON**<br>Limit **1MΩ** | 5.1 | Setting test parameters for insulation resistance. |
| **TAB** | 4.3.2 | Exit parameter mode. |
| **F1** | 4.3.2 | Set **PAUSE** (wait to reconnect measuring leads). |
| ← / → | 4.3.7 | Set PAUSE: **ON.** |
| ↓ | 4.3.7 | Select **COMMENT.** |
| → (2 x) | 4.3.7 | Select COMMENT: **#2.** |
| **TEST** | 4.3.7 | Confirm selected pause and its comment. |
| ↓ | 4.3 | Next step. |
| ← / → | 4.3.2 | Select **VOLTAGE.** |
| **F1** | 4.3.2 | Set **PAUSE** (wait to connect mains voltage). |
| ← / → | 4.3.7 | Set PAUSE: **ON.** |
| ↓ | 4.3.7 | Select **COMMENT.** |
| → (3 x) | 4.3.7 | Select COMMENT: **#3.** |
| **TEST** | 4.3.7 | Confirm selected pause and its comment. |
| ↓ | 4.3 | Next step. |
| ← / → | 4.3.2 | Select **Z-LINE.** |
| **TAB** | 4.3.2 | Enter test parameter selection mode. |
| FUSE type **gG**<br>FUSE I **6A**<br>FUSE T **5s** | 5.5 | Set test parameters for line impedance and fuse test. |
| **TAB** | 4.3.2 | Exit parameter mode. |
| ↓ | 4.3 | Next step. |
| ← / → | 4.3.2 | Select **RCD.** |
| **TAB** | 4.3.2 | Enter test parameter selection mode. |
| TEST **Tripout current**<br>Idn **30mA**<br>type ~G<br>Ulim **50V** | 5.3 | Test parameters for RCD trip-out current test (*results of this test are also contact voltage at* $I_{\Delta}$ *and trip out time).* |
| **TAB** | 4.3.2 | Exit parameter mode. |
| ↓ | 4.3 | Next step. |
| **F1** | 4.3.2 | Set **PAUSE** (wait to activate RCD). |
| ← / → | 4.3.7 | Set PAUSE: **ON.** |
| ↓ | 4.3.7 | Select **COMMENT.** |
| → (4 x) | 4.3.7 | Select COMMENT: **#4.** |
| **TEST** | 4.3.7 | Confirm selected pause and its comment. |
| ← / → | 4.3.2 | Select **RCD.** |
| **TAB** | 4.3.2 | Enter test parameter selection mode. |
| TEST **Tripout time t**<br>Idn **30mA**<br>type ~G<br>MUL x5<br>Ulim **50V** | 5.3 | Test parameters for RCD trip out time test at $5I_{\Delta N}$ (*result of this test is also contact voltage at* $I_{\Delta N}$*).* |

| | | |
|---|---|---|
| **TAB** | 4.3.2 | Exit parameter mode. |
| ↑ (6 x) | 4.3 | Exit the editing of sequence field. |
| **F2** | 4.3.5 | Store prepared test sequence. |
| **TEST** | 4.3.5 | Confirm storing. |

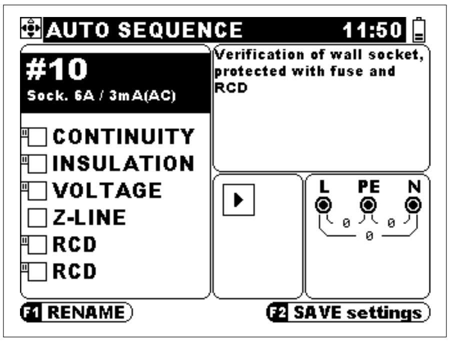



*Figure 4.21: Auto sequence screen of the example above*

## 4.4 Miscellaneous

Different instrument options can be set in the 

menu.

Options are:

- Selection of language,
- Selection of mains supply system,
- Recalling and clearing stored results,
- Setting date and time,
- Selection of communication port,
- Setting the instrument to initial values,
- Entering locator function,
- Selection of operator.

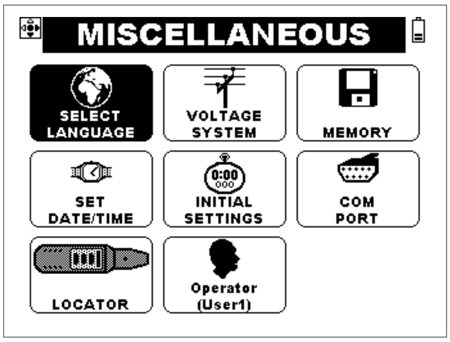



*Figure 4.22: Options in Miscellaneous menu*

Keys:

| | |
|---|---|
| **↓ / ↑ / ← / →** | Selection of option. |
| **TEST** | Enters selected option. |
| **ESC** | Returns to the main menu. |

### 4.4.1 Language

The instrument supports different languages.

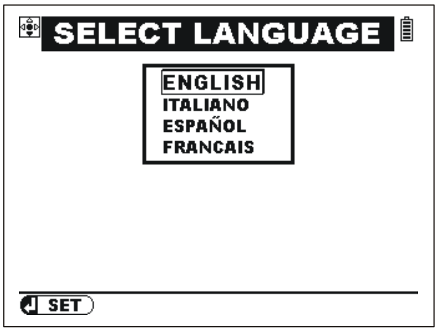



*Figure 4.23: Language selection*

Keys:

| | |
|---|---|
| **↓ / ↑** | Select language. |
| **TEST** | Confirms selected language and exits to settings menu. |
| **ESC** | Exits to settings menu without changes. |

### 4.4.2 Supply system, Isc factor, RCD standard

In the **Voltage system** menu the following parameters can be selected:

| | |
|---|---|
| **Voltage system** | Mains supply system type. |
| **Set Isc factor** | Correction factor for Isc calculation (ksc). |
| **RDC testing** | RCD normative reference. |

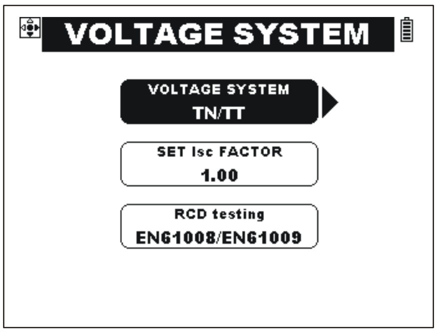



*Figure 4.24: System parameters*

Keys:

| | |
|---|---|
| **↓ / ↑** | Select option. |
| **← / →** | Change the option. |
| **TEST** | Confirms selected option. |
| **ESC** | Exits to settings menu with new setup. |

**Mains supply systems**

The following supplying systems are supported:
- TT / TN (earthed systems),
- IT (system insulated from earth),
- 110 V reduced low voltage (2 x 55 V center tap grounded),
- 110 V reduced low voltage (3 x 63 V three phase, star center grounded).

TN, TT and IT systems are defined in EN 60364-1 standard. 110 V reduced low voltage systems are defined in BS 7671.

See *Appendix D* for particular characteristics of IT supply system measurements and instrument characteristics.
See *Appendix E* for particular characteristics of 110 V reduced low voltage supply systems measurements and instrument characteristics.

**Isc factor - ksc**

Short circuit current Isc in the supply system is important for selection or verification of protective circuit breakers (fuses, over-current breaking devices, RCDs).
The default value of ksc is 1.00. Change the value as required by local regulative for tested type of mains supply system.
Range for adjustment of the ksc is 0.20 ÷ 3.00.

### RCD normative references

Maximum RCD disconnection times differ in various standards.
The trip-out times defined in individual standards are listed below.

Trip-out times according to EN 61008 / EN 61009:

| | ½×$I_{\Delta N}$ *) | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ |
|---|---|---|---|---|
| General RCDs (non-delayed) | $t_\Delta > 300$ ms | $t_\Delta < 300$ ms | $t_\Delta < 150$ ms | $t_\Delta < 40$ ms |
| Selective RCDs (time-delayed) | $t_\Delta > 500$ ms | 130 ms $< t_\Delta <$ 500 ms | 60 ms $< t_\Delta <$ 200 ms | 50 ms $< t_\Delta <$ 150 ms |

Trip-out times according to IEC 60364-4-41:

| | ½×$I_{\Delta N}$ *) | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ |
|---|---|---|---|---|
| General RCDs (non-delayed) | $t_\Delta > 999$ ms | $t_\Delta < 999$ ms | $t_\Delta < 150$ ms | $t_\Delta < 40$ ms |
| Selective RCDs (time-delayed) | $t_\Delta > 999$ ms | 130 ms $< t_\Delta <$ 999 ms | 60 ms $< t_\Delta <$ 200 ms | 50 ms $< t_\Delta <$ 150 ms |

Trip-out times according to BS 7671:

| | ½×$I_{\Delta N}$ *) | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ |
|---|---|---|---|---|
| General RCDs (non-delayed) | $t_\Delta > 1999$ ms | $t_\Delta < 300$ ms | $t_\Delta < 150$ ms | $t_\Delta < 40$ ms |
| Selective RCDs (time-delayed) | $t_\Delta > 1999$ ms | 130 ms $< t_\Delta <$ 500 ms | 60 ms $< t_\Delta <$ 200 ms | 50 ms $< t_\Delta <$ 150 ms |

Trip-out times according to AS/NZS 3017**):

| | | ½×$I_{\Delta N}$ *) | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ | |
|---|---|---|---|---|---|---|
| RCD type | $I_{\Delta N}$ [mA] | $t_\Delta$ | $t_\Delta$ | $t_\Delta$ | $t_\Delta$ | Note |
| I | $\leq 10$ | > 999 ms | 40 ms | 40 ms | 40 ms | Maximum break time |
| II | $> 10 \leq 30$ | | 300 ms | 150 ms | 40 ms | |
| III | > 30 | | 300 ms | 150 ms | 40 ms | |
| IV S | > 30 | > 999 ms | 500 ms | 200 ms | 150 ms | |
| | | | 130 ms | 60 ms | 50 ms | Minimum non-actuating time |

*) Minimum test period for current of ½×$I_{\Delta N}$, RCD shall not trip-out.
**) Test current and measurement accuracy correspond to AS/NZS 3017 requirements.

Maximum test times related to selected test current for general (non-delayed) RCD

| Standard | ½×$I_{\Delta N}$ | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ |
|---|---|---|---|---|
| EN 61008 / EN 61009 | 300 ms | 300 ms | 150 ms | 40 ms |
| IEC 60364-4-41 | 1000 ms | 1000 ms | 150 ms | 40 ms |
| BS 7671 | 2000 ms | 300 ms | 150 ms | 40 ms |
| AS/NZS 3017 (I, II, III) | 1000 ms | 1000 ms | 150 ms | 40 ms |

Maximum test times related to selected test current for selective (time-delayed) RCD

| Standard | ½×$I_{\Delta N}$ | $I_{\Delta N}$ | 2×$I_{\Delta N}$ | 5×$I_{\Delta N}$ |
|---|---|---|---|---|
| EN 61008 / EN 61009 | 500 ms | 500 ms | 200 ms | 150 ms |
| IEC 60364-4-41 | 1000 ms | 1000 ms | 200 ms | 150 ms |
| BS 7671 | 2000 ms | 500 ms | 200 ms | 150 ms |
| AS/NZS 3017 (IV) | 1000 ms | 1000 ms | 200 ms | 150 ms |

### 4.4.3 Memory

In this menu the stored data can be recalled, viewed and cleared. See chapter *6 Data handling* for more information.

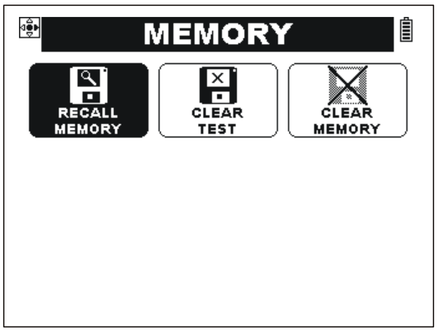



*Figure 4.25: Memory options*

Keys:

| | |
|---|---|
| ← / → | Select option. |
| **ESC** | Exits this option. |
| **TEST** | Enters selected option. |

### 4.4.4 Date and time

Date and time can be set in this menu.

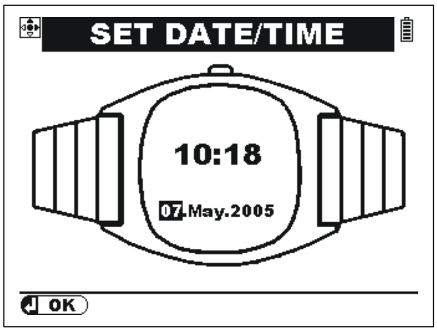



*Figure 4.26: Setting date and time*

Keys:

| | |
|---|---|
| → | Selects the field to be changed. |
| ↑ / ↓ | Modify selected field. |
| **ESC** | Exits date and time setup without changes. |
| **TEST** | Confirms new setup and exits. |

### 4.4.5 Initial settings

Instrument settings and measurement parameters and limits are set to their initial values in this menu.

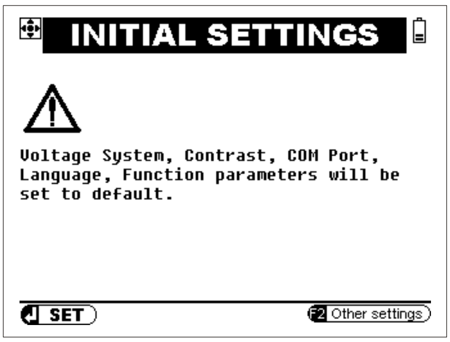



*Figure 4.27: Initial settings dialogue*

Keys:

| | |
|---|---|
| **TEST** | Restores default settings. |
| **ESC** | Exits the menu without changes. |
| **F2** | Opens other settings menu. |

**Warning:**

- Custom made settings will be lost when this option is used!

The default setup is listed below:

| Instrument setting | Default value |
|---|---|
| Contrast | As defined and stored by adjustment procedure |
| Isc factor | 1.00 |
| Supply system | TN / TT |
| RCD standards | EN 61008 / EN 61009 |
| COM port | RS 232 |
| Language | English |

| Function<br>Sub-function | Parameter / limit value |
|---|---|
| CONTINUITY<br>R LOWΩ<br>Continuity | R 200 mA<br>High limit resistance value: OFF<br>High limit resistance value: OFF |
| INSULATION | Nominal test voltage: 500 V<br>Low limit resistance value: OFF<br>Selected test leads combination: LN |
| Z - LINE<br>ΔU | Fuse type: none selected<br>Limit: 4.0 %<br>$Z_{ref}$ : 0.00 Ω |
| Z - LOOP | Protection: Fuse<br>Fuse type: none selected |
| 2 Ω line/loop impedance | mΩ L-N Fuse type: none selected |
| RCD | RCD t<br>Nominal differential current: $I_{\Delta N}$=30 mA<br>RCD type: AC □ non-delayed<br>Test current starting polarity: ⏦ (0°)<br>Limit contact voltage: 50 V<br>Current multiplier: ×1 |
| Earth resistance<br>3-wire<br>Specific resistance | 3-wire<br>Limit value: OFF<br>Distance unit: m |
| Varistor test | Lo limit: 300 V<br>Hi limit: 400 V |

**Other settings**

| | |
|---|---|
| **F2** | Enters menu to select other instrument options |

Other instrument options can be set in this menu.

Options are:
- Unlocking default autotests & comments
- Setting units of measurements
- Commander support
- Initialization of Bluetooth dongle

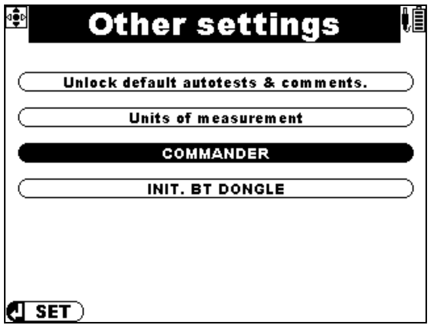



*Figure 4.28: Other settings dialogue*

Keys:

| | |
|---|---|
| ↑ / ↓ | Select other settings item. |
| **TEST** | Enters selected item. |
| **ESC** | Exits the menu without changes. |

**Unlocking default autotests and comments**

Protection flag (key) for all default auto test sequences and associated comments will be cleared.

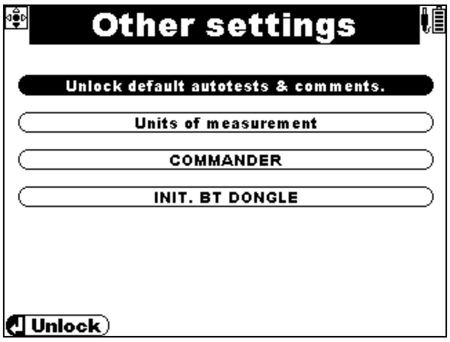



*Figure 4.29: Unlock default autotests dialogue*

| | |
|---|---|
| **TEST** | Unlocks locked auto test sequences. |
| **ESC** | Exits the menu without changes. |

**Units selection**

Unit for specific earth resistance will be selected.

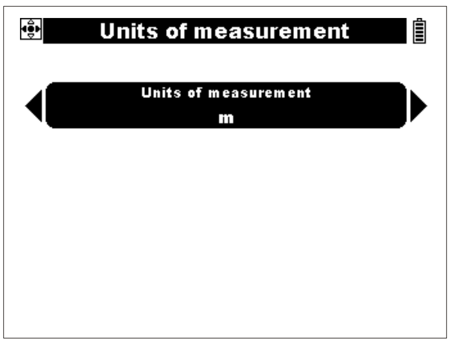



*Figure 4.30: Units of measurement dialogue*

| | |
|---|---|
| ← / → | Select distance units. |
| **TEST** | Enters selected distance units. |
| **ESC** | Exits the menu without changes. |

**Commander support**

The commanders operation can be set in this menu.

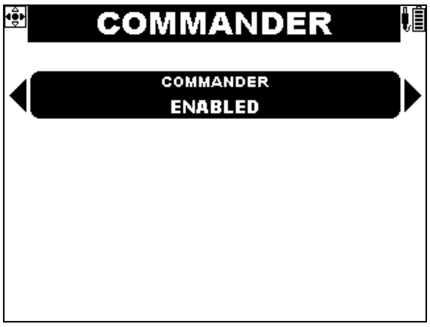



*Figure 4.31: Commander operation menu*

| | |
|---|---|
| ← / → | Selects commander enabled / disabled |
| **TEST** | Enters selected option. |
| **ESC** | Exits the menu without changes. |

**Note**:
- Commander disabled option is intended to disable the commander's remote keys. In the case of high EM interfering noise the operation of the commander's key can be irregular.

**Initialization of the Bluetooth dongle**

In this menu the Bluetooth dongle A 1436 can be initialized.

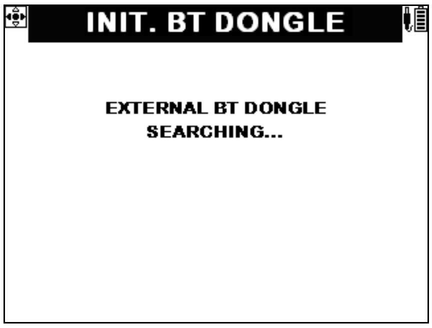



*Figure 4.32: Bluetooth initialization screen*

| | |
|---|---|
| **TEST** | Initializes Bluetooth dongle |
| **ESC** | Exits the menu without changes. |

**Initialization of the Bluetooth dongle**
The Bluetooth dongle A 1436 should be initialized when it is used with the instrument for the first time. During initialization the instrument sets the dongle parameters and name in order to communicate properly with PC and other devices via Bluetooth.

**Initialization procedure**

1. Connect Bluetooth dongle A 1436 to the instrument.
2. Press RESET key on the Bluetooth dongle A 1436 for **at least 5 seconds.**
3. Select INIT. BT DONGLE in Other settings menu and press TEST.

| |
|---|
| 4. Wait for confirmation message and beep. Following message is displayed if dongle was initialized properly:<br>EXTERNAL BT DONGLE<br>SEARCHING…<br><br>OK |

**Notes:**

- The Bluetooth dongle A 1436 should always be initialized before first use with the instrument.
- If the dongle was initialized by another Metrel instrument it will probably not work properly when working with the previous instrument again. Bluetooth dongle initialization should be repeated in that case.
- For more information about communication via Bluetooth refer to chapter 6.7 Communications and A 1436 manual.

### 4.4.6 Communication port

The communication port (RS232 or USB) can be selected in this menu.

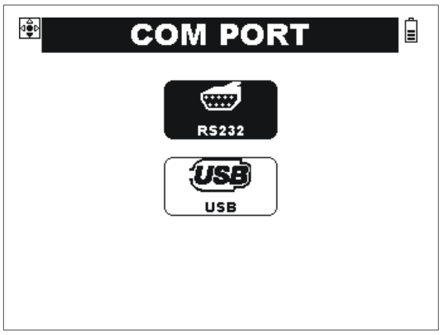



*Figure 4.33: Communication port selection*

Keys:

| | |
|---|---|
| ↑ / ↓ | Select communication port. |
| **TEST** | Confirms selected port. |
| **ESC** | Exits without changes. |

**Note**:

- Only one port can be active at the same time.

### 4.4.7 Locator

This function enables tracing electrical lines.

Keys:

| | |
|---|---|
| **TEST** | Starts locator function. |
| **ESC** | Exits miscellaneous menu. |

See chapter *5.10 Locator* for locator operation.

### 4.4.8 Operator

This menu enables registering the operator of the instrument. Selected operator name appears on the bottom of the LCD during turning on of the instrument. It is also associated to stored measurement results. Up to 5 operators can be defined.

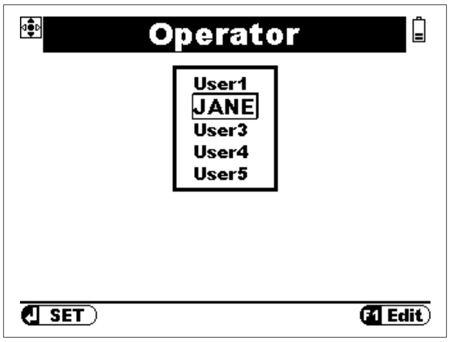


*Figure 4.34: Operator menu*

Keys:

| | |
|---|---|
| **↑ / ↓** | Select operator. |
| **TEST** | Accepts selected operator. |
| **ESC** | Exits to miscellaneous menu without changes. |
| **F1** | Enters operators name edit menu. |

Operators name can be entered or modified.

Maximum 15 characters can be entered for operator.

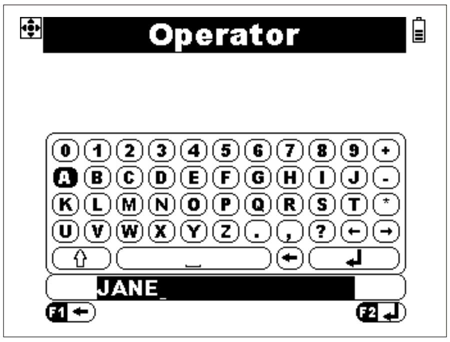


*Figure 4.35: Operator name edit menu*

Keys:

| | |
|---|---|
| **Highlighted key** | Selected symbol or activity. |
| **← / → / ↓ / ↑** | Select symbol or activity. |
| **TEST** | Enters selected symbol or performs selected activity. |
| **F1** | Deletes last entered symbol in the name line. |
| **F2** | Confirms comment and returns to operator main menu. |
| **ESC** | Deletes operator (immediately after entering the editor).<br>Returns to operator main menu without changes. |

# 5 Measurements

## 5.1 Insulation resistance

Insulation resistance measurement is performed in order to assure safety against electric shock through insulation. It is covered by the EN 61557-2 standard. Typical applications are:

- Insulation resistance between conductors of installation,
- Insulation resistance of non-conductive rooms (walls and floors),
- Insulation resistance of ground cables,
- Resistance of semi-conductive (antistatic) floors.

See chapter *4.2 Single test* for functionality of keys.

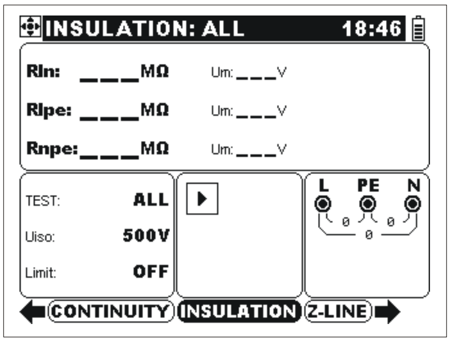



*Figure 5.1: Insulation resistance*

**Test parameters for insulation resistance measurement**

| | |
|---|---|
| TEST | **Test configuration** [L-N, L-PE, N-PE, ‘L-PE,N-PE’, ‘L-N,L-PE’, ALL] |
| Uiso | **Test voltage** [50 V, 100 V, 250 V, 500 V, 1000 V] |
| Limit | **Minimum insulation resistance** [OFF, 0.1 MΩ ÷ 200 MΩ, (‘L-PE,N-PE’, ‘L-N,L-PE’, **ALL**: 20 MΩ)] |

**Test circuits for insulation resistance**

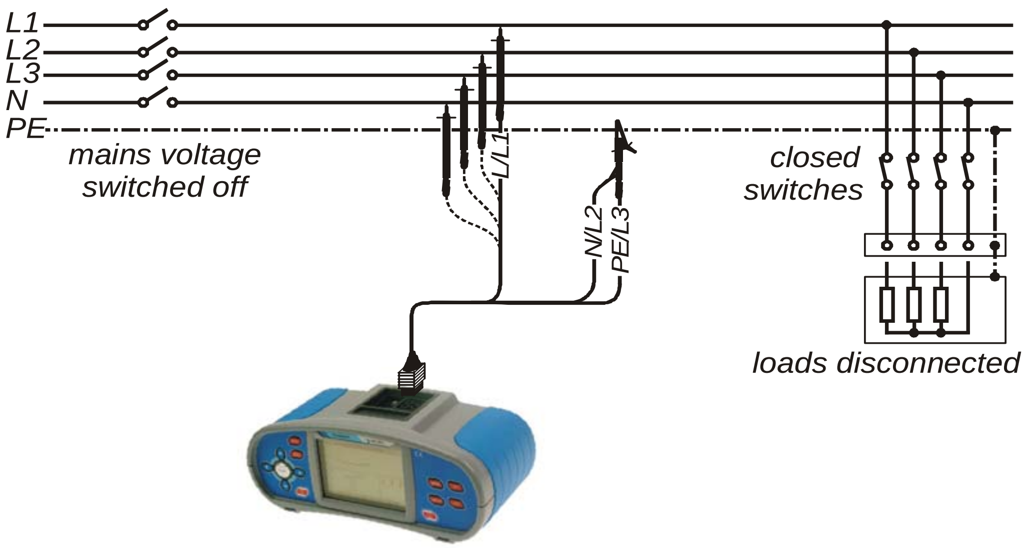



*Figure 5.2: Connection of universal test cable for general insulation resistance measurement (TEST: L-PE)*

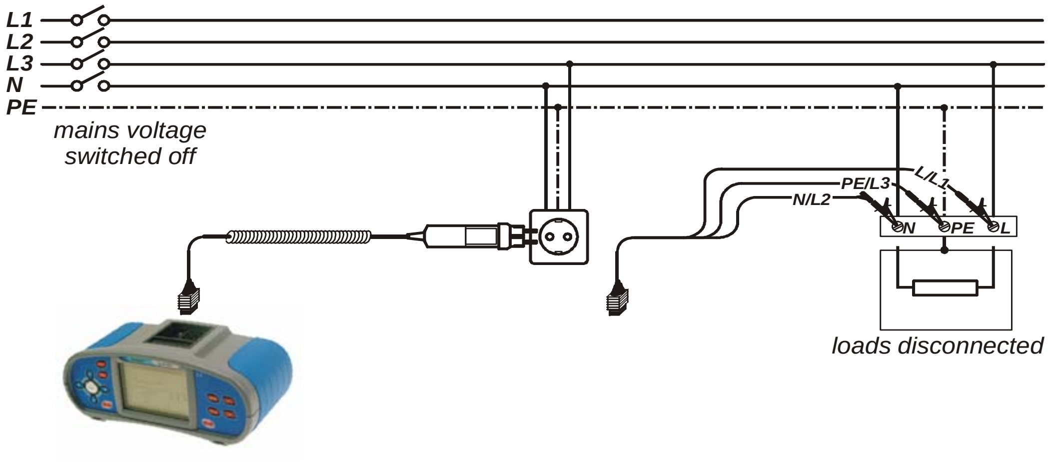



*Figure 5.3: Application of plug commander and universal test cable for insulation resistance measurement (TEST: ‘L-PE,N-PE’, ‘L-N,L-PE’, ALL)*

**Insulation resistance measuring procedure**

- Select the **INSULATION** function.
- Set test **parameters**.
- Enable and set **limit** value (optional).
- **Disconnect** tested installation from mains supply (and discharge tested insulation).
- **Connect** test cable to the instrument and tested item (see figures 5.2 and 5.3).
- Press the **TEST** key for measurement (keep pressing for continuous measurement).
- After the measurement is finished wait until tested item is discharged.
- **Store** the result (optional).

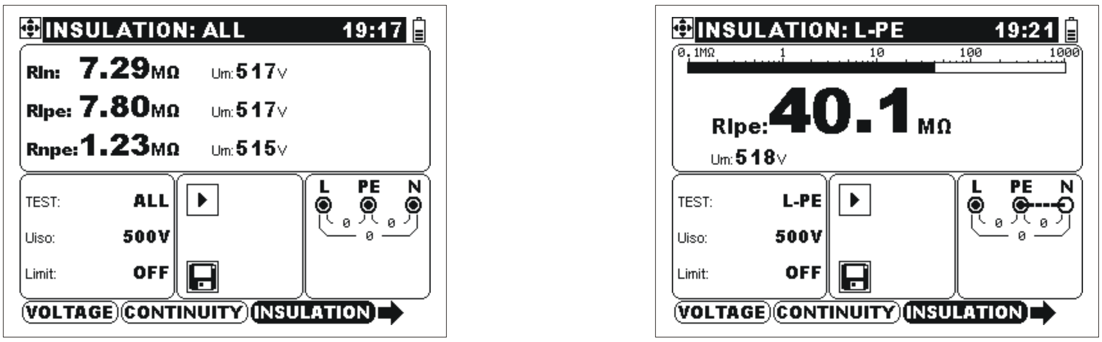
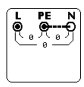



*Figure 5.4: Examples of insulation resistance measurement results*

Displayed results:
Rln ..........Insulation resistance between L (+) and N (-).
Rlpe ........Insulation resistance between L (+) and PE (-).
Rnpe .......Insulation resistance between N (+) and PE (-).
Um ..........Test voltage(s) – actual value(s).

**Note:**

- Follow the correct test wiring as indicated in terminal voltage monitor  when the particular insulation test is selected. If only two test wires are connected, and L-N, L-PE or N-PE test is selected, then technical specification for INSULATION ALL applies.

## 5.2 Resistance to earth connection and equipotential bonding

The resistance measurement is performed in order to assure that protective measures against electric shock through earth bond connections are effective. Four subfunctions are available:

- Earth bond resistance measurement according to EN 61557-4 (between N and PE terminals, test current >200 mA),
- Earth bond resistance measurement according to EN 61557-4 (between L and PE terminals, test current >200 mA),
- Continuous resistance measurement with lower test current (between N and PE terminals, test current ca 7 mA),
- Continuous resistance measurement with lower test current (between L and PE terminals, test current ca 7 mA).

See chapter *4.2 Single test* for functionality of keys.

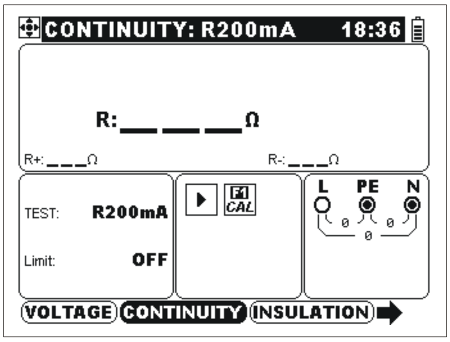



*Figure 5.5: Continuity*

**Test parameters for resistance measurement**

| | |
|---|---|
| TEST | Resistance measurement **sub-function** [R200mA NPE, R7mA NPE, R200mA LPE, R7mA LPE] |
| Limit | **Maximum resistance** [OFF, 0.1 Ω ÷ 20.0 Ω] |

### 5.2.1 Continuity R200 mA measurement

The resistance measurement is performed with automatic polarity reversal of the test voltage.

### Test circuit for Continuity R200mA measurement

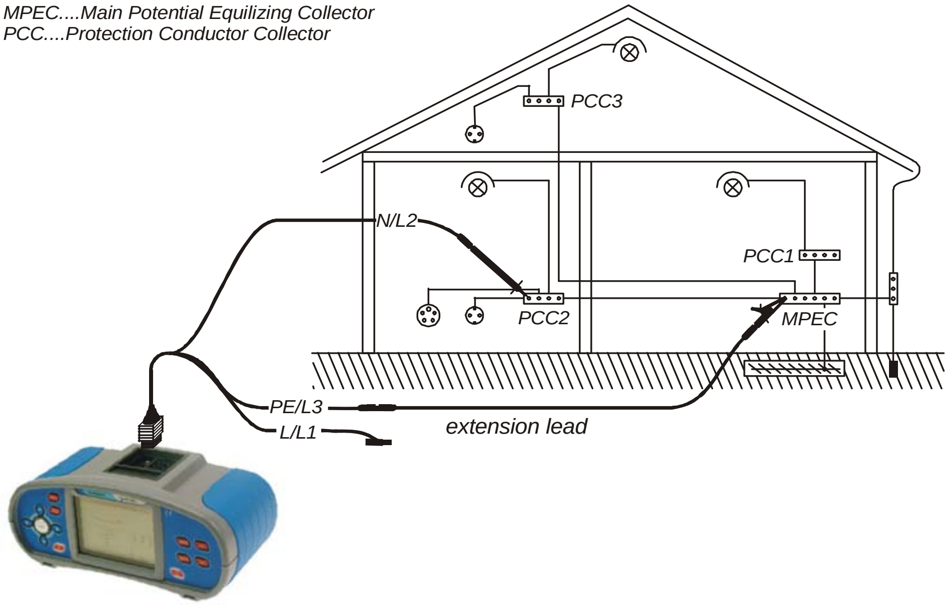



*Figure 5.6: Connection of universal test cable plus optional extension lead*

### Resistance to earth connection and equipotential bonding measurement procedure

- Select the **CONTINUITY** function.
- Set sub-function **R200mA (L-PE or N-PE)**.
- Enable and set **limit** (optional).
- **Connect** test cable to the instrument.
- **Compensate** test leads resistance (if necessary).
- **Disconnect** from mains supply and discharge tested installation.
- **Connect** test leads to the tested PE wiring (see *figure 5.6*).
- Press the **TEST** key for measurement.
- After the measurement is finished **store** the result (optional).

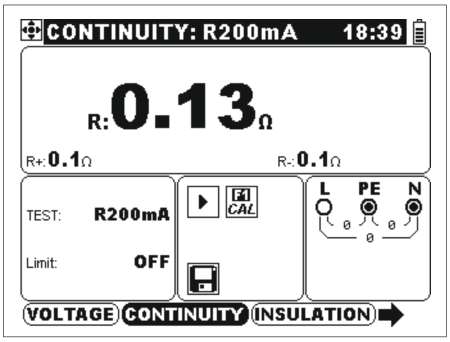



*Figure 5.7: Example of continuity R200mA result*

Displayed results:
R..............Main R200mA resistance (average of R+ and R- results),
R+............R200mA sub-resistance with positive voltage at N terminal,
R- ............R200mA sub-resistance with positive voltage at PE terminal.

## 5.2.2 7 mA resistance measurement

In general this function serves as standard Ω-meter with low test current. The measurement is performed continuously without pole reversal. The function can also be applied for testing continuity of inductive components.

**Test circuit for continuous resistance measurement**

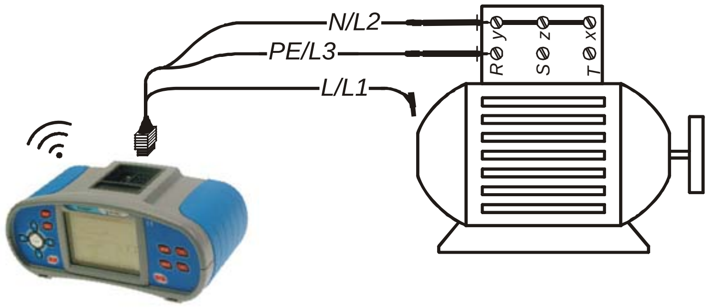



*Figure 5.8: Universal test cable application*

**Continuous resistance measurement procedure**

- Select the **CONTINUITY** function.
- Set sub-function **R 7mA (L-PE or N-PE).**
- Enable and set **limit** (optional).
- **Connect** test cable to the instrument.
- **Compensate** test leads resistance (if necessary).
- **Disconnect** from mains supply and discharge tested object.
- **Connect** test leads to the tested object (see *figure 5.8*).
- Press the **TEST** key for continuous measurement.
- Press the **TEST** key to stop measurement.
- After the measurement is finished **store** the result (optional).

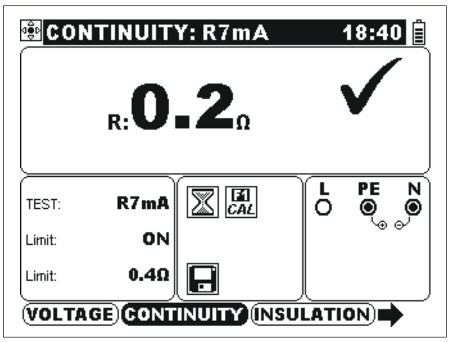



*Figure 5.9: Example of 7 mA resistance measurement*

Displayed result:
R..............Resistance.

### 5.2.3 Compensation of test leads resistance

This chapter describes common principle for compensation of test leads resistance for both CONTINUITY functions. The compensation is required to eliminate the influence of test leads resistance plus internal resistances of the instrument. The lead compensation is very important to obtain correct result. The compensation status ( / ) is indicated in the message field.

Key:

| | |
|---|---|
| **F1** | Enters test leads resistance compensation menu for any of mentioned functions. |

See chapter *4.2 Single test* for functionality of keys.

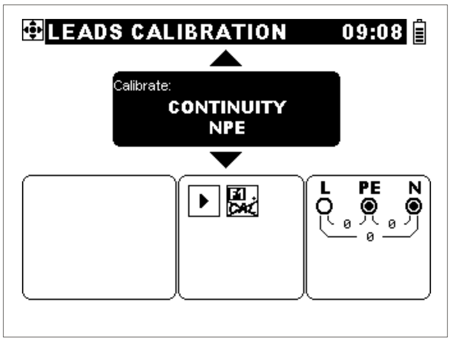



*Figure 5.10: Test leads resistance compensation menu*

Keys:

| | |
|---|---|
| **TEST** | Performs compensation |
| **↓ / ↑** | Sets function to be compensated |

The instrument compensates following Continuity subfunctions.

**Compensation NPE**
Same compensation for both **7 mA** and **200 mA** measurements. — Short N and PE terminals.

**Compensation LPE**
Same compensation for both **7 mA** and **200 mA** measurements. — Short L and PE terminals

### Circuits for compensating the resistance of test leads

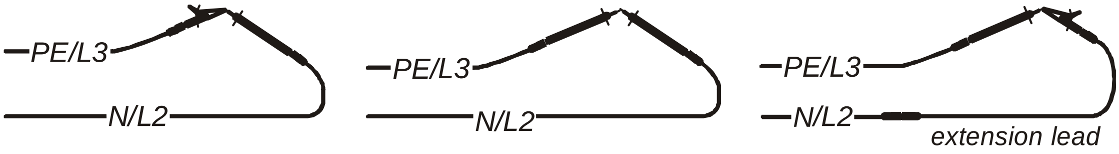



*Figure 5.11: Shorted test leads-examples for N-PE*

### Compensation of test leads resistance procedure

- Select the CONTINUITY function (any).
- **Connect** test cable to the instrument and short N/PE or L/PE terminals (see figure *5.11*).
- Press the **F1** key to open test leads resistance compensation menu.
- Press the **TEST** key for measurement and compensation of test leads resistance.
- Press the **ESC** key to return to function menu.

**Note:**

- 20 Ω is limit value for test leads resistance compensation.

## 5.3 Testing RCDs

Various test and measurements are required for verification of RCD(s) in RCD protected installations. Measurements are based on the EN 61557-6 standard.

The following measurements and tests (sub-functions) can be performed:

- Contact voltage,
- Trip-out time,
- Trip-out current,
- RCD autotest.

See chapter *4.2 Single test* for functionality of keys.

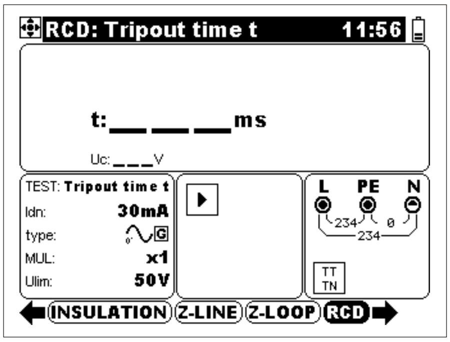



*Figure 5.12: RCD test*

**Test parameters for RCD test and measurement**

| | |
|---|---|
| TEST | RCD **sub-function** test [Tripout time t, Uc, AUTO, Tripout current]. |
| Idn | **Rated** RCD residual current sensitivity $I_{\Delta N}$ [10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]. |
| type | RCD **type** AC, A, F, B, B+, starting **polarity** [ , , , , , ], **selective** S or **general** ☐ characteristic. |
| MUL | **Actual** test current relative to rated Idn [½, 1, 2, 5]. |
| Ulim | Conventional touch voltage **limit** [25 V, 50 V]. |

**Note**:

- Selective (time delayed) RCDs have delayed response characteristics. As the contact voltage pre-test or other RCD tests influence the time delayed RCD it takes a certain period to recover into normal state. Therefore a time delay of 30 s is inserted before performing trip-out test by default.

### Circuits for testing RCD

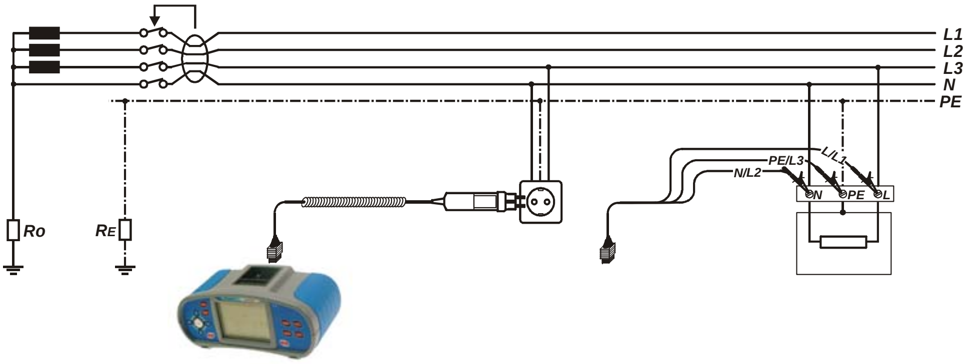



*Figure 5.13: Connecting the plug commander and the universal test cable*

## 5.3.1 Contact voltage (RCD Uc)

A current flowing into the PE terminal causes a voltage drop on earth resistance, i.e. voltage difference between PE equipotential bonding circuit and earth. This voltage difference is called contact voltage. The voltage is present on all accessible conductive parts connected to the PE. It should always be lower than the conventional safety limit voltage. The contact voltage is measured with a test current lower than ½ $I_{\Delta N}$ to avoid trip-out of the RCD and then normalized to the rated $I_{\Delta N}$.

### Contact voltage measurement procedure

- Select the **RCD** function.
- Set sub-function **Uc.**
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figure 5.13*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

Displayed contact voltage relates to the rated nominal residual current of the RCD and is multiplied by appropriate factor. Common factor of 1.05 is applied to avoid negative tolerance of result, additional depend on RCD type and type of test current. See table 5.1 for detailed contact voltage calculation.

| RCD type | | Contact voltage Uc proportional to | Rated $I_{\Delta N}$ |
|---|---|---|---|
| AC | □ | $1.05 \times I_{\Delta N}$ | any |
| AC | S | $2 \times 1.05 \times I_{\Delta N}$ | |
| A, F | □ | $1.4 \times 1.05 \times I_{\Delta N}$ | ≥ 30 mA |
| A, F | S | $2 \times 1.4 \times 1.05 \times I_{\Delta N}$ | |
| A, F | □ | $2 \times 1.05 \times I_{\Delta N}$ | < 30 mA |
| A, F | S | $2 \times 2 \times 1.05 \times I_{\Delta N}$ | |
| B, B+ | □ | $2 \times 1.05 \times I\Delta N$ | any |
| B, B+ | S | $2 \times 2 \times 1.05 \times I\Delta N$ | |

*Table 5.1: Relationship between Uc and $I_{\Delta N}$*

Loop resistance is indicative and calculated from Uc result (without additional proportional factors) according to: $R_L = \frac{U_C}{I_{\Delta N}}$.

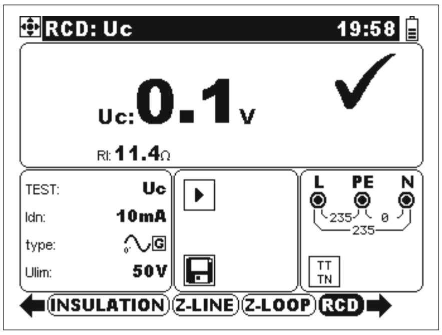



*Figure 5.14: Example of contact voltage measurement results*

Displayed results:
Uc....... Contact voltage.
Rl........ Fault loop resistance.

## 5.3.2 Trip-out time (RCD t)

Trip-out time measurement verifies the sensitivity of an RCD at different residual currents.

**Trip-out time measurement procedure**

- Select the **RCD** function.
- Set sub-function **Tripout time t.**
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figure 5.13*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

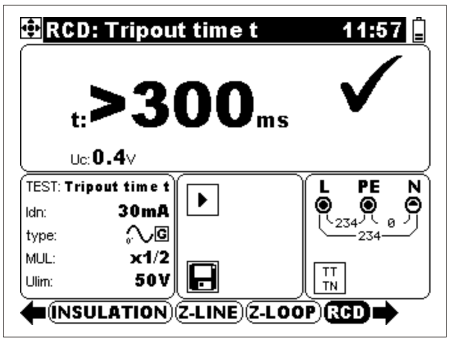



*Figure 5.15: Example of trip-out time measurement results*

Displayed results:
t .......... Trip-out time,
Uc....... Contact voltage for rated $I_{\Delta N}$.

**Note:**

- See *4.4.2 RCD standard* for selection of appropriate standard test conditions.

### 5.3.3 Trip-out current (RCD $I_\Delta$)

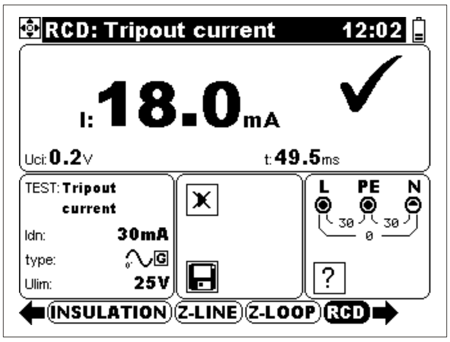
A continuously rising residual current is intended for testing the threshold sensitivity for RCD trip-out. The instrument increases the test current in small steps through appropriate range as follows:

| RCD type | Slope range | | Waveform |
|---|---|---|---|
| | Start value | End value | |
| AC | $0.2\times I_{\Delta N}$ | $1.1\times I_{\Delta N}$ | Sine |
| A, F ($I_{\Delta N} \geq 30$ mA) | $0.2\times I_{\Delta N}$ | $1.5\times I_{\Delta N}$ | Pulsed |
| A, F ($I_{\Delta N} = 10$ mA) | $0.2\times I_{\Delta N}$ | $2.2\times I_{\Delta N}$ | |
| B, B+ | $0.2\times I_{\Delta N}$ | $2.2\times I_{\Delta N}$ | DC |

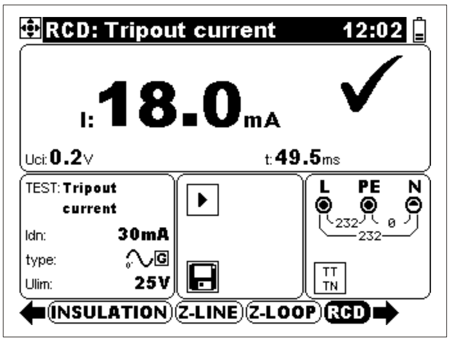
Maximum test current is $I_\Delta$ (trip-out current) or end value in case the RCD didn't trip-out.

**Trip-out current measurement procedure**

- Select the **RCD** function.
- Set sub-function **Tripout current**.
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figure 5.13*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).




*Trip-out*




*After the RCD is turned on again*

*Figure 5.16: Trip-out current measurement result example*

Displayed results:
I .......... Trip-out current,
Uci ...... Contact voltage at trip-out current I or end value in case the RCD didn't trip,
t .......... Trip-out time.

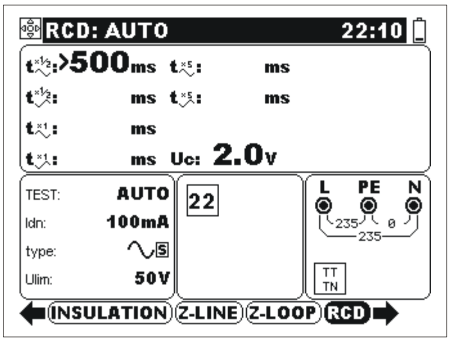
## 5.3.4 RCD Autotest

RCD autotest function is intended to perform complete RCD testing and measurement of belonging parameters (contact voltage, fault loop resistance and trip-out time at different residual currents) in one set of automatic tests, guided by the instrument. If any false parameter is noticed during the RCD autotest, then individual parameter test has to be used for further investigation.

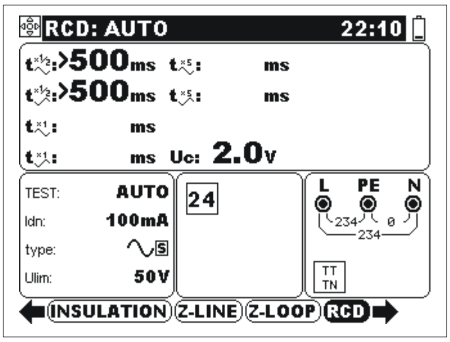
**RCD autotest procedure**

| **RCD Autotest steps** | **Notes** |
|---|---|
| ❑ Select the **RCD** function.<br>❑ Set sub-function **AUTO.**<br>❑ Set test **parameters** (if necessary).<br>❑ **Connect** test cable to the instrument.<br>❑ **Connect** test leads to the tested object (see *figure 5.13*).<br>❑ Press the **TEST** key. | <br><br><br><br><br>Start of test |
| ❑ Test with ½×$I_{\Delta N}$, 0° (step 1). | RCD should not trip-out |
| ❑ Test with ½×$I_{\Delta N}$, 180° (step 2). | RCD should not trip-out |
| ❑ Test with $I_{\Delta N}$, 0° (step 3). | RCD should trip-out |
| ❑ **Re-activate** RCD.<br>❑ Test with $I_{\Delta N}$, 180° (step 4). | <br>RCD should trip-out |
| ❑ **Re-activate** RCD.<br>❑ Test with 5×$I_{\Delta N}$, 0° (step 5). | <br>RCD should trip-out |
| ❑ **Re-activate** RCD.<br>❑ Test with 5×$I_{\Delta N}$, 180° (step 6). | <br>RCD should trip-out |
| ❑ **Re-activate** RCD.<br>❑ After the measurement is finished **store** the result (optional). | <br>End of test |

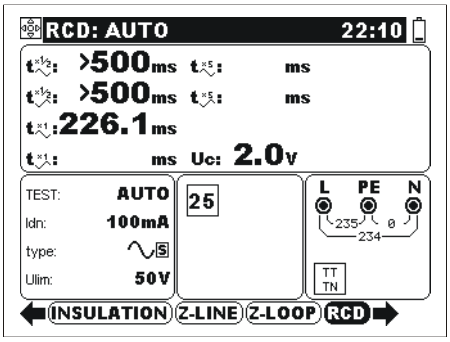
Result examples:



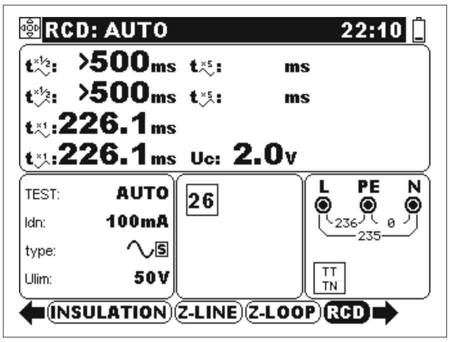

*Step 1*



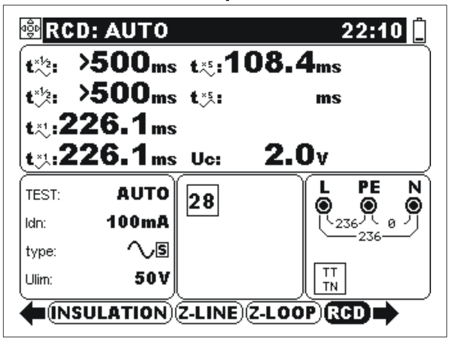

*Step 2*



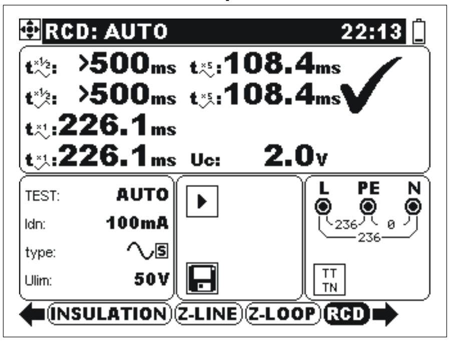

Step 3




Step 4




Step 5




Step 6

*Figure 5.17: Individual steps in RCD autotest*

Displayed results:
t×½: .... Step 1 trip-out time (½×IΔN, 0º),
t×½: .... Step 2 trip-out time (½×IΔN, 180º),
t×1: ... Step 3 trip-out time (IΔN, 0º),
t×1: ... Step 4 trip-out time (IΔN, 180º),
t×5: ... Step 5 trip-out time (5×IΔN, 0º),
t×5: ... Step 6 trip-out time (5×IΔN, 180º),
Uc....... Contact voltage for rated IΔN.

**Notes:**

- The autotest sequence is immediately stopped if any incorrect condition is detected, e.g. excessive Uc or trip-out time out of bounds.
- Auto test is finished without t×5: tests in case of testing the RCD types A, F with rated residual currents of IΔn = 300 mA, 500 mA, and 1000 mA. In this case auto test result passes if all previous results pass, and indications t×5: and t×5: are omitted.

## 5.4 Fault loop impedance and prospective fault current

Fault loop is a loop comprising mains source, line wiring and PE return path to the mains source. The instrument has ability to measure impedance of mentioned loop and calculate short circuit current and contact voltage regarding the selected circuit breaker type. The measurement is covered by requirements of the EN 61557-3 standard.

See *4.2 Single test* for active keys.

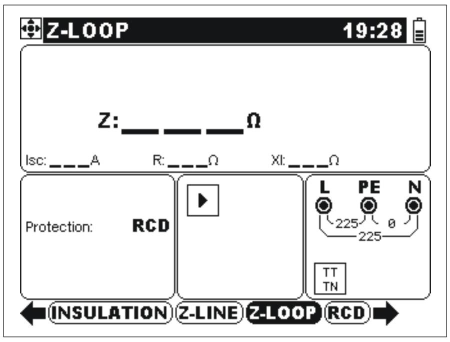



*Figure 5.18: Fault loop impedance*

**Test parameters for fault loop impedance measurement**

| | |
|---|---|
| Protection | Selection of main **protection device** in fault loop [RCD, FUSE]* |
| Fuse type | Selection of **fuse type** [---, NV, gG, B, C, K, D] ** |
| Fuse I | **Rated current** of selected fuse |
| Fuse T. | Maximum **breaking time** of selected fuse |
| Isc_lim | Minimum short circuit **current** for selected fuse combination. |

See Appendix A for reference fuse data.
* Select RCD to prevent trip-out of RCD in RCD protected installation.
** --- Means no fuse selected.

**Circuits for measurement of fault loop impedance**

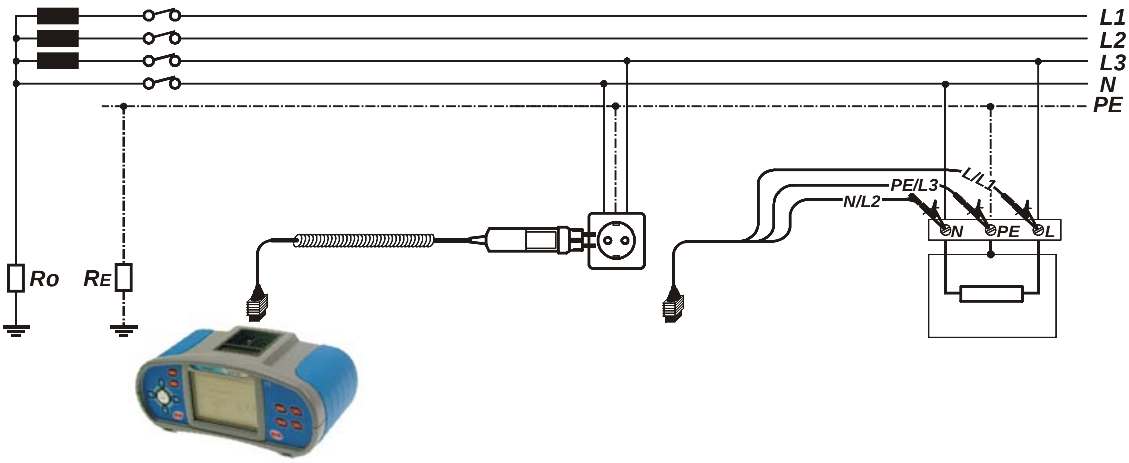



*Figure 5.19: Connection of plug cable and universal test cable*

### Fault loop impedance measurement procedure

- Select the **Z-LOOP** function.
- Select test **parameters** (optional).
- **Connect** test cable to the EurotestAT**.**
- **Connect** test leads to the tested object (see *figure 5.19*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

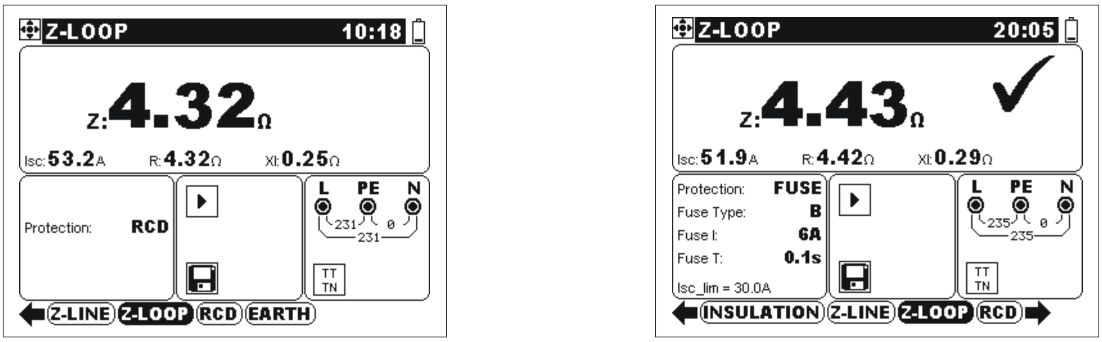



*Figure 5.20: Examples of loop impedance measurement result*

Displayed results:
Z..............Fault loop impedance,
Isc............Prospective fault current,
R..............Resistive part of loop impedance,
Xl.............Reactive part of loop impedance.

Prospective fault current $I_{SC}$ is calculated from measured impedance as follows:

$$I_{SC} = \frac{Un \times k_{SC}}{Z}$$

where:
Un........Nominal $U_{L\text{-}PE}$ voltage (see table below),
ksc.......Correction factor for Isc (see chapter *4.4.2*).

| $U_n$ | Input voltage (L-PE) |
|---|---|
| 110 V | (93 V ≤ $U_{L\text{-}PE}$ < 134 V) |
| 230 V | (185 V ≤ $U_{L\text{-}PE}$ ≤ 266 V) |

**Notes:**

- High fluctuations of mains voltage influence the measurement results. The noise sign is displayed in the message field in such case. Repeat the measurement.
- Isc is not calculated in case the terminal voltage monitor does not detect voltage state that corresponds to the selected supply system, indication ?.
- This measurement will trip-out RCD in RCD-protected electrical installation if FUSE is selected as breaking device instead of RCD.

## 5.5 Line impedance / prospective short-circuit current and Voltage drop

Line impedance is measured in loop comprising of mains voltage source and line wiring. It is covered by the requirements of the EN 61557-3 standard.
The Voltage drop sub-function is intended to check that a voltage in the installation stays above acceptable levels if the highest current is flowing in the circuit. The highest current is defined as the nominal current of the circuit's fuse. The limit values are described in the standard EN 60364-5-52.

Sub-functions:

- Z-LINE – Line impedance measurement according to EN 61557-3,
- ΔU – Voltage drop measurement.

See *4.2 Single test* for keys functionality.

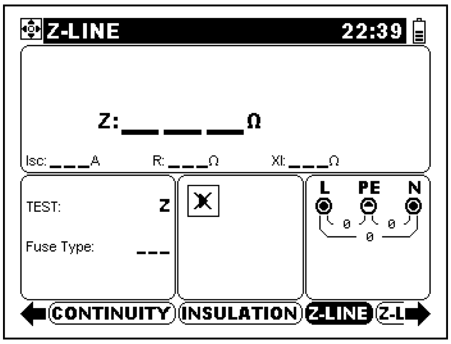



*Figure 5.21: Line impedance*

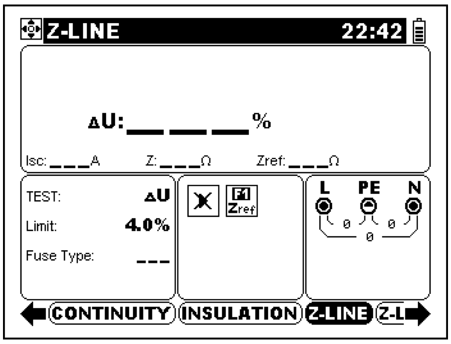



*Figure 5.22: Voltage drop*

**Test parameters for line impedance measurement**

| | |
|---|---|
| TEST | Selection of **sub-function** [Z, ΔU] |
| FUSE Type | Selection of **fuse type** [---, NV, gG, B, C, K, D] * |
| FUSE I | **Rated current** of selected fuse |
| FUSE T | Maximum **breaking time** of selected fuse |
| Isc_lim | Minimum short circuit **current** for selected fuse combination. |

See Appendix A for reference fuse data.
*--- Means no fuse selected

Additional test parameters for voltage drop measurement

| | |
|---|---|
| Limit | Maximum voltage drop [3.0 % ÷ 9.0 %]. |

## 5.5.1 Line impedance and prospective short circuit current

### Circuit for measurement of line impedance

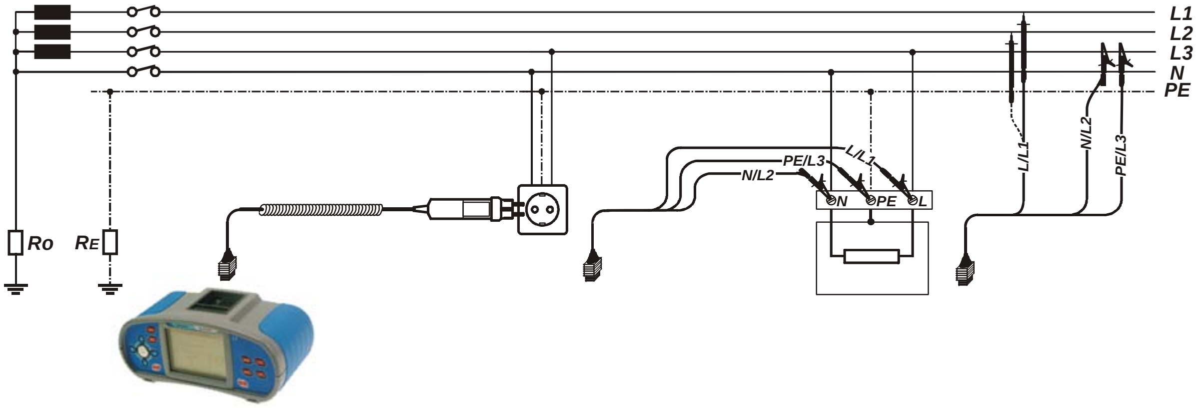
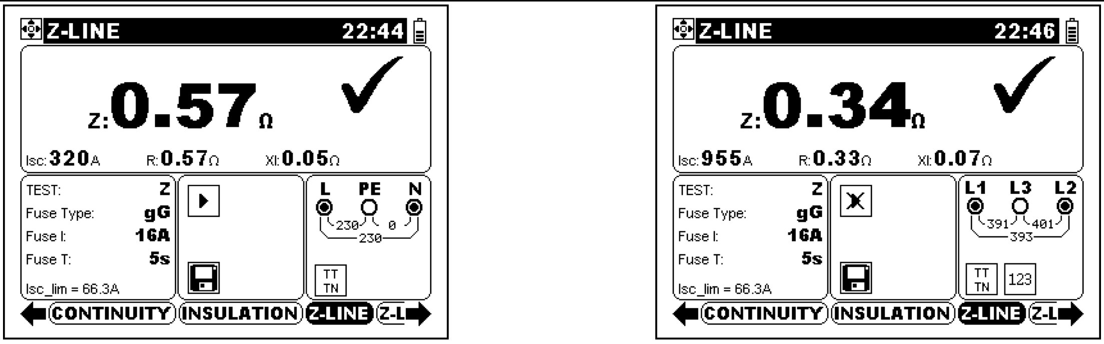



*Figure 5.23: Phase-neutral or phase-phase line impedance measurement – connection of plug commander and universal test cable*

### Line impedance measurement procedure

- Select the **Z-LINE** function.
- Select the **Z** sub-function.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figure 5.23*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).




*Line to neutral* *Line to line*

*Figure 5.24: Examples of line impedance measurement result*

Displayed results:
Z..............Line impedance,
ISC............Prospective short-circuit current,
R..............Resistive part of line impedance,
XL............Reactive part of line impedance.

Prospective short circuit current is calculated as follows:

$$I_{SC} = \frac{Un \times k_{SC}}{Z}$$

where:
Un ........Nominal L-N or L1-L2 voltage (see table below),

ksc .......Correction factor for Isc (see chapter *4.4.2*).

| $U_n$ | Input voltage range (L-N or L1-L2) |
|---|---|
| 110 V | (93 V ≤ $U_{L-N}$ < 134 V) |
| 230 V | (185 V ≤ $U_{L-N}$ ≤ 266 V) |
| 400 V | (321 V < $U_{L-L}$ ≤ 485 V) |

**Note:**

- High fluctuations of mains voltage influence the measurement results. The noise sign is displayed in the message field in this case. Repeat the measurement.
- Isc is not calculated in case the terminal voltage monitor does not detect voltage state that corresponds to the selected supply system, indication ?.

## 5.5.2 Voltage drop

The voltage drop is calculated based on the difference of line impedance at connection points (sockets) and the line impedance at the reference point (usually the impedance at the switchboard).

**Circuits for voltage drop measurement**

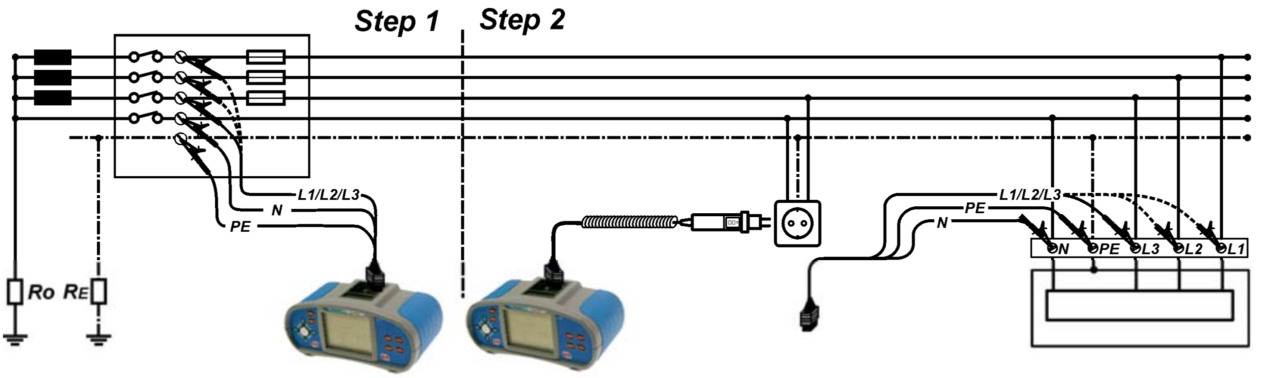



*Figure 5.25: Phase-neutral or phase-phase voltage drop measurement – connection of plug commander and 3-wire test lead*

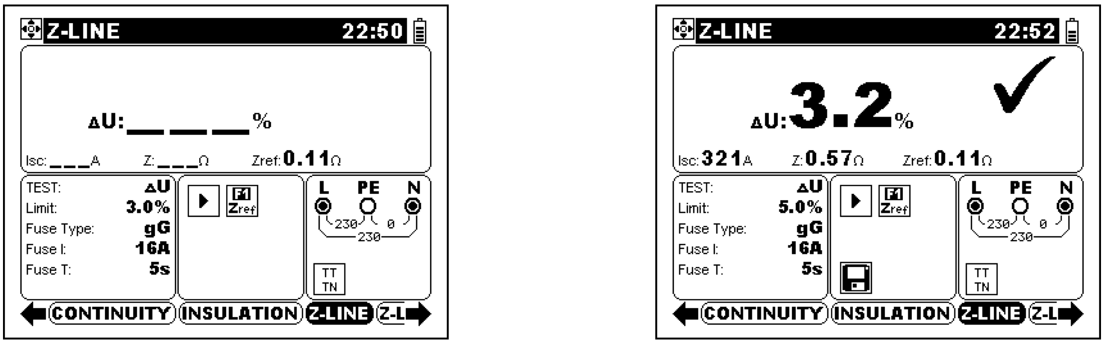
**Voltage drop measurement procedure**

Step 1: Measuring the impedance Zref at electrical installation origin

- Select the **Z-LINE** function.
- Select the **ΔU** sub-function.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** the test leads to the origin of electrical installation (see figure 5.25).
- Press the **F1** key to perform the measurement of Zref.

Step 2: Measuring the voltage drop

- Keep the **ΔU** sub-function selected.
- Select test **parameters** (Fuse type must be selected).
- **Connect** test cable or plug commander to the instrument.
- **Connect** the test leads to the tested points (see figure 5.25).
- Press the **TEST** key to perform the measurement.
- After the measurement is finished **Store** the result (optional).




*Step 1 - Zref* *Step 2 - Voltage drop*

*Figure 5.26: Examples of voltage drop measurement result*

Displayed results:
ΔU ...........Voltage drop,
$I_{SC}$ ............Prospective short-circuit current,
Z ..............Line impedance at measured point,
Zref..........Reference impedance

Voltage drop is calculated as follows:

$$\Delta U[\%] = \frac{(Z - Z_{REF}) \cdot I_N}{U_N} \cdot 100$$

where:
ΔU........calculated voltage drop
Z ..........impedance at test point
$Z_{REF}$......impedance at reference point
$I_N$..........rated current of selected fuse
$U_N$ ........nominal voltage (see table below)

| $U_n$ | Input voltage range (L-N or L1-L2) |
|---|---|
| 110 V | (93 V ≤ $U_{L-N}$ < 134 V) |
| 230 V | (185 V ≤ $U_{L-N}$ ≤ 266 V) |
| 400 V | (321 V < $U_{L-L}$ ≤ 485 V) |

**Note:**

- If the reference impedance is not set the value of Zref is considered as 0.00 Ω.
- The Zref is cleared (set to 0.00 Ω) if pressing F1 key while instrument is not connected to a voltage source.
- $I_{SC}$ is calculated as described in chapter 5.5.1 Line impedance and prospective short circuit current.
- If the measured voltage is outside the ranges described in the table above the ΔU result will not be calculated.
- High fluctuations of mains voltage can influence the measurement results (the noise sign is displayed in the message field). In this case it is recommended to repeat few measurements to check if the readings are stable.

# 5.6 Voltage, frequency and phase sequence

Voltage and frequency measurement is always active in the terminal voltage monitor. In the special **voltage** menu the measured voltage, frequency and information about detected three-phase connection can be stored. Phase sequence measurement conforms to the EN 61557-7 standard.

See *4.2 Single test* for keys functionality

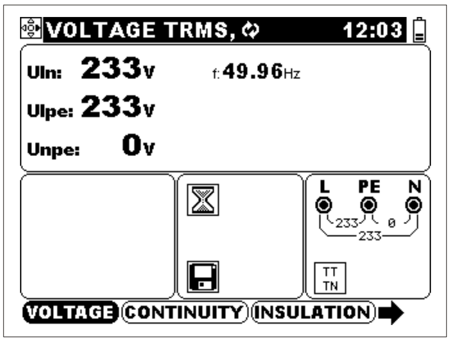



*Figure 5.27: Voltage in single phase system*

### Test parameters for voltage measurement

There are no parameters.

### Circuits for voltage measurement

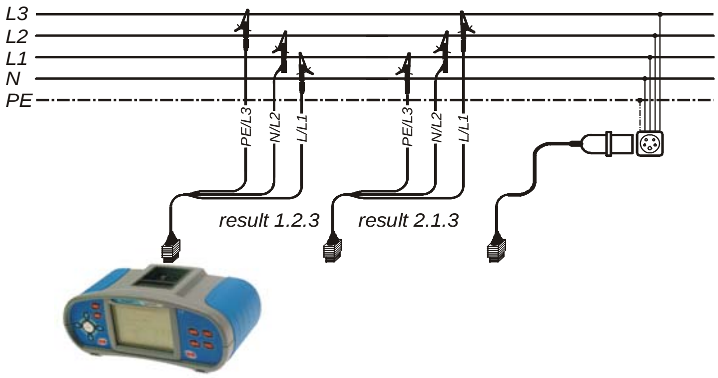



*Figure 5.28: Connection of universal test cable and optional adapter in three-phase system*

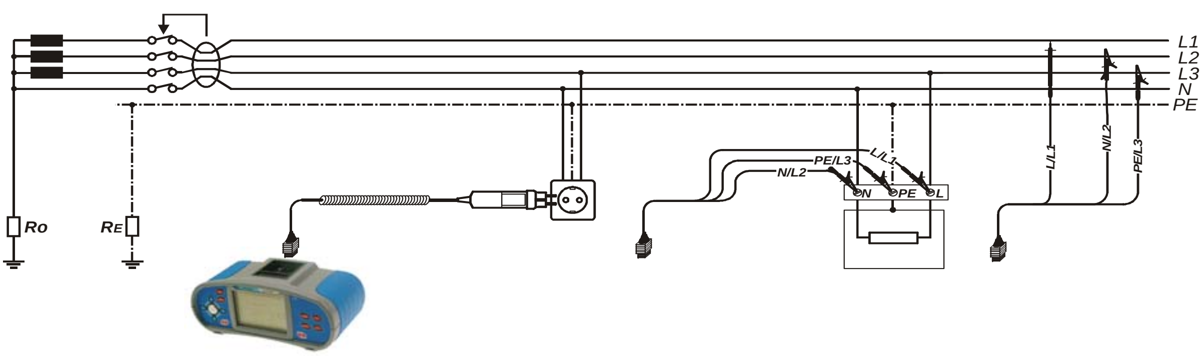
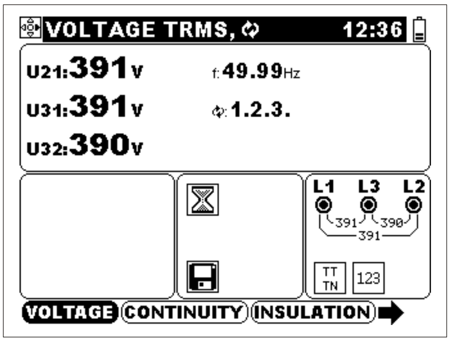



*Figure 5.29: Connection of plug commander and universal test cable in single-phase system*

### Voltage measurement procedure

- Select the **VOLTAGE** function.
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figures 5.28 and 5.29*).
- **Store** current measurement result (optional).

Measurement runs immediately after selection of **VOLTAGE** function.



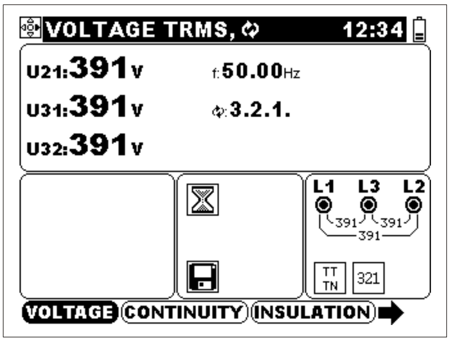




*Figure 5.30: Examples of voltage measurement in three-phase system*

Displayed results for **single phase** system:
Uln...........Voltage between phase and neutral conductors,
Ulpe.........Voltage between phase and protective conductors,
Unpe........Voltage between neutral and protective conductors,
f ...............frequency.

Displayed results for **three-phase** system:
U12..........Voltage between phases L1 and L2,
U13..........Voltage between phases L1 and L3,
U23..........Voltage between phases L2 and L3,
1.2.3 ........Correct connection – CW rotation sequence,
3.2.1 ........Invalid connection – CCW rotation sequence,
f ...............frequency.

# 5.7 Resistance to earth

Resistance to earth is important for protection against electric shock. This function is intended for verification of earthing of house installation and other earthings, e.g., earthing for lighting. The measurement conforms to the EN 61557-6 standard. The following resistance to earth sub-functions are available:

- Standard 3-wire, for standard resistance to earth measurements.
- Specific earth resistance by using optional external adapter.

See *4.2 Single test* for keys functionality.

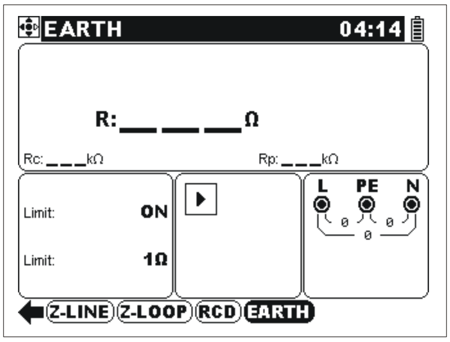



*Figure 5.31: Resistance to earth*

**Test parameters for earth resistance measurement**

| | |
|---|---|
| TEST | **Test configuration** [3-wire, ρ] |
| Limit | **Maximum resistance** [OFF, 1 Ω ÷ 5 kΩ] |
| If ρ selected: | |
| Distance | **Distance between probes** [0.1 m ÷ 30.0 m] or [1 ft ÷ 100 ft] |

### 5.7.1 Standard 3-wire measurement

**Circuits for measuring resistance to earth**

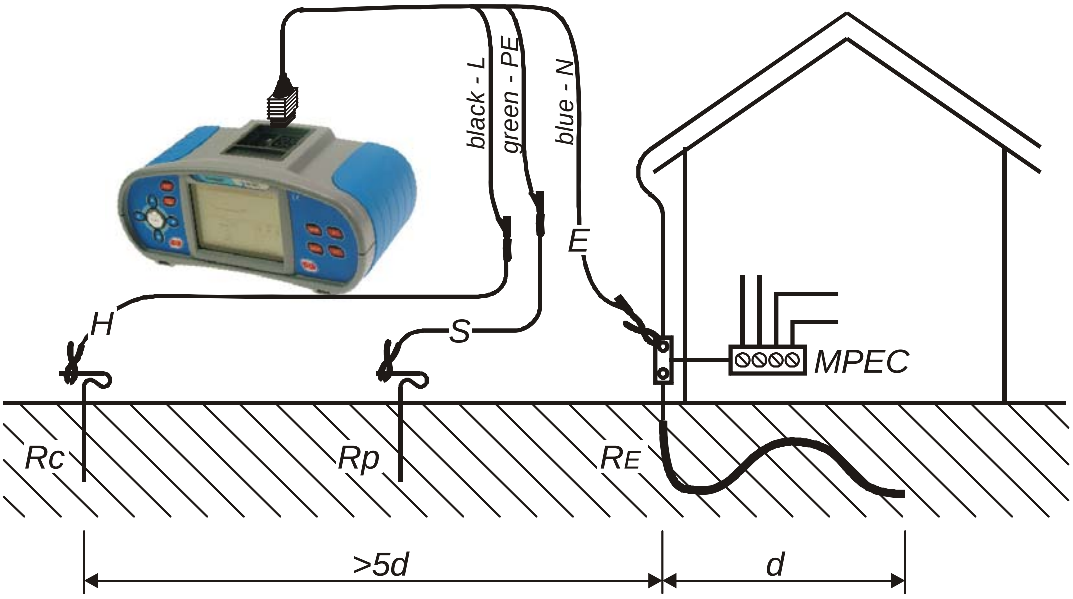



*Figure 5.32: Resistance to earth measurement – PE grounding*

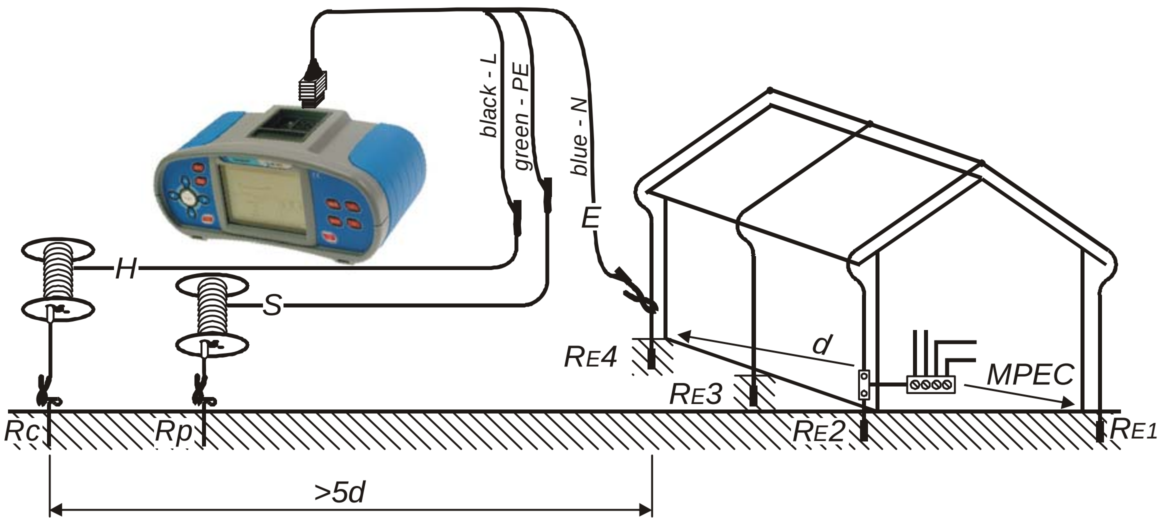



*Figure 5.33: Resistance to earth measurement – lighting protection*

**Resistance to earth measurement procedure**

- Select the **EARTH** function.
- Enable and set **limit** (optional).
- **Connect** test cable to the instrument.
- **Disconnect** tested object from mains supply.
- **Connect** test leads to the tested object (see *figures 5.32 and 5.33*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

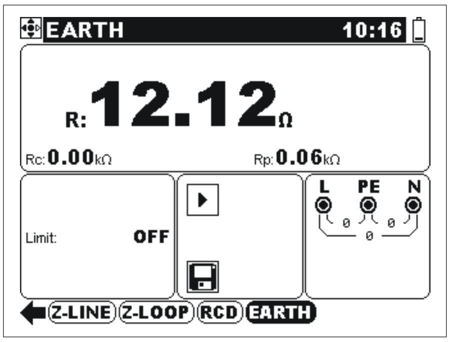



*Figure 5.34: Example of resistance to earth measurement result*

Displayed results for earth resistance measurement:
R..............Earth resistance,
Rc............Resistance of S probe,
Rp............Resistance of H probe.

### 5.7.2 Specific earth resistance measurement

The measurement is intended for measuring specific earth resistance by using special adapter A1199.

**Circuit for specific earth resistance measurement**

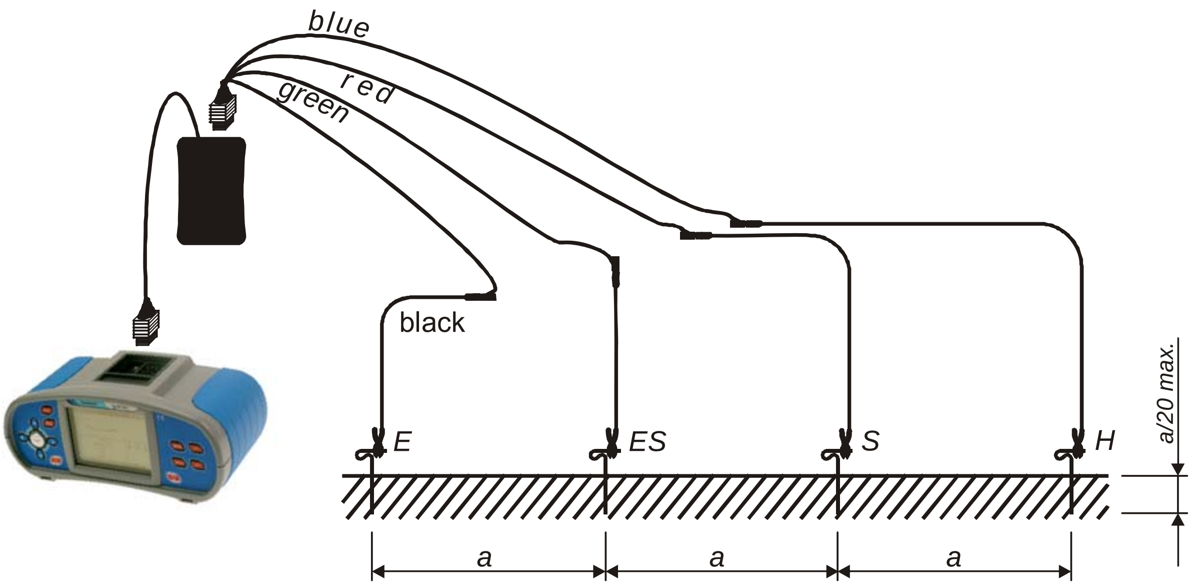



*Figure 5.35: Specific earth resistance measurement with ρ-adapter*

**Specific earth resistance measurement procedure**

- Select the **EARTH** function.
- Connect ρ**-adapter** to the instrument.
- Select ρ measurement.
- Select distance **unit** (optional).
- Set **distance** (optional).
- Connect test leads of ρ**-adapter** to tested object (see figure *5.35*)
- Press the **TEST** key.
- After the measurement is finished, **store** the result (optional).

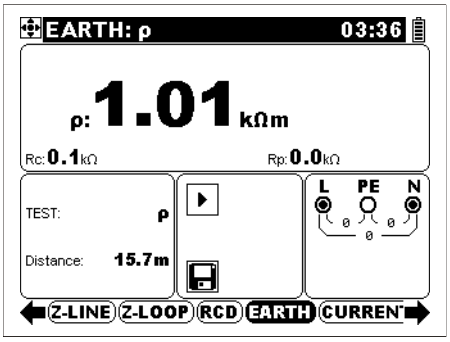



*Figure 5.36: Example of specific earth resistance measurement result*

Displayed results for earth resistance measurement:
ρ ..............Specific earth resistance.

**Note**:
- Distance units can be selected in Miscellaneous/Initial settings/Other settings menu, see 4.4.5.

## 5.8 2 Ω line/loop impedance

The measurement extends application range of the instrument and is performed with Impedance adapter A1143 connected to the instrument via RS 232 interface. It is automatically recognized in Z-LINE and Z-LOOP functions. With this adapter, low impedances up to 1999 mΩ can be measured. The measurement is covered by requirements of the EN 61557-3 standard.

See chapter *4.2 Single test* for functionality of keys.

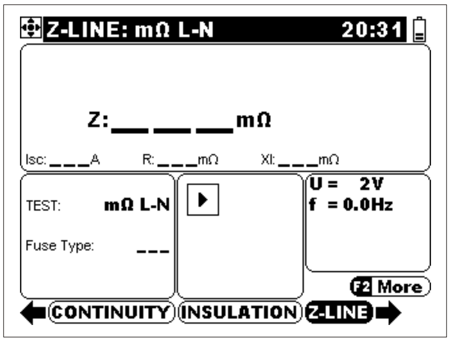



*Figure 5.37: Impedance adapter connected*

**Test parameters for 2 Ω line/loop impedance measurement**

| | |
|---|---|
| Function Z-LINE | |
| Test | **Impedance function** [mΩ L-N, mΩ L-L] |
| Functions Z-LINE and Z-LOOP | |
| FUSE type | Selection of **fuse type** [---, NV, gG, B, C, K, D] * |
| FUSE I | **Rated current** of selected fuse |
| FUSE T | Maximum **breaking time** of selected fuse |
| Isc_lim | Minimum short circuit **current** for selected fuse combination. |

See Appendix A for reference fuse data.
*--- Means no fuse selected

Additional key:

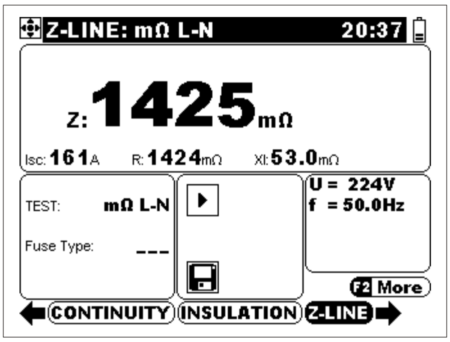
| | |
|---|---|
| **F2** | Toggles between result screens. |

**Test setup for 2 Ω line/loop impedance measurement**


*Figure 5.38: Connection of impedance adapter to the instrument*

**2 Ω line/loop impedance measuring procedure**

- **Connect** Impedance adapter to the instrument (see *figure 5.38*).
- Select the functions **Z-LINE** or **Z-LOOP**.
- Enable and set **limit** value (optional).
- Power **ON** the Impedance adapter (ON/OFF key, green LED will lit).
- **Connect** Impedance adapter to tested installation.
- Press the **TEST** key for measurement.
- **Store** the result (optional).



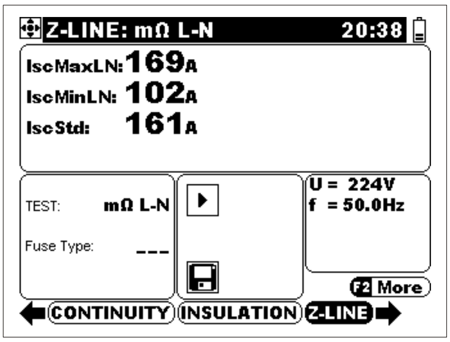




*Figure 5.39: Example of 2 Ω line/loop measurement results*

Displayed results:
Z ........................ Line / loop impedance,
Isc ....................... Prospective short-circuit current,
R......................... Resistive part of line impedance,
Xl ........................ Reactive part of line impedance.

The following parameters are displayed in sub-screen for single-phase line impedance measurement:

IscMaxL-N ......... Maximum prospective short-circuit current.
IscMinL-N .......... Minimum prospective short-circuit current.
IscStd ................ Standard prospective short-circuit current.

When testing phase-to-phase line impedance the following parameters are displayed in sub-screen:

IscMax3Ph......... Maximum three-phase prospective short-circuit current.
IscMin3Ph.......... Minimum three-phase prospective short-circuit current.
IscMax2Ph......... Maximum two-phase prospective short-circuit current.
IscMin2Ph.......... Minimum two-phase prospective short-circuit current.
IscStd ................ Standard prospective short-circuit current.

The following parameters are displayed in sub-screen for loop impedance measurement:

IscMaxL-Pe ....... Maximum prospective fault current.
IscMinL-Pe ........ Minimum prospective fault current.
IscStd ................ Standard prospective fault current.
Ub...................... Contact voltage at maximum prospective fault current (Contact voltage is measured against probe S).

**Notes:**

- For application and technical data of the Impedance adapter A1143, *see its user manual 20750859*.
- High fluctuations of mains voltage can influence the measurement results.

Check adapter indications in case the abort ⊘ symbol appears after the start of measurement.

## 5.9 PE test terminal

It can happen that a dangerous voltage is applied to the PE wire or other accessible metal parts. This is a very dangerous situation since the PE wire and MPEs are considered to be earthed. A common reason for this fault is incorrect wiring (see examples below).
When touching the TEST key in all functions that require mains supply the user automatically performs this test.

**Examples for application of PE test terminal**

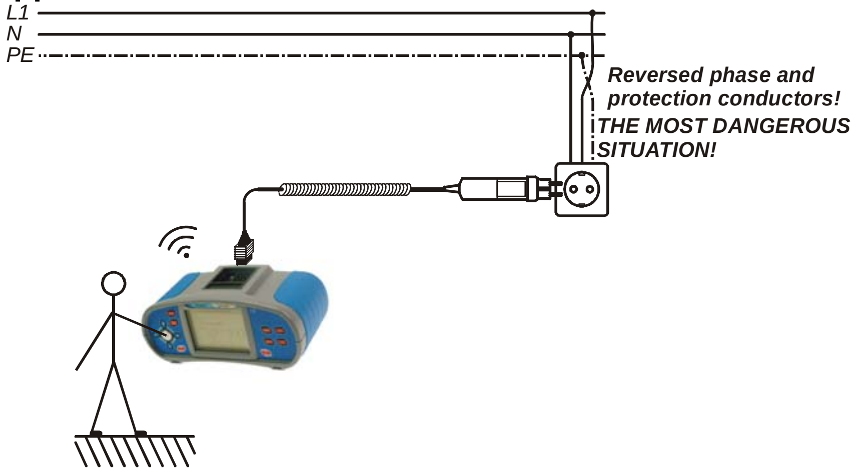



*Figure 5.40: Reversed L and PE conductors (application of plug commander)*

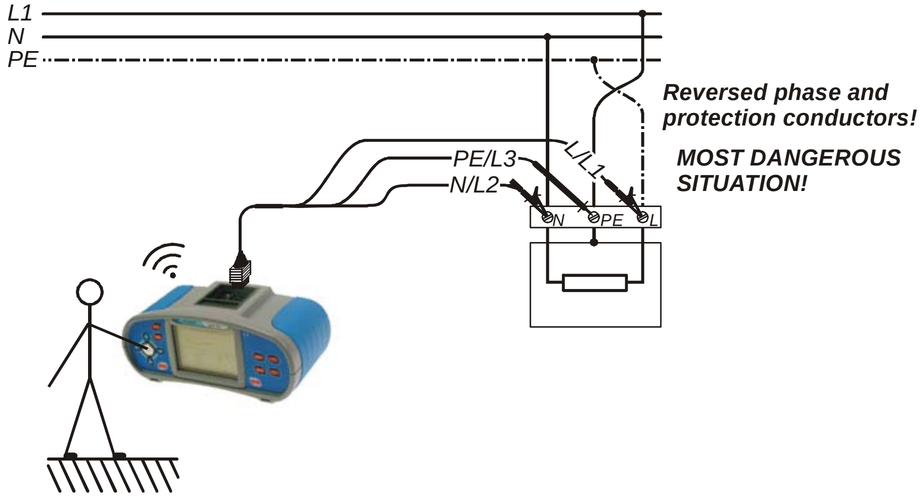



*Figure 5.41: Reversed L and PE conductors (application of universal test cable)*

**PE terminal test procedure**

- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figures 5.40* and *5.41*).
- Touch PE test probe (the **TEST** key) for at least one second.
- If PE terminal is connected to phase voltage the warning message is displayed, instrument buzzer is activated, and further measurements are disabled in Z-LOOP and RCD functions.

**Warning:**

- If line voltage is detected on the tested PE terminal, immediately stop all measurements, find and remove the fault!

**Notes:**

- In main and miscellaneous menus the PE terminal is not tested.
- PE test terminal does not operate in case the operator's body is completely insulated from floor or walls!

## 5.10 Locator

This function is intended for tracing mains installation, like:

- Tracing lines,
- Finding shorts, breaks in lines,
- Detecting fuses.

The instrument generates test signals that can be traced with the handheld tracer receiver R10K. See *Locator appendix* for additional information.

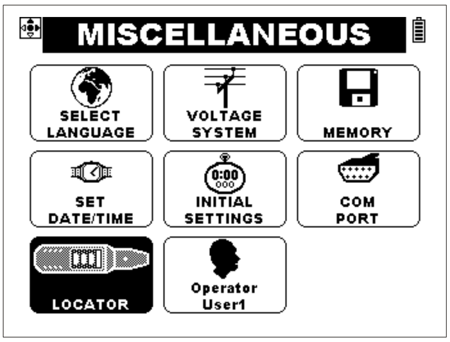



*Figure 5.42: Locator entry point*

**Parameters for locator**

There are no parameters.

### Typical applications for tracing electrical installation

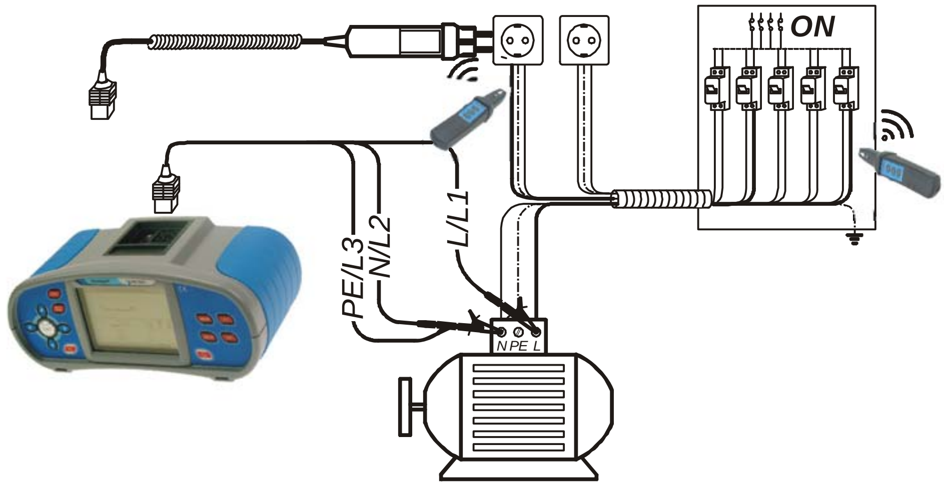



*Figure 5.43: Tracing wires under walls and in cabinets*

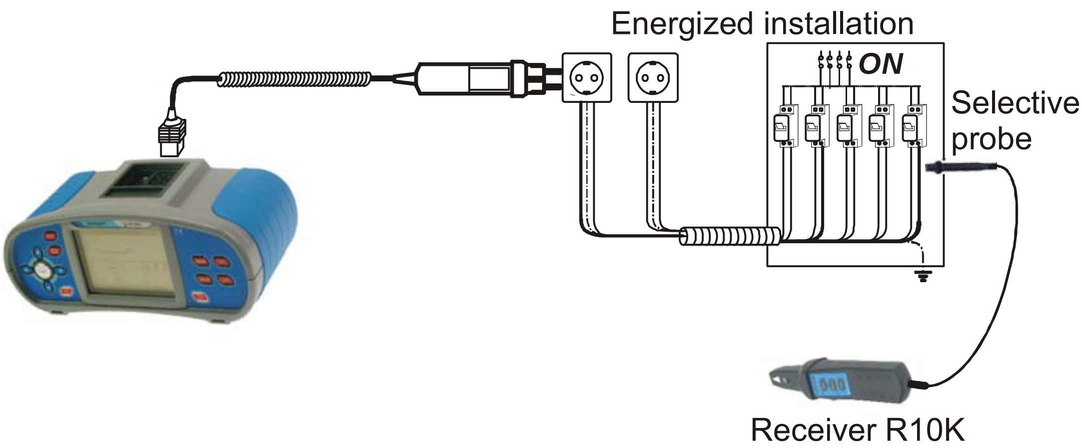



*Figure 5.44: Locating individual fuses*

### Line tracing procedure

- Select the **LOCATOR** function in MISC menu.
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figures 5.43 and 5.44*).
- Press the **TEST** key.
- Trace lines with receiver (in IND mode) or receiver plus its optional accessory.
- After tracing is finished press the **ESC** key to stop generating test signal.

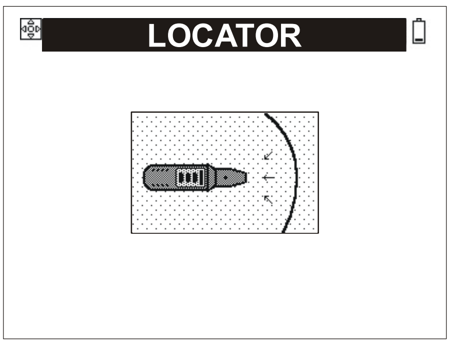



*Figure 5.45: Locator active*

## 5.11 Varistor test

This test is performed to verify overvoltage protection devices. Typical devices are:

- Metal oxide varistors,
- Gas arresters,
- Semiconductor transient voltage suppressors.

See chapter *4.2 Single test* for functionality of keys.

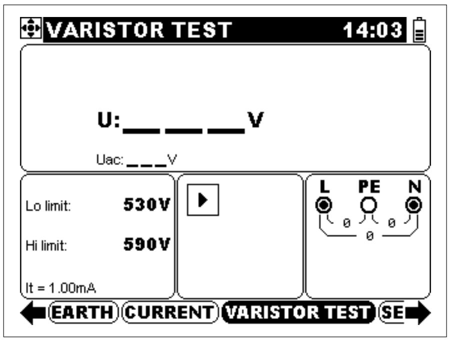



*Figure 5.46: Varistor test menu*

**Test parameters for varistor test**

| | |
|---|---|
| Lo limit | **Low limit** DC threshold voltage [50 V ÷ 1000 V] |
| Hi limit | **High limit** DC threshold voltage [50 V ÷ 1000 V] |
| It = 1.00 mA | **Threshold current** |

**Test circuit for varistor test**

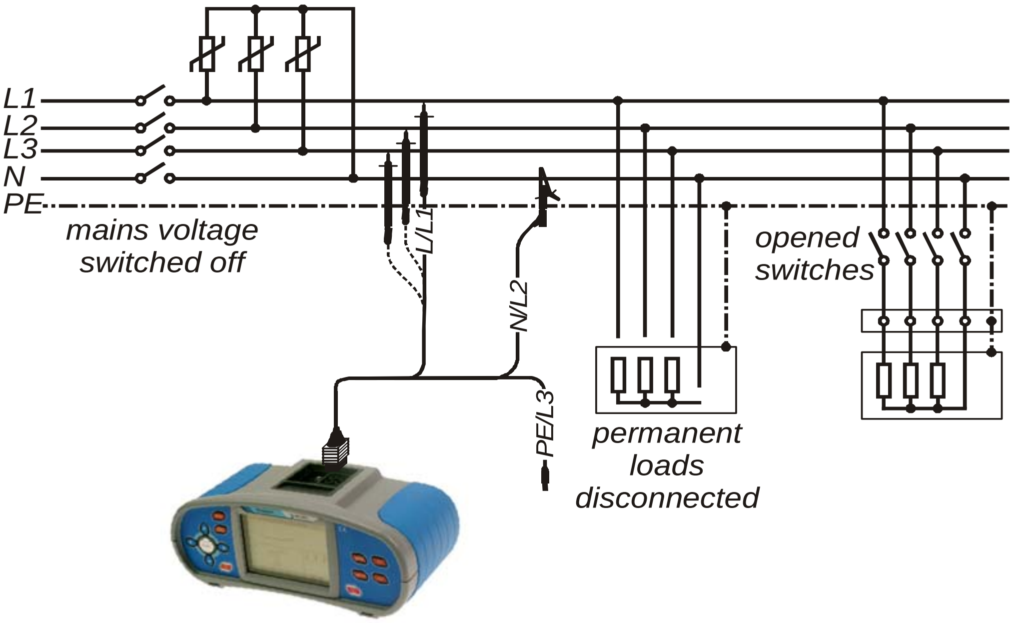



*Figure 5.47: Connection of universal test cable for varistor test*

**Varistor test procedure**

- Select the **VARISTOR TEST** function.
- Set test **parameters**.
- Disconnect mains supply and consumers from tested overvoltage device.
- **Connect** test cable to the instrument and tested item (see figure 5.47).
- Press the **TEST** key for measurement.
- After the measurement is finished wait until tested item is discharged.
- **Store** the result (optional).

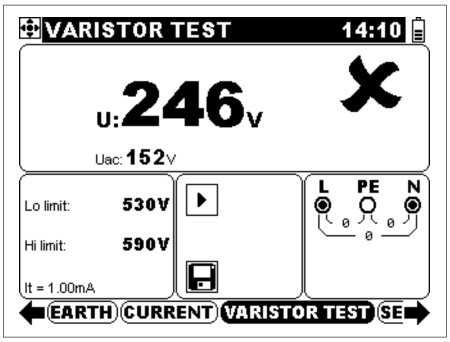



*Figure 5.48: Example of varistor test result*

Displayed results:
U .............Measured threshold voltage at It (1 mA).
Uac .........Rated AC voltage.

Uac is calculated from U according to: Uac = U/1.6.

# 6 Data handling

## 6.1 Memory organization

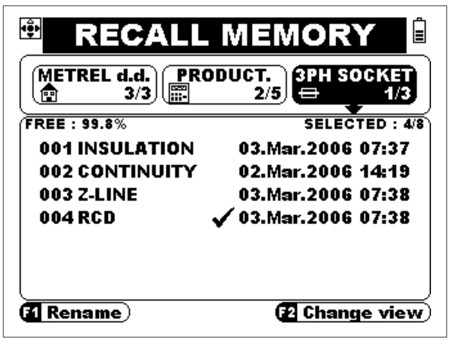
The following data can be stored in instrument memory:
- Auto sequence name, sequence, and function parameters,
- Auto sequence and single test results with belonging parameters,
- Installation structure with belonging data.

Stored data can be organized according to the installation structure of the tested object. Measured results can be stored into corresponding location of the structure.

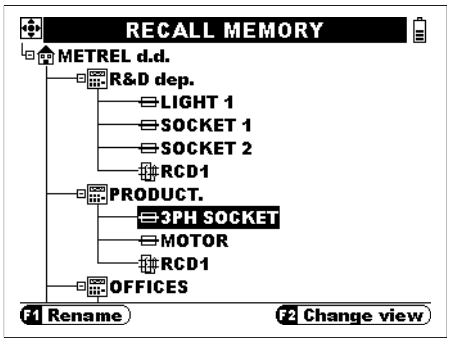
## 6.2 Installation data structure

This functionality helps to organize operation with data in a simple and effective manner. The memory organization can be customized according to the actual structure of the tested electrical installation.
Main benefits are:
- Test results can be organized and grouped in a structured manner that equals the structure of the tested electrical installation. If a test plan for verification of electrical installation is prepared it is possible to organize the data structure according to it. Each tested location place like room, floor, installation node, switchgear, etc. can be reflected as its own location in memory.
- Simple browsing through structure and results.
- Test reports can be created with no or little modifications after downloading results to a PC.
- Test procedures can be prepared in advance on the PC and sent to the instrument.
- A new installation structure can be built on the instrument
- An existing structure can be upgraded on the instrument.
- A name can be assigned to each location.

The data structure can be accessed and updated in each of the three main memory menus (store, recall, clear memory), but also through tree structure view.




*Basic view*




*Tree structure view*

*Figure 6.1: Example of data structure fields*

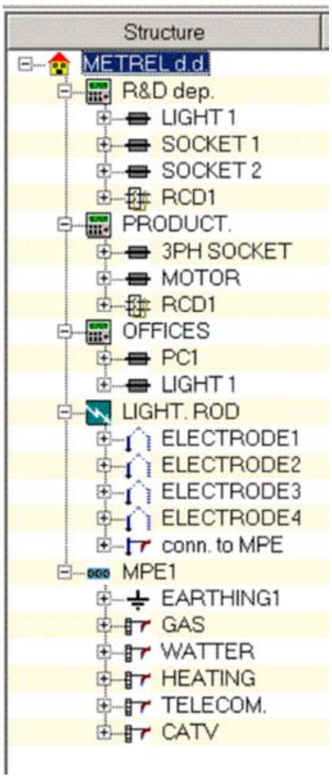



*Figure 6.2: Installation structure example as presented on PC*

Legend:

| | |
|---|---|
| RECALL MEMORY | Memory operation menu |
| METREL d.d. 1/1 · PRODUCT. 2/5 · 3PH SOCKET 1/3 | Installation data structure field |
| METREL d.d. 1/1 | Root level in the structure:<br>❑ **METREL d.d.**: 1st level location name.<br>❑ **1/1**: No. of selected / available locations on this level. |
| PRODUCT. 2/5 | Sub-level (level 2) in the structure:<br>❑ **PRODUCT.**: sub-location name.<br>❑ **2/5**: No. of selected / available locations on this level. |
| 3PH SOCKET 1/3 | Sub-level (level 3) in the structure:<br>❑ **3PH SOCKET**: location name.<br>❑ **1/3**: No. of selected / available locations on this level. |
| FREE : 99.8% SELECTED : 4/6<br>001 INSULATION 07.Sep.2005 10:18<br>002 CONTINUITY 07.Sep.2005 10:18<br>003 Z-LINE 07.Sep.2005 10:27<br>004 RCD ✓07.Sep.2005 10:28 | Results field – stored results in the selected location. |
| ← → ↑ ↓ | Arrows point to existing non-displayed structure locations. |
| FREE : 98.9% | Available memory information. |
| SELECTED : 4/43 | No. of stored test results in selected location / No. of all stored test results (in complete structure). |
| HELP | Option for opening the structure tree view. |
| RENAME ADD | Options for modification of the structure (see chapter *6.6*). |

**Note**:
- ❑ Only three locations in the installation data structure field (placed horizontally) can be displayed at the same time in the basic view.

Keys:

| | |
|---|---|
| **↓ / ↑ / ← / →** | Select the existing location. |
| **↓** | Pressed for 2 s opens dialog box for adding a new location. |
| **F2** | Enters installation structure tree screen. |
| **F1** | Renames the current location. |
| **HELP** | Enters installation structure tree screen. |
| **ESC** | Back to the last operation mode of the instrument. |

**Note**:

- The tree structure is limited to 2000 locations with 10 levels in depth, see *figure 6.3*.

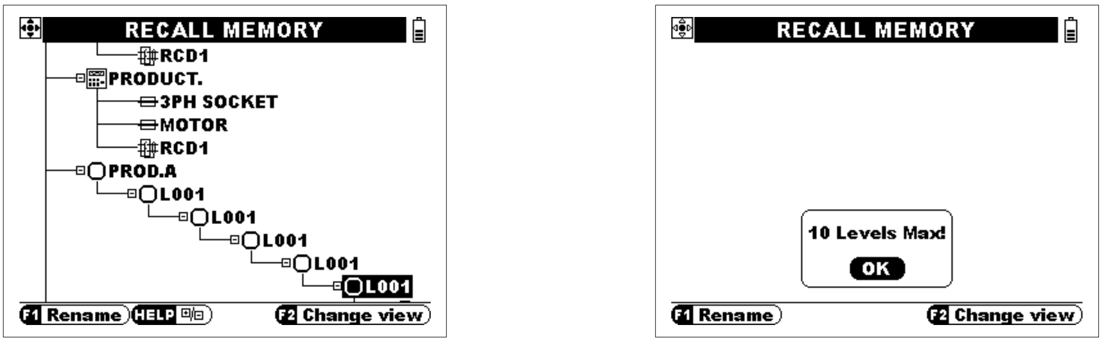



*Figure 6.3: Sub-levels depth definition*

*Figure 6.4* shows how individual structure elements are displayed on the instrument. The outlook is the same for all three memory menus.

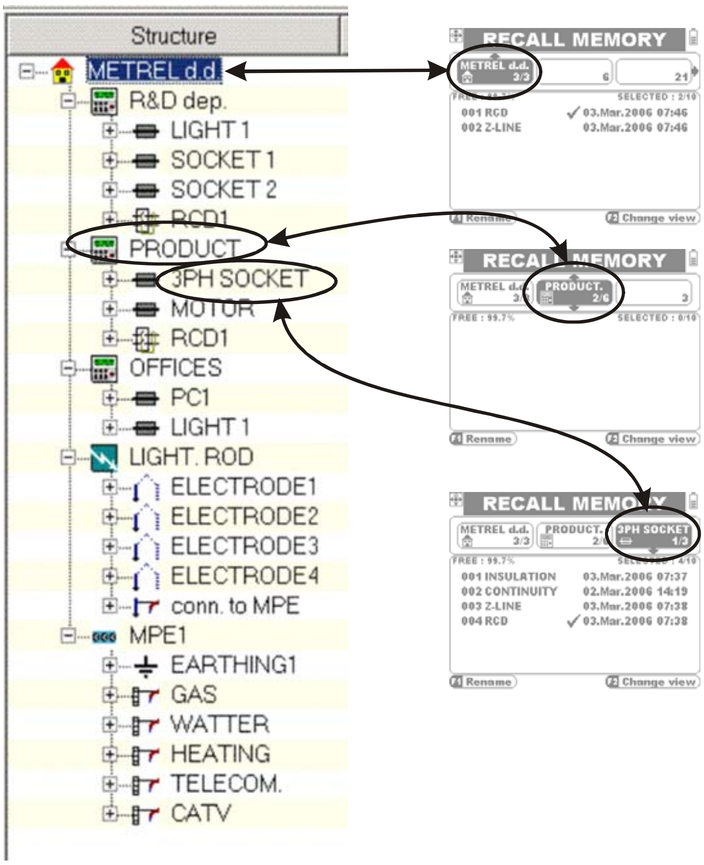



*Figure 6.4: Data structure elements*

## 6.3 Storing test results

After the completion of a single test or auto sequence the results and parameters are ready for storing ( icon is displayed in the information field). Press the **MEM** key to store the results.

See *chapter 6.2* for definitions of displayed fields.

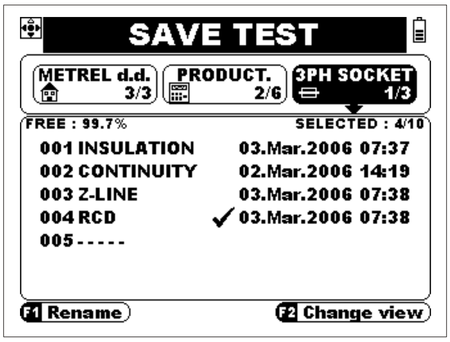



*Figure 6.5: Save test menu*

Keys in save test menu - installation data structure field:

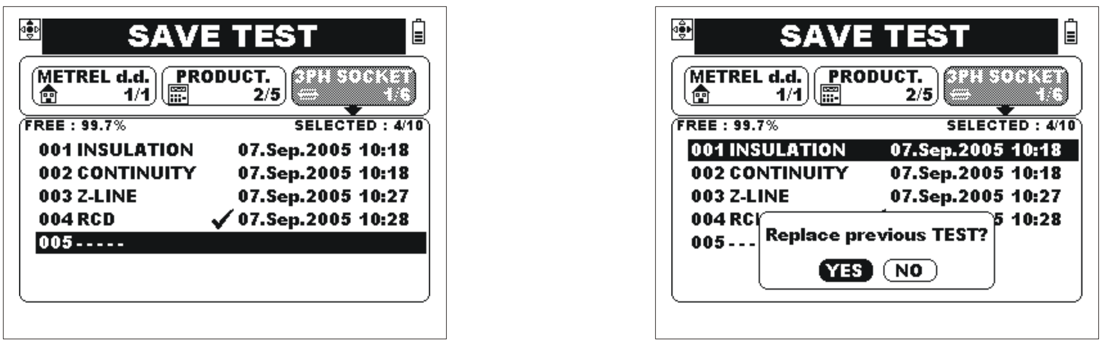
| | |
|---|---|
| ← / → / ↓ / ↑ | *Short press* - select the location in structure of installation data field. *Pressed for a few seconds in some cases* - add a new location in the structure, see *6.6.1*. |
| **MEM** | Saves test results to the last position in selected location and returns to the measuring menu. |
| **TAB** | Toggles between results and structure data fields, see *6.3.1*. |
| **ESC** | Exits save test menu. |
| **F1** | Edits name of selected location (see *4.3.4).* |
| **F2** | Enters installation structure tree view to select appropriate location. |

**Notes:**

- Press the **MEM** key twice to quickly store the results to pre-selected location.
- By default it is offered to append the result to the existing results in the selected location.

### 6.3.1 Saving results specialties

It is possible to overwrite existing result when storing new result.




*Appending new result* *Overwriting requires confirmation*

*Figure 6.6: Saving in result field*

Keys in save test menu - results field:

| | |
|---|---|
| ↓ / ↑ | Select stored test result. |
| **TEST** | Saves test result into selected line (confirmation is needed to overwrite an existing result). |
| **ESC** | Back to store test menu - installation data structure field. |

Keys with open dialog:

| | |
|---|---|
| ← / → | Select YES / NO. |
| **TEST** | Confirms selected option. |
| **ESC** | Cancels without changes. |

For information about storing into a new non-existent location see *6.6.1*.

## 6.4 Recalling test results and parameters

Press the **MEM** key in single or auto sequence menu when there is no result available for storing or select in **MISC** menu.

See *6.2* for definitions of displayed fields.

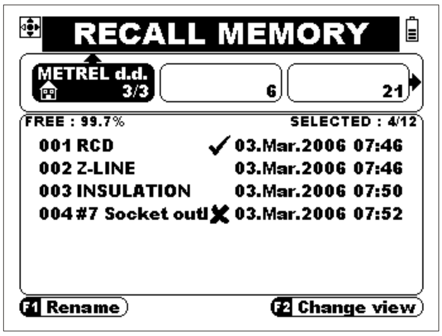



*Figure 6.7: Main recall menu*

Keys in main recall memory menu:

| | |
|---|---|
| ← / → / ↓ / ↑ | *Short press* - select the location in structure of installation data field. *Pressed for a few seconds in some cases* - add a new location in the structure, see *6.6.1*. |
| **TAB** | Toggles between results and structure data field. |
| **ESC** | Exits to the last state of the instrument. |
| **F1** | Edits name of selected location (for editing see *4.3.4).* |
| **F2** | Enters installation structure tree view to select appropriate location. |

### 6.4.1 Recalling result

Result field has to be selected.

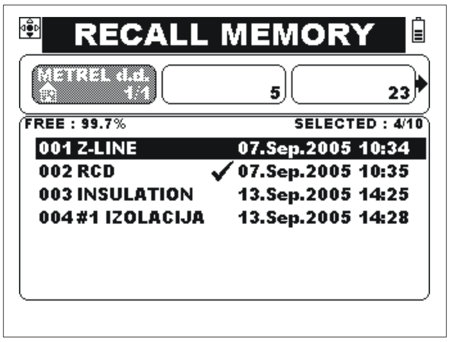



*Figure 6.8: Recall data menu*

Keys in results field:

| | |
|---|---|
| ↓ / ↑ | Select the stored data. |
| **TEST** | Opens selected stored item. |
| **TAB, ESC** | Back to recall memory main menu. |

Key:

| | |
|---|---|
| **ESC** | Back to recall memory main menu. |

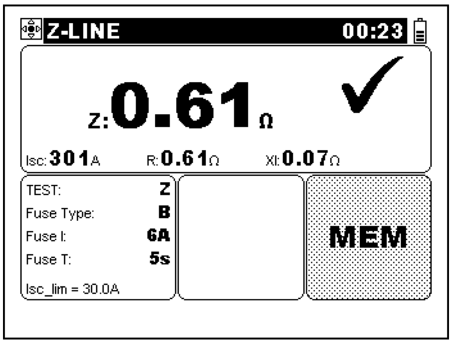



*Figure 6.9: Stored single test example*

Keys:

| | |
|---|---|
| ↓ / ↑ | Select stored data. |
| **TEST** | Opens function result. |
| **ESC** | Back to recall memory main menu. |

Key in open function result:

| | |
|---|---|
| **ESC** | Back to observed auto sequence. |

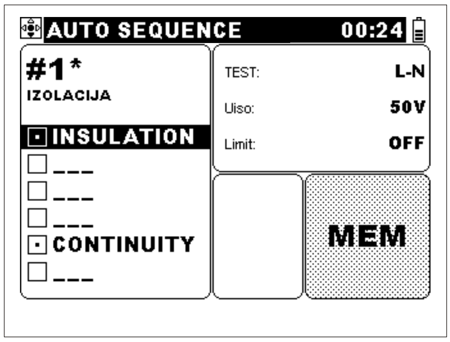



*Figure 6.10: Auto sequence stored example*

## 6.5 Clearing saved data

From main menu select miscellaneous menu and enter MEMORY option (see *4.4.3*).

In MEMORY select CLEAR MEMORY option for erasing complete test results memory.

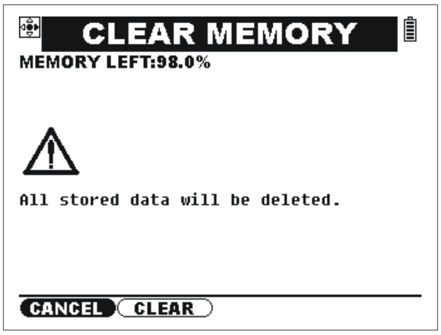



*Figure 6.11: Clear memory*

Keys:

| | |
|---|---|
| ← / → | Select CANCEL / CLEAR. |
| **TEST** | Confirms selected option. |
| **ESC** | Cancels dialog without changes. |

In MEMORY select CLEAR TEST option to delete particular result or modify installation data structure.

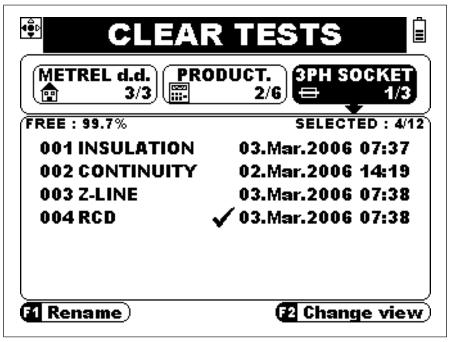


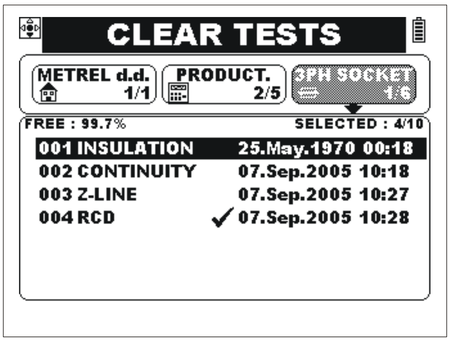

*Figure 6.12: Clear test menu*

Keys:

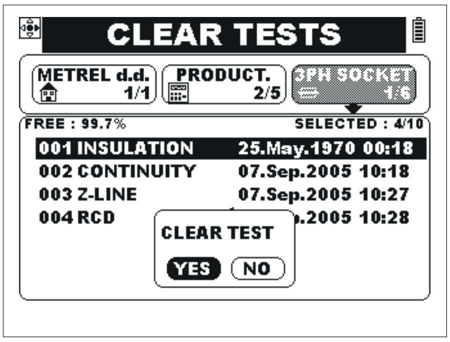
| | |
|---|---|
| ↓ / ↑ | Select location. |
| **TEST** | Opens dialog for clearing in installation data structure. |
| **TAB** | Moves focus into result field for selection of surplus result, see *6.5.1*. |
| **F2** | Enters installation structure tree view to select appropriate location. |
| **F1** | Renames current location. |
| **ESC** | Back to the last mode of the instrument. |

### 6.5.1 Clearing specialties

In the result field the particular stored test result can be cleared.




*Selection of data for clearing*




*Dialog before clear*

*Figure 6.13: Clearing particular test*

Keys:

| | |
|---|---|
| ↓ / ↑ | Select stored test. |
| **TEST** | Opens dialog for clearing selected test. |
| **ESC** | Back to last mode of the instrument. |

Keys in opened dialog:

| | |
|---|---|
| ← / → | Select YES / NO. |
| **TEST** | Confirms selected option. |
| **ESC** | Cancels without changes. |

Legend for clearing in installation data structure:

| | |
|---|---|
| **CURRENT Location** | Results in current location. |
| **SUB Locations** | Results in sub-locations. |
| **TREE Structure** | Remove current location and its sub-locations. |

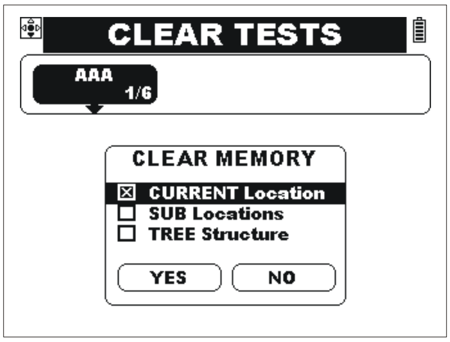



*Figure 6.14: Clear in installation data structure menu*

Keys:

| | |
|---|---|
| ← / → / ↓ / ↑ | Select option. |
| **TEST** | Confirms option. |
| **ESC** | Cancels dialog without changes. |

# 6.6 Editing installation data structure

Installation data structure when once stored in the instrument can also be modified during use of the instrument. Editing possibilities are:

- Adding new location – see *6.6.1*,
- Modifying the name of selected location,
- Clearing location / tree structure, see *6.5.1*.

The possibilities are accessible in save, recall and clear (partly) menus.

## 6.6.1 Adding new locations

**Note**:

- The structure can be expanded to 10 horizontal levels deep and with maximum 2000 storing locations.

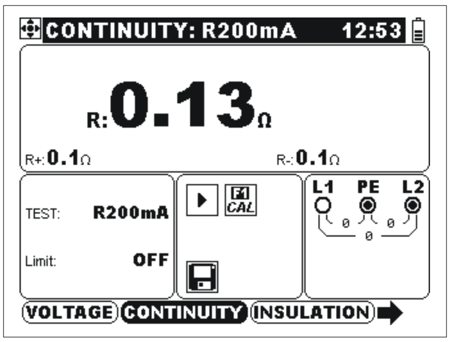
Keys:

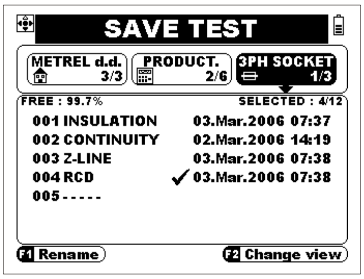
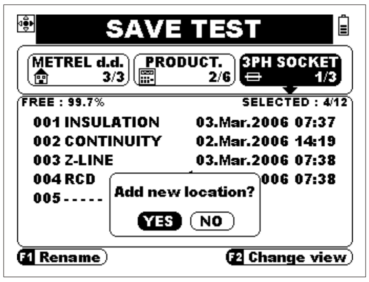
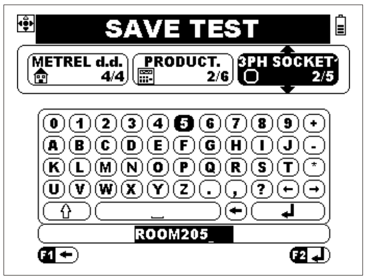
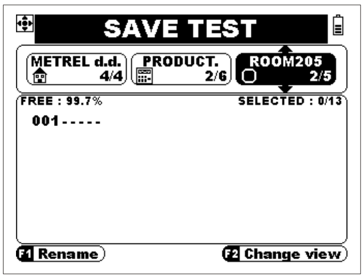
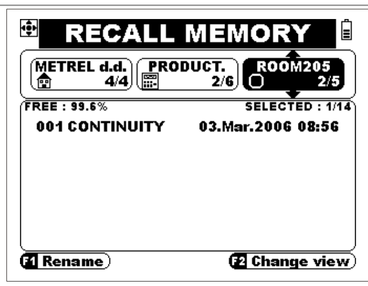
| | |
|---|---|
| ← / → / ↓ / ↑ | Select the existing location.<br>*Pressed for a few seconds in some cases* - add a new location in the structure, see *6.6.1*. |
| **F2** | Enters installation structure tree view to select appropriate location. |
| **F1** | Renames the current location. |
| **ESC** | Back to the last operation mode of the instrument. |
| ↓ (for 2 seconds) | Opens dialog box for adding new location at the same level.<br>Active only if selected location is the last in the level.<br>Name of the new location: *Same name as previous +1.* |
| → (for 2 seconds) | Opens dialog box for adding new location at the next sublevel.<br>Active only if there are no sublevels at the selected location.<br>Name of the new location: *Location* |

Keys in open dialog box:

| | |
|---|---|
| ← / → | Select YES / NO. |
| **TEST** | Confirms selected option. |
| **ESC** | Cancels dialog box without changes. |

An example for opening a new location and storing a test result into the location is presented below.

| | |
|---|---|
| Finished test with the results prepared for **saving** is marked with 🖫 icon. | <br>*Figure 6.15: Test result prepared for saving* |

| | |
|---|---|
| Key:<br>**MEM** Enters the save test menu. | <br>*Figure 6.16: Save test menu* |
| Keys:<br>**F2** Changes structure view.<br>**TEST** Confirms the new location.<br>**F1** Enters name of the location. | <br>*Figure 6.17: Dialog box for new location* |
| Enter **name** of the location.<br>Key:<br>**F2** Confirms the name. | <br>*Figure 6.18: Entering name for the new location* |
| Key:<br>**MEM** Saves results into the location. | <br>*Figure 6.19: Location prepared* |
| | <br>*Figure 6.20: Stored example* |

# 6.7 Communication

Stored results can be transferred to a PC. A special communication program on the PC automatically identifies the instrument and enables data transfer between the instrument and the PC.
There are three communication interfaces available: USB, RS 232 and Bluetooth.

## 6.7.1 USB and RS232 communication

For setting USB or RS 232 communication interface see chapter *4.4.6*.

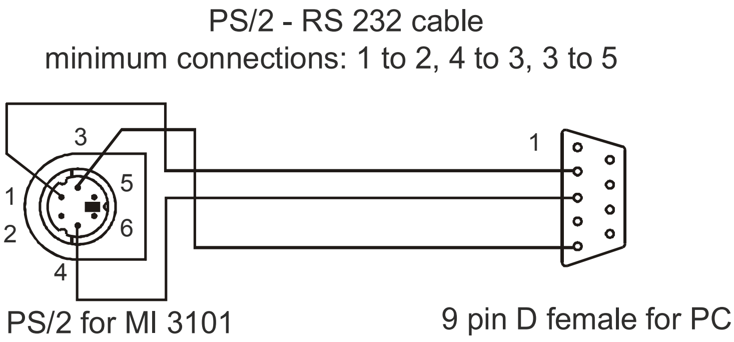



*Figure 6.21: Interface connection for data transfer over PC COM port*

*How to establish an USB or RS232 link:*

- In the MISC:  select appropriate communication interface (USB / RS 232).

***RS 232** selected: connect a PC COM port to the instrument PS/2 connector using the PS/2 - RS232 serial communication cable;*
***USB** selected: connect a PC USB port to the instrument USB connector using the USB interface cable.*

- Power **on** the PC and the instrument.
- **Run** the program *EurolinkPRO**.***
- The PC and the instrument automatically recognize each other.
- The program on the PC enables the following possibilities:

*Downloading data;*
*Clearing storage;*
*Changing and downloading user data;*
*Preparing a simple report form;*
*Preparing a file for exporting to a spreadsheet.*

The program *EurolinkPRO* is a PC software running on ~~Windows NT, Windows 2000,~~ Windows XP, Windows Vista, Windows 7, and Windows 8. Read the file README_EuroLink.txt on CD for instructions about installing and running the program.

**Note**:

- USB drivers should be installed on PC before using the USB interface. Refer to USB installation instructions available on installation CD.

### 6.7.2 Bluetooth communication

With the optional Bluetooth dongle A 1436 the EurotestAT instrument can communicate via Bluetooth. Instruments with (hardware version HW 5 or higher) support this operation.

***How to configure a Bluetooth link between instrument and PC***

- Switch Off and On the instrument. Bluetooth dongle A 1436 must be inserted.
- Be sure that the dongle is properly initialized. If not the Bluetooth dongle must be initialized as described in chapter *4.4.5 Initialization of the Bluetooth dongle.*
- On PC configure a Standard Serial Port to enable communication over Bluetooth link between instrument and PC. No code for pairing the devices is needed.
- Run the *EurolinkPRO* program.
- The PC and the instrument will automatically recognize each other.
- The instrument is prepared to communicate with the PC.

***How to configure a Bluetooth link between instrument and Android device***

- Switch Off and On the instrument. Bluetooth dongle A 1436 must be inserted.
- Be sure that the dongle is properly initialized. If not the Bluetooth dongle must be initialized as described in chapter *4.4.5 Initialization of the Bluetooth dongle.*
- Some Android applications automatically carry out the setup of a Bluetooth connection. It is preferred to use this option if it exists.
  This option is supported by Metrel's Android applications.
- If this option is not supported by the selected Android application then configure a Bluetooth link via Android device’s Bluetooth configuration tool. No code for pairing the devices is needed.
- The instrument and Android device are ready to communicate.

**Notes**:

- Make sure that RS232 communication interface is set on the EurotestAT instrument, before using Bluetooth dongle A 1436. (For setting communication port see chapter *4.4.6).*
- Sometimes there will be a demand from the PC or Android device to enter the code. Enter code ‘NNNN’ to correctly configure the Bluetooth link.
- The name of a correctly configured Bluetooth device must consist of the instrument type plus serial number, eg. *MI 3101-12240429D*. If the Bluetooth dongle got another name, the configuration must be repeated.

## 6.8 Operation with barcode scanner

Instruments (hardware version HW 5 or higher) support operation with barcode scanner. The main application is to identify barcode labeled installation structure elements.

*How to read data with barcode scanner:*

- Connect barcode scanner to PS/2 communication port
- In ‘Edit location menu’ (see chapter 6.6, figure 6.18) the location name can be alternatively read from barcode.

**Note**:

- Proper operation is assured only with barcode scanners supplied by METREL.
- For support of different barcode format refer to Barcode reader’s manual.
- Maximal length of barcode is 10 characters.

# 7 Maintenance

Unauthorized person is not allowed to open the EurotestAT instrument. There are no user replaceable components inside the instrument, except three fuses and batteries under rear cover.

## 7.1 Replacing fuses

There are three fuses under back cover of the EurotestAT instrument.

- F1
  M 0.315 A / 250 V, 20×5 mm
  This fuse protects internal circuitry of continuity function if test probes are connected to the mains supply voltage by mistake during measurement.

- F2, F3
  F 4 A / 500 V, 32×6.3 mm
  General input protection fuses of test terminals L/L1 and N/L2.

**Warnings:**

- ⚠ Disconnect any measuring accessory and power off the instrument before opening battery/fuse compartment cover, hazardous voltage inside!
- Replace blown fuse with original type only, otherwise the instrument may be damaged and/or operator's safety impaired!

Position of fuses can be seen in *Figure 3.4* in chapter *3.3 Back panel*.

## 7.2 Cleaning

No special maintenance is required for the housing. To clean the surface of the instrument use a soft cloth slightly moistened with soapy water or alcohol. Then leave the instrument to dry totally before use.

**Warnings:**

- Do not use liquids based on petrol or hydrocarbons!
- Do not spill cleaning liquid over the instrument!

## 7.3 Periodic calibration

It is essential that the test instrument is regularly calibrated in order technical specification listed in this manual is guaranteed. We recommend an annual calibration. Only an authorized technical person can do the calibration. Please contact your dealer for further information.

## 7.4 Service

For repairs under warranty, or at any other time, please contact your distributor.

# 8 Technical specifications

## 8.1 Insulation resistance

**Insulation LN, LPE, NPE**
Insulation resistance (nominal voltages 50 $V_{DC}$, 100 $V_{DC}$ and 250 $V_{DC}$)
Measuring range according to EN61557 is 0.25 MΩ ÷ 199.9 MΩ.

| Measuring range (MΩ) | Resolution (MΩ) | Accuracy |
|---|---|---|
| 0.00 ÷ 19.99 | 0.01 | ±(5 % of reading + 5 digits) |
| 20.0 ÷ 99.9 | 0.1 | ±(10 % of reading) |
| 100.0 ÷ 199.9 | | ±(20 % of reading) |

Insulation resistance (nominal voltages 500 $V_{DC}$ and 1000 $V_{DC}$)
Measuring range according to EN61557 is 0.15 MΩ ÷ 1000 MΩ.

| Measuring range (MΩ) | Resolution (MΩ) | Accuracy |
|---|---|---|
| 0.00 ÷ 19.99 | 0.01 | ±(5 % of reading + 3 digits) |
| 20.0 ÷ 199.9 | 0.1 | ±(10 % of reading) |
| 200 ÷ 299 | 1 | |
| 300 ÷ 1000 | 1 | ±(20 % of reading) |

**Insulation ALL and ‘L-PE,N-PE’, ‘L-N,L-PE’**
Insulation resistance (nominal voltages 50 $V_{DC}$, 100 $V_{DC}$ , 250 $V_{DC}$ ,500 $V_{DC,}$ 1000 $V_{DC}$)
Measuring range according to EN61557 is 0.34 MΩ ÷ 30.0 MΩ.

| Measuring range (MΩ) | Resolution (MΩ) | Accuracy |
|---|---|---|
| 0.00 ÷ 19.99 | 0.01 | ±(10 % of reading + 5 digits) |
| 20.0 ÷ 30.0 | 0.1 | |

Voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0 ÷ 1200 | 1 | ±(3 % of reading + 3 digits) |

Nominal voltages .............................. 50 $V_{DC}$, 100 $V_{DC}$, 250 $V_{DC}$, 500 $V_{DC}$, 1000 $V_{DC}$
Open circuit voltage .......................... -0 % / + 20 % of nominal voltage
Measuring current............................ min. 1 mA at RN=UN×1 kΩ/V
Short circuit current.......................... max. 0.6 mA
Specified accuracy is valid if universal test cable is used while it is valid up to 100 MΩ if tip commander is used.
Specified accuracy is valid up to 100 MΩ if relative humidity > 85%.
In case the instrument gets moistened the results could be impaired. In such case it is recommended to dry the instrument and accessories for at least 24 hours.
The error in operating conditions could be at most the error for reference conditions (specified above for each function) ±5 % of measured value.
The number of possible tests........... > 1200, with a fully charged battery
Auto discharge after test.

# 8.2 Continuity

## 8.2.1 Resistance R200mA (LPE, NPE)

Measuring range according to EN61557 is 0.16 Ω ÷ 1999 Ω.

| **Measuring range R (Ω)** | **Resolution (Ω)** | **Accuracy** |
|---|---|---|
| 0.00 ÷ 19.99 | 0.01 | ±(3 % of reading + 3 digits) |
| 20.0 ÷ 199.9 | 0.1 | ±(5 % of reading) |
| 200 ÷ 1999 | 1 | |
| 2000 ÷ 9999 | 1 | Indicator only |

| **Measuring range R+, R- (Ω)** | **Resolution (Ω)** | **Accuracy** |
|---|---|---|
| 0.00 ÷ 19.9 | 0.1 | ±(5 % of reading + 5 digits) |
| 20.0 ÷ 199.9 | 0.1 | ±(10 % of reading) |
| 200 ÷ 1999 | 1 | |
| 2000 ÷ 9999 | 1 | Indicator only |

Open-circuit voltage.......................... 6.5 VDC ÷ 9 VDC
Measuring current............................. min. 200 mA into load resistance of 2 Ω
Test lead compensation.................... up to 20 Ω
The number of possible tests ........... > 2000, with a fully charged battery
Automatic polarity reversal of the test voltage.

## 8.2.2 Resistance R7mA (LPE, NPE)

| **Measuring range (Ω)** | **Resolution (Ω)** | **Accuracy** |
|---|---|---|
| 0.0 ÷ 19.9 | 0.1 | ±(5 % of reading + 3 digits) |
| 20 ÷ 1999 | 1 | |
| 2000 ÷ 9999 | 1 | Indicator only |

Open-circuit voltage.......................... 6.5 VDC ÷ 9 VDC
Short-circuit current .......................... max. 30 mA
Test lead compensation.................... up to 20 Ω

# 8.3 RCD testing

## 8.3.1 General data

Nominal residual current (A, F, AC).. 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA
Nominal residual current accuracy.... -0 / +0.1·IΔ; IΔ = IΔN, 2×IΔN, 5×IΔN
-0.1·IΔ / +0; IΔ = 0.5×IΔN
AS / NZ selected: ± 5 %
Test current shape ............................ Sine-wave (AC), pulsed (A, F), DC (B, B+)
DC offset for pulsed test current ....... 6 mA (typical)
RCD type .......................................... (non-delayed), S (time-delayed)
Test current starting polarity ............. 0 º or 180 º
Voltage range ................................... 40 V ÷ 264 V (14 Hz ÷ 500 Hz)

RCD test current selection (r.m.s. value calculated to 20ms) according to IEC 61009:

| | IΔN × 1/2 | | | IΔN × 1 | | | IΔN × 2 | | | IΔN × 5 | | | RCD IΔ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IΔN (mA) | AC | A,F | B,B+ | AC | A,F | B,B+ | AC | A,F | B,B+ | AC | A,F | B,B+ | AC | A,F | B,B+ |
| 10 | 5 | 3.5 | 5 | 10 | 20 | 20 | 20 | 40 | 40 | 50 | 100 | 100 | ✓ | ✓ | ✓ |
| 30 | 15 | 10.5 | 15 | 30 | 42 | 60 | 60 | 84 | 120 | 150 | 212 | 300 | ✓ | ✓ | ✓ |
| 100 | 50 | 35 | 50 | 100 | 141 | 200 | 200 | 282 | 400 | 500 | 707 | 1000 | ✓ | ✓ | ✓ |
| 300 | 150 | 105 | 150 | 300 | 424 | 600 | 600 | 848 | n.a. | 1500 | n.a. | n.a. | ✓ | ✓ | ✓ |
| 500 | 250 | 175 | 250 | 500 | 707 | 1000 | 1000 | 1410 | n.a. | 2500 | n.a. | n.a. | ✓ | ✓ | ✓ |
| 1000 | 500 | 350 | 500 | 1000 | 1410 | n.a. | 2000 | n.a. | n.a. | n.a. | n.a. | n.a. | ✓ | ✓ | n.a. |

n.a.................................................... not applicable
AC type ............................................ sine wave test current
A, F types…… ................................. pulsed current
B, B+ types ...................................... smooth DC current

### 8.3.2 Contact voltage RCD-Uc

Measuring range according to EN61557 is 20.0 V ÷ 31.0V for limit contact voltage 25V
Measuring range according to EN61557 is 20.0 V ÷ 62.0V for limit contact voltage 50V

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0.0 ÷ 19.9 | 0.1 | (-0 % / +15 %) of reading ± 10 digits |
| 20.0 ÷ 99.9 | | (-0 % / +15 %) of reading |

The accuracy is valid if mains voltage is stabile during the measurement and PE terminal is free of interfering voltages.

Test current...................................... max. $0.5\times I_{\Delta N}$
Limit contact voltage ......................... 25 V, 50 V
Specified accuracy is valid for complete operating range.

### 8.3.3 Trip-out time

Complete measurement range corresponds to EN 61557 requirements.
Maximum measuring times set according to selected reference for RCD testing.

| Measuring range (ms) | Resolution (ms) | Accuracy |
|---|---|---|
| 0.0 ÷ 40.0 | 0.1 | ±1 ms |
| 0.0 ÷ max. time * | 0.1 | ±3 ms |

* For max. time see normative references in *4.4.2* – this specification applies to max. time >40 ms.

Test current...................................... $½\times I_{\Delta N}$, $I_{\Delta N}$, $2\times I_{\Delta N}$, $5\times I_{\Delta N}$
$5\times I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types AC) or $I_{\Delta N} \geq$ 300 mA (RCD types A, F, B, B+).
$2\times I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types A, F) or $I_{\Delta N} \geq$ 300 mA (RCD types B, B+).
$1\times I_{\Delta N}$ is not available $I_{\Delta N}$=1000 mA (RCD Types B, B+).

### 8.3.4 Trip-out current

Trip-out current
Complete measurement range corresponds to EN 61557 requirements.

| Measuring range $I_{\Delta}$ | Resolution $I_{\Delta}$ | Accuracy |
|---|---|---|
| $0.2 \times I_{\Delta N} \div 1.1 \times I_{\Delta N}$ (AC type) | $0.05 \times I_{\Delta N}$ | $\pm 0.1 \times I_{\Delta N}$ |
| $0.2 \times I_{\Delta N} \div 1.5 \times I_{\Delta N}$ (A, F types, $I_{\Delta N} \geq 30$ mA) | $0.05 \times I_{\Delta N}$ | $\pm 0.1 \times I_{\Delta N}$ |
| $0.2 \times I_{\Delta N} \div 2.2 \times I_{\Delta N}$ (A, F types, $I_{\Delta N} < 30$ mA) | $0.05 \times I_{\Delta N}$ | $\pm 0.1 \times I_{\Delta N}$ |
| 0.2×IΔN ÷ 2.2×IΔN (B, B+ types) | 0.05×IΔN | ±0.1×IΔN |

Trip-out time

| Measuring range (ms) | Resolution (ms) | Accuracy |
|---|---|---|
| 0 ÷ 300 | 1 | ±3 ms |

Contact voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0.0 ÷ 19.9 | 0.1 | (-0 % / +15 %) of reading ± 10 digits |
| 20.0 ÷ 99.9 | 0.1 | (-0 % / +15 %) of reading |

The accuracy is valid if mains voltage is stabile during the measurement and PE terminal is free of interfering voltages.
Measurement cannot be performed for $I_{\Delta N}$=1000 mA (RCD types B, B+).
Specified accuracy is valid for complete operating range.

## 8.4 Fault loop impedance and prospective fault current

### 8.4.1 No disconnecting device or FUSE selected

Fault loop impedance
Measuring range according to EN61557 is 0.25 Ω ÷ 19999 Ω.

| Measuring range (Ω) | Resolution (Ω) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(5 % of reading + 5 digits) |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 19999 | 1 | |

Prospective fault current (calculated value)

| Measuring range (A) | Resolution (A) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | Consider accuracy of fault loop impedance measurement |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 23.0k | 100 | |

The accuracy is valid if mains voltage is stable during the measurement.

Test current (at 230 V)....................... 6.5 A (10 ms)
Nominal voltage range....................... 30 V ÷ 500 V (14 Hz ÷ 500 Hz)

### 8.4.2 RCD selected

Fault loop impedance
Measuring range according to EN61557 is 0.46 Ω ÷ 19999 Ω.

| **Measuring range (Ω)** | **Resolution (Ω)** | **Accuracy *** |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(5 % of reading + 10 digits) |
| 10.0 ÷ 99.9 | 0.1 | ±10 % of reading |
| 100 ÷ 19999 | 1 | ±10 % of reading |

* Accuracy may be impaired in case of heavy noise on mains voltage

Prospective fault current (calculated value)

| **Measuring range (A)** | **Resolution (A)** | **Accuracy** |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | Consider accuracy of fault loop impedance measurement |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 23.0k | 100 | |

Nominal voltage range...................... 30 V ÷ 500 V (14 Hz ÷ 500 Hz)
No trip out of RCD.
R, XL values are indicative.

## 8.5 Line impedance / prospective short-circuit current and Voltage drop

Line impedance
Measuring range according to EN61557 is 0.25 Ω ÷ 19.9 kΩ.

| **Measuring range (Ω)** | **Resolution (Ω)** | **Accuracy** |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(5 % of reading + 5 digits) |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 19.9k | 100 | |

Prospective short-circuit current (calculated value)

| **Measuring range (A)** | **Resolution (A)** | **Accuracy** |
|---|---|---|
| 0.00 ÷ 0.99 | 0.01 | Consider accuracy of line impedance measurement |
| 1.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 99.99k | 10 | |
| 100k ÷ 199k | 1000 | |

Test current (at 230 V)...................... 6.5 A (10 ms)
Nominal voltage range...................... 30 V ÷ 500 V (14 Hz ÷ 500 Hz)
R, XL values are indicative.

Voltage drop (calculated value)

| Measuring range (%) | Resolution (%) | Accuracy |
|---|---|---|
| 0.0 ÷ 99.9 | 0.1 | Consider accuracy of line impedance measurement |

$Z_{REF}$ measuring range………………………0.00 Ω ÷ 20.0 Ω

## 8.6 Voltage, frequency, and phase rotation

### 8.6.1 Phase rotation

Nominal system voltage range.......... 100 $V_{AC}$ ÷ 550 $V_{AC}$
Nominal frequency range.................. 14 Hz ÷ 500 Hz
Result displayed ............................... 1.2.3 or 3.2.1

### 8.6.2 Voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0 ÷ 550 | 1 | ±(2 % of reading + 2 digits) |

Result type....................................... True r.m.s. (trms)
Nominal frequency range.................. 0 Hz, 14 Hz ÷ 500 Hz

### 8.6.3 Frequency

| Measuring range (Hz) | Resolution (Hz) | Accuracy |
|---|---|---|
| 0.00 ÷ 999.99 | 0.01 | ±(0.2 % of reading + 1 digit) |

Nominal voltage range...................... 10 V ÷ 550 V

## 8.7 Online terminal voltage monitor

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 10 ÷ 550 | 1 | ±(2 % of reading + 2 digits) |

## 8.8 Earth resistance

**Earth resistance three-wire method**

Measuring range according to EN61557 is 0.67 Ω ÷ 9999 Ω

| Measuring range (Ω) | Resolution (Ω) | Accuracy |
|---|---|---|
| 0.00 ÷ 19.99 | 0.01 | ±(3 % of reading + 3 digits) |
| 20.0 ÷ 199.9 | 0.1 | |
| 200 ÷ 1999 | 1 | ± 5 % of reading |
| 2000 ÷ 9999 | 1 | ± 10 % of reading |

Additional spike resistance error if
Rc max. or Rp max. is exceeded...... ±(5 % of reading + 10 digits)
Rc max. ........................................... 100 $R_E$ or 50 kΩ (whichever is lower)

Rp max. ........................................... 100 $R_E$ or 50 kΩ (whichever is lower)
Automatic test of probe resistance.......... yes
Additional error
at 3 V voltage noise (50 Hz).............. ±(5 % of reading +10 digits)
Automatic test of voltage noise ......... yes
Noise voltage indication threshold .... 1 V (<50 Ω, worst case)
Open-terminal test voltage................ 40 $V_{AC}$
Test voltage frequency...................... 125 Hz / 150 Hz
Short-circuit test current.................... < 20 mA

**Specific earth resistance**

| Measuring range (Ωm) | Resolution (Ωm) | Accuracy |
|---|---|---|
| 0.0 ÷ 99.9 | 0.1 | See accuracy note |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 0.01k | |
| 10.0k ÷ 99.9k | 0.1k | |
| >100k | 1k | |

| Measuring range (Ωft) | Resolution (Ωft) | Accuracy |
|---|---|---|
| 0.0 ÷ 99.9 | 0.1 | See accuracy note |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 0.01k | |
| 10.0k ÷ 99.9k | 0.1k | |
| >100k | 1k | |

Principle:
$\rho = 2 \cdot \pi \cdot distance \cdot Re$,
with Re as measured resistance in 4-wire method.

**Accuracy note:**

- Accuracy of the specific earth resistance result depends on measured resistance Re and is as follows:

| Measuring range (Ω) | Accuracy |
|---|---|
| 1.00 ÷ 1999 | ±5 % of measured |
| 2000÷ 19.99k | ±10 % of measured |
| >20k | ±20 % of measured |

Additional error
See *Earth resistance three-wire method.*

# 8.9 2 Ω line/loop impedance

## 8.9.1 High precision line impedance

Measuring range according to EN61557 is 5.0 ÷ 1999 mΩ

| Measuring range (mΩ) | Resolution (mΩ) | Accuracy |
|---|---|---|
| 0.1 ÷ 199.9 | 0.1 | ±(5 % + 1 mΩ) |
| 200 ÷ 1999 | 1 | |

Nominal voltage range ........................... 100 V ÷ 440 V
Nominal frequency ................................. 50 Hz
Maximum test current (at 400V)............. 267 A (10 ms)

Calculation of prospective short-circuit current (standard voltage value):

$$I_K = \frac{230\ V}{Z} \qquad U_{L\text{-}N} = 230\ V \pm 10\ \%$$

$$I_K = \frac{400\ V}{Z} \qquad U_{L\text{-}L} = 400\ V \pm 10\ \%$$

Calculation of prospective short-circuit current (non-standard voltage value):

$$I_{KMAX3ph} = \frac{C_{MAX} \times U_{N(L\text{-}L)}}{\sqrt{3}} \times \frac{2}{Z_{L\text{-}L}} \qquad I_{KMIN3ph} = \frac{C_{MIN} \times U_{N(L\text{-}L)}}{\sqrt{3}} \times \frac{2}{Z_{(L\text{-}L)HOT}}$$

$$I_{KMAX2ph} = \frac{C_{MAX} \times U_{N(L\text{-}L)}}{Z_{L\text{-}L}} \qquad I_{KMIN2ph} = \frac{C_{MIN} \times U_{N(L\text{-}L)}}{Z_{(L\text{-}L)HOT}}$$

$$I_{KMAX(L\text{-}N)} = \frac{C_{MAX} \times U_{N(L\text{-}N)}}{Z_{L\text{-}N}} \qquad I_{KMIN(L\text{-}N)} = \frac{C_{MIN} \times U_{N(L\text{-}N)}}{Z_{(L\text{-}N)HOT}}$$

$$Z_{L\text{-}L} = \sqrt{R_{L\text{-}L}^2 + X_{L\text{-}L}^2} \qquad Z_{(L\text{-}L)HOT} = \sqrt{(1.5 \times R_{L\text{-}L})^2 + X_{L\text{-}L}^2}$$

$$Z_{L\text{-}N} = \sqrt{R_{L\text{-}N}^2 + X_{L\text{-}N}^2} \qquad Z_{(L\text{-}N)HOT} = \sqrt{(1.5 \times R_{L\text{-}N})^2 + X_{L\text{-}N}^2}$$

| | $U_{N(L\text{-}N)} = 230\ V \pm 10\ \%$<br>$U_{N(L\text{-}L)} = 400\ V \pm 10\ \%$ | $230\ V < U_N < 400\ V$ |
|---|---|---|
| $C_{MAX}$ | 1.05 | 1.10 |
| $C_{MIN}$ | 0.95 | 1.00 |

## 8.9.2 High precision fault loop impedance

Measuring range according to EN61557 is 5.0 ÷ 1999 mΩ

| **Measuring range (mΩ)** | **Resolution (mΩ)** | **Accuracy** |
|---|---|---|
| 0.0 ÷ 199.9 | 0.1 | ±(5 % + 1 mΩ) |
| 200 ÷ 1999 | 1 | |

Nominal voltage range ........................... 100 V ÷ 440 V
Nominal frequency ................................. 50 Hz
Maximum test current (at 230 V)............ 154 A (10 ms)

Calculation of prospective short-circuit current (standard voltage value):

$$I_K = \frac{230\ V}{Z} \qquad U_{L\text{-}PE} = 230\ V \pm 10\ \%$$

Calculation of prospective short-circuit current (non-standard voltage value):

$$I_{KMAX(L\text{-}PE)} = \frac{C_{MAX} \times U_{N(L\text{-}PE)}}{Z_{L\text{-}PE}} \qquad I_{KMIN(L\text{-}PE)} = \frac{C_{MIN} \times U_{N(L\text{-}PE)}}{Z_{(L\text{-}PE)HOT}}$$

$$Z_{L\text{-}PE} = \sqrt{R_{L\text{-}PE}^2 + X_{L\text{-}PE}^2} \qquad Z_{(L\text{-}PE)HOT} = \sqrt{(1.5 \times R_{L\text{-}PE})^2 + X_{L\text{-}PE}^2}$$

| | $U_{N(L-PE)}$ = 230 V ± 10 % | 230 V < $U_N$ < 400 V |
|---|---|---|
| $C_{MAX}$ | 1.05 | 1.10 |
| $C_{MIN}$ | 0.95 | 1.00 |

### 8.9.3 Contact voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0 ÷ 100 | 1 | ±(10 % + 3 digits) |

## 8.10 Varistor test

DC voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0 ÷ 1000 | 1 | ±(3 % of reading + 3 digits) |

AC voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0 ÷ 625 | 1 | Consider accuracy of DC voltage |

Measurement principle...................... d.c. voltage ramp
Test voltage slope............................ 500 V/s
Threshold current.............................. 1 mA

## 8.11 General data

Power supply voltage........................ 9 $V_{DC}$ (6×1.5 V battery or accu, size AA)
Operation ......................................... typical 13 h
Charger socket input voltage ............ 12 V ± 10 %
Charger socket input current............. 400 mA max.
Battery charging current.................... 250 mA (internally regulated)
Overvoltage category........................ 600 V CAT III, 300 V CAT IV, (Altitude: up to 2000 m)
600 V CAT II, 300 V CAT III, (Altitude: up to 4500 m)
Plug commander
overvoltage category ................ 300 V CAT II
Protection classification .................... double insulation
Pollution degree................................ 2
Protection degree ............................. IP 40
Maximum altitude.............................. 4500 m

Display ........................................... 320x240 dots matrix display with backlight

Dimensions (w × h × d) ..................... 23 cm × 10.3 cm × 11.5 cm
Weight ............................................ 1.32 kg, without battery cells

Reference conditions
Reference temperature range........... 10 °C ÷ 30 °C
Reference humidity range................. 40 %RH ÷ 70 %RH

Operation conditions
Working temperature range .............. 0 °C ÷ 40 °C
Maximum relative humidity ............... 95 %RH (0 °C ÷ 40 °C), non-condensing

Storage conditions
Temperature range ........................... -10 °C ÷ +70 °C
Maximum relative humidity ............... 90 %RH (-10 °C ÷ +40 °C)
80 %RH (40 °C ÷ 60 °C)

Locator............................................. supports inductive mode
Maximum operation voltage.............. 440 V a.c.

Communication transfer speed
RS 232............................................. 115200 baud
USB ................................................. 256000 baud

The error in operating conditions could be at most the error for reference conditions (specified in the manual for each function) +1 % of measured value + 1 digit, unless otherwise specified in the manual for particular function.

# A Appendix A - Fuse table

## A.1 Fuse table - IPSC

**Fuse type NV**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | 5 |
| | **Min. prospective short- circuit current (A)** | | | | |
| 2 | 32.5 | 22.3 | 18.7 | 15.9 | 9.1 |
| 4 | 65.6 | 46.4 | 38.8 | 31.9 | 18.7 |
| 6 | 102.8 | 70 | 56.5 | 46.4 | 26.7 |
| 10 | 165.8 | 115.3 | 96.5 | 80.7 | 46.4 |
| 16 | 206.9 | 150.8 | 126.1 | 107.4 | 66.3 |
| 20 | 276.8 | 204.2 | 170.8 | 145.5 | 86.7 |
| 25 | 361.3 | 257.5 | 215.4 | 180.2 | 109.3 |
| 35 | 618.1 | 453.2 | 374 | 308.7 | 169.5 |
| 50 | 919.2 | 640 | 545 | 464.2 | 266.9 |
| 63 | 1217.2 | 821.7 | 663.3 | 545 | 319.1 |
| 80 | 1567.2 | 1133.1 | 964.9 | 836.5 | 447.9 |
| 100 | 2075.3 | 1429 | 1195.4 | 1018 | 585.4 |
| 125 | 2826.3 | 2006 | 1708.3 | 1454.8 | 765.1 |
| 160 | 3538.2 | 2485.1 | 2042.1 | 1678.1 | 947.9 |
| 200 | 4555.5 | 3488.5 | 2970.8 | 2529.9 | 1354.5 |
| 250 | 6032.4 | 4399.6 | 3615.3 | 2918.2 | 1590.6 |
| 315 | 7766.8 | 6066.6 | 4985.1 | 4096.4 | 2272.9 |
| 400 | 10577.7 | 7929.1 | 6632.9 | 5450.5 | 2766.1 |
| 500 | 13619 | 10933.5 | 8825.4 | 7515.7 | 3952.7 |
| 630 | 19619.3 | 14037.4 | 11534.9 | 9310.9 | 4985.1 |
| 710 | 19712.3 | 17766.9 | 14341.3 | 11996.9 | 6423.2 |
| 800 | 25260.3 | 20059.8 | 16192.1 | 13545.1 | 7252.1 |
| 1000 | 34402.1 | 23555.5 | 19356.3 | 16192.1 | 9146.2 |
| 1250 | 45555.1 | 36152.6 | 29182.1 | 24411.6 | 13070.1 |

**Fuse type gG**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | 5 |
| | **Min. prospective short- circuit current (A)** | | | | |
| 2 | 32.5 | 22.3 | 18.7 | 15.9 | 9.1 |
| 4 | 65.6 | 46.4 | 38.8 | 31.9 | 18.7 |
| 6 | 102.8 | 70 | 56.5 | 46.4 | 26.7 |
| 10 | 165.8 | 115.3 | 96.5 | 80.7 | 46.4 |
| 13 | 193.1 | 144.8 | 117.9 | 100 | 56.2 |
| 16 | 206.9 | 150.8 | 126.1 | 107.4 | 66.3 |
| 20 | 276.8 | 204.2 | 170.8 | 145.5 | 86.7 |
| 25 | 361.3 | 257.5 | 215.4 | 180.2 | 109.3 |
| 32 | 539.1 | 361.5 | 307.9 | 271.7 | 159.1 |
| 35 | 618.1 | 453.2 | 374 | 308.7 | 169.5 |
| 40 | 694.2 | 464.2 | 381.4 | 319.1 | 190.1 |
| 50 | 919.2 | 640 | 545 | 464.2 | 266.9 |
| 63 | 1217.2 | 821.7 | 663.3 | 545 | 319.1 |
| 80 | 1567.2 | 1133.1 | 964.9 | 836.5 | 447.9 |
| 100 | 2075.3 | 1429 | 1195.4 | 1018 | 585.4 |

**Fuse type B**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | 5 |
| | **Min. prospective short- circuit current (A)** | | | | |
| 6 | 30 | 30 | 30 | 30 | 30 |
| 10 | 50 | 50 | 50 | 50 | 50 |
| 13 | 65 | 65 | 65 | 65 | 65 |
| 15 | 75 | 75 | 75 | 75 | 75 |
| 16 | 80 | 80 | 80 | 80 | 80 |
| 20 | 100 | 100 | 100 | 100 | 100 |
| 25 | 125 | 125 | 125 | 125 | 125 |
| 32 | 160 | 160 | 160 | 160 | 160 |
| 40 | 200 | 200 | 200 | 200 | 200 |
| 50 | 250 | 250 | 250 | 250 | 250 |
| 63 | 315 | 315 | 315 | 315 | 315 |

**Fuse type C**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | 5 |
| | **Min. prospective short- circuit current (A)** | | | | |
| 0.5 | 5 | 5 | 5 | 5 | 2.7 |
| 1 | 10 | 10 | 10 | 10 | 5.4 |
| 1.6 | 16 | 16 | 16 | 16 | 8.6 |
| 2 | 20 | 20 | 20 | 20 | 10.8 |
| 4 | 40 | 40 | 40 | 40 | 21.6 |
| 6 | 60 | 60 | 60 | 60 | 32.4 |
| 10 | 100 | 100 | 100 | 100 | 54 |
| 13 | 130 | 130 | 130 | 130 | 70.2 |
| 15 | 150 | 150 | 150 | 150 | 83 |
| 16 | 160 | 160 | 160 | 160 | 86.4 |
| 20 | 200 | 200 | 200 | 200 | 108 |
| 25 | 250 | 250 | 250 | 250 | 135 |
| 32 | 320 | 320 | 320 | 320 | 172.8 |
| 40 | 400 | 400 | 400 | 400 | 216 |
| 50 | 500 | 500 | 500 | 500 | 270 |
| 63 | 630 | 630 | 630 | 630 | 340.2 |

**Fuse type K**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | |
| | **Min. prospective short- circuit current (A)** | | | | |
| 0.5 | 7.5 | 7.5 | 7.5 | 7.5 | |
| 1 | 15 | 15 | 15 | 15 | |
| 1.6 | 24 | 24 | 24 | 24 | |
| 2 | 30 | 30 | 30 | 30 | |
| 4 | 60 | 60 | 60 | 60 | |
| 6 | 90 | 90 | 90 | 90 | |
| 10 | 150 | 150 | 150 | 150 | |
| 13 | 195 | 195 | 195 | 195 | |
| 15 | 225 | 225 | 225 | 225 | |
| 16 | 240 | 240 | 240 | 240 | |
| 20 | 300 | 300 | 300 | 300 | |
| 25 | 375 | 375 | 375 | 375 | |
| 32 | 480 | 480 | 480 | 480 | |

**Fuse type D**

| Rated current (A) | Disconnection time [s] | | | | |
|---|---|---|---|---|---|
| | 35m | 0.1 | 0.2 | 0.4 | 5 |
| | **Min. prospective short- circuit current (A)** | | | | |
| 0.5 | 10 | 10 | 10 | 10 | 2.7 |
| 1 | 20 | 20 | 20 | 20 | 5.4 |
| 1.6 | 32 | 32 | 32 | 32 | 8.6 |
| 2 | 40 | 40 | 40 | 40 | 10.8 |
| 4 | 80 | 80 | 80 | 80 | 21.6 |
| 6 | 120 | 120 | 120 | 120 | 32.4 |
| 10 | 200 | 200 | 200 | 200 | 54 |
| 13 | 260 | 260 | 260 | 260 | 70.2 |
| 15 | 300 | 300 | 300 | 300 | 81 |
| 16 | 320 | 320 | 320 | 320 | 86.4 |
| 20 | 400 | 400 | 400 | 400 | 108 |
| 25 | 500 | 500 | 500 | 500 | 135 |
| 32 | 640 | 640 | 640 | 640 | 172.8 |

## A.2 Fuse table – Impedances at 230 V a.c. (AS/NZS 3017)

**Type B**

| Rated current (A) | Disconnection time [s] | | |
|---|---|---|---|
| | | 0.4 | |
| | **Max. loop impedance (Ω)** | | |
| 6 | | 9.58 | |
| 10 | | 5.75 | |
| 16 | | 3.59 | |
| 20 | | 2.88 | |
| 25 | | 2.30 | |
| 32 | | 1.80 | |
| 40 | | 1.44 | |
| 50 | | 1.15 | |
| 63 | | 0.91 | |
| 80 | | 0.72 | |
| 100 | | 0.58 | |
| 125 | | 0.46 | |
| 160 | | 0.36 | |
| 200 | | 0.29 | |

**Type C**

| Rated current (A) | Disconnection time [s] | | |
|---|---|---|---|
| | | 0.4 | |
| | **Max. loop impedance (Ω)** | | |
| 6 | | 5.11 | |
| 10 | | 3.07 | |
| 16 | | 1.92 | |
| 20 | | 1.53 | |
| 25 | | 1.23 | |
| 32 | | 0.96 | |
| 40 | | 0.77 | |
| 50 | | 0.61 | |
| 63 | | 0.49 | |
| 80 | | 0.38 | |
| 100 | | 0.31 | |
| 125 | | 0.25 | |
| 160 | | 0.19 | |
| 200 | | 0.15 | |

**Type D**

| Rated current (A) | Disconnection time [s] | | |
|---|---|---|---|
| | | 0.4 | |
| | **Max. loop impedance (Ω)** | | |
| 6 | | 3.07 | |
| 10 | | 1.84 | |
| 16 | | 1.15 | |
| 20 | | 0.92 | |
| 25 | | 0.74 | |
| 32 | | 0.58 | |
| 40 | | 0.46 | |
| 50 | | 0.37 | |
| 63 | | 0.29 | |
| 80 | | 0.23 | |
| 100 | | 0.18 | |
| 125 | | 0.15 | |
| 160 | | 0.12 | |
| 200 | | 0.09 | |

**Fuse**

| Rated current (A) | Disconnection time [s] | | |
|---|---|---|---|
| | | 0.4 | 5 |
| | **Max. loop impedance (Ω)** | | |
| 6 | | 11.50 | 15.33 |
| 10 | | 6.39 | 9.20 |
| 16 | | 3.07 | 5.00 |
| 20 | | 2.09 | 3.59 |
| 25 | | 1.64 | 2.71 |
| 32 | | 1.28 | 2.19 |
| 40 | | 0.96 | 1.64 |
| 50 | | 0.72 | 1.28 |
| 63 | | 0.55 | 0.94 |
| 80 | | 0.38 | 0.68 |
| 100 | | 0.27 | 0.48 |
| 125 | | 0.21 | 0.43 |
| 160 | | 0.16 | 0.30 |
| 200 | | 0.13 | 0.23 |

All impedances are scaled with factor 1.00.

# B Appendix B - Accessories for specific measurements

The table below presents standard and optional accessories required for specific measurement. The accessories marked as optional may also be standard ones in some sets. Please see attached list of standard accessories for your set or contact your distributor for further information.

| **Function** | **Suitable accessories (Optional with ordering code A….)** |
|---|---|
| Insulation | ❑ Universal test cable<br>❑ Tip commander (A 1176) |
| Continuity | ❑ Universal test cable<br>❑ Tip commander (A 1176)<br>❑ Probe test lead 4m (A 1012) |
| Continuity 7mA | ❑ Universal test cable<br>❑ Tip commander (A 1176) |
| Line impedance / Voltage drop | ❑ Universal test cable<br>❑ Plug commander<br>❑ Plug cable<br>❑ Tip commander (A 1176) |
| Fault loop impedance | ❑ Universal test cable<br>❑ Plug commander<br>❑ Plug cable<br>❑ Tip commander (A 1176) |
| RCD testing | ❑ Universal test cable<br>❑ Plug commander<br>❑ Plug cable |
| Phase sequence | ❑ Universal test cable<br>❑ Three-phase cable (A 1110)<br>❑ Three-phase adapter (A 1111) |
| Voltage, frequency | ❑ Universal test cable<br>❑ Plug commander<br>❑ Plug cable<br>❑ Tip commander (A 1176) |
| Earth resistance | ❑ Universal test cable |
| Specific earth resistance | ❑ ρ-Adapter (A1199) |
| Locator | ❑ Receiver R10K (A 1191)<br>❑ 1000 A current clamp (A 1019)<br>❑ 200 A current clamp (A 1074)<br>❑ Clamp interface (A 1068)<br>❑ Selective probe (A 1192) |
| 2 Ω line/loop impedance | ❑ Impedance adapter (A1143) |
| Varistor test | ❑ Universal test cable |

# C Appendix C – Locator receiver R10K

The highly sensitive hand-held **receiver R10K** detects the fields caused by the currents in the traced line. It generates sound and visual output according to the signal intensity. The operating mode switch in the head detector should always be set in IND (inductive) mode. The CAP (capacitive) operating mode is intended for operating in combination with other Metrel measuring equipment.
The built in field detector is placed in the front end of the receiver. External detectors can be connected via the rear connector.
Traced object must be energized when working with the EurotestAT.

| **Detectors** | **Operation** |
|---|---|
| In built inductive sensor (**IND**) | Tracing hidden wires. |
| Current clamp | Connected trough the rear connector.<br>Locating wires. |
| Selective probe | Connected trough the rear connector.<br>Locating fuses in fuse cabinets. |

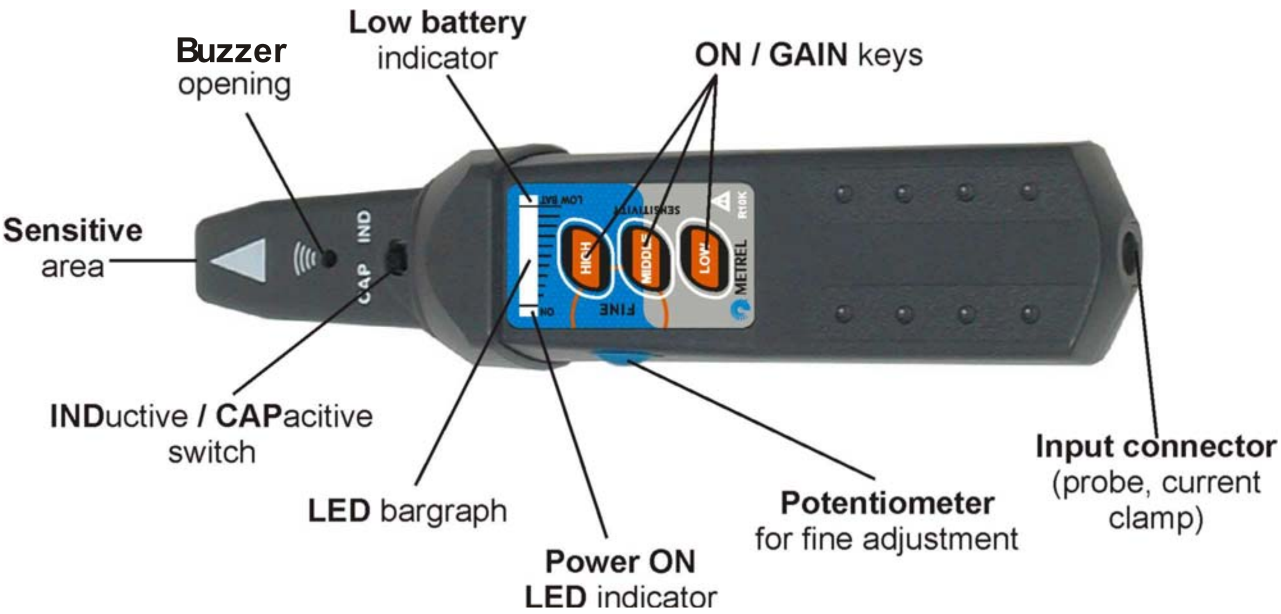



*Figure C.1: Receiver R10K*

The user can choose between three sensitivity levels (low, middle and high). An extra potentiometer is added for fine sensitivity adjustment. A buzzer sound and 10-level LED bar graph indicator indicates the strength of the magnetic field e.g. proximity of the traced object.

**Note**:

- The field strength can vary during tracing. The sensitivity should always be adjusted to optimum for each individual tracing.

# C.1 Tracing principles

## C.1.1 Positioning the receiver

The receiver has to be correctly positioned (see the figures below) to obtain the best results! Also wire position can be defined this way.

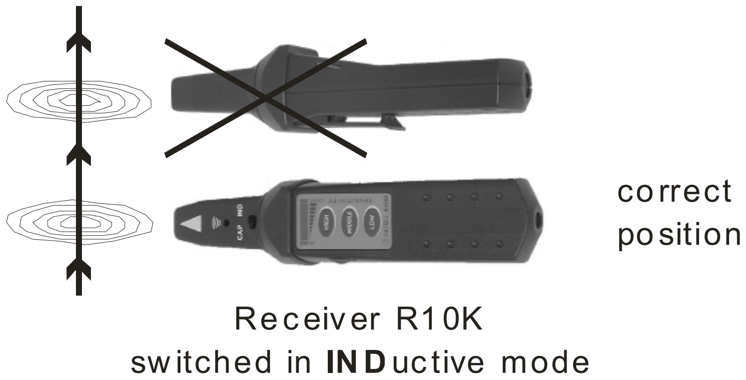



*Figure C.2: Detection of electromagnetic field*

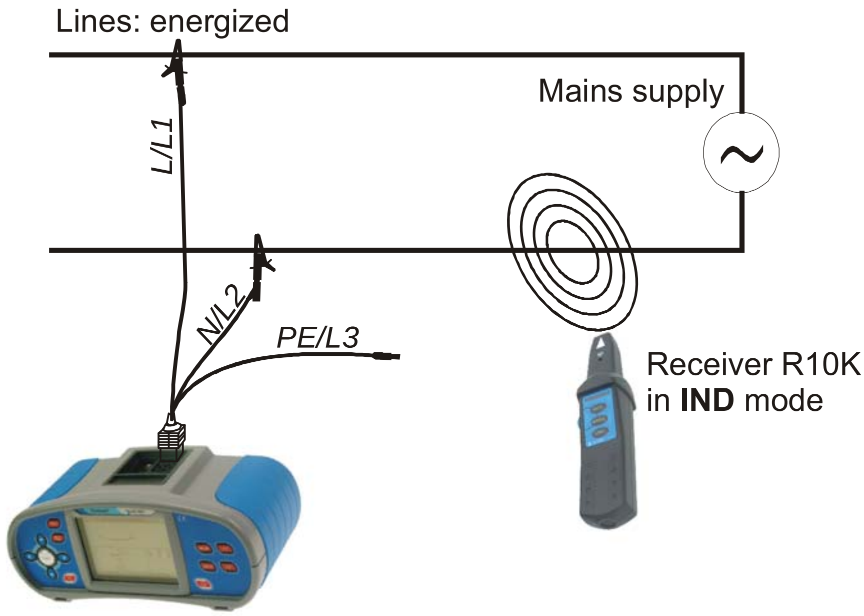



*Figure C.3: The EurotestAT as a signal source for tracing lines*

## C.1.2 Positioning current clamp

Whenever it is possible to embrace the traced wire it is recommended to use the appropriate current clamp instead of the receiver inductive sensor (see figure below). By using the clamp, the signal selectivity will considerably improve.
Always keep maximum distance between current clamp and R10K.

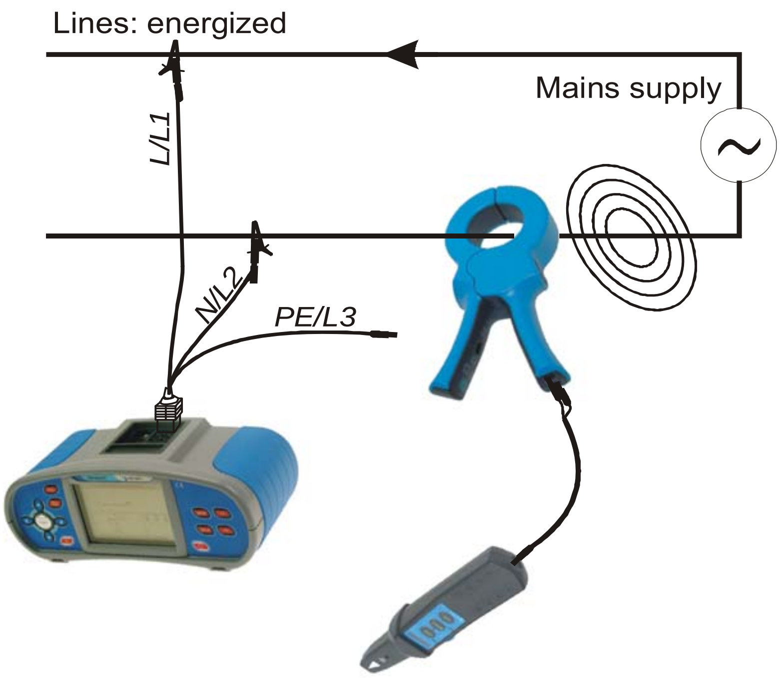



*Figure C.4: Transmitter as active load, clamp used instead of inductive sensor*

### C.1.3 Positioning selective probe

For searching a fuse in a group the selective probe shall be used. The wire or housing of the fuse must be touched at the right angle with it. Find the best signal by rotating the probe.
Keep the maximum distance between R10K and selective probe.

**Note**:
- Keep fingers behind the probe barrier to avoid electric shock and access of live parts.

## C.2 Detection distances for different connections

| **Connection** | **Distance up to** |
|---|---|
| Connection between L and N wire in same wall socket | 40 cm |
| Connection between L wire in one wall socket and N wire in other wall socket with separated conduits* | 2 m |

* WARNING! Avoid connection of the EurotestAT in trace mode between line and PE of different wall sockets, electric shock hazard!

## C.3 R10K power supply

The receiver R10K is supplied by a 9 V alkaline battery (IEC 6LR61).

## C.4 Maintenance

Remove battery from R10K when not in use for a longer time.
Apply maintenance instructions from chapter 7 of this document.

# D Appendix D - IT supply systems

In order for operator to be familiar enough with measurements in and their typical applications in IT supply system it is advisable to read Metrel handbook *Measurements on IT power supply systems*.

## D.1 Standard references

EN 60364-4-41, EN 60364-6, EN 60364-7-710, BS 7671

## D.2 Fundamentals

IT supply system is mains supply system that is insulated from ground (PE) – it is ungrounded supplying system. The system is without direct connection to the ground or the connection is provided through relatively high impedance. It is applied mostly in areas where additional protection to electric shock is required. Typical places are medical surgery rooms.
IT supply system also omits any grounding currents except leakages, and in this way there aren't problems with step voltage, i.e. voltage drop in one step, neither high energy sparking in Ex areas.

In normal cases the high impedance to the ground exists and is formed by capacitances of supply wires to the ground plus capacitances between primary and secondary windings of IT supply transformer. Minor part is formed by Y capacitors (EMC) in mains section of connected equipment. Selecting appropriate transformer, installation cabling and selection of optional high impedance connection to ground can control maximum leakage current.
Depending on application area additional impedance to the ground can be applied as presented in *figure D.1* or through special loading equipment. Value of the impedance should begin from 100 Ω.

IT system represents additional level of protection to electric shock. In the case of a failure of any line insulation to the PE through equipment failure, wrong application or procedure, this system is still safe but converted to TN / TT type. However, additional failure is hazardous, which means that the insulation has to be continuously checked and repaired immediately after detected failure.
Supplementary to other protection devices the IT system normally contains insulation monitoring device (IMD) or system that alarms when insulation resistance or impedance is below set threshold. Threshold value depends on environment. Typical value for medical installations is 55 kΩ.
In some countries it is not enough to trace insulation resistance of IT supply system to the ground, they require tracing of system capacitance, too.

**IEC 60364-4-41 (©IEC)**: In IT systems live parts shall be insulated from earth or connected to earth through sufficiently high impedance. This connection may be made either at the neutral point or midpoint of the system or at an artificial neutral point. The latter may be connected directly to earth if the resulting impedance to earth is sufficiently high at the system frequency. Where no neutral point or mid-point exists a line conductor may be connected to earth through high impedance.

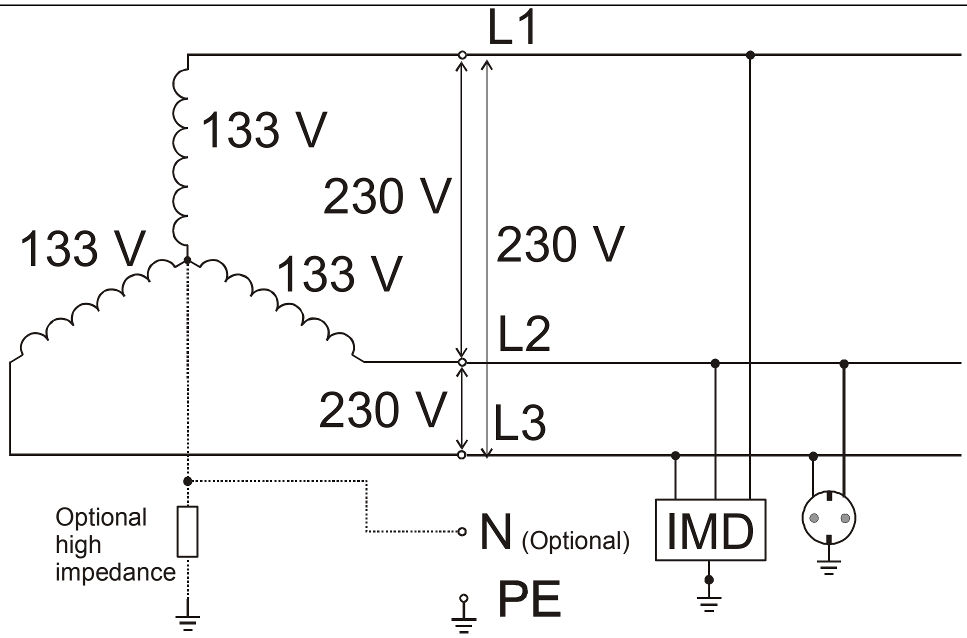



*Figure D.1: General IT supply system*

- Three phase star connection, optional delta connection.
- Optional neutral line.
- Single-phase connection is also possible.
- Various system voltages – not only three phase 230 V as indicated above.
- One faulty connection of any line to PE is treated as first fault and is regular but it has to be repaired as soon as possible.
- **IEC 60364-4-41**: In IT systems the following monitoring devices and protective devices may be used:
  - Insulation monitoring devices (IMDs),
  - Residual current monitoring devices (RCMs),
  - Insulation fault location systems,
  - Overcurrent protective devices,
  - Residual current protective devices (RCDs).

**NOTE**: Where a residual current operating device (RCD) is used, tripping of the RCD in the event of a first fault cannot be excluded due to capacitive leakage currents.

Testing of IT supply system is slightly different to standard tests in TN / TT system.

## D.3 Measurement guides

The user has to select the IT supply system in the instrument before testing it. The procedure for selecting the IT supply system is defined in chapter *4.4.2 Supply system, Isc factor, RCD standard.* Once the IT system is selected the instrument can be used immediately. The instrument keeps selected IT system when it is turned off.

When the instrument detects appropriate voltage levels for selected IT system, the terminal voltage monitor shows IT system icon IT.

## D.3.1 MI 3101 test functions and IT systems

The table below contains functions of the instrument including compatibility notes related to the IT system.

| **IT system functions** | **Note** |
|---|---|
| **Voltage** | |
| Voltage | Symbols modified for IT system, see *figure D.2.* |
| Phase rotation | For three phase system only, automatic detection. |
| **RCD functions** | Not applicable. |
| RCD - Uc | |
| RCD - Trip out Time t | |
| RCD - Tripping Current | |
| RCD – Automatic test | |
| **Loop functions** | Not applicable. |
| Fault Loop Impedance | |
| Fault Loop Prospective Short-circuit Current | |
| **Line functions** | |
| Line Impedance | Impedance $Z_{Line-Line}$. |
| Line Prospective Short-circuit Current | $I_{SC}$ for rated $U_{Line-Line}$. |
| **Continuity functions** | Independent of selected supply system. |
| **Insulation Resistance** | Independent of selected supply system. |
| **Earth resistance** | Independent of selected supply system. |
| **PE test probe** | Active, but does not inhibit selected test if voltage is detected. |

### D.3.1.1 Voltage measurements

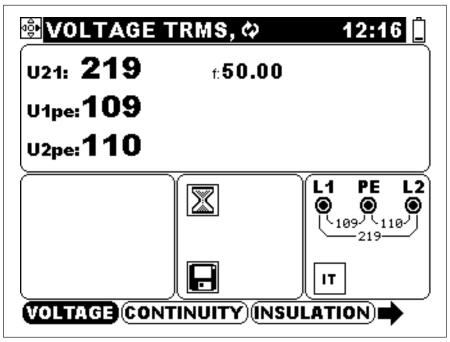



*Figure D.2: Voltage measurements*

Displayed results for **single phase** system:
U21..........Voltage between line conductors,
U1pe........Voltage between line 1 and protective conductor,
U2pe........Voltage between line 2 and protective conductor.

### D.3.1.2 Line impedance

See chapter *5.5*, the measurement is the same; only terminal voltage monitor indication corresponds to IT system.

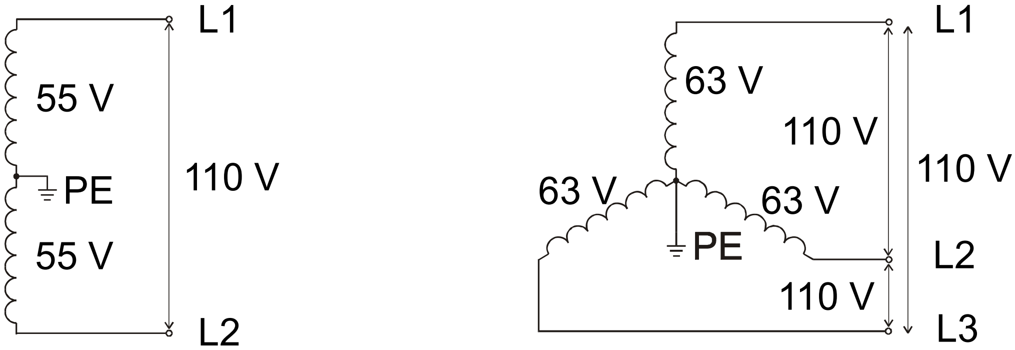
# E Appendix E - Reduced low voltage supply systems

## E.1 Standard reference

BS7671

## E.2 Fundamentals

Special supply systems are applied where inherent protection to electric shock is required but no SELV used. Reduced low voltage supply with ground reference can be used for this purpose.
There are two options with 110 V nominal voltage.




- Single phase with center tap connected to PE (i.e. 2 x 55 V).
- No neutral line.

- Three phase star connection, center tap connected to PE (i.e. 3 x 63 V).
- No neutral line.

*Figure E.1: General reduced low voltage supply systems*

## E.3 MI 3101 guides

The user has to select the reduced low voltage supply system in the instrument before testing it. The procedure for selecting the reduced low voltage supply system is defined in chapter *4.4.2 Supply system, Isc factor, RCD standard.* Once the reduced low voltage system is selected the instrument can be used immediately. The instrument keeps selected reduced low voltage system when it is turned off.

When the instrument detects appropriate voltage levels for selected reduced low voltage system, the terminal voltage monitor shows reduced low voltage system icon RV.

## E.3.1 MI 3101 functions and reduced low voltage systems

The table below contains EurotestAT functions intended for test and measurement of supply systems with compatibility notes related to the reduced low voltage system.

| **Reduced low voltage system functions** | **Note** |
|---|---|
| **Voltage** | |
| Voltage | Symbols modified for reduced low voltage system. |
| Phase rotation | Three-phase system automatic detected. |
| **RCD functions** | |
| RCD – Contact voltage Uc | For both possibilities, L1-PE and L2-PE. |
| RCD - Trip out time t | |
| RCD - Tripping current | |
| RCD – Automatic test | |
| **Loop functions** | |
| Fault Loop Impedance | Both fault loops, $Z_1$ (L1-PE) and $Z_2$ (L2-PE). |
| Fault Loop Prospective Short-circuit Current | $I_{SC1}$ and $I_{SC2}$ for both fault loops. |
| **Line functions** | |
| Line Impedance | Impedance $Z_{Line-Line}$. |
| Line Prospective Short-circuit Current | $I_{SC}$ for $U_{Line-Line}$ = 110 V. |
| **Continuity functions** | Independent of selected supply system. |
| **Insulation Resistance** | Independent of selected supply system. |
| **Earth resistance** | Independent of selected supply system. |
| **PE test probe** | Disabled. |

### E.3.1.1 Voltage measurements

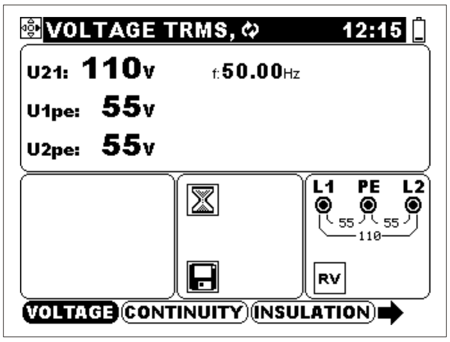



*Figure E.2: Voltage measurements*

Displayed results for **single phase** system:
U21..........Voltage between line conductors
U1pe........Voltage between line 1 and protective conductors
U2pe........Voltage between line 2 and protective conductors

## E.3.1.2 RCD tests

Maximum regular RCD test current is 1 A r.m.s. (1.4 A peak) and can be achieved only when fault loop impedance is lower than 1 Ω.

Tests are carried out for both combination L1-PE and L2-PE automatically.
Each individual test result is accompanied with appropriate indication.

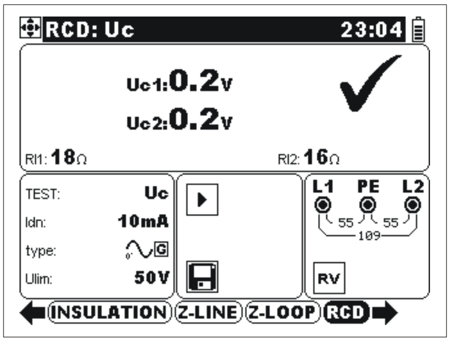



*Figure E.3: RCD Uc test*

If input voltage is out of range it is displayed on terminal voltage monitor, together with the indicator of disabled test .

## E.3.1.3 Line impedance test

Measured impedance represents Line-Line impedance ($Z_{L1-L2}$). Nominal system voltage for calculation of $I_{PSC}$ is set to 110 V.
Nominal system voltage range for line impedance measurement is 90 V to 121 V. If input voltage is out of range it is displayed on terminal voltage monitor, together with the indicator of disabled test .

## E.3.1.4 Fault loop impedance tests

Definition of nominal system voltage for calculation of $I_{PSC}$ is changed to:
- 55 V for single-phase center-tap system selected,
- 63 V for three-phase system selected.

Tests can be carried out for both combination L1-PE and L2-PE. Each individual test result is accompanied with appropriate indication.

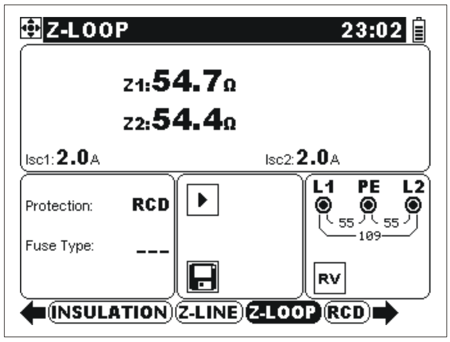



*Figure E.4: Fault loop impedance*

Nominal input voltages are:

| | |
|---|---|
| (44 V ≤ Uinp < 61 V) | for single-phase 55 V system |
| (56 V ≤ Uinp ≤ 70 V) | for three-phase 63 V system |

If input voltage is out of range it is displayed on terminal voltage monitor, together with the indicator of disabled test .

# E.4 Technical specifications

Only those technical specifications are listed below that are different to specifications from chapter *8* of this document.

## E.4.1 RCD

### General

Nominal differential currents ...................... 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1 A
Accuracy of actual differential currents: ..... $-0 / +0.1 \cdot I_{\Delta}$ for $I_{\Delta} = I_{\Delta N}$, $2 \cdot I_{\Delta N}$, $5 \cdot I_{\Delta N}$
$-0.1 \cdot I_{\Delta N} / +0$ for $I_{\Delta} = 0.5 \cdot I_{\Delta N}$
Maximum nominal differential currents ...... 1000 mA for $I_{\Delta N}$
for declared accuracy: .............................. 500 mA for $2 \cdot I_{\Delta N}$
100 mA for $5 \cdot I_{\Delta N}$
Maximum test current: ............................... 1 A (for Z-LOOP < 1 Ω)
Test current shape .................................... sine wave (AC), pulsed (A)
DC offset for pulsed test current ................ 6 mA (typical)
RCD type .................................................. (non-delayed), S (time-delayed)
Test current starting polarity ...................... 0 º or 180 º
Nominal input voltage ................................ 55 V / 63 V / 14 Hz ÷ 500 Hz
Test possibilities ....................................... L1 - PE and L2 - PE

### Contact voltage $U_C$

Measuring range according to EN61557 is 20.0 V ÷ 31.0 V (limit contact voltage 25 V).
Measuring range according to EN61557 is 20.0 V ÷ 62.0 V (limit contact voltage 50 V).

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0.0 ÷ 19.9 | 0.1 | (-0 % / +15 %) of reading ± 10 digits |
| 20.0 ÷ 99.9 | | (-0 % / +15 %) of reading |

The accuracy is valid if mains voltage is stabile during the measurement and PE terminal is free of interfering voltages.

Test current............................................... < 0.5 $I_{\Delta N}$
Limit contact voltage ................................. 25 V or 50 V
Contact voltage is calculated to ................ $I_{\Delta N}$ (standard type) or to $2I_{\Delta N}$ (selective type).

**Trip out time**

Complete measurement range corresponds to EN 61557 requirements.
Maximum measuring times set according to selected reference for RCD testing.

| Measuring range (ms) | Resolution (ms) | Accuracy |
|---|---|---|
| 0.0 ÷ 40.0 | 0.1 | ±1 ms |
| 0.0 ÷ max. time * | 0.1 | ±3 ms |

* For max. time see normative references in *4.4.2* – this specification applies to max. time >40 ms.

Test current...................................... ½×$I_{\Delta N}$, $I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
5×$I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types AC) or $I_{\Delta N}$ ≥ 300 mA (RCD types A, F, B, B+).
2×$I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types A, F) or $I_{\Delta N}$ ≥ 300 mA (RCD types B, B+).
1×$I_{\Delta N}$ is not available $I_{\Delta N}$=1000 mA (RCD Types B, B+).

**Trip-out current**

Trip-out current
Complete measurement range corresponds to EN 61557 requirements.

| Measuring range $I_{\Delta}$ | Resolution $I_{\Delta}$ | Accuracy |
|---|---|---|
| 0.2×$I_{\Delta N}$ ÷ 1.1×$I_{\Delta N}$ (AC type) | 0.05×$I_{\Delta N}$ | ±0.1×$I_{\Delta N}$ |
| 0.2×$I_{\Delta N}$ ÷ 1.5×$I_{\Delta N}$ (A, F type, $I_{\Delta N}$ ≥30 mA) | 0.05×$I_{\Delta N}$ | ±0.1×$I_{\Delta N}$ |
| 0.2×$I_{\Delta N}$ ÷ 2.2×$I_{\Delta N}$ (A, F type, $I_{\Delta N}$ <30 mA) | 0.05×$I_{\Delta N}$ | ±0.1×$I_{\Delta N}$ |

Trip-out time

| Measuring range (ms) | Resolution (ms) | Accuracy |
|---|---|---|
| 0 ÷ 300 | 1 | ±3 ms |

Contact voltage

| Measuring range (V) | Resolution (V) | Accuracy |
|---|---|---|
| 0.0 ÷ 19.9 | 0.1 | (-0 % / +15 %) of reading ± 10 digits |
| 20.0 ÷ 99.9 | 0.1 | (-0 % / +15 %) of reading |

*The accuracy is valid if mains voltage is stabile during the measurement and PE terminal is free of interfering voltages.

$I_{\Delta N}$ is not applicable for $I_{\Delta N}$=1000 mA (RCD type AC) or $I_{\Delta N}$≥500 mA (RCD types A, F).
$U_{Cl}$ voltage is calculated to tripping current $I_{\Delta}$.

## E.4.2 Fault loop impedance and prospective short-circuit current

**Fuse or no circuit breaker selected**

Fault loop impedance
Measuring range according to EN61557 is 0.32 Ω ÷ 19999 Ω.

| Measuring range (Ω) | Resolution (Ω) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(10 % of reading + 5 digits) |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 19999 | 1 | |

Prospective fault current (calculated value)

| Measuring range (A) | Resolution (A) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | Consider accuracy of fault loop impedance measurement |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 23.0k | 100 | |

The accuracy is valid if mains voltage is stable during the measurement.
IPSC calculation: ....................................... IPSC = UN·kSC / ZL-PE
$U_N$ = 55 V; (44 V ≤ Uinp < 61 V) for selected 55 V single-phase system
$U_N$ = 63 V; (56 V ≤ Uinp < 70 V) for selected 63 V three-phase system
Maximum loading....................................... 1.9 A / 10 ms
Nominal input voltage ................................ 55 V / 63 V, 14 Hz ÷ 500 Hz
Test possibilities ........................................ L1 - PE and L2 - PE

**RCD selected**

Loop impedance
Measuring range according to EN61557 is 0.85 Ω ÷ 19999 Ω.

| Measuring range (Ω) | Resolution (Ω) | Accuracy * |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(10 % of reading + 15 digits) |
| 10.0 ÷ 99.9 | 0.1 | ±15 % of reading |
| 100 ÷ 19999 | 1 | ±20 % of reading |

* Acccuracy may be impaired in case of heavy noise on mains voltage

Prospective fault current (calculated value)

| Measuring range (A) | Resolution (A) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | Consider accuracy of fault loop impedance measurement |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 23.0k | 100 | |

IPSC calculation: ........................................IPSC = $U_N$·ksc / ZL-PE
$U_N$ = 55 V; (44 V ≤ Uinp < 61 V) for selected 55 V single-phase system
$U_N$ = 63 V; (56 V ≤ Uinp < 70 V) for selected 63 V three-phase system
Nominal input voltage ................................55 V / 63 V, 14 Hz ÷ 500 Hz
Test possibilities ........................................L1 - PE and L2 - PE
No trip out of RCD.
R, XL values are indicative.

## E.4.3 Line impedance and prospective short-circuit current

$Z_{Line-Line}$
Measuring range according to EN61557 is 0.25 Ω ÷ 19.9 kΩ.

| Measuring range (Ω) | Resolution (Ω) | Accuracy |
|---|---|---|
| 0.00 ÷ 9.99 | 0.01 | ±(5 % of reading + 5 digits) |
| 10.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 9.99k | 10 | |
| 10.0k ÷ 19.9k | 100 | |

Prospective short-circuit current
Measuring range according to EN61557 is 0.25 A ÷ 440A (ksc = 1)

| Measuring range (A) | Resolution (A) | Accuracy |
|---|---|---|
| 0.00 ÷ 0.99 | 0.01 | Consider accuracy of line impedance measurement |
| 1.0 ÷ 99.9 | 0.1 | |
| 100 ÷ 999 | 1 | |
| 1.00k ÷ 99.99k | 10 | |
| 100k ÷ 199k | 1000 | |

*The accuracy is valid if:
Mains voltage is stable during the measurement

IPSC calculation: ....................................... IPSC = $U_N$·ksc / ZLine-Line
$U_N$ = 110 V; (90 V ≤ Uinp < 121 V)
Maximum loading....................................... 3.1 A / 10 ms
Nominal input voltage ................................ 110 V, 14 Hz ÷ 500 Hz
R, XL values are indicative.

# F Appendix F – Country notes

This appendix F contains collection of minor modifications related to particular country requirements. Some of the modifications mean modified listed function characteristics related to main chapters and others are additional functions. Some minor modifications are related also to different requirements of the same market that are covered by various suppliers.

## F.1 List of country modifications

The following table contains current list of applied modifications.

| Country | Related chapters | Modification type | Note |
|---|---|---|---|
| AT | 5.3, 8.3, F.2.1 | Appended | Special G type RCD |
| ES | F.2.2 | Appended | CONTINUITY LOOP RE |
| IT | F.2.3 | Appended | CONTINUITY LOOP RE |
| CH | F.2.4 | Appended | Change L/N |
| ES1 | Appendix G | Appended | Application of regulative UNE-202008 |
| DK | F.2.5, 5.4 | Appended | Fault loop test modified |
| AUS/NZ | F.2.6, 4.4.2, 4.4.5, 5.4, 5.5, 5.5.1, 5.8, Appendix A | Appended | AUS/NZ fuse table added |

## F.2 Modification issues

### F.2.1 AT modification - G type RCD

Modified is the following related to the mentioned in the chapter *5.3*:
- Added G type RCD,
- Time limits are the same as for general type RCD,
- Contact voltage is calculated the same as for general type RCD.

*Modifications of the chapter 5.3*

**Test parameters for RCD test and measurement**

| | |
|---|---|
| TEST | RCD **sub-function** test [Tripout time t, Uc, AUTO, Tripout current]. |
| Idn | **Rated** RCD residual current sensitivity $I_{\Delta N}$ [10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]. |
| type | RCD **type** AC, A, F, B, B+, starting **polarity** [0°, 180°, 0°, 180°, +, –], **selective** S, **general** □, **delayed** G characteristic. |
| MUL | **Actual** test current relative to rated Idn [½, 1, 2, 5]. |
| Ulim | Conventional touch voltage **limit** [25 V, 50 V]. |

**Note:**
- Selective (time delayed) RCDs and RCDs with (G) - time delayed characteristic demonstrate delayed response characteristics. They contain residual current integrating mechanism for generation of delayed trip out. However, contact voltage pre-test in the measuring procedure also influences the RCD and it takes a period to recover into idle state. Time delay of 30 s is inserted before performing trip-out

test to recover S type RCD after pre-tests and time delay of 5 s is inserted for the same purpose for G type RCD.

*Modification of the chapter 5.3.1*

| **RCD type** | | **Contact voltage Uc proportional to** | **Rated $I_{\Delta N}$** |
|---|---|---|---|
| AC | □, G | $1.05 \times I_{\Delta N}$ | any |
| AC | S | $2 \times 1.05 \times I_{\Delta N}$ | |
| A, F | □, G | $1.4 \times 1.05 \times I_{\Delta N}$ | ≥ 30 mA |
| A, F | S | $2 \times 1.4 \times 1.05 \times I_{\Delta N}$ | |
| A, F | □, G | $2 \times 1.05 \times I_{\Delta N}$ | < 30 mA |
| A, F | S | $2 \times 2 \times 1.05 \times I_{\Delta N}$ | |
| B, B+ | □ | $2 \times 1.05 \times I_{\Delta N}$ | any |
| B, B+ | S | $2 \times 2 \times 1.05 \times I_{\Delta N}$ | |

*Table F.1: Relationship between Uc and $I_{\Delta N}$*

Technical specifications remain the same.

### F.2.2 ES modification - CONTINUITY LOOP Re

The procedure is intended for measurement the resistance of PE wiring between distribution board and individual wall sockets. This is autotest only accessible procedure consisting of two special functions: the **LOOP Re** and the **CONTINUITY** with **LOOP Re sub-function**.

**Test parameters for LOOP Re function**

This function does not have any parameters.

**Test parameters for CONTINUITY LOOP Re function**

| | |
|---|---|
| TEST | Test **sub-function** [**LOOP Re**, R200mA, R7mA]. |
| With LOOP Re selected: | |
| Fuse I | Rated **current** of the fuse for over-current protection of tested socket outlet. |
| Uc | Conventional touch voltage **limit** [25 V, 50 V]. |
| Limit | Calculated limit value for PE wiring resistance (Uc/I). |
| Re_DB | Resistance of PE wiring to distribution board (result of LOOP Re measurement). |

### Circuit for measurement the resistance of PE wire

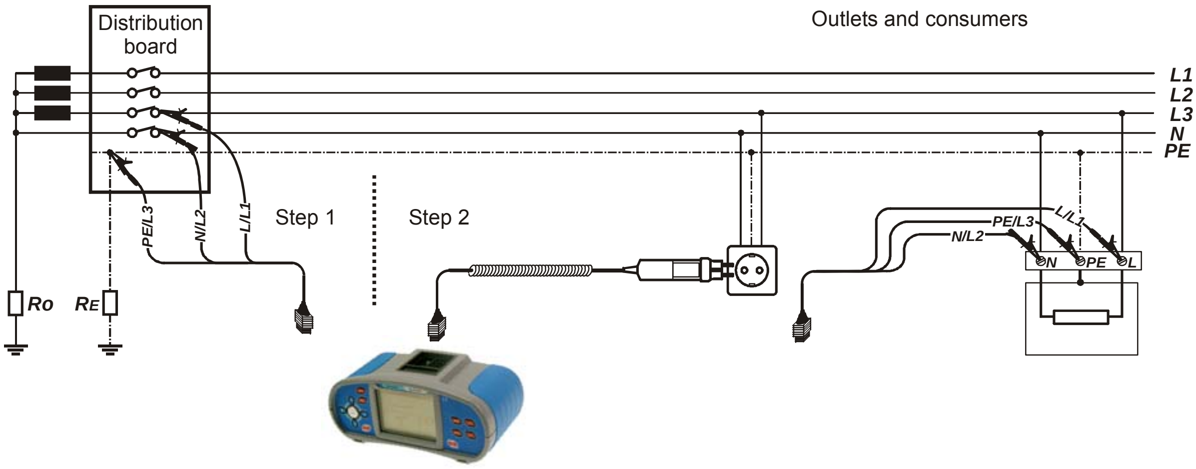


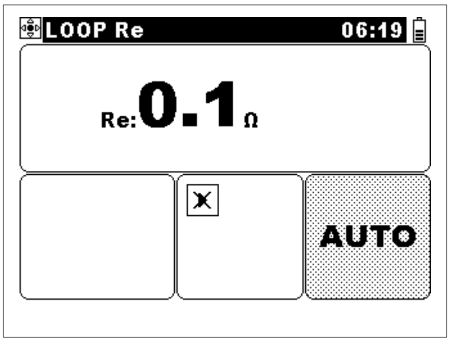

*Figure F.1: Two step procedure for PE wiring resistance measurement – connection of plug commander and universal test cable*

### Auto sequence recommendation

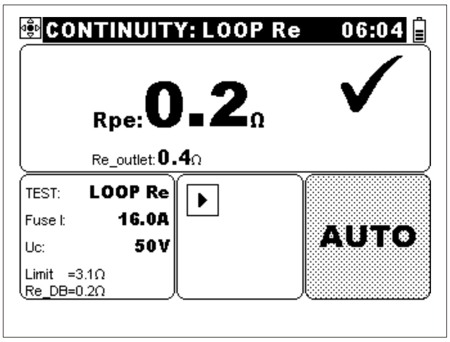
For measurement of the PE resistance the following shall be applied:
- Two auto sequences with at least one function can be prepared (see *4.3*).
- The first auto sequence (*sequence* ***A***) intended for measurement at distribution board level shall contain function **LOOP Re**.
- The second auto sequence (*sequence* ***B***) intended for measurement of wall sockets and consumers shall contain **CONTINUITY** function with sub-function **LOOP Re**.

### PE wire resistance measurement procedure

- Select the **AUTOSEQUENCE** mode.
- Select auto sequence ***A***.
- **Connect** test leads to the tested distribution board and the instrument (see *figure F.1*).
- Press the **TEST** key.
- After the measurement is finished, select auto sequence ***B***.
- **Connect** test leads to the tested wall socket or consumer and the instrument (see *figure F.1*).
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- Press the **TEST** key.
- After the measurement is finished, **store** the result (optional).




*LOOP Re at distribution board*




*LOOP Re at wall socket*

*Figure F.2: Examples of LOOP Re measurement results*

Displayed results:
Re..............Resistance of PE wiring at distribution board.
Rpe............Resistance of PE wiring between distribution board and wall socket.
Re_outlet...Resistance of complete PE wiring.

**Notes:**

- Resistance Re for distribution board (=Re_DB) is kept in the instrument memory until new LOOP Re is done or the instrument initialized (see *4.4.5*).
- CONTINUITY with LOOP Re sub-function operates only with the right connected test connection.

### F.2.3 IT modification - CONTINUITY LOOP Re

The procedure is intended for measurement the resistance of PE wiring between distribution board and individual wall sockets. This is auto test only accessible procedure consisting of two special functions: the **LOOP Re** and the **CONTINUITY** with **LOOP Re sub-function**.

**Test parameters for LOOP Re function**

This function does not have any parameters.

**Test parameters for CONTINUITY LOOP Re function**

| | |
|---|---|
| TEST | Test **sub-function** [**LOOP Re**, R200mA, R7mA]. |
| With LOOP Re selected: | |
| Limit | **Maximum resistance** [OFF, 0.1 Ω ÷ 20.0 Ω] |
| Re_DB | Resistance of PE wiring to distribution board (result of LOOP Re measurement). |

### Circuit for measurement the resistance of PE wire

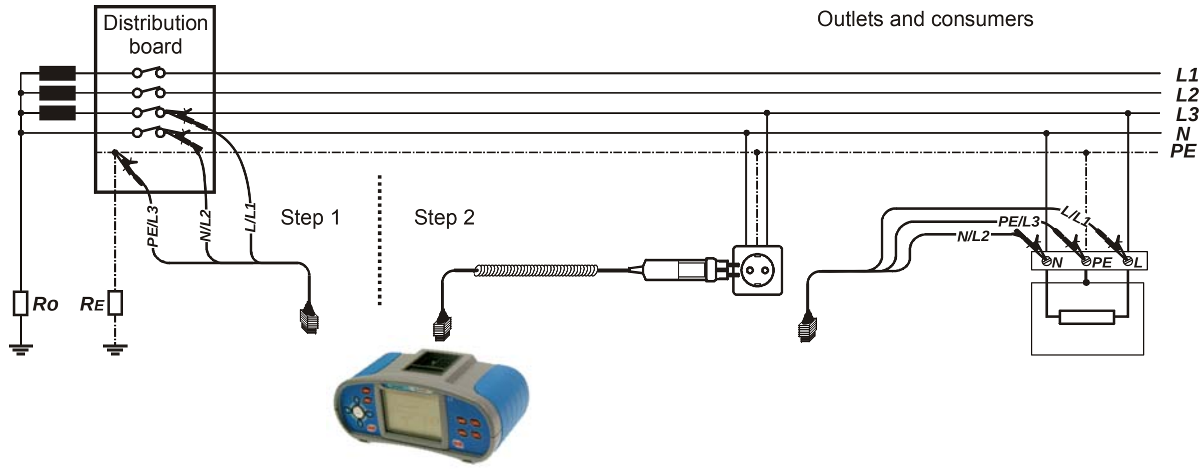



*Figure F.3: Two step procedure for PE wiring resistance measurement – connection of plug commander and universal test cable*

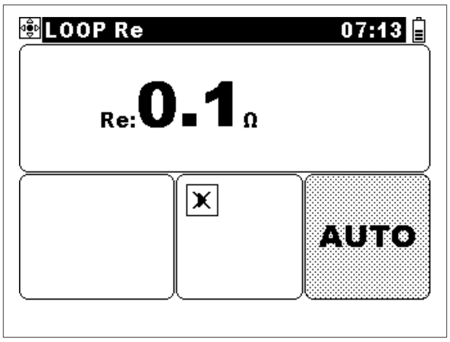
### Auto sequence recommendation

For measurement of the PE resistance the following shall be applied:

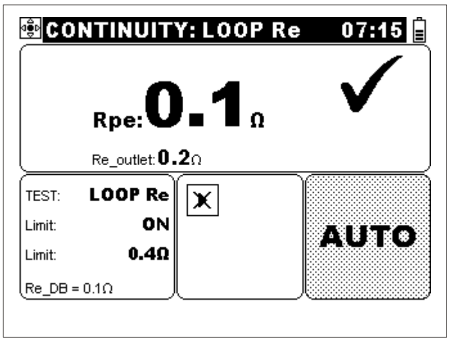
- Two auto sequences with at least one function can be prepared (see *4.3*).
- The first auto sequence (*sequence **A***) intended for measurement at distribution board level shall contain function **LOOP Re**.
- The second auto sequence (*sequence **B***) intended for measurement of wall sockets and consumers shall contain **CONTINUITY** function with sub-function **LOOP Re**.

### PE wire resistance measurement procedure

- Select the **AUTOSEQUENCE** mode.
- Select auto sequence ***A***.
- **Connect** test leads to the tested distribution board and the instrument (see *figure F.3*).
- Press the **TEST** key.
- After the measurement is finished, select auto sequence ***B***.
- **Connect** test leads to the tested wall socket or consumer and the instrument (see *figure F.3*).
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- Press the **TEST** key.
- After the measurement is finished, **store** the result (optional).




*LOOP Re at distribution board*




*LOOP Re at wall socket*

*Figure F.4: Examples of LOOP Re measurement results*

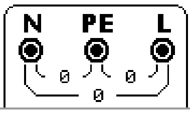
Displayed results:
Re..............Resistance of PE wiring at distribution board.
Rpe............Resistance of PE wiring between distribution board and wall socket.
Re_outlet....Resistance of complete PE wiring.

**Notes:**
- Resistance Re for distribution board (=Re_DB) is kept in the instrument memory until new LOOP Re is done or the instrument initialized (see *4.4.5*).
- CONTINUITY with LOOP Re sub-function operates only with the right connected test connection.

### F.2.4 CH modification - Change L/N

In the terminal voltage monitor (see *3.5.1*) the positions of L and N indications are opposite to standard version.

Voltage monitor example:




Online voltage is displayed together with test terminal indication.

**Note**:
- All figures in main text of the user manual containing the terminal voltage monitor has to be read as the example above for this modification.

### F.2.5 DK modifications

DK modifications relate to modified fault loop test group.

**Fault loop impedance and prospective fault current**

Fault loop is a loop comprising mains source, line wiring and PE return path to the mains source. The instrument has ability to measure impedance of mentioned loop and calculate short circuit current and contact voltage regarding the selected circuit breaker type. The measurement is covered by requirements of the EN 61557-3 standard.

See *4.2 Single test* for active keys.

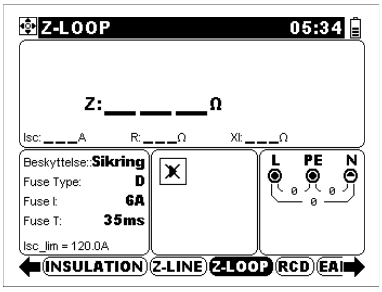



*Figure F.5: Fault loop impedance*

**Test parameters for fault loop impedance measurement**

| | |
|---|---|
| TEST | Selection the **type of** fault loop **measurement** [Sikring, RCD*, Rs(RCD)*] |
| **Sikring** or **RCD** selected: | |
| Fuse type | Selection of **fuse type** [---, NV, gG, B, C, K, D] ** |
| Fuse I | **Rated current** of selected fuse |
| Fuse T | Maximum **breaking time** of selected fuse |
| Isc_lim | Minimum short circuit **current** for selected fuse combination |
| **Rs(RCD)** selected: | |
| RCD | Rated residual current **sensitivity** of RCD [10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA] |
| Uc | Touch voltage **limit** [50 V, 25 V] |
| Rlim | Maximum fault loop **resistance** for selected RCD and Uc combination |

See Appendix A for reference fuse data.
* Select RCD or Rs(RCD) to prevent trip-out of RCD in RCD protected installation.
** --- Means no fuse selected.

**Circuits for measurement of fault loop impedance**

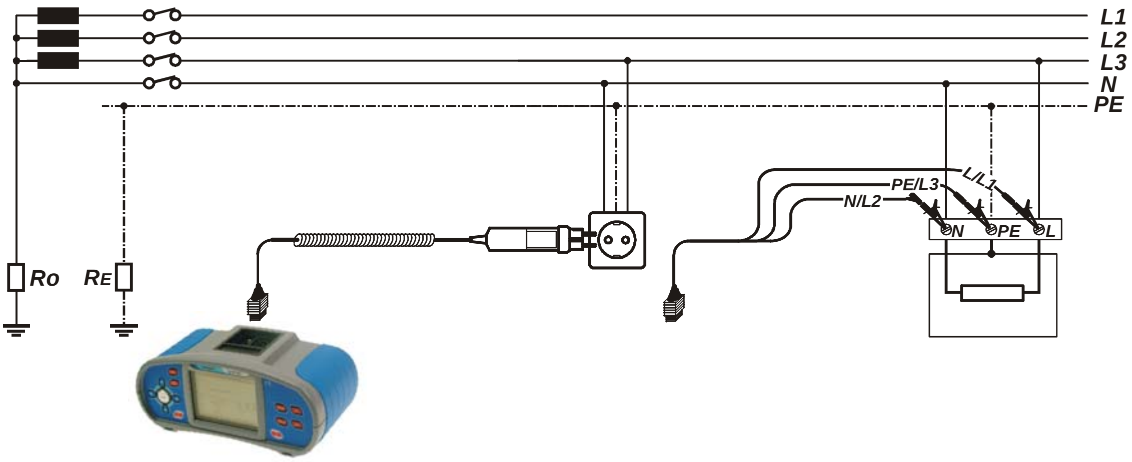



*Figure F.6: Connection of plug cable and universal test cable*

**Fault loop impedance measurement procedure**

- Select the **Z-LOOP** function.
- Select test **parameters** (optional).
- **Connect** test cable to the EurotestAT**.**
- **Connect** test leads to the tested object (see *figure F.6*).

- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

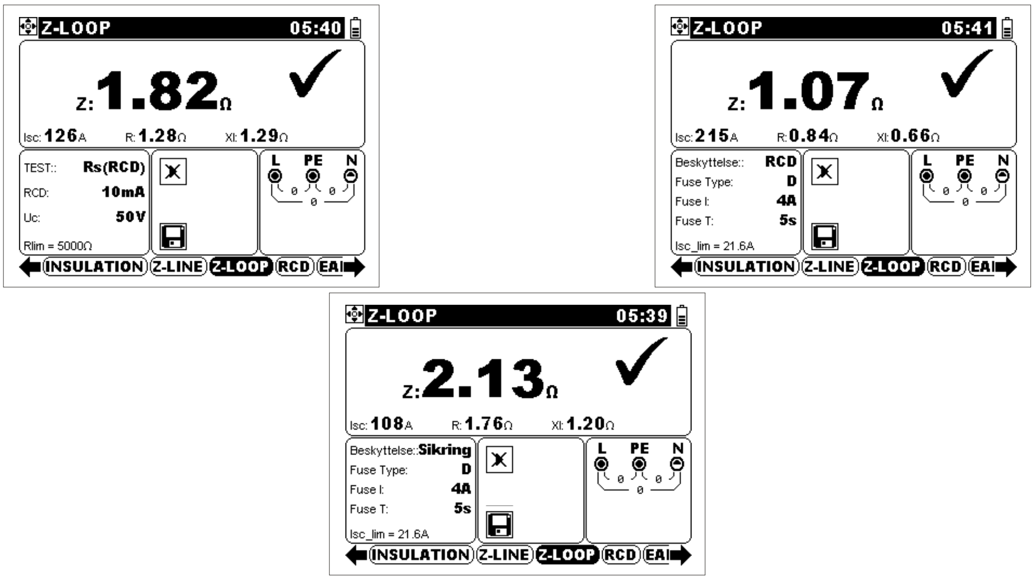



*Figure F.7: Examples of loop impedance measurement results*

Displayed results:
Z ..............Fault loop impedance,
$I_{SC}$ ............Prospective fault current,
R..............Resistive part of loop impedance,
Xl .............Reactive part of loop impedance,

Prospective fault current $I_{SC}$ is calculated from measured impedance as follows:

$$I_{SC} = \frac{Un \times k_{SC}}{Z}$$

where:
Un ........Nominal $U_{L\text{-}PE}$ voltage (see table below),
ksc .......Correction factor for Isc (see chapter *4.4.2*).

| $U_n$ | Input voltage (L-PE) |
|---|---|
| 110 V | $(93\ V \le U_{L\text{-}PE} < 134\ V)$ |
| 230 V | $(185\ V \le U_{L\text{-}PE} \le 266\ V)$ |

**Notes:**

- High fluctuations of mains voltage influence the measurement results. The noise sign is displayed in the message field in such case. Repeat the measurement.
- Isc is not calculated in case the terminal voltage monitor does not detect voltage state that corresponds to the selected supply system, indication ?.
- This measurement will trip-out RCD in RCD-protected electrical installation if Sikring is selected as breaking device instead of RCD.

### F.2.6 AUS/NZ modifications

AUS/NZ modifications relate to modified fuse table.

*Modification of the chapter 4.4.2*

Isc factor is replaced with Z factor.

In the **Voltage system** menu the following parameters can be selected:

| | |
|---|---|
| **Voltage system** | Mains supply system type. |
| **Set Z factor** | Impedance limit correction factor. |
| **RDC testing** | RCD normative reference. |

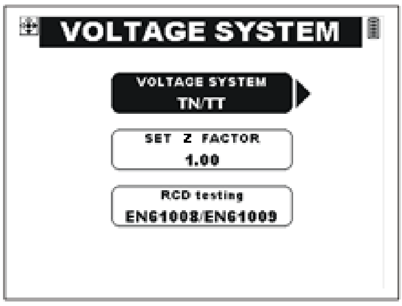



*Figure 4.24: System parameters*

The impedance limit values for different overcurrent protective devices depend on nominal voltage and are calculated using the Z factor. Z factor 1.00 is used for nominal voltage 230 V and Z factor 1.04 is used for nominal voltage 240 V.

*Modification of the chapter 4.4.5*

The default setup is listed below:

| **Instrument setting** | **Default value** |
|---|---|
| Z factor | 1.00 |
| RCD standards | AS/NZS 3017 |

*Modification of the chapter 5.4*

**Modified test parameters for fault loop impedance measurement**

| | |
|---|---|
| Fuse type | Selection of **fuse type** [---, FUSE, B, C, D] ** |
| Z_lim | **High limit fault loop impedance value** for selected fuse. |

See Appendix A.2 for reference fuse data.
** --- Means no fuse selected.

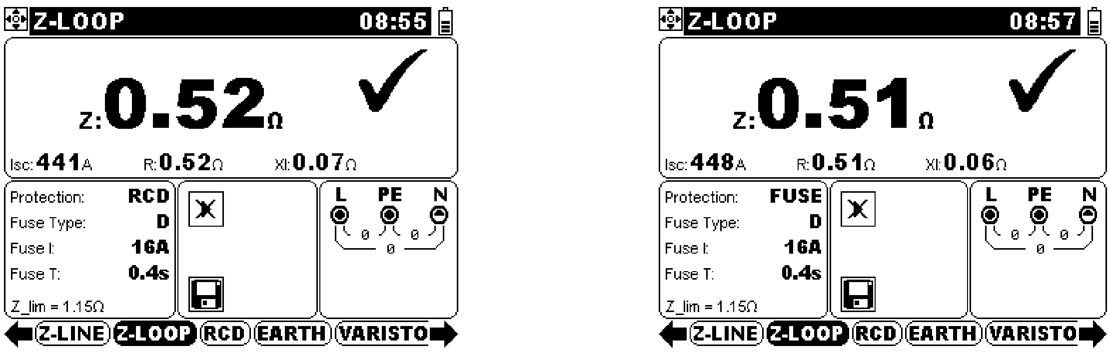



*Figure F.1: Examples of loop impedance measurement result*

Displayed results:
Z..............Fault loop impedance,
Isc............Prospective fault current,
R..............Resistive part of loop impedance,
Xl.............Reactive part of loop impedance.

Prospective fault current $I_{PFC}$ is calculated from measured impedance as follows:

$$I_{PFC} = \frac{U_N}{Z_{L-PE} \cdot scaling\_factor}$$

where:
Un ........Nominal $U_{L-PE}$ voltage (see table below),
scalling_factor......Correction factor for Isc (set to 1.00).

| $U_n$ | Input voltage (L-PE) |
|---|---|
| 110 V | (93 V ≤ $U_{L-PE}$ < 134 V) |
| 230 V | (185 V ≤ $U_{L-PE}$ ≤ 266 V) |

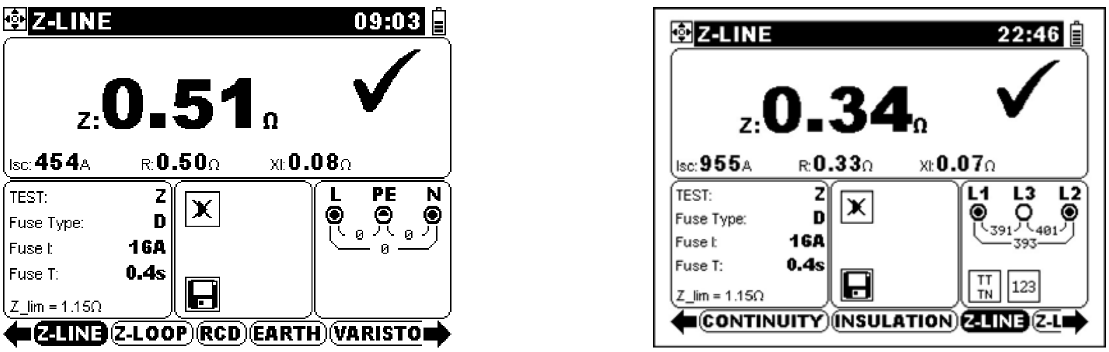
*Modification of the chapter 5.5*

**Modified test parameters for fault loop impedance measurement**

| | |
|---|---|
| Fuse type | Selection of **fuse type** [---, FUSE, B, C, D] * |
| Z_lim | **High limit line impedance value** for selected fuse. |

See Appendix A.2 for reference fuse data.
* --- Means no fuse selected.

*Modification of the chapter 5.5.1*




*Line to neutral* *Line to line*

*Figure F.2: Examples of line impedance measurement result*

Displayed results:
Z..............Line impedance,
Isc............Prospective short-circuit current,
R..............Resistive part of line impedance,
XL............Reactive part of line impedance.

Prospective short circuit current is calculated as follows:

$$I_{PFC} = \frac{U_N}{Z_{L-N(L)} \cdot scaling\_factor}$$

where:
Un ........ Nominal L-N or L1-L2 voltage (see table below),
Scalling factor ...... Correction factor for Isc (set to 1.00).

| $U_n$ | Input voltage range (L-N or L1-L2) |
| --- | --- |
| 110 V | ($93 V \le U_{L-N} < 134 V$) |
| 230 V | ($185 V \le U_{L-N} \le 266 V$) |
| 400 V | ($321 V < U_{L-L} \le 485 V$) |

*Modification of the chapter 5.8*

**Modified test parameters for 2 Ω line/loop impedance measurement**

| | |
| --- | --- |
| Fuse type | Selection of **fuse type** [---, FUSE, B, C, D] * |
| Z_lim | **High limit line impedance value** for selected fuse. |

See Appendix A.2 for reference fuse data.
* --- Means no fuse selected.

# G Appendix G – ES1; application of regulative UNE-202008

ES1 modification enables operator to select limits and test procedures according to national regulative UNE-202008.

## G.1 Main menu

In the **Main** menu an additional operation mode to those listed in chapter *4.1* can be set.

- Inspection menu.

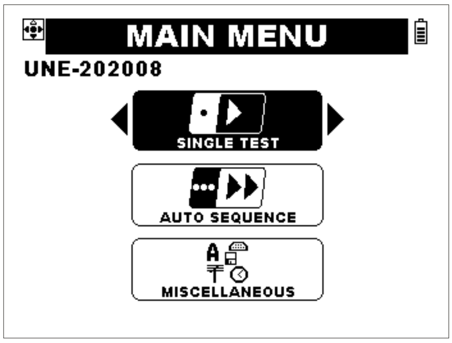



*Figure 4.1: Main menu*

Additional keys:

| | |
|---|---|
| ← / → | Toggle between Single test and Inspection menu |

is intended to run individual measurement functions (see *4.2*).

is intended for visual inspections (see *G.1.1*).

### G.1.1 Inspection

Keys in main **Inspection** screen:

| | |
|---|---|
| ← / → | Select inspection type:<br>□ <**Aplicacion REBT 2002**> Periodic inspection according to REBT 2002.<br>□ <**Aplicacion REBT 1973***> Periodic inspection according to REBT 1973.<br>□ <**Hasta diciembre 1975***> Periodic inspection according to requirements from 1975. |
| **TEST** | Starts selected inspection type. |
| **F2** | Clears all schedule flags. |
| **TEST, ESC** | Stops inspection. |
| **MEM** | Stores inspection results / recalls inspection results. |

See *Chapter 5* for more information about standard operations of the instrument in single test and *Chapter G.3* for regulative UNE-202008 related operations of the instrument in single test plus inspection functions.

## G.2 Miscellaneous

menu as defined in *chapter 4.4 Miscellaneous* has additional option.

Additional option is:

- Selection standard or regulative supported measurement.

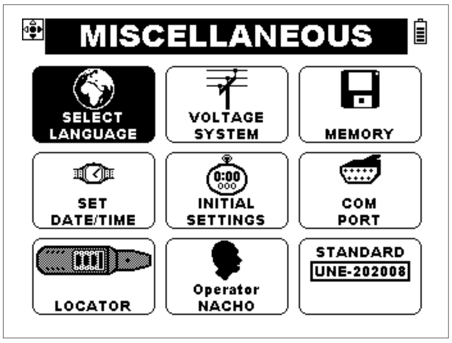



*Figure G.1: Options in Miscellaneous menu*

### G.2.1 Operation mode

Standard measurements plus parameters or measurements with parameters that support UNE-202008 can be selected in this menu.

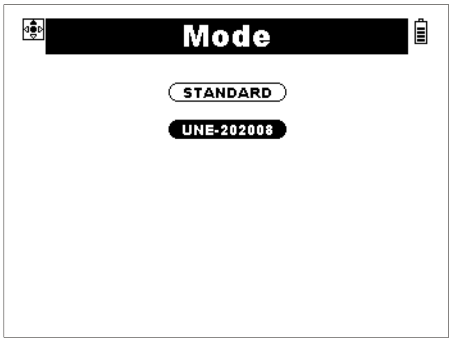



*Figure G.2: Operation mode selection*

Keys:

| | |
|---|---|
| ↑ / ↓ | Select operation mode. |
| **TEST** | Confirms selected mode. |
| **ESC** | Exits without changes. |

## G.3 Measurements

This chapter contains description of operation of single tests / inspection that are new or different to standard procedures from *Chapter 5*.

### G.3.1 Inspections

This function is intended to support visual inspections of tested installation or installation assemblies. Result flags for each individual item can be set.

See chapter *G.1.1 Inspection* for functionality of keys in Main inspection menu.


*Figure G.3: Inspections menu*

**Inspection types**

| | |
|---|---|
| Item | **Inspection type** [Aplicacion REBT 2002, Aplicacion REBT1973*, Hasta diciembre 1975*] |

Further keys are active after starting inspection:

| | |
|---|---|
| **F2** | Clears all flags in selected schedule. |
| ↓ / ↑ | Select individual item in selected schedule. |
| ← / → | *Selected header line:* Apply same flag to all items in selected header. |
| | *Selected particular item:* Apply appropriate result (flag) to selected item. |

**Inspection procedure**

- Select the **INSPECTION** function.
- Select Inspection **type**.
- Press **TEST** key to start inspection.
- Browse through items line by line and apply appropriate flags.
- Press **TEST** or **ESC** key to stop inspection.
- **Store** the inspection result (optional).

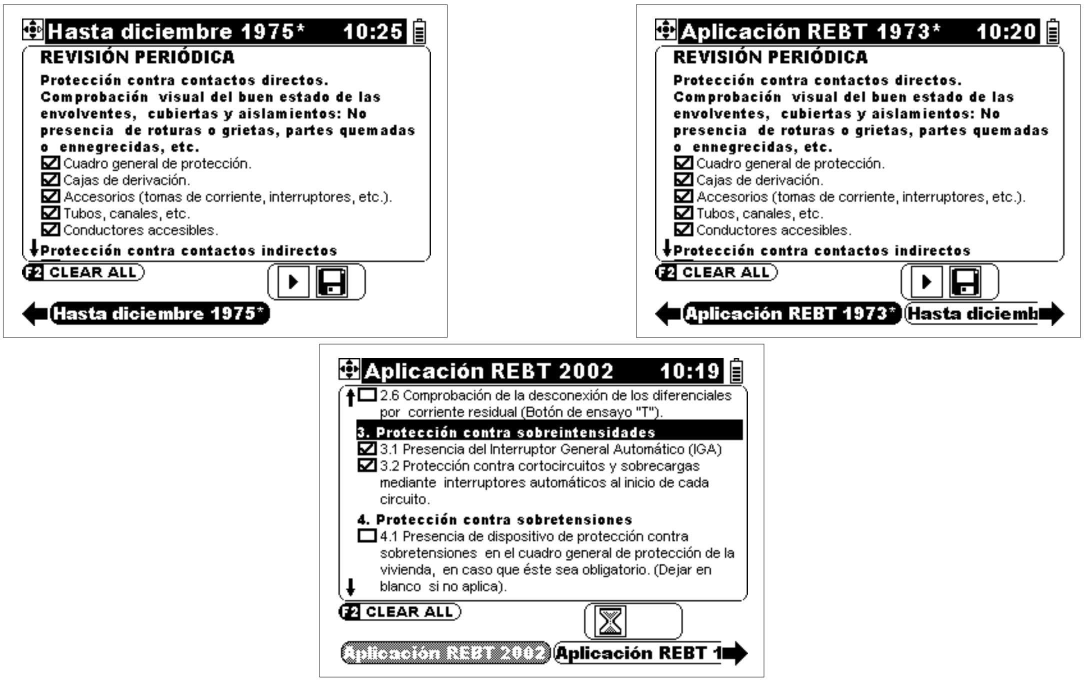



*Figure G.4: Examples of results*

Markings:
☐ ...........Inspection was not performed
☑ ...........Inspection passed.
☒ ...........Inspection failed.

### G.3.2 Resistance to earth connection and equipotential bonding

The resistance measurement is performed in order to assure that protective measures against electric shock through earth bond connections are effective. Five subfunctions are available:

- Earth bond resistance measurement according to EN 61557-4 (between N and PE terminals, test current >200 mA),
- Earth bond resistance measurement according to EN 61557-4 (between L and PE terminals, test current >200 mA),
- Continuous resistance measurement with lower test current (between N and PE terminals, test current ca 7 mA),
- Continuous resistance measurement with lower test current (between L and PE terminals, test current ca 7 mA), and
- Resistance of PE conductor through fault loop measurement.

See chapter *4.2 Single test* for functionality of keys.

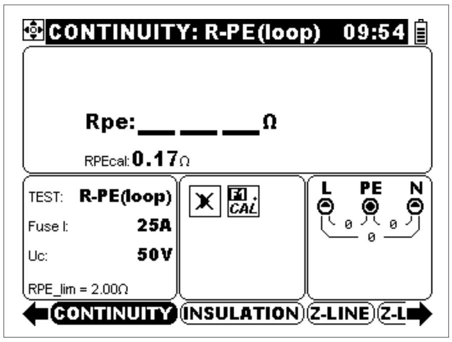



*Figure G.5: Continuity*

**Test parameters for resistance measurement**

| | |
|---|---|
| TEST | Resistance measurement **sub-function** [R200mA NPE, R7mA NPE, R200mA LPE, R7mA LPE, R-PE(loop)] |
| **If** R-PE(loop) then | |
| Fuse I | **Rated current** of fuse [---, 6 A, 10 A, 16 A, 20 A, 25 A]*. |
| Uc | Touch voltage **limit** [25 V, 50 V]. |
| RPE_lim | **Maximum** PE resistance. |
| RPE_cal | **Calibrated value** of PE resistance given by reference loop impedance measurement (see *G.3.3 Fault loop impedance and prospective fault current*). |
| **else** | |
| Limit | **Maximum resistance** [OFF, 0.1 Ω ÷ 20.0 Ω] |

*--- Means no fuse selected.

#### G.3.2.1 Continuity R200 mA measurement

See *Chapter 5.2.1 Continuity R200 mA measurement*.

#### G.3.2.2 7 mA resistance measurement

See *Chapter 5.2.2 7 mA resistance measurement*.

### G.3.2.3 R-PE(loop) measurement

It is based on Z-Loop measurement which also gives reference value measured at e.g. switchboard or common coupling point of tested electrical installation.

**Test circuit for R-PE(loop) measurement**

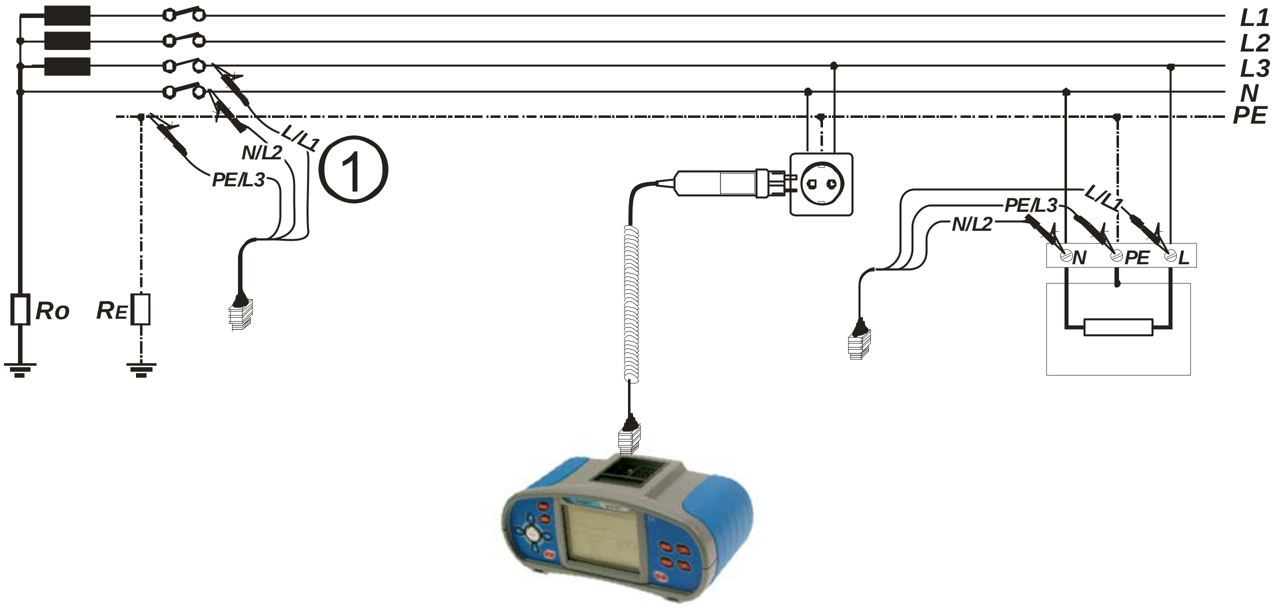



*Figure G.6: Connection for reference (1) and socket measurements*

**R-PE(loop) measurement procedure**
(For reference measurement procedure see chapter *G.3.3 Fault loop impedance and prospective fault current*)

- Select the **CONTINUITY** function.
- Set sub-function **R-PE(loop)**.
- Enable and select **Fuse I** (optional).
- Select maximum **touch voltage Uc** (optional).
- **Connect** test cable to the instrument.
- Tested installation must be in normal operating condition with mains supply.
- **Connect** test leads to the tested socket (see *figure G.6*).
- Press the **TEST** key for measurement.
- After the measurement is finished **store** the result (optional).

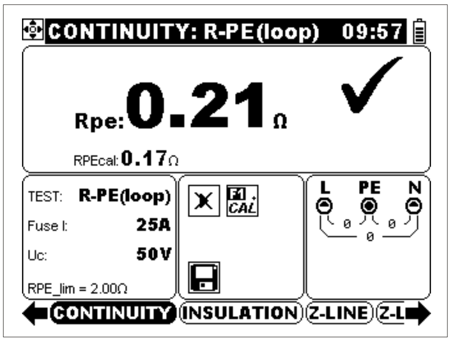



*Figure G.7: Example of continuity R-PE(loop) result*

Displayed results:
Rpe..........Resistance of PE conductor between reference point and tested socket,
RPEcal ....PE resistance value of reference socket (given in Z-LOOP function).

**Notes**:
- **Warning! Measurement is executed on live installation!**
- Pay attention on proper selected location for reference fault loop impedance measurement!
- Measurement can only be done with right polarity of connected test leads.
- High fluctuations of mains voltage influence the measurement results. The noise sign is displayed in the message field in such case. Repeat the measurement.

### G.3.3 Fault loop impedance and prospective fault current

Fault loop is a loop comprising mains source, line wiring and PE return path to the mains source. The instrument has ability to measure impedance of mentioned loop and calculate short circuit current and contact voltage regarding the selected circuit breaker type. The measurement is covered by requirements of the EN 61557-3 standard.

See *4.2 Single test* for active keys.

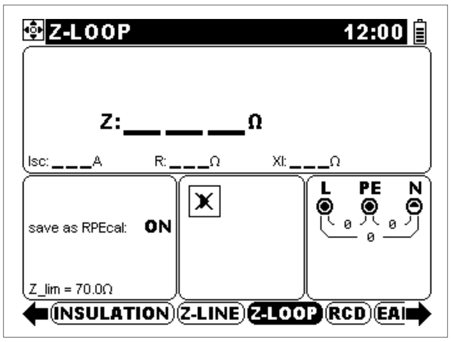



*Figure G.8: Fault loop impedance*

**Test parameters for fault loop impedance measurement**

| | |
|---|---|
| Save as RPEcal | Use result as reference value for **$R_{PE}$ measurement** [ON, OFF] |
| Z_lim = 70.0 Ω | Maximum **fault loop impedance** by default from regulative. |

**Circuits for measurement of fault loop impedance**

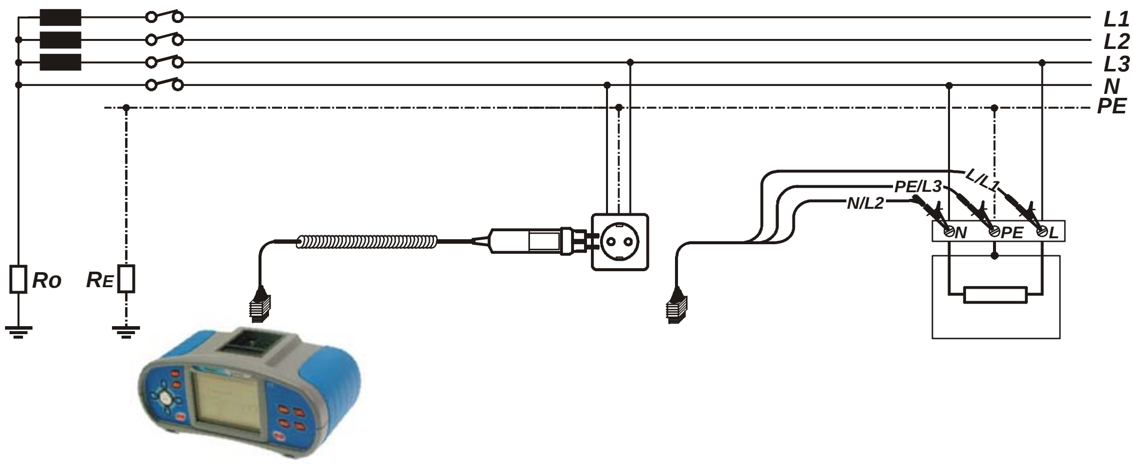



*Figure G.9: Connection of plug cable and universal test cable*

**Fault loop impedance measurement procedure**

- Select the **Z-LOOP** function.
- Select test **parameters** (optional).
- **Connect** test cable to the EurotestAT**.**
- **Connect** test leads to the tested object (see *figure G.9*).
- Press the **TEST** key.
- After the measurement is finished **store** the result (optional).

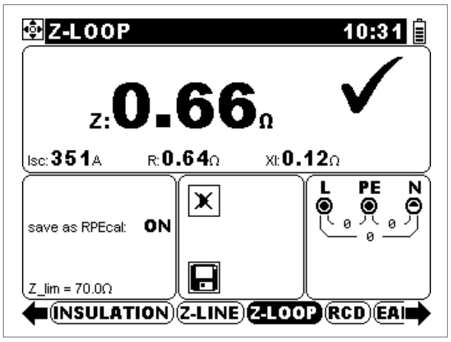



*Figure G.10: Example of loop impedance measurement result*

Displayed results:
Z..............Fault loop impedance,
$I_{SC}$............Prospective fault current,
R..............Resistive part of loop impedance,
Xl.............Reactive part of loop impedance.

Prospective fault current $I_{SC}$ is calculated from measured impedance as follows:

$$I_{SC} = \frac{Un \times k_{SC}}{Z}$$

where:
Un ........Nominal $U_{L-PE}$ voltage (see table below),
ksc .......Correction factor for Isc (see chapter *4.4.2*).

| $U_n$ | Input voltage (L-PE) |
|---|---|
| 110 V | $(93\ V \le U_{L-PE} < 134\ V)$ |
| 230 V | $(185\ V \le U_{L-PE} \le 266\ V)$ |

**Notes:**

- High fluctuations of mains voltage influence the measurement results. The noise sign is displayed in the message field in such case. Repeat the measurement.
- Isc is not calculated in case the terminal voltage monitor does not detect voltage state that corresponds to the selected supply system, indication ?.
- This measurement will trip-out RCD in RCD-protected electrical installation if FUSE is selected as breaking device instead of RCD.

### G.3.4 Line impedance and prospective short-circuit current

Line impedance is measured in loop comprising of mains voltage source and line wiring (L and N). It is covered by requirements of the EN 61557-3 standard.

See *4.2 Single test* for keys functionality.

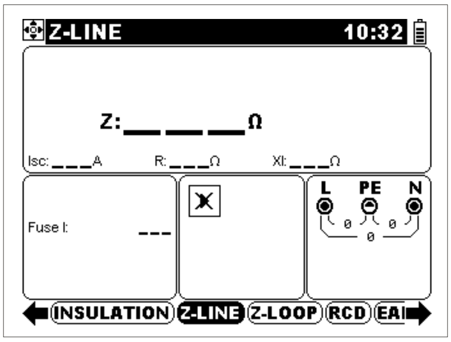



*Figure G.11: Line impedance*

**Test parameters for line impedance measurement**

| | |
|---|---|
| FUSE I | **Rated current** of fuse [---, 6 A, 10 A, 16 A, 20 A, 25 A].* |
| Z_lim | Maximum **line impedance** for selected fuse. |

*--- Means no fuse selected

**Circuit for measurement of line impedance**

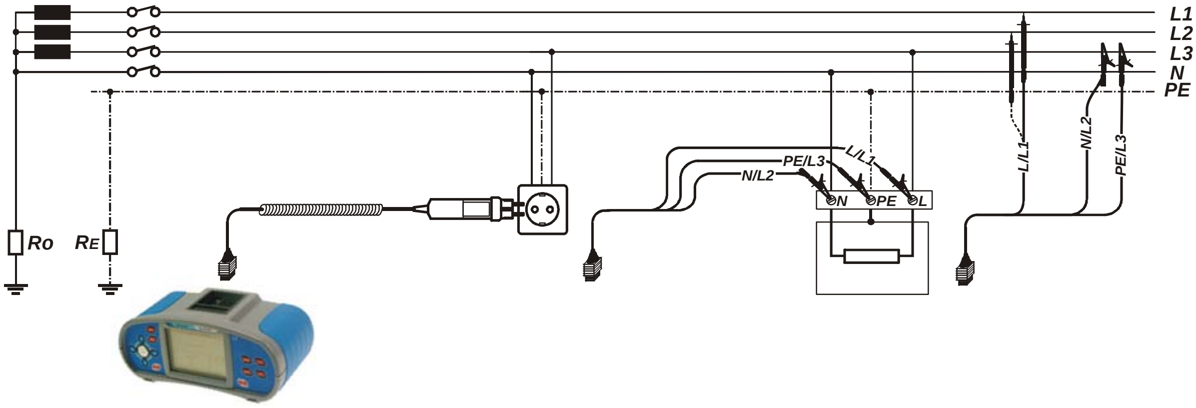
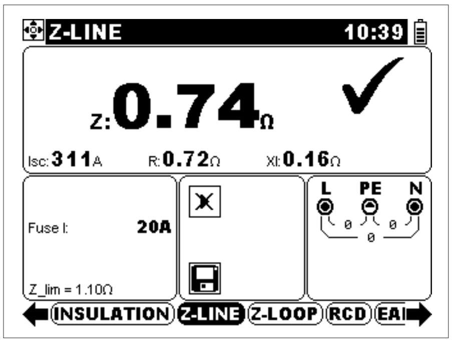


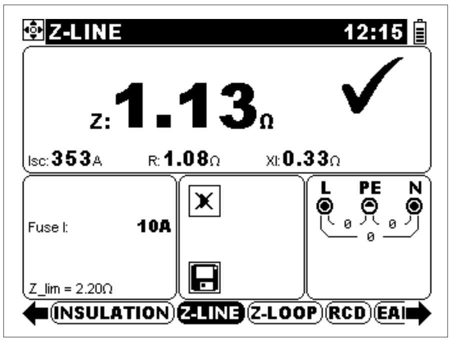

*Figure G.12: Phase-neutral or phase-phase line resistance measurement – connection of plug commander and universal test cable*

**Line impedance measurement procedure**

- Select the **Z-LINE** function.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** test leads to the tested object (see *figure G.12*).
- Press the **TEST** key.
- After the measurement is finished, **store** the result (optional).




*Line to neutral*




*Line to line*

*Figure G.13: Examples of line impedance measurement result*

Displayed results:
Z..............Line impedance,
Isc............Prospective short-circuit current,
R..............Resistive part of line impedance,
Xl.............Reactive part of line impedance.

Prospective short circuit current is calculated as follows:

$$I_{SC} = \frac{Un \times k_{SC}}{Z}$$

where:
Un........Nominal L-N or L1-L2 voltage (see table below),
ksc.......Correction factor for Isc (see chapter *4.4.2*).

| $U_n$ | Input voltage range (L-N or L1-L2) |
|---|---|
| 110 V | (93 V ≤ $U_{L-N}$ < 134 V) |
| 230 V | (185 V ≤ $U_{L-N}$ ≤ 266 V) |
| 400 V | (321 V < $U_{L-L}$ ≤ 485 V) |

**Note:**

- High fluctuations of mains voltage can influence the measurement results. The noise sign is displayed in the message field in this case. Repeat the measurement.
- Isc is not calculated in case the terminal voltage monitor does not detect voltage state that corresponds to the selected supply system, indication ?.