EurotestDL/XE

MI 3002/ MI 3102

Instruction manual

Version 1.0, HW 3; Code No. 20 750 468

METREL®

Distributor:

Manufacturer:

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

1 Preface

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

The Eurotest instrument is professional, multifunctional, hand-held test instrument intended to perform all the measurements required in order for a total inspection of electrical installations in buildings. The following measurements and tests can be performed:

- Voltage and frequency,
- Continuity tests,
- Insulation resistance tests,
- RCD testing,
- Fault loop / RCD trip-lock impedance measurements,
- Line impedance,
- Phase sequence,
- IMD testing (MI 3102 only),
- Resistance to earth (MI 3102 only),
- TRMS current (MI 3102 only),
- Illumination (MI 3102 only).

The large graphic matrix display with backlight offers easy to read results, indications, measurement parameters and messages. The operation of the instrument is designed to be as simple and clear as possible and no special training (except for the reading this instruction manual) is required in order to begin using the instrument.

To become more familiar with how to perform measurements in general and in typical applications, we recommend reading Metrel handbook *Measurements on electric installations in theory and practice*.

The instrument is equipped with all accessories required in order to perform testing comfortably. The soft carrying bag, included with the meter, protect the instrument and keep all accessories together making it simple and easy to move between locations.

2 Safety and operational considerations

2.1 Warnings and notes

In order to maintain the highest level of operator safety while carrying out various tests and measurements, Metrel recommends keeping your Eurotest instruments in good condition and undamaged. When using the instrument, consider the following general warnings:

- **The ⚠ symbol on the instrument means »Read the Instruction manual with special care for safe 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 could be impaired!**
- **Read this user manual carefully, otherwise the use of the instrument may be dangerous for the operator, the instrument or for the equipment under test!**
- **Do not use the instrument or any of the accessories if any damage is noticed!**
- **If a fuse blows in the instrument, follow the instructions in this manual in order 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 is only allowed to be carried out by a competent authorized personnel!**
- **Use only standard or optional test accessories supplied by your distributor!**
- **Consider that older accessories and some of the new optional test accessories compatible with this instrument only meet CAT III / 300 V overvoltage safety rating! This means that maximal allowed voltage between test terminals and ground is 300 V!**
- **The instrument comes supplied with rechargeable Ni-Cd or Ni-MH battery cells. The cells should only be replaced with the same type as defined on the battery compartment label or as described in this manual. Do not use standard alkaline battery cells while the 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.**
- **Do not connect any voltage source on CLAMP CURRENT input. It is intended only for connection of current clamp with current output. The Maximum continuous input current is 30 mA!**
- **All normal safety precautions must be taken in order to avoid risk of electric shock while working on electrical installations!**

Warnings related to measurement functions

Insulation resistance

- Insulation resistance measurement should only be performed on de-energized objects!
- When measuring the insulation resistance between installation conductors, all loads must be disconnected and all switches closed!
- Do not touch the test object during the measurement or before it is fully discharged! Risk of electric shock!
- When an insulation resistance measurement has been performed on a capacitive object, automatic discharge may not be done immediately! The warning message and the actual voltage is displayed during discharge until voltage drops below 10 V.
- Do not connect test terminals to external voltage higher than 550 V (AC or DC) in order not to damage the test instrument!

Continuity functions

- Continuity measurements should only be performed on de-energized objects!
- Parallel impedances or transient currents may influence test results.

Testing PE terminal

- If phase voltage is detected on the tested PE terminal, stop all measurements immediately and ensure the cause of the fault is eliminated before proceeding with any activity!

Notes related to measurement functions

General

- The indicator means that the selected measurement cannot be performed because of irregular conditions on input terminals.
- Insulation resistance, continuity functions and earth resistance measurements can only be performed on de-energized objects.
- PASS / FAIL indication is enabled when limit is set. Apply appropriate limit value for evaluation of measurement results.
- In the case that only two of the three wires are connected to the electrical installation under test, only voltage indication between these two wires is valid.

Insulation resistance

- If voltages of higher than 10 V (AC or DC) are detected between test terminals, the insulation resistance measurement will not be performed.

Continuity functions

- If voltages of higher than 10 V (AC or DC) are detected between test terminals, the continuity resistance test will not be performed.
- Before performing a continuity measurement, where necessary, compensate test lead resistance.

RCD functions

- Parameters set in one function are also kept for other RCD functions!
- The measurement of contact voltage does not normally trip an RCD. However, the trip limit of the RCD may be exceeded as a result of leakage current flowing to the PE protective conductor or a capacitive connection between L and PE conductors.
- The RCD trip-lock sub-function (function selector switch in **LOOP** position) takes longer to complete but offers much better accuracy of fault loop resistance (in comparison to the R_L sub-result in **Contact voltage** function).
- RCD trip-out time and RCD trip-out current measurements will only be performed if the contact voltage in the pre-test at nominal differential current is lower than the set contact voltage limit!
- The autotest sequence (RCD AUTO function) stops when trip-out time is out of allowable time period.

Fault loop / RCD trip-lock impedance

- The low limit prospective short-circuit current value depends on fuse type, fuse current rating, fuse trip-out time and impedance scaling factor.
- The specified accuracy of tested parameters is valid only if the mains voltage is stable during the measurement.
- Fault loop impedance measurements will trip an RCD.
- The measurement of fault loop impedance using trip-lock function does not normally trip an RCD. However, the trip limit may be exceeded as a result of leakage current flowing to the PE protective conductor or a capacitive connection between L and PE conductors.

Line impedance

- The low limit prospective short-circuit current value depends on fuse type, fuse current rating, fuse trip-out time and impedance scaling factor.
- The specified accuracy of tested parameters is valid only if the mains voltage is stable during the measurement.

Resistance to earth (MI 3102 only)

- If voltage between test terminals is higher than 30 V, the resistance to earth measurement will not be performed.
- If a noise voltage higher than approx. 5 V is present between the H and E or S test terminals, the “⌁” (noise) warning symbol will be displayed, indicating that the test result may be incorrect!

TRMS current (MI 3102 only)

- Use only a test clamp supplied by Metrel or another clamp with similar characteristics (current output, ratio, range). Consider the error of the test clamp when evaluating measured results!
- Metrel A 1074 and A 1019 current clamps are suitable for use with the MI 3102 EurotestXE instrument in range 0.2 A ÷ 200 A. Below 0.2 A they can be used as indicator only. They are not suitable for leakage current measurements.

Illumination (MI 3102 only)

- For accurate measurement make sure that the milk glass bulb is lit without any shadows being cast on it (e.g. by hand, body or other unwanted objects etc).
- It is very important to know that the artificial light source has reach full power/ illuminance (see technical data of light source for time periods) and should be therefore switched on for this period of time before any measurements are taken.

Testing the PE terminal

- The PE terminal can only be tested in the RCD, LOOP and LINE functions!
- For correct testing of PE terminal, the TEST key has to be touched for a few seconds.
- Make sure to stand on non-isolated floor while carrying out the test, otherwise the test result may be wrong!

2.2 Batteries

- ⚠ When connected to an installation, the instruments battery compartment can contain hazardous voltage inside! When replacing battery cells or before opening the battery/fuse compartment cover, disconnect any measuring accessory connected to the instrument and turn off the instrument,
- Ensure that the battery cells are inserted correctly otherwise the instrument will not operate and the batteries could be discharged.
- If the instrument is not to be used for a long period of time, remove all batteries from the battery compartment.
- Alkaline or rechargeable Ni-Cd or Ni-MH batteries (size AA) can be used. Metrel recommends only using rechargeable batteries with a capacity of 2100mAh or above.
- Do not recharge alkaline battery cells!

2.3 Charging

The batteries will begin charging whenever the power supply adapter is connected to the instrument. The built-in protection circuits control the charging procedure and assure maximum battery lifetime. The power supply socket polarity is shown in figure 2.1.

Figure 2.1: Power supply socket polarity

Note:

- Use only power supply adapter delivered from the manufacturer or distributor of the test equipment to avoid possible fire or electric shock!

2.4 Precautions on charging of new battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during the charging of new battery cells or cells that have been left unused for long periods of time (more than 3 months). Ni-MH and Ni-Cd cells can be subject to these chemical effects (sometimes called the memory effect). As a result the instrument operation time can be significantly reduced during the initial charging/discharging cycles of the batteries.

In this situation, Metrel recommend the following procedure to improve the battery lifetime:

- Completely charge the batteries for at least 14h via the instrument built-in charger.
- Completely discharge the batteries (this can be performed by using the instrument normally until the instrument is fully discharged).
- Repeat the charge/discharge cycle at least 2-4 times in order to restore the batteries to their normal capacity..

When using an external intelligent battery charger, one complete discharging/charging cycle can be performed automatically. After performing this procedure, a normal battery capacity should be fully restored and the operating time of the instrument will approximately meet the data set out in the in the technical specification.

Notes:

- The charger in the instrument is a pack cell charger. This means that the cells are connected in series during the charging so all of them must be in similar state (similarly charged, same type and age).
- If even one deteriorated battery cell (or just one of a different type e.g. capacity, chemical design) can cause disrupted charging of the entire battery pack which could lead to overheating of the battery pack and a significant decrease in the operating time.
- If no improvement is achieved after performing several charging/discharging cycles, the state of each individual battery cells should be determined (by comparing battery voltages, checking them in a cell charger, etc). It is very likely that one or more of the battery cells could have deteriorated.
- The effects described above should not be mixed with the normal battery capacity decrease over time. All charging batteries lose some of their capacity when repeatedly charged/discharged. The actual decrease in capacity compared to the number of charging cycles depends on the battery type. This information is normally provided in the technical specification from battery manufacturer.

2.5 Standards applied

The EurotestDL and EurotestXE instruments are manufactured and tested in accordance with the following regulations:

Electromagnetic compatibility (EMC)	
BS EN 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements Class B (Hand-held equipment used in controlled EM environments)
Safety (LVD)	
BS EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
BS EN 61010-031	Safety requirements for hand-held probe assemblies for electrical measurement and test
BS EN 61010-2-032	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement
Functionality	
BS EN 61557	Electrical safety in low voltage distribution systems up to 1000 V_{AC} and 1500 V_{AC} – 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 (MI 3102 only) Part 6 .... Residual current devices (RCDs) in TT and TN systems Part 7 .... Phase sequence Part 10........ Combined measuring equipment
DIN 5032	Photometry Part 7 .... Classification of illuminance meters and luminance meters
Other reference standards for testing RCDs	
BS EN 61008	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses
BS EN 61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses
EN 60364-4-41	Electrical installations of buildings Part 4-41 .... Protection for safety – protection against electric shock
BS 7671	IEE Wiring Regulations (17^{th} edition)

Note about EN and IEC standards:

- Text of this manual contains references to European and British 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

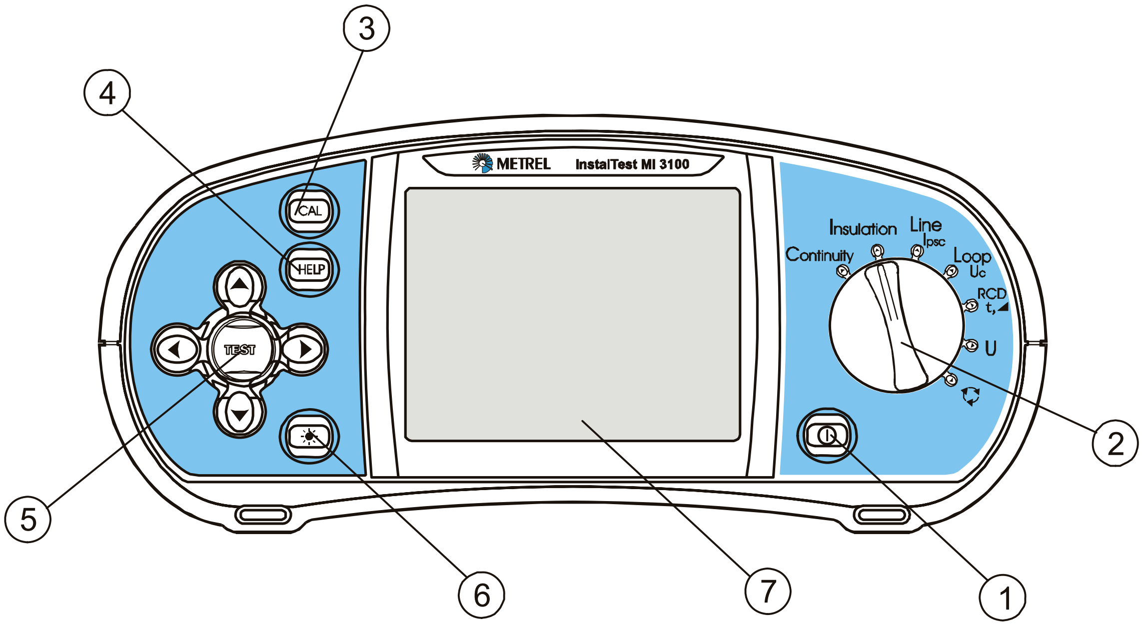


Figure 3.1: Front panel

Legend:

1 .... ON/OFF key, to switch the instrument on and off.
The instrument will automatically switch off 10 minutes after the last key press / function switch rotation.

2 .... Function selector switch.

3 .... MEM key, to access memory operations.

4 .... HELP/CAL key, to access help menus. CAL function can be used to compensate for the test lead resistance in low-value resistance measurements.

5 .... Jogger keypad with cursors for navigating screen menus and TEST keys for starting tests.
The TEST key also acts as the PE touching electrode which detects potentially dangerous voltages appearing on the PE conductor.

6 .... BACKLIGHT and CONTRAST key. This is used to turn the backlight on and off and for adjusting the level of the contrast.
The high level backlight is automatically shut off 20 seconds after the last key press / function switch rotation in order to extend service life of the battery.

7 .... 128 × 64 dots matrix display with backlight.

3.2 Connector panel

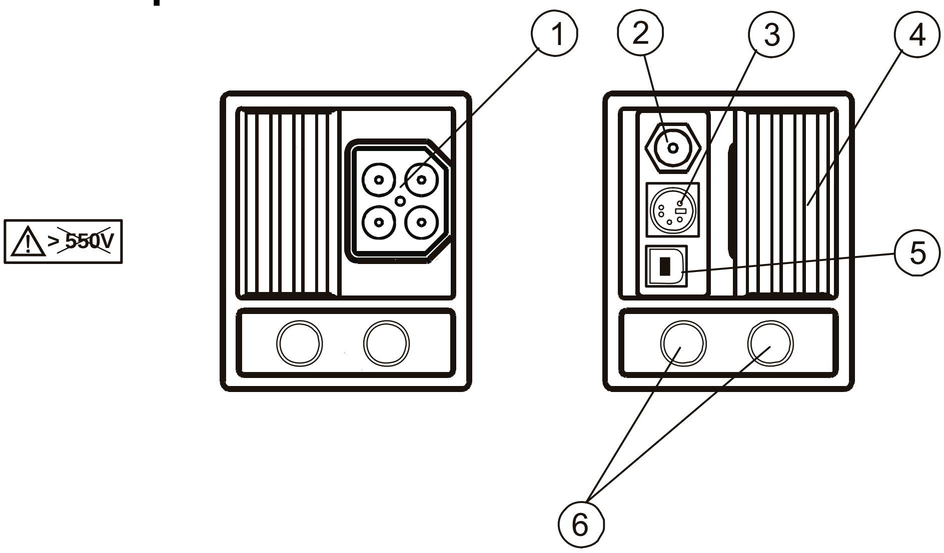


Figure 3.2: Connector panel

Legend:

1........ Test connector.
Warning! Maximum allowed voltage between test terminals and ground is 600V! Maximal allowed voltage between test terminals is 550 V!

MI 3102 only: In the earth resistance function, the test connector terminals are used as follows:

- N/L2 blue test lead is used for the earth electrode (E).
- L/L1 black test lead is used for the auxiliary earth electrode (H).
- PE/L3 green test lead is used for the probe (S).

2........ Power supply socket.

3........ RS 232 connector

4........ Protection connector cover.

5........ USB connector

6........ CLAMP CURRENT input (MI 3102 only).
Warning! Do not connect any voltage source to the current clamp input. It is intended for the connection of current clamps with current output only. The maximum continuous input current is 30 mA!

3.3 Back panel

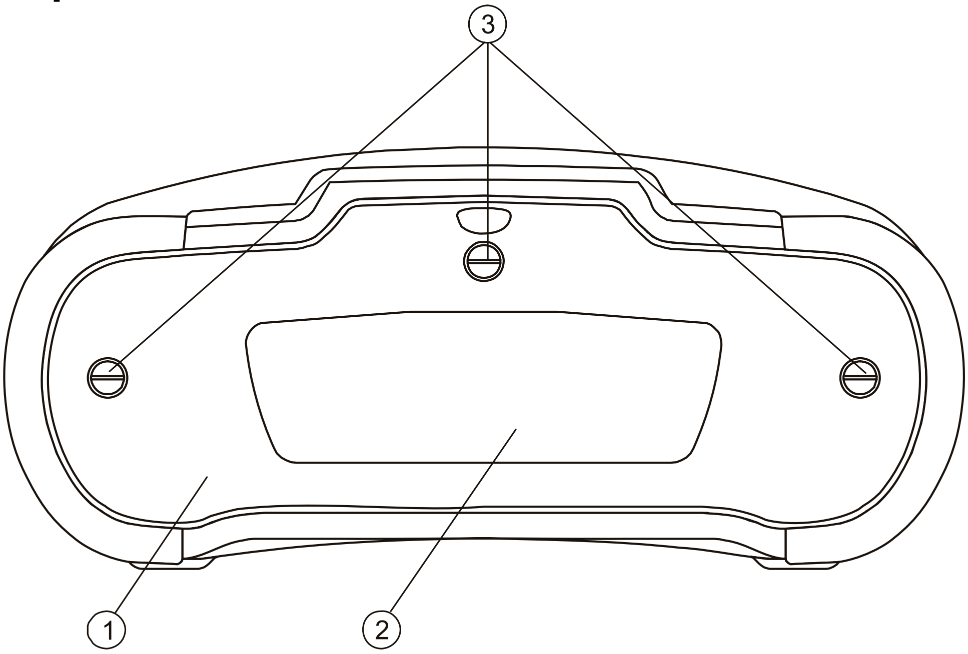


Figure 3.3: Back panel

Legend:

1........Battery/fuse compartment cover.
2........Information label.
3........Fixing screws for battery/fuse compartment cover.

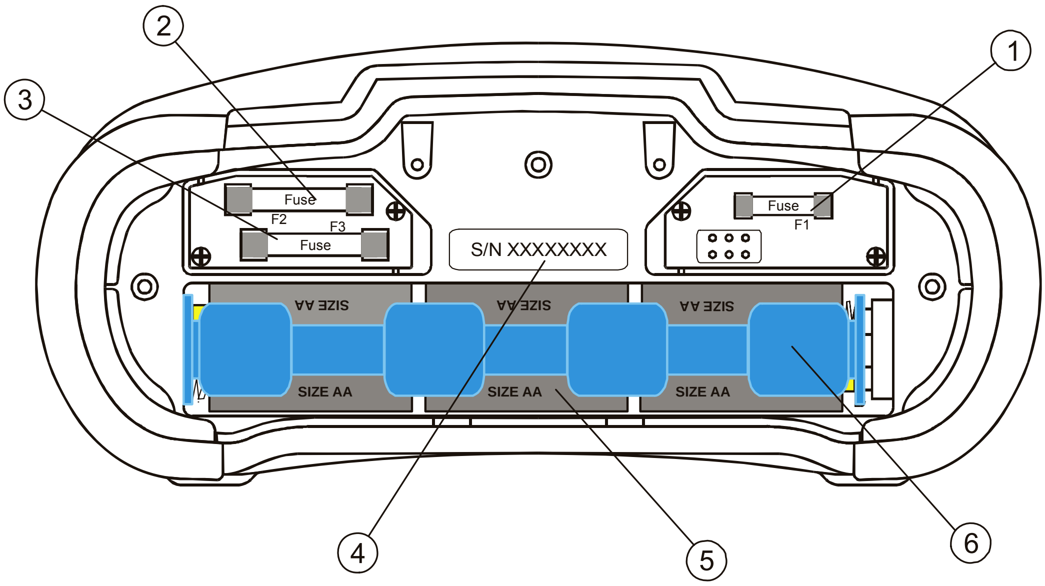


Figure 3.4.: Battery and fuse compartment

Legend:

1 .... Fuse F1.

2 .... Fuse F2.

3 .... Fuse F3.

4 .... Serial number label.

5 .... Battery cells (size AA).

6 .... Battery holder.

3.4 Bottom view

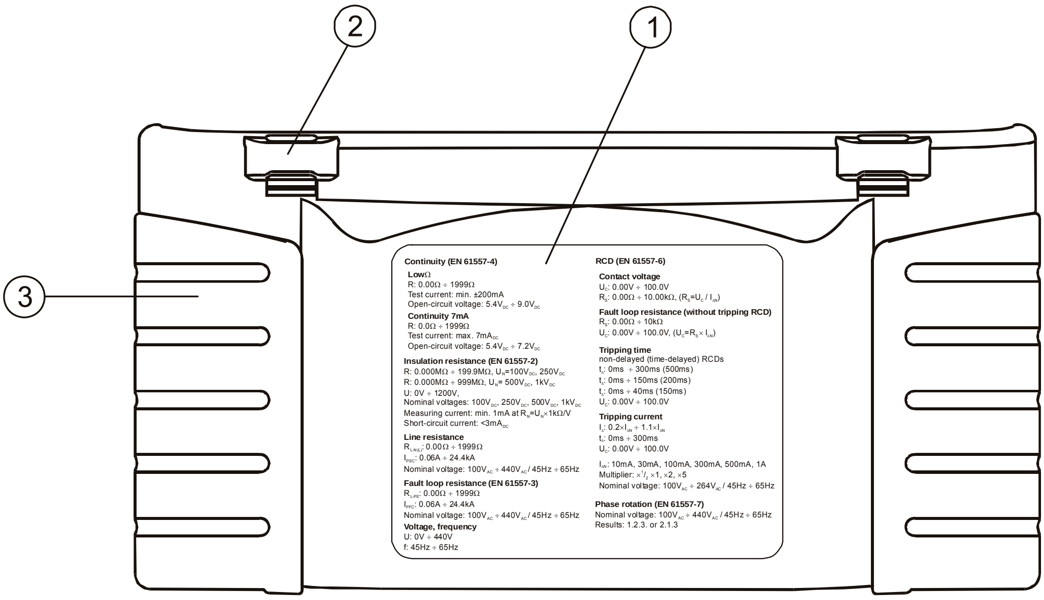


Figure 3.5: Bottom view

Legend:

1 .... Information label.

2 .... Neck strap openings.

3 .... Handling side covers.

3.5 Carrying the instrument

The neck strap supplied in standard set allows the instrument to be carried in a variety of different ways.. The operator can choose the most appropriate method based on the tasks they are performing. See the following examples:

		The instrument can be hung around operator's neck allowing the instrument to move freely. This allows equipment to be moved quickly between test locations.

	The instrument can be used from inside the soft carrying case – test cables can be connected to the instrument through the front flap of the carry case.

4 Instrument operation

4.1 Meaning of symbols and messages on the instrument display

The instrument display is divided into four sections:

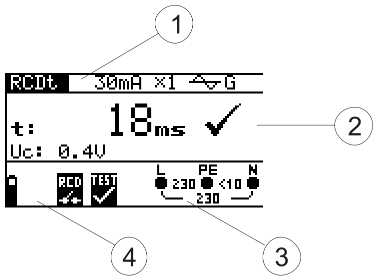


Figure 4.1: Display outlook

Legend:

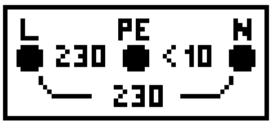
1 .... Function and parameter line.
In the top line of the display, the measuring function/sub-function and parameters are displayed.

2 .... Result field.
In this field the main result and sub-results together with the PASS/FAIL/ABORT status are displayed.

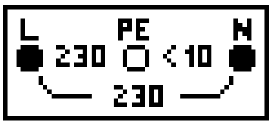
3 .... Online voltage and output monitor.

4 .... Message field.

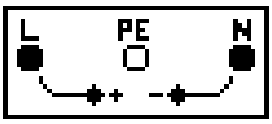
4.1.1 The online voltage and output terminal monitor



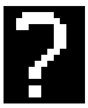
Online voltages are displayed together with test terminal indication. All three test terminals are used for selected measurement.



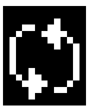
Online voltages are displayed together with test terminal indication. L and N test terminals are used for selected measurement.



Polarity of test voltage applied to the output terminals, L and N.



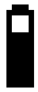
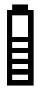
Unknown supply system.



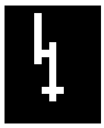
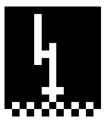
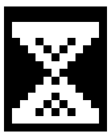
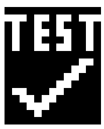
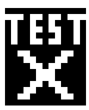
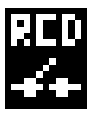
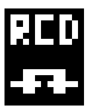
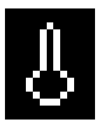
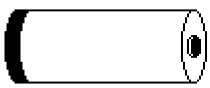
L – N polarity changed.

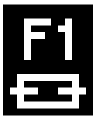
Frequency out of range.

4.1.2 Message field – battery status

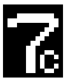
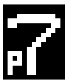
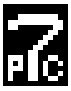
	Battery power indication.
	Low battery indication. Battery pack is too weak to guarantee correct result. Replace the batteries.
	Recharging is running (if power supply adapter is connected).

4.1.3 Message field – measurement warnings/messages

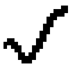
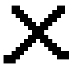
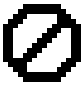
	**Warning!** High voltage is applied to the test terminals.
	**Warning!** Phase voltage on the PE terminal! Stop all the measurements immediately and eliminate the fault before proceeding with any activity!
	Measurement is running. Consider any displayed warnings!
	Measurement can be performed after pressing the TEST key. Consider any displayed warning after starting the measurement!
	Measurement prohibited. Consider any displayed warnings and check online voltage/terminal monitor!
Co	Test leads resistance in low-value resistance measurement is compensated.
	RCD tripped during the measurement. The trip limit may be exceeded as a result of leakage current flowing to the PE protective conductor or capacitive connection between L and PE conductors.
	RCD not tripped during the measurement.
	Instrument overheated. Temperature of internal components in the instrument reached top limit. Measurement is prohibited until the temperature is lower then that limit.
	Battery capacity is too low to guarantee correct result. Replace the batteries.

	Fuse F1 (continuity circuit) blown or not inserted.
	Single fault condition in IT system.
	Noise voltage is present between H and E or S test terminals.

MI 3102 only:

	Resistance of auxiliary earth electrode is higher than 100×R_E. Check the auxiliary earth electrode.
	Probe resistance is higher than 100×R_E. Check the probe.
	Resistances of auxiliary earth electrode and probe are higher than 100×R_E. Check all probes.

4.1.4 Result field

	Measurement passed.
	Measurement failed.
	Measurement is aborted. Check the conditions at the input terminal.

4.1.5 Other messages

Hard Reset	Instrument settings and measurement parameters/limits are set to initial (factory) values. For more information refer to chapter 4.5.4 *Recalling original settings.*
No probe	LUXmeter probe is turned off or disconnected from the EurotestXE instrument. Connect probe to the instrument using RS232 connector and turn it on (MI 3102 only).
First measurement	First stored measurement results are displayed.
Last measurement	Last stored measurement results are displayed.
Memory full	All memory locations are occupied.
Already saved	Measurement results already saved.
CHECK SUM ERROR	Memory contents damaged. Contact your distributor or manufacturer for further information.

4.1.6 Sound warnings

The shortest sound	Pressed key deactivated. Sub-function is not available.
Short sound	Pressed key activated. Measurement has been started after pressing the TEST key. Consider any displayed warnings during measurement.
Long sound	Measurement is prohibited. Consider any displayed warnings and check online voltage/terminal monitor!
Periodic sound	**Warning!** Phase voltage on the PE terminal! Stop all the measurements immediately and eliminate the fault before proceeding with any activity!

4.1.7 Function and parameter line

Figure 4.2: Function selector switch and belonging parameter line

Legend:

1……Main function name.

2……Function or sub-function name.

3……Measuring parameters and limit values.

4.2 Selecting measurement function/ subfunction

The following measurements can be selected with the function selector switch:

- Voltage and frequency,
- Insulation resistance,
- Low-value resistance,
- RCD testing,
- Fault loop impedance,
- Line impedance,
- Phase sequence,
- Resistance to earth (MI 3102 only),
- TRMS current (MI 3102 only),
- Illumination (MI 3102 only).

The function/sub-function name is highlighted on the display by default.
Sub-function can be selected by using ⋏ and ⋎ keys in function/parameter line.

4.3 Setting measurement parameters and limits

By using ≺ and ≻ keys select the parameter/limit value you want to edit. By using ⋏ and ⋎ keys the selected parameter can be set.

Once the measurement parameters are set, the settings are retained until new changes are made or the original settings are recalled.

4.4 Help menu

Help menus are available in all functions. The **Help** menu contains schematic diagrams for illustrating how to properly connect the instrument to electric installation. After selecting the measurement you want to perform, press the HELP key in order to view the associated **Help** menu.
Press the HELP key again to see further **Help** screens (if available) or to return to the function menu.

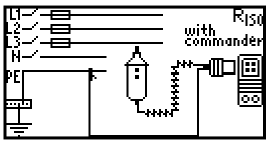


Figure 4.3: Example of help menu

4.5 Setup menu

In the **Setup** menu, the following actions can be taken:

- Supply system selection,
- Impedance scaling factor adjustment,
- Language selection,
- Communication port settings
- Support for remote commanders.

To enter the **Setup** menu press the BACKLIGHT key and rotate function selector switch in any direction at the same time.

Rotate function selector switch again to leave **Setup** menu or setup sub-menus.

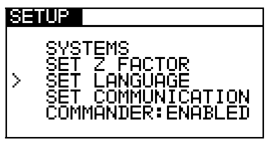


Figure 4.4: Setup menu

4.5.1 Supply system setup

The instrument enables tests and measurements in the following supply systems:

- TN (TT) system,
- IT system,
- Reduced low voltage system (2×55 V),
- Reduced low voltage system (3×63 V).

Select SYSTEMS in the **Setup** menu by using ⋏ and ⋎ keys and press the TEST key to enter the **Supply system** setup menu.

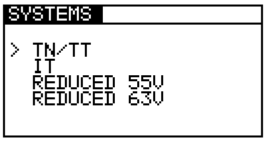


Figure 4.5: Supply systems selecting menu

By using ⋏ and ⋎ keys select supply system and press the TEST key to accept the setting.

4.5.2 Impedance scaling factor adjustment

Select SET Z FACTOR in **Setup** menu by using ⋏ and ⋎ keys and press the TEST key to enter the **Impedance scaling factor** adjustment menu.

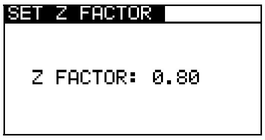


Figure 4.6: Scaling factor adjustment menu

Use the ⋏ and ⋎ keys to adjust the scaling factor and press the TEST key to accept the new setting.
The impedance limit values for different overcurrent protective devices are scaled down by a factor 0,8 or 0,75 (Z factor). This means that the fault current will still be high enough also at increased conductor temperatures and low supply voltage. This assures a safe operation of the overcurrent protection device in all conditions.

4.5.3 Language selection

Select SET LANGUAGE in **Setup** menu by using the ⮝ and ⮟ keys and press the TEST key to enter the **Language** selection menu.

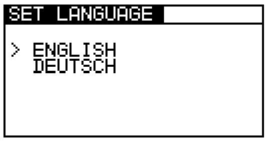


Figure 4.7: Language selecting menu

By using ⮝ and ⮟ keys select the language you want to use and press The TEST key to accept the new setting.

4.5.4 Communication port selection

Use the ⮝ and ⮟ keys in the **Setup** menu to highlight the SET COMMUNICATION PORT option and press the TEST key to enter the **Communication** menu.

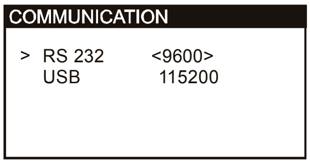


Figure 4.8: Communication menu

By using the ⮝ and ⮟ keys, select communication port you want to use. If the RS232 communication port is selected, use ⮜ and ⮞ keys to select baud rate (The USB port has a baud rate set to 115200 bps). Press the TEST key to accept the new setting.

Note:

- Only one port can be active at one time.

4.5.5 Plug / Tip commander support

Select COMMANDER in the **Setup** menu by using the ⮝ and ⮟ keys and press the TEST key to enable / disable the support for remote commanders.

If ***disable*** is selected, then keys on the Plug / Tip commander are disabled (except backlight key). This implies that the selected test can only be started (or results can be saved) using the keys on the instrument.
If ***enable*** is selected, the keys on Plug / Tip commander are activated and tests can be started and results saved either from the buttons on the instrument or the buttons on the remote commanders.

Note:

- This 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.

4.5.6 Recalling original settings

The following parameters and settings can be automatically set back to initial (factory) values:

- Test parameters and limit values,
- Contrast,
- Impedance scaling factor,
- Supply system,
- Communication port
- Support for remote commanders.

In order to restore the original setting of the instrument, press and hold ➢ key and switch on the instrument (the external charger must not be connected). »Hard reset« message will be displayed at start-up.

Instrument settings, measurement parameters and limits are set to their initial values as follows:

Instrument settings	**Default value**
Contrast	50 %
Impedance scaling factor	0.8
Supply system	TN/TT
Communication	RS232, 9600 bps
Commander	Enabled

Function **Sub-function**	**Parameter / limit value**
CONTINUITY r1, r2,rN, R1+R2, R2	High limit resistance value: 2.0 Ω
INSULATION ISO L/N, ISO L/E, ISO N/E, ISO L/L	Nominal test voltage: 500 V Low limit resistance value: 1 MΩ
LINE	Fuse type: none selected (∗F) Fuse current rating: none selected (∗A) Fuse tripping current: none selected (∗ms)
LOOP Z s Zs (rcd)	Fuse type: none selected (∗F) Fuse current rating: none selected (∗A) Fuse tripping current: none selected (∗ms)
RCD	Selected function: RCD Uc
Contact voltage – RCD Uc Trip-out time – RCD t Trip-out current – RCD ıll Autotest – RCD AUTO	Nominal differential current: $I_{\Delta N}$=30 mA RCD type and test current starting polarity: G Limit contact voltage: 50 V Nominal differential current multiplier: ×1
RESISTANCE TO EARTH (MI 3102 only)	High limit resistance value: 50 Ω
ILLUMINATION (MI 3102 only)	Low limit illumination value: 300 lux
TRMS CURRENT (MI 3102 only)	Current limit: 4.5 mA

4.6 Display contrast adjustment

When the low-level backlight is activated, press and hold the BACKLIGHT key until the **Display contrast** adjustment menu is displayed.

Figure 4.9: Contrast adjustment menu

Use the ⋀ and ⋁ keys to adjust the contrast level and, when satisfied, press the TEST key to accept the new setting.

5 Measurements

5.1 Insulation resistance

The Insulation resistance measurement is performed in order to ensure safety against electric shock. Using this measurement the following items can be determined:

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

For additional information concerning insulation resistance measurements refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

Four Insulation resistance sub-functions are available:

- ISO L/E,
- ISO L/N
- ISO L/L
- ISO N/E

The insulation resistance tests are carried out in the same way regardless which sub-functions is selected. However it is important to select the appropriate sub-function in order to classify the measurement to be correctly considered in verification documents (Electrical Installation Certificate, Periodic Inspection Report etc.).

How to perform an insulation resistance measurement

Step 1 Select **Insulation** function with the function selector switch and sub-function with the ⋏/⋎ keys .The following menu is displayed:

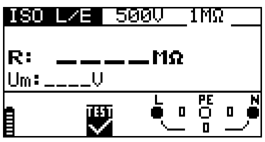


Figure 5.1: Insulation resistance measurement menu

Step 2 Set the following measuring parameter and limit values:

- Nominal test voltage,
- Low limit resistance value.

Step 3 Ensure that no voltages are present on the item for testing. Connect the test leads to the Eurotest instrument, Connect the test cables to the item under test. (see figure 5.2) to perform insulation resistance measurement. Use the **Help** function if necessary for further reference.

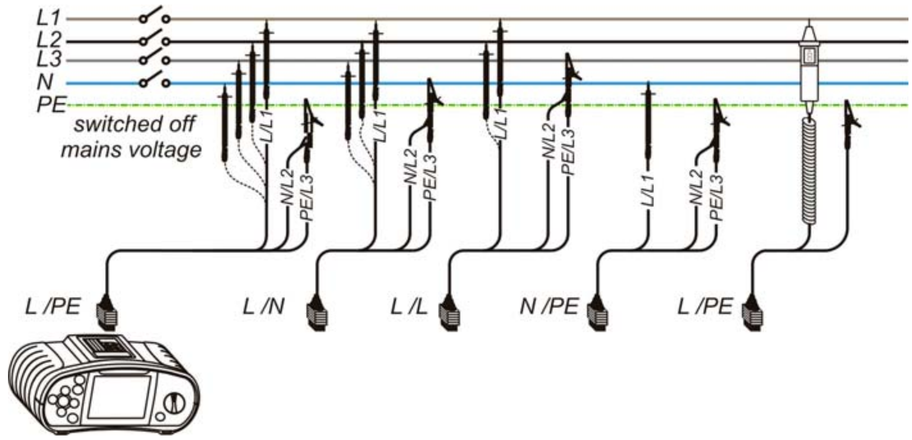


Figure 5.2: Connection of universal test cable and tip commander

Step 4 Check the displayed warnings and online voltage/terminal monitor before starting the measurement. If OK, press and hold the TEST key until the result has stabilised. Actual measured results are shown on the display during measurement.
After the TEST key is released the last measured results are displayed, together with the PASS/FAIL indication (if applicable).

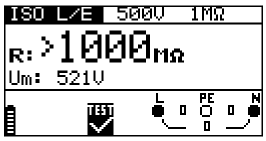


Figure 5.3: Example of insulation resistance measurement results

Displayed results:

R.............Insulation resistance,
Um..........Actual voltage applied to item under test

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Warnings:

- Insulation resistance measurement should only be performed on de-energized objects!
- When measuring the insulation resistance between installation conductors, all loads must be disconnected and all switches closed!
- Do not touch the test object during the measurement or before it is fully discharged! Risk of electric shock!
- When an insulation resistance measurement has been performed on a capacitive object, an automatic discharge may not be done immediately! The warning message and actual voltage is displayed during discharge until the voltage of the item under test drops below 10 V.
- In order to prevent damaging the test instrument, do not connect test terminals to an external voltage higher than 600 V (AC or DC)

Note:

- If a voltage higher than 10 V (AC or DC) appears between the test terminals, the insulation resistance measurement will not be performed.

5.2 Continuity

This function is used to test the resistance between two different points of the installation to ensure that a conductive path exists between them. The test ensures that all protective conductors, earth conductors or bonding conductors are correctly connected, terminated and have the correct resistive value.
The Continuity measurement is performed with a test current of more than 200mA. An automatic pole reversal of the test voltage and the test current is performed during the test. This test checks for any components (e.g. diodes, transistors, SCRs) that may have a rectifying effect on the circuit which could cause problems when a voltage is applied.

This measurement completely complies with EN61557-4 regulations.
Five Continuity sub-functions are available:

- r_1,
- r_N
- r_2
- R_1+R_2
- R_2

The continuity tests are carried out in the same way regardless of which sub-functions is selected. However it is important to select the appropriate sub-function in order to classify the measurement to be correctly considered in verification documents (Electrical Installation Certificate, Periodic Inspection Report etc.).

How to perform a Continuity resistance measurement

Step 1 Select the **Continuity** function with the function selector switch and the sub-function with the ∧/∨ keys. The following menus will be displayed:

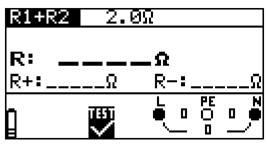


Figure 5.4: Continuity measurement menu (example for sub-function R1+R2)

Step 2 Set the following limit value:

- High limit resistance value.

Step 3 Connect test cable to the Eurotest instrument. Before performing a Continuity measurement, compensate for the test leads resistance as follows:

1. Short test leads first as shown in figure 5.5.

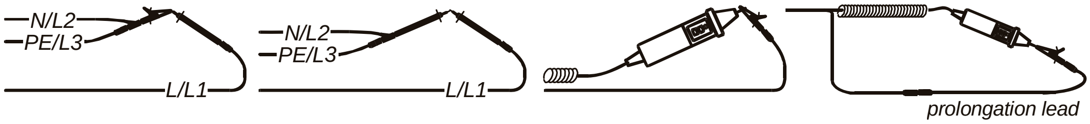


Figure 5.5: Shorted test leads

2. Press the TEST key in order to perform regular measurement. The displayed result should be close to 0.00 Ω.(depending on the length of test leads used).
3. Press the CAL key. After performing test leads compensation the compensated test leads indicator **Co** will be displayed on the top line.
4. In order to remove any test lead resistance compensation, follow the procedure described in step3 with test leads separated from one another. After removing any test lead compensation, the compensation indicator will disappear from the top line of the display.

The compensation of the test leads can be carried out in any of the Continuity sub-functions (r1, r2, rN, R1+R2, R2). The compensation value will then be transferred to all other subfunctions.

Step 4 Ensure that the item for testing is disconnected from any voltage source. Connect the test cables to the item under test. Follow the connection diagrams shown in figures 5.6 and 5.8 to perform a Continuity measurement. Use the Help function if necessary.

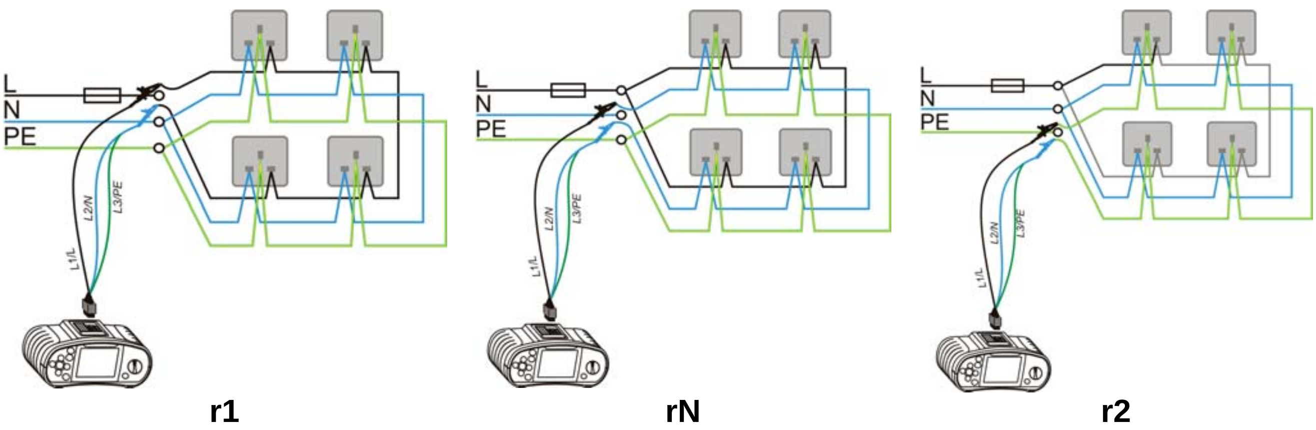


Figure 5.6: Connection for testing the r1, rN, and r2 sections of the wiring

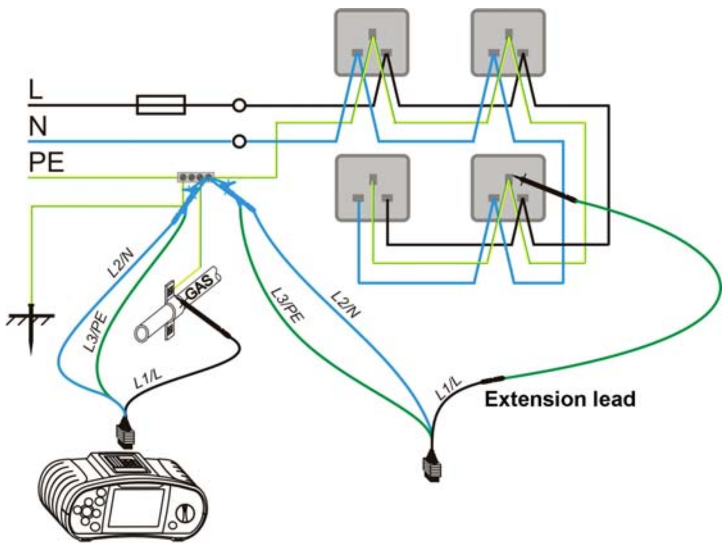


Figure 5.7: Connection for testing the R2 section of the wiring and bonding connections

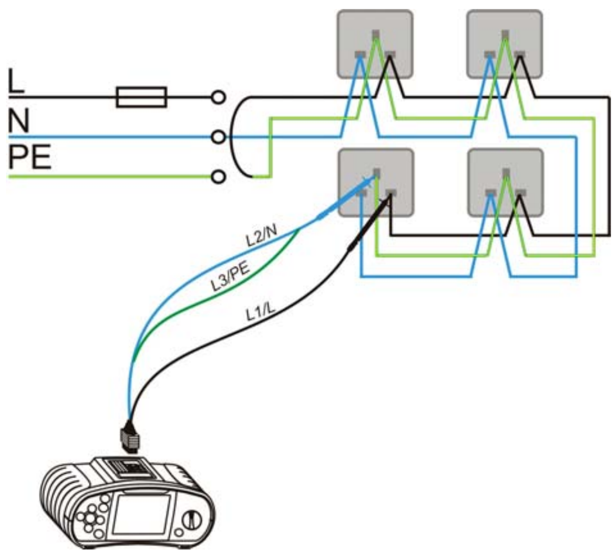


Figure 5.8: Connection for testing the R1+R2 section of the wiring

Step 5 Check for any warnings and the online voltage/terminal monitor on the display before starting the measurement. If everything is OK, press the TEST key. After performing the measurement, the results appear on the display together with the PASS/FAIL indication (if applicable).

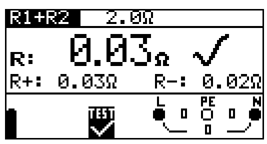


Figure 5.9: Examples of Continuity measurement results

Displayed results:
R.............Main Continuity result (average of R+ and R- results),

R+...........Resistance sub-result with positive voltage at L terminal,
R-............Resistance sub-result with positive voltage at N terminal.

Refer to chapter 6.1. Saving results for information on how to save the displayed results for documentation purposes.

Warnings:

- Low-value resistance measurements should only be performed on de-energized objects!
- Parallel impedances or transient currents may influence test results.

Note:

- If voltage between test terminals is higher than 10 V the measurement will not be performed**.**

5.3 Testing RCDs

When testing RCDs, the following sub-functions can be performed:

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

In general the following parameters and limits can be set when testing RCDs:

- Limit contact voltage,
- Nominal differential RCD trip-out current,
- Multiplier of nominal differential RCD trip-out current,
- RCD type,
- Test current starting polarity.

5.3.1 Limit contact voltage

Safety contact voltage is limited to 50 V_{AC} for standard domestic area. In special environments (hospitals, wet places, etc.) contact voltages up to 25 V_{AC} are permitted. Limit contact voltage can be set in contact voltage **Uc** function only!

5.3.2 Nominal differential trip-out current

Nominal differential current is the rated trip-out current of an RCD. The following RCD current ratings can be set: 10 mA, 30 mA, 100 mA, 300 mA, 500 mA and 1000 mA.

5.3.3 Multiplier of nominal residual current

Selected nominal differential current can be multiplied by ½, 1, 2 or 5.

5.3.4 RCD type and test current starting polarity

The Eurotest instrument enables testing of general (non-delayed) and selective (time-delayed, marked with the [S] symbol). The types of RCD the instrument is suitable for testing include:

- Alternating residual current (AC type, marked with ∿ symbol),
- Pulsating DC residual current (A type, marked with ⌒– symbol).

Test current starting polarity can be started with the positive half-wave at 0^0 or with the negative half-wave at 180^0.

positive start polarity (0°) *negative start polarity (180°)*

Figure 5.10: Test current started with the positive or negative half-wave

5.3.5 Testing selective (time-delayed) RCDs

Selective RCDs demonstrate delayed response characteristics. Trip-out performance is influenced due to pre-loading during measurement of contact voltage. In order to eliminate the pre-loading a time delay of 30 s is inserted before performing the trip-out test.

5.3.6 Contact voltage

Leakage current flowing to the PE terminal causes a voltage drop across earth resistance, which is called contact voltage (Uc). This voltage is present on all accessible parts connected to the PE terminal and should be lower than the safety limit voltage. The parameter contact voltage is measured without tripping-out the RCD. R_L is a fault loop resistance and is calculated as follows:

$$R_L = \frac{U_C}{I_{\Delta N}}$$

Displayed contact voltage relates to the rated nominal differential current of the RCD and is multiplied by a safety factor. See the table 5.1 for detailed contact voltage calculation.

RCD type	Contact voltage Uc
∿G ∿G	$Uc \propto 1.05\times I_{\Delta N}$
∿S ∿S	$Uc \propto 1.05\times 2\times I_{\Delta N}$
⌒–G ⌣–G	$Uc \propto 1.05\times \sqrt{2}\times I_{\Delta N}$
⌒–S ⌣–S	$Uc \propto 1.05\times 2\times \sqrt{2}\times I_{\Delta N}$

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

For additional general information concerning contact voltage measurement refer to Metrel’s handbook *Measurements on electric installations in theory and practice*.

How to perform contact voltage measurement

Step 1 Select **RCD** function with the function selector switch first. Use the ⋀/⋁ keys to select contact voltage function (Uc). The following menu will be displayed:

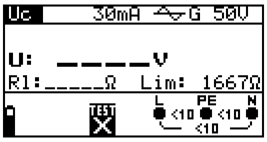


Figure 5.11: Contact voltage measurement menu

Step 2 Set the following measuring parameters and limit values:

- Nominal residual current,
- RCD type,
- Limit contact voltage.

Step 3 Connect the test leads to the instrument and follow the connection diagram shown in figure 5.12 to perform contact voltage measurement. Use the **Help** function if necessary.

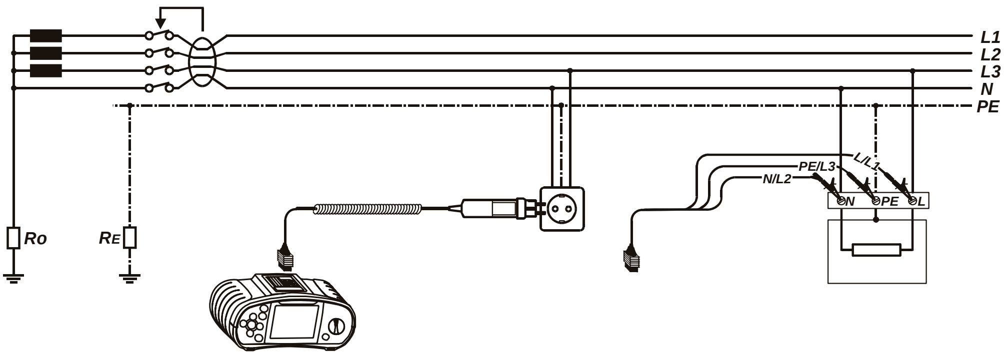


Figure 5.12: Connection of plug test cable or universal test cable

Step 4 Check for any warnings and check the online voltage/terminal monitor on the display before starting the measurement. If everything is ok, press the TEST key. After performing the measurement, the results will be displayed along with a PASS/FAIL indication.

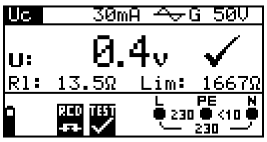


Figure 5.13: Example of contact voltage measurement results

Displayed results:

U.............Contact voltage.
Rl............Fault loop resistance.

Lim ....Limit earth fault loop resistance value according to BS 7671.

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- Parameters set in this function are also kept for all other RCD functions!
- The measurement of contact voltage does not normally trip an RCD. However, the trip limit may be exceeded as a result of leakage currents flowing through the PE protective conductor or a capacitive connection between the L and PE conductor.
- RCD trip-lock sub-function (function selector switch in **LOOP** position) takes longer to complete but offers much better accuracy of a fault loop resistance result (in comparison with the R_L sub-result in **Contact voltage** function).

5.3.7 Trip-out time

Trip-out time measurement is used to verify the effectiveness of an RCD. This is achieved by a test simulating an appropriate fault condition. Trip-out times vary between standards and are listed below.

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

	$\frac{1}{2}\times I_{\Delta N}$ *)	$I_{\Delta N}$	$2\times I_{\Delta N}$	$5\times I_{\Delta N}$
General (non-delayed) RCDs	t_Δ > 300 ms	t_Δ < 300 ms	t_Δ < 150 ms	t_Δ < 40 ms
Selective (time-delayed) RCDs	t_Δ > 500 ms	130 ms < t_Δ < 500 ms	60 ms < t_Δ < 200 ms	50 ms < t_Δ < 150 ms

Trip-out times according to BS 7671:

	$\frac{1}{2}\times I_{\Delta N}$ *)	$I_{\Delta N}$	$2\times I_{\Delta N}$	$5\times I_{\Delta N}$
General (non-delayed) RCDs	t_Δ > 1999 ms	t_Δ < 300 ms	t_Δ < 150 ms	t_Δ < 40 ms
Selective (time-delayed) RCDs	t_Δ > 1999 ms	130 ms < t_Δ < 500 ms	60 ms < t_Δ < 200 ms	50 ms < t_Δ < 150 ms

*) Test current of $\frac{1}{2}\times I_{\Delta N}$ cannot cause trip-out of the RCDs.

For additional information concerning trip-out time measurement refer to the Metrel handbook *Measurements on electric installations in theory and practice*.

How to perform trip-out time measurement

Step 1 Select the **RCD** function with the function selector switch and use the ⋀/⋁ keys to select the **Trip-out time** function (RCDt). The following menu will be displayed:

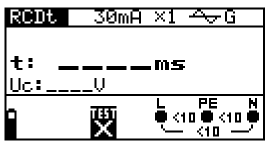


Figure 5.14: Trip-out time measurement menu

Step 2 Set the following measuring parameters:

- Nominal differential trip-out current,
- Nominal differential trip-out current multiplier,
- RCD type, and
- Test current starting polarity.

Step 3 Connect the leads to the instrument and follow the connection diagram shown in figure 5.12 (see the chapter *5.3.6 Contact voltage*) to perform trip-out time measurement.

Step 4 Check for any warnings and check the online voltage/terminal monitor on the display before starting measurement. If everything is ok, press the TEST key.

After performing the measurement, results will appear on the display along with a PASS/FAIL indication.

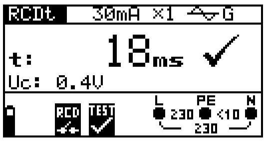


Figure 5.15: Example of trip-out time measurement results

Displayed results:

t ....Trip-out time,
U_C ....Contact voltage.

Save displayed results for documentation purposes. Refer to chapter *6.1. Saving results* (MI 3002 and MI 3102).

Notes:

- Parameters set in this function are also transferred onto all other RCD functions!
- RCD trip-out time measurement will be performed only if the contact voltage at nominal differential current is lower than the limit set in the contact voltage setting!
- The measurement of the contact voltage in pre-test does not normally trip an RCD. However, the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

5.3.8 Trip-out current

This test is used to determine the minimum current required to trip the RCD. After the measurement has been started, the test current generated by the instrument is continuously increased, starting at $0.2\times I_{\Delta N}$ to $1.1\times I_{\Delta N}$ (to $1.5\times I_{\Delta N}$ / $2.2\times I_{\Delta N}$ ($I_{\Delta N}$ =10 mA) for pulsating DC residual currents), until the RCD trips.

For additional information concerning the trip-out current measurement, refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

How to perform trip-out current measurement

Step 1 Select **RCD** function with the function selector and use the ⋀/⋁ keys to select the **Trip-out current** (RCD ◢) function. The following menu is displayed:

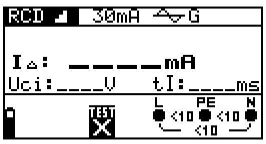


Figure 5.16: Trip-out current measurement menu

Step 2 By using cursor keys the following parameters can be set in this measurement:

- Nominal residual current,
- RCD type,
- Test current starting polarity.

Step 3 Connect the test leads to the instrument and follow the connection diagram shown in figure 5.12 (see the chapter *5.3.6 Contact voltage*) to perform trip-out current measurements. Use the **Help** function if necessary.

Step 4 Check for any warnings and check the online voltage/terminal monitor shown on the display before starting the measurement. If everything is ok, press the TEST key. After performing the measurement, the results will be displayed along with a PASS/FAIL indication.

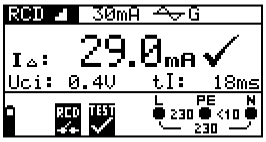


Figure 5.17: Example of trip-out current measurement result

Displayed results:

I_Δ ....Trip-out current,
U_{Ci} ....Contact voltage,
tI ....Trip-out time.

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- Parameters set in this function are also kept for other RCD functions!
- RCD trip-out current measurement will be performed only if the contact voltage at nominal differential current is lower than set limit contact voltage!
- The measurement of contact voltage in the pre-test does not normally trip an RCD. However, the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

5.3.9 Autotest

The purpose of the autotest function is to perform a complete RCD testing and measurement of most important associated parameters (contact voltage, fault loop resistance and trip-out time at different fault currents) with one press of a button. If a faulty parameter is noticed during the autotest, the test will stop to highlight the need for further investigation.

Notes:

- The measurement of contact voltage in the pre-test does not normally trip an RCD. However, the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

- The autotest sequence stops when the trip-out time is out of allowed time period.

5.3.9.1 How to perform RCD autotest

Step 1 Select **RCD** function with the function selector switch first. Use the ∧/∨ keys to select **RCD autotest** function (AUTO). The following menu is displayed:

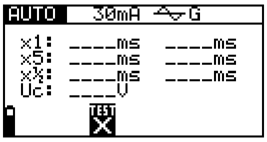


Figure 5.18: RCD autotest menu

Step 2 Set the following measuring parameters:

- Nominal differential trip-out current,
- RCD type.

Step 3 Connect the test leads to the instrument and follow the connection diagram shown in figure 5.12 (also see the chapter *5.3.6 Contact voltage*) to perform the RCD autotest. Use the **Help** function if necessary.

Step 4 Check for any warnings and check the online voltage/terminal monitor displayed on the screen before starting the measurement. If everything is ok, press the TEST key. The autotest sequence will then start to run as follows:

1. Trip-out time measurement with the following measurement parameters:
   - Test current of $I_{\Delta N}$,
   - Test current started with the positive half-wave at 0^0.

Measurement normally trips an RCD within allowed time period. The following menu is displayed:

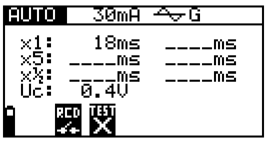


Figure 5.19: Step 1 RCD autotest results

After re-activating the RCD, the autotest sequence automatically proceeds with step 2.

2. Trip-out time measurement with the following measurement parameters:
   - Test current of $I_{\Delta N}$,
   - Test current started with the negative half-wave at 180^0.

Measurement normally trips an RCD. The following menu is displayed:

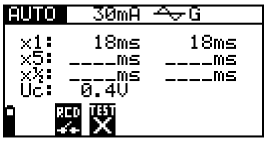


Figure 5.20: Step 2 RCD autotest results

After re-activating the RCD, the autotest sequence automatically proceeds with step 3.

3. Trip-out time measurement with the following measurement parameters:

- Test current of $5 \times I_{\Delta N}$,
- Test current started with the positive half-wave at 0^0.

Measurement normally trips an RCD within allowed time period. The following menu is displayed:

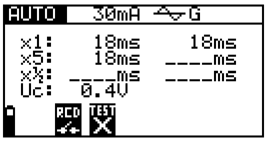


Figure 5.21: Step 3 RCD autotest results

After re-activating the RCD the autotest sequence automatically proceeds with step 4.

4. Trip-out time measurement with the following measurement parameters:

- Test current of $5 \times I_{\Delta N}$,
- Test current started with the negative half-wave at 180^0.

Measurement normally trips an RCD within allowed time period. The following menu is displayed:

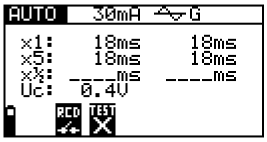


Figure 5.22: Step 4 RCD autotest results

After re-activating the RCD the autotest sequence automatically proceeds with step 5.

5. Trip-out time measurement with the following measurement parameters:

- Test current of $½ \times I_{\Delta N}$,
- Test current started with the positive half-wave at 0^0.

Measurement does not normally trip an RCD. The following menu is displayed:

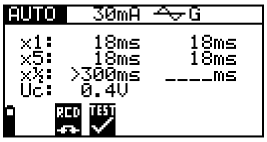


Figure 5.23: Step 5 RCD autotest results

After performing step 5 the RCD autotest sequence automatically proceeds with step 6.

6. Trip-out time measurement with the following measurement parameters:

   - Test current of ½×$I_{\Delta N}$,
   - Test current started with the negative half-wave at 180^0.

Measurement does not normally trip an RCD. The following menu is displayed:

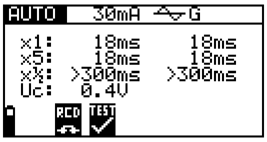


Figure 5.24: Step 6 RCD autotest results

Displayed results:
x1 (left) ...... Step 1 trip-out time result, t3 ($I_{\Delta N}$, 0^0),
x1 (right) .... Step 2 trip-out time result, t4 ($I_{\Delta N}$, 180^0),
x5 (left) ...... Step 3 trip-out time result, t5 (5×$I_{\Delta N}$, 0^0),
x5 (right) .... Step 4 trip-out time result, t6 (5×$I_{\Delta N}$, 180^0),
x½ (left) ..... Step 5 trip-out time result, t1 (½×$I_{\Delta N}$, 0^0),
x½ (right) ... Step 6 trip-out time result, t2 (½×$I_{\Delta N}$, 180^0),
Uc...........Contact voltage.
Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Note:

- In case of testing the RCD type A with rated residual currents of IΔn = 300 mA, 500 mA, and 1000 mA, the **x5** Auto tests will be automatically skipped. In this case, the auto test result passes if the t1 to t4 results pass, and on the display are omitted t5 and t6.

5.4 Fault loop impedance and prospective fault current

The loop impedance function has two sub-functions available:

Zs sub-function performs a fast fault loop impedance measurement on supply systems which do not contain RCD protection.
Zs(rcd) trip-lock sub-function performs fault loop impedance measurement on supply systems which are protected by RCDs..

5.4.1 Fault loop impedance

The fault loop impedance measures the impedance of the fault loop in the event that a short-circuit to an exposed conductive parts occurs (i.e. a conductive connection occurs between the phase conductor and protective earth conductor). In order to measure loop impedance the instrument uses a high test current.
Prospective fault current (IPFC) is calculated on the basis of the measured resistance as follows:

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

Where:

Nominal input voltage U_N	**Voltage range**
115 V	(100 V ≤ U_{L-PE} < 160 V)
230 V	(160 V ≤ U_{L-PE} ≤ 264 V)

For additional information concerning fault loop impedance measurement refer to Metrel’s handbook *Measurements on electric installations in theory and practice*.

5.4.1.1 How to perform fault loop impedance measurement

Step 1 Select the **LOOP** function with the function selector switch and use the ⋀/⋁ keys to select the **Zs** sub-function. The following menu is displayed:

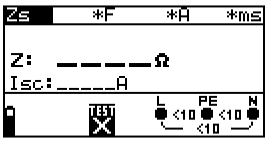


Figure 5.25: Loop impedance measurement menu

Step 2 Set the following measuring parameters:

- Fuse type,
- Fuse current rating,
- Fuse trip-out time,
- Impedance scaling factor (see chapter *4.5.2 Impedance scaling factor adjustment*).

The complete list of available fuse types can be found in Appendix A.

Step 3 Connect the test leads to the instrument and follow the connection diagram shown in the figure 5.26 to perform fault loop impedance measurement. Use the **Help** function if necessary.

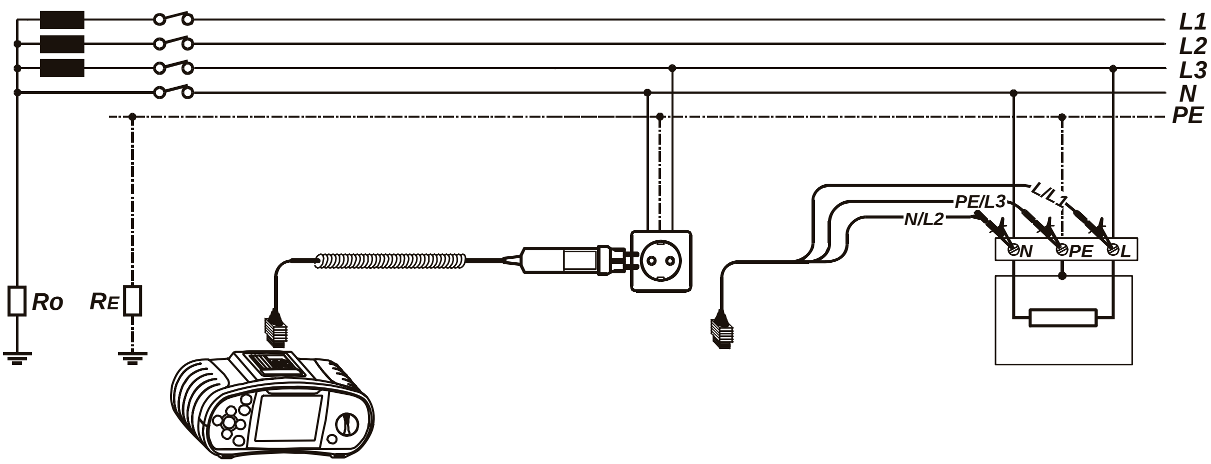


Figure 5.26: Connection of plug cable and universal test cable

Step 4 Check for any warnings displayed on the screen and check the online voltage/terminal monitor before starting the measurement. If everything is ok, press the TEST key. After performing the measurement, the test results will appear on the display together with the PASS/FAIL indication (if applicable).

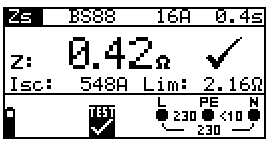


Figure 5.27: Example of loop impedance measurement results

Displayed results:

Z ....Fault loop impedance,
I_{SC} ....Prospective fault current (displayed in amps),
Lim ....High limit fault loop impedance value (if applicable).

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- The fault loop impedance limit depends on the fuse type, fuse current rating, fuse trip-out time and Impedance scaling factor.
- The specified accuracy of test parameters is valid only if mains voltage is stable during the measurement.
- The Zs Fault loop impedance measurement trips RCD protected circuits.

5.4.2 The fault loop impedance test for RCD protected circuits

The fault loop impedance is measured with a low test current to avoid tripping the RCD. This function can also be used for fault loop impedance measurement in system equipped with RCDs which have a rated trip-out current of 10 mA and above.

Prospective fault current (IPFC) is calculated on basis of measured resistance as follows:

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

Where:

Nominal input voltage U_N	Voltage range
115 V	$(100\ V \le U_{L-PE} < 160\ V)$,
230 V	$(160\ V \le U_{L-PE} \le 264\ V)$,

For additional information concerning fault loop impedance measurement refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

5.4.2.1 How to perform RCD trip-lock measurement

Step 1 Select the **LOOP** function with the function selector switch and use the ▲/▼ keys to select **Zsrcd** sub-function. The following menu is displayed:

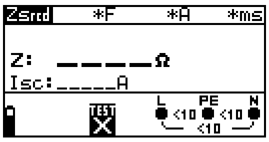


Figure 5.28: Trip-lock function menu

Step 2 Set the following measuring parameters:

- Fuse type,
- Fuse current rating,
- Fuse trip-out time,
- Impedance scaling factor (see chapter *4.5.2 Impedance scaling factor adjustment*).

The complete list of available fuse types can be found in Appendix A.

Step 3 Connect the appropriate test leads to the instrument and follow the connection diagram shown in figure 5.12 to perform RCD trip-lock measurement (see chapter *5.3.6 Contact voltage*). Use **Help** function if necessary.

Step 4 Check for warnings on the display and check the online voltage/terminal monitor before starting the measurement. If everything is ok, press the TEST key. After performing the measurement the results will appear on the display.

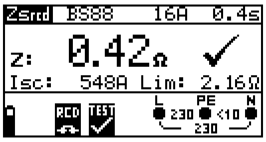


Figure 5.29: Example of fault loop impedance measurement results using trip-lock function

Displayed result:

Z ....Fault loop impedance,
I_{SC} ....Prospective fault current,
Lim ....High limit fault loop impedance value (if applicable).

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- The measurement of fault loop impedance using trip-lock function does not normally trip an RCD. However, if the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

- The specified accuracy of test parameter is valid only if mains voltage is stable during the measurement.

5.5 Line impedance and prospective short-circuit current

The line impedance is a measurement of the impedance of the current loop when a short-circuit to the neutral conductor occurs (conductive connection between phase conductor and neutral conductor in single-phase system or between two phase conductors in three-phase system). A high test current is used to perform the line impedance measurement.
Prospective short circuit current is calculated as follows:

$$I_{PSC} = \frac{U_N}{Z_{L-N(L)}}$$

Where:

Nominal input voltage U_N	**Voltage range**
115 V	(100 V ≤ U_{L-PE} < 160 V)
230 V	(160 V ≤ U_{L-PE} ≤ 264 V)
400 V	(264 V < U_{L-PE} ≤ 440 V)

For additional information concerning line impedance refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

How to perform line impedance measurement

Step 1 Select the **LINE** function with function selector switch. The following menu is displayed:

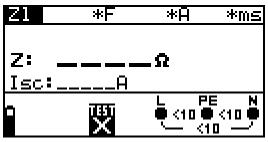


Figure 5.30: Line impedance measurement menu

Step 2 Set the following measuring parameters:

- Fuse type,
- Fuse current rating,
- Fuse trip-out time,
- Impedance scaling factor (see chapter *4.5.2 Impedance scaling factor adjustment*).

The complete list of available fuse types can be found in Appendix A.

Step 3 Connect the appropriate test leads to the instrument and follow the connection diagram shown in figure 5.31 to perform phase-neutral or phase-phase line impedance measurement. Use the **Help** function if necessary.

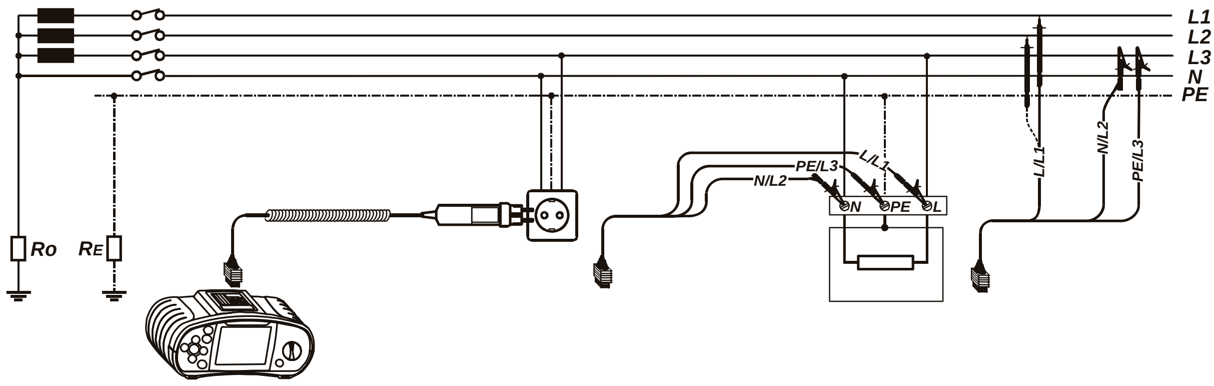


Figure 5.31: Phase-neutral or phase-phase line impedance measurement

Step 4 Check for warnings displayed on the screen and check the online voltage/terminal monitor before starting the measurement. If everything is ok, press the TEST key. After performing the measurement, the results will appear on the display together with the PASS/FAIL indication (if applicable).

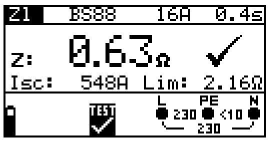


Figure 5.32: Example of line impedance measurement results

Displayed results:

Z ....Line impedance,
I_{SC}...........Prospective short-circuit current,
Lim.........High limit fault loop impedance value (if applicable).

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- The fault loop impedance limit depends on fuse type, fuse current rating, fuse trip-out time and Impedance scaling factor.
- The specified accuracy of the test parameter is valid only if mains voltage is stable during the measurement.

5.6 Phase sequence testing

In practice, we often deal with the connection of three-phase loads (motors and other electro-mechanical machines) to three-phase mains installation. Some loads (ventilators, conveyors, motors, electro-mechanical machines, etc.) require a specific phase rotation and some may even be damaged if the rotation is reversed. This is why it is advisable to test phase rotation before connection is made.

For information concerning phase sequence testing refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

How to test the phase sequence

Step 1 Select the **PHASE ROTATION** function ( ) with the function selector switch. The following menu is displayed.

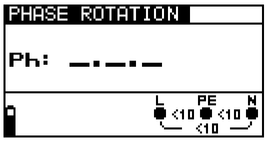


Figure 5.33: Phase rotation test menu

Step 2 Connect test cable to the Eurotest instrument and follow the connection diagram shown in figure 5.34 to test phase sequence.

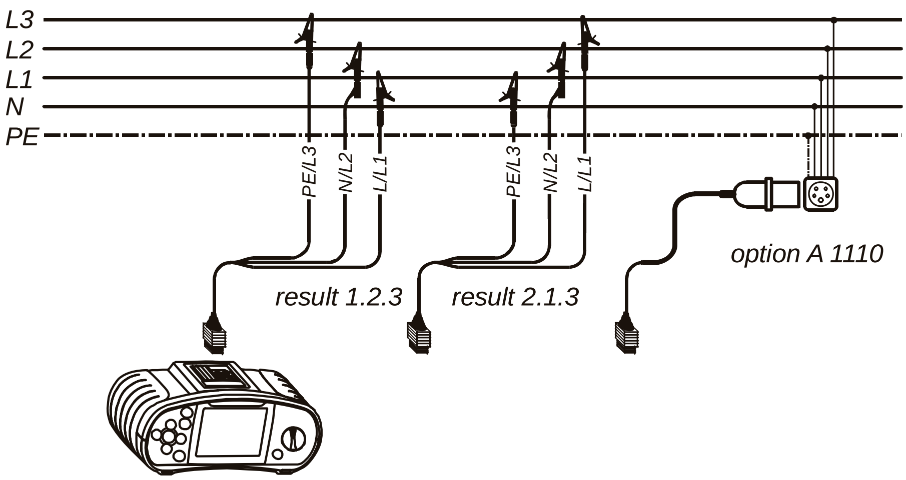


Figure 5.34: Connection of universal test cable and optional three phase cable

Step 3 Check for warnings on the display and check the online voltage/terminal monitor. The phase sequence test is a continuously running test hence the results will be displayed as soon as the full test lead connection to the item under test has been made.. All three-phase voltages are displayed in order of their sequence represented by the numbers 1, 2 and 3.

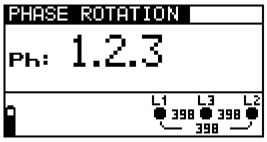


Figure 5.35: Example of phase sequence test result

Displayed results:

Ph...........Phase sequence,
1.2.3........Correct connection,
2.3.1........Invalid connection,
-.-.-..........Irregular voltages.

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

5.7 Voltage and frequency

Voltage measurements should be carried out regularly while dealing with electric installations (carrying out different measurements and tests, looking for fault locations, etc.). Frequency is measured for example when establishing the source of mains voltage (power transformer or individual generator).

How to perform voltage and frequency measurement

Step 1 Select the **VOLTAGE** function (Volt.) with the function selector switch. The following menu is displayed:

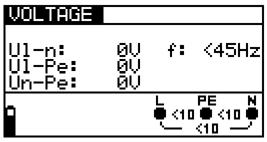


Figure 5.36: Voltage and frequency measurement menu

Step 2 Connect test cable to the Eurotest instrument and follow the connection diagram shown in figure 5.37 to perform a voltage and frequency measurement.

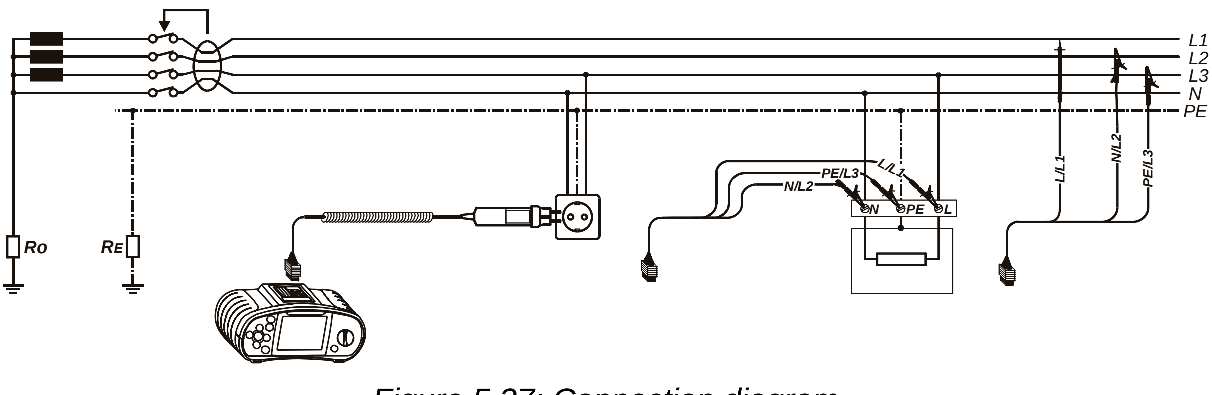
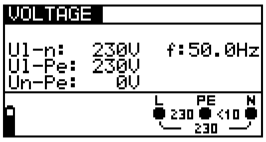


Figure 5.37: Connection diagram

Step 3 Check the displayed warnings. The Voltage and Frequency test continually runs, showing fluctuantions as they occur, these results are shown on the display during measurement.



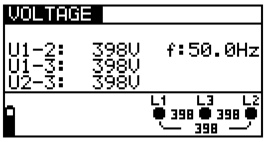


Figure 5.38: Examples of voltage and frequency measurements

Displayed results:

Ul-n.........Voltage between phase and neutral conductors,
Ul-pe.......Voltage between phase and protective conductors,
Un-pe .....Voltage between neutral and protective conductors.

When testing three-phase system the following results are displayed:

U1-2........Voltage between phases L1 and L2,
U1-3........Voltage between phases L1 and L3,
U2-3........Voltage between phases L2 and L3.

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

5.8 Resistance to earth (MI 3102 only)

The MI3102 EurotestXE can perform a 3-wire resistance to earth measurements. This function is useful for testing the quality of the earthing electrode in TT and IT systems

Consider the following instructions when performing resistance to earth measurement:

- The probe (S) is positioned between the earth electrode (E) and auxiliary earth electrode (H) in the ground reference plane (see figure 5.40).
- The distance from the earth electrode (E) to the auxiliary earth electrode (H) should be at least 5 times the depth of earthing electrode rod or the length of the band electrode.
- If measuring the total earth resistance of a complex earthing system, the required distance depends on the longest diagonal distance between the individual earthing electrodes.

For additional information concerning resistance to earth measurement refer to METREL's handbook *Measurements on electric installations in theory and practice*.

How to perform resistance to earth measurement

Step 1 Select the **EARTH** function with function selector switch. The following menu is displayed:

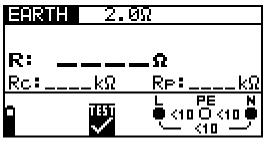


Figure 5.39: Earth resistance measurement menu

Step 2 Set the following measuring parameter:

- High limit resistance value.

Step 3 Connect the leads to the instrument and follow the connection diagram shown in figure 5.40 to perform a resistance to earth measurement. Use the **Help** function if necessary.

Test connector terminals are used as follows:

- N/L2 blue test lead is used for the earth electrode (E).
- L/L1 black test lead is used for the auxiliary earth electrode (H).
- PE/L3 green test lead is used for the probe (S).

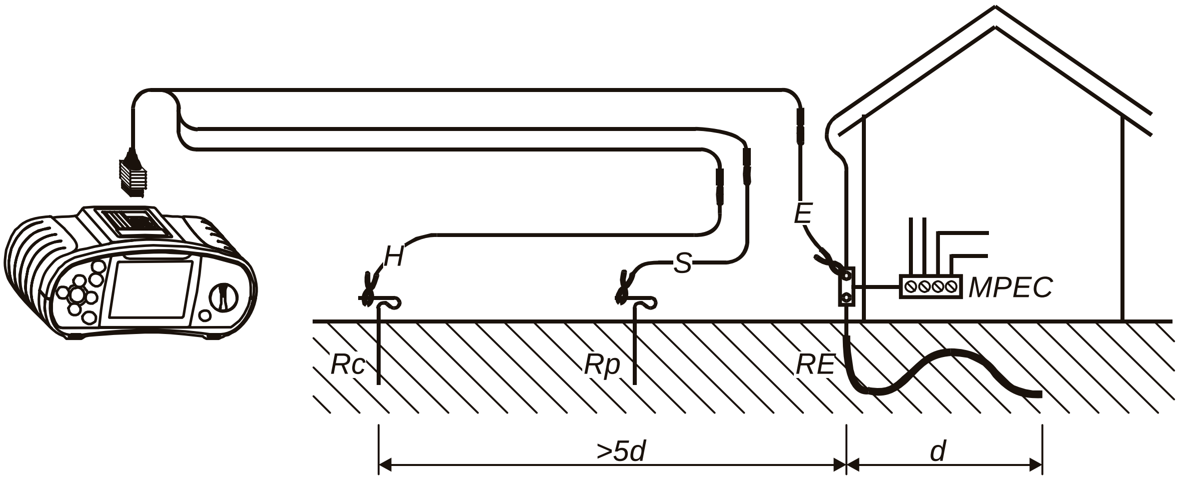


Figure 5.40: Connection of standard 20 m long test leads

Step 4 Check for warnings on the display and check the online voltage/terminal monitor before starting the measurement. If everything is ok, press the TEST key. After performing the measurement, the results will appear on the display together with the PASS/FAIL indication (if applicable).

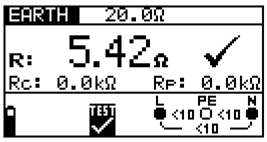


Figure 5.41: Example of resistance to earth measurement results

Displayed results:

R.............resistance to earth,
R_C...........auxiliary earth electrode resistance,
R_P...........probe resistance.

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- If a voltage higher than 30 V is present between the test terminals, the test will be prevented from being performed.
- If a noise voltage higher than approx. 5 V is present between the H and E or S test terminals, the (noise) warning symbol "-∿-" will be displayed, indicating that the test result may not be correct!

5.9 TRMS current (MI 3102 only)

This function enables measuring of AC currents in a wide range from 0.5 mA to 20 A using sensitive current clamp (A 1018) supplied by METREL.

For additional information concerning TRMS current measurement refer to the METREL's handbook *Measurements on electric installations in theory and practice*.

How to perform a TRMS current measurement

Step 1 Select the **TRMS CURRENT** function (TRMS) with the function selector switch. The following menu is displayed:

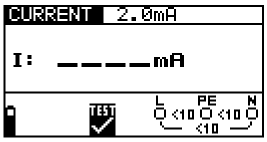


Figure 5.42: TRMS current measurement menu

Step 2 Set the following limit value:

- High limit current value.

Step 3 Connect the test leads to the Eurotest instrument and follow the connection diagram shown in Figure 5.43 to perform a TRMS current measurement. Use the **Help** function if necessary.

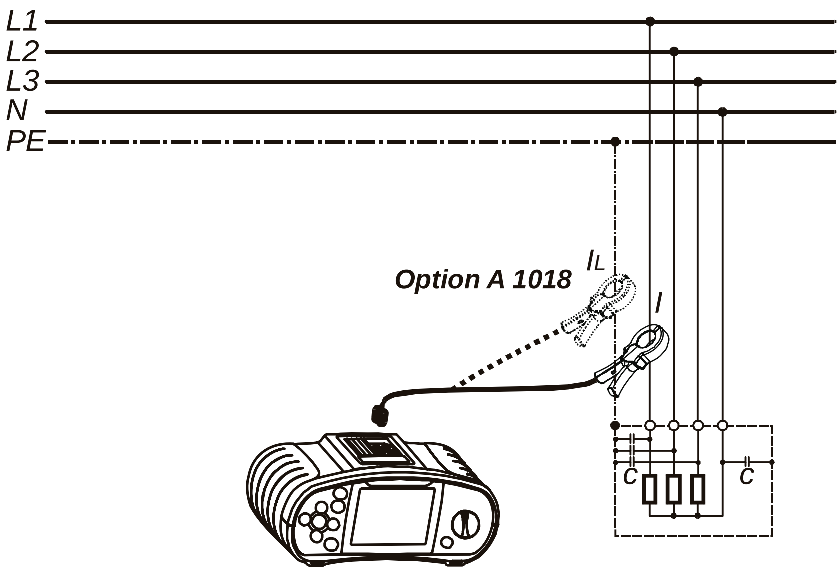


Figure 5.43: Connection diagram

Step 4 Check for any warnings on the display before starting the measurement. If everything is ok, press the TEST key.
After starting the test, the test will run continuously until the user stops the measurement. To stop measurement, press the TEST key again. The last measured result will be displayed together with the PASS/FAIL indication (if applicable).

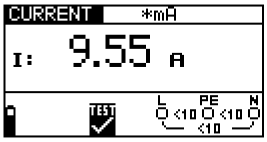


Figure 5.44: Example of TRMS current measurement result

Displayed results:

I ....TRMS current (or TRMS leakage current).

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes*:*

- Use test clamp supplied by METREL or another clamp with similar characteristics (current output, 1000:1 clamp ratio, appropriate measuring range, consider the error of the test clamp when evaluating the measured results)!
- Current clamps Metrel A 1074 and A 1019 are suitable for use with MI 3102 EurotestXE instrument in range 0.2 A ÷ 200 A. Below 0.2 A they can be used as indicator only. They are not suitable for leakage current measurements.

5.10 Illumination (MI 3102 only)

The illumination measurements should be performed whenever planning or installing indoor or outdoor lighting.
Illumination measurement can be performed using a LUXmeter probe connected to the RS232 connector of the instrument. The EurotestXE instrument supports type B LUXmeter and type C LUXmeter probes.

How to perform illumination measurement

Step 1 Select the **SENSOR** function with the function selector switch. The following menu is displayed:

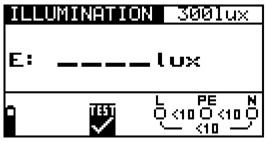


Figure 5.45: Illumination measurement menu

Step 2 Set the following limit value:

- Low limit illumination value.

Step 3 Connect LUXmeter probe to the instrument RS232 connector and follow the positioning diagram shown in figure 5.46 to perform illumination measurement. Turn on the LUXmeter probe by pressing its ON/OFF key. (the Green LED should light on the probe). Use the **Help** function if necessary.

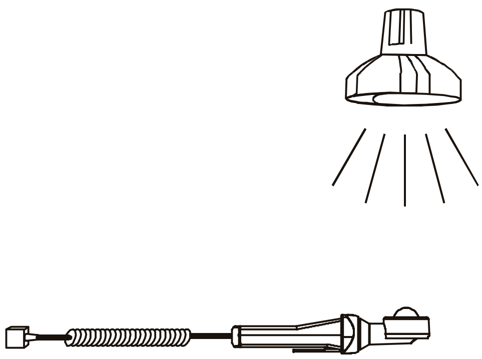


Figure 5.46: LUXmeter probe positioning

Step 4 Check for any warnings on the display before starting the measurement. If everything is ok, press the TEST key to start the measurement. The results will appear on the display along with a PASS/FAIL indication (if applicable). After starting the test, the test will run continuously until the user stops the measurement. To stop measurement, press the TEST key again The last measured result will be displayed, together with the PASS/FAIL indication (if applicable).

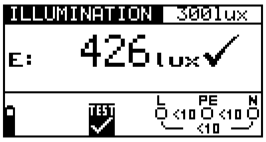


Figure 5.47: Example of illumination measurement result

Displayed result:

E.............Illumination

Refer to chapter *6.1. Saving results* for information on how to save the displayed results for documentation purposes.

Notes:

- For accurate measurements, make sure that the milk glass bulb is lit without any shadows cast by hand, body or any other unwanted objects.
- It is very important to know when the artificial light sources will reach full power (this may take a period of time see technical data for light sources for more information) and should therefore be switched on for this period of time before any measurements are taken.

5.11 Testing the PE terminal

In new or adapted installations it may occur that the position of the PE conductor and the phase conductor become reversed – this is a very dangerous situation! This is why it is important to test for the presence of a phase voltage on the PE protection terminal. This test should be performed before a mains supply voltage is applied to the instrument circuitry and before installation is used.

For additional information concerning PE terminal test, refer to Metrel's handbook *Measurements on electric installations in theory and practice*.

How to test PE terminal

Step 1 Connect test cable to the instrument.

Step 2 Follow the connection diagrams shown in figures 5.48 and 5.49 to test PE terminal.

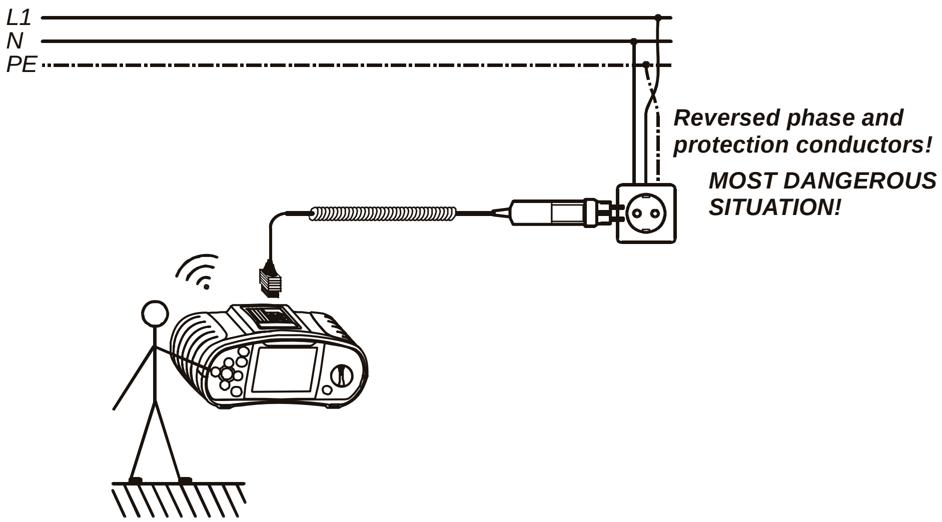


Figure 5.48: Connection of plug cable to mains outlet with reversed L and PE conductors

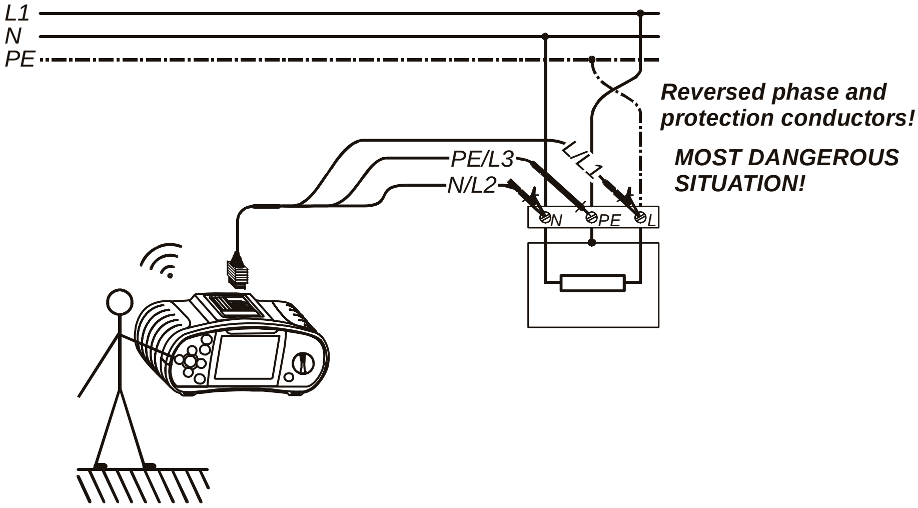


Figure 5.49: Connection of universal test cable to load connection terminals with reversed L and PE conductors

Step 3 Touch the PE test probe (TEST key) for a few seconds. If PE terminal is connected to phase voltage a warning message will be displayed and instrument buzzer will sound.

Warning:

- If phase voltage is detected on tested PE terminal, stop all measurements immediately and remove the cause of the fault before proceeding with any activity!

Notes:

- The PE terminal can only be tested with the function selector set to RCD, LOOP or LINE!
- For correct testing of PE terminals, the TEST key has to be touched for a few seconds.
- When testing, make sure the instrument operated is stood on non-isolated floor (otherwise the test result may be wrong!)

6 Working with results

After a measurement is completed, the results can be stored into the memory of the instrument, together with any sub-results and function parameters.
Electrical installations can be represented by a multi-level structure. The instrument's memory storage is designed in a three-level structure as follows:

- Object (1st structure level),
- Distribution Board (2nd structure level),
- Circuit, Earth Electrode, Bonding conductors (3rd structure level).

OBJECT 001
- DISTRIBUTION BOARD 001
  - CIRCUIT 001
  - CIRCUIT 002
  - ...
  - CIRCUIT 499
  - EARTH ELECTRODE
  - BONDING Water
  - BONDING Oil
  - BONDING Lightning
  - BONDING Gas
  - BONDING Structural Steel
  - BONDING Other
  - BONDING Earthing conductor
- DISTRIBUTION BOARD 002
  - CIRCUIT 001
  - CIRCUIT 002
  - ...
  - CIRCUIT 499
  - EARTH ELECTRODE
  - BONDING Water
  - BONDING Oil
  - BONDING Lightning
  - BONDING Gas
  - BONDING Structural Steel
  - BONDING Other
  - BONDING Earthing conductor
- DISTRIBUTION BOARD 999
  - CIRCUIT 001
  - CIRCUIT 002
  - ...
  - CIRCUIT 499
  - EARTH ELECTRODE
  - BONDING Water
  - BONDING Oil
  - BONDING Lightning
  - BONDING Gas
  - BONDING Structural Steel
  - BONDING Other
  - BONDING Earthing conductor

OBJECT 002
...
OBJECT 999

Figure 6.1: Instrument memory organization

The memory structure is organized in a way that is suited to the BS 7671 and other verification documents (Electrical Installation Certificate, Periodic Inspection Report etc.). If the results are stored in appropriate memory locations the automatic creation of a certificate/ report is possible via the PC software.

6.1 Saving results

How to save measurement results

Step 1 When the measurement has completed, press the MEM key. The SAVE results menu is displayed with the last used memory location selected.

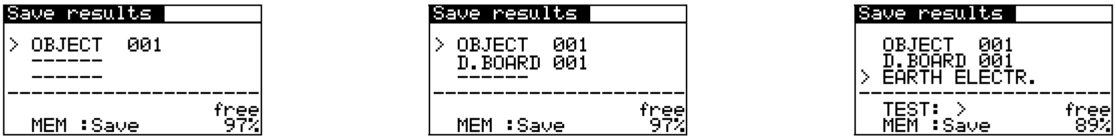


Figure 6.2: Examples of Save results menu

Step 2 The results can be saved into the selected memory location as follows:

By using the ⋀/⋎ keys, position the cursor on the ***Object*** line. Use the ⋞/⋟ keys to select appropriate ‘Object’ memory location (three-digit number).

By using the ⋀/⋎ keys, position the cursor on the ***D. Board*** line. Use the ⋞/⋟ keys to select appropriate ‘Distribution block’ memory location (three-digit number).

By using the ⋀/⋎ keys, position the cursor on the **Circuit** / **Earth Electr.** / **Bonding** line.
Choose between the various options (‘Circuit’, ‘Earth Electrode’ or ‘Bonding’) by pressing the TEST key.
If ***Circuit*** is selected, use the ⋞/⋟ keys to select the appropriate ‘Circuit’ memory location (three-digit number).
If ***Bonding*** is selected, use the ⋞/⋟ keys to select the appropriate ‘Bonding’ memory location (Water/ Oil/ Lightning/ Gas/ Str.steel/ Earth.cond).

Step 3 After the memory location is set, press the MEM key to save the results. »*Saved to memory*« message will displayed to confirm that the results have been saved. After saving the results the instrument returns to normal test screen.

Note:

- Each measurement result can be saved only once.

6.2 Recalling results

Stored results can be recalled from the memory in the ***Memory*** menu.. To enter the ***Memory*** menu press the MEM key.

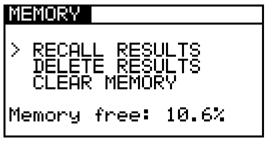


Figure 6.3: Memory menu

How to recall saved results

Step 1 Select ***Recall results*** from the ***Memory*** menu by using the ⮝ and ⮟ keys and press the TEST key to confirm. The ***Recall results*** menu will be displayed and the last used memory location will be selected.

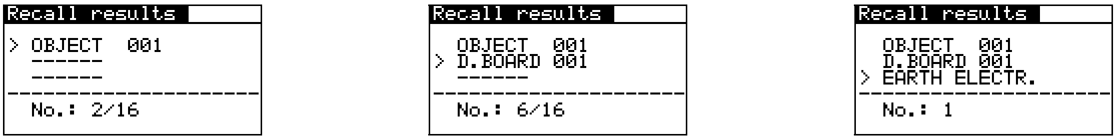


Figure 6.4: Examples of menus for selection of memory location

Step 2 To recall a saved result the memory location must be selected first:

The ***Object*** line can be selected with the ⮝/⮟ keys. Use the ⮜/⮞ keys to select the appropriate ‘Object ‘memory location (three-digit number).
In the lower part of the display, two numbers will be displayed (e.g. No.:2/16 see figure 6.4):

- the first number is the number of measurements stored in the selected ‘Object’ memory location.
- the second number is the number of measurements stored in the selected ‘Object’ memory location and its sub-locations (i.e. D.board, Circuit, Earth Electrode, Bonding memory locations).

The ***D. Board*** line can be selected with the ⮝/⮟ keys. Use the ⮜/⮞ keys to select appropriate ‘D. Board memory location (three-digit number).
In the lower part of the display, two numbers will be displayed (e.g. 6/16 see figure 6.4):

- the first number is the number of measurements stored in the selected ‘D. Board’ memory location.
- the second number is the number of measurements stored in the selected ‘D. Board’ memory location and its sub-locations (Circuit, Electrode, Bonding memory locations).

The **Circuit** / **Earth Electrode** / **Bonding** line can be selected with the ⮝/⮟ keys.
The appropriate memory location (‘Circuit’ or ‘Earth Electrode’or ‘Bonding’) can be selected with the TEST key.
If the ***Circuit*** is selected, use the ⮜/⮞ keys to select the appropriate ‘Circuit’ memory location.(three-digit number). In the lower part of the display (**No.** line) the number of measurements stored in the selected ‘Circuit’ memory location is shown.
If the ***Bonding*** is selected, use the ⮜/⮞ keys to select appropriate ‘Bonding’ memory location (e.g. Water/ Oil/ Lightning/ Gas/ Str.Steel/ Earth.cond.). In the lower part of the display the number of measurements stored in the selected ‘Bonding’ memory location is shown.
If the ***Earth Electrode*** is selected, the number of measurements stored in the selected ‘Electrode’ memory location will be displayed in the lower part of the display.

Step 3 Once the memory location is set, press the MEM key and the cursor will jump down to the ***No***. line

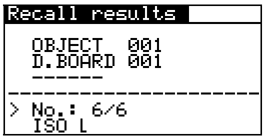


Figure 6.5: Menu for selection of measurements

Use the ⮜/⮞ keys to select the function for which you want to view results and press the TEST key to confirm.

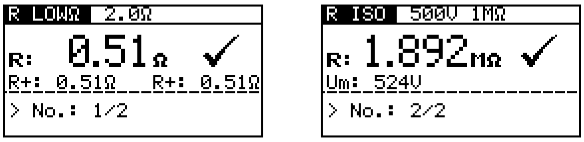


Figure 6.6: Examples of recalled results menu

Under the same memory location the other saved results can be viewed by using the ⮜/⮞ keys,
Pressing the MEM key returns the instrument back to the Memory Menu in order selection of an alternative memory location..

To exit the ***Recall results*** menu, rotate the function switch.

6.3 Deleting results

When deleting results the following actions can be taken:

- Individual results can be deleted,
- Results in a memory location and its sub-locations can be deleted
- All saved results can be deleted.

The stored results can be deleted from the memory from the ***Memory*** menu.
To enter the ***Memory*** menu, press the MEM key.

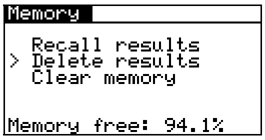


Figure 6.7: Memory menu

How to select result(s) to be deleted

Step 1 Select ***Delete results*** from the ***Memory menu*** by using the ▲ and ▼ keys to place the cursor next to the option and press the TEST key to confirm. The ***Delete results*** menu will be displayed and the last used memory location will be selected

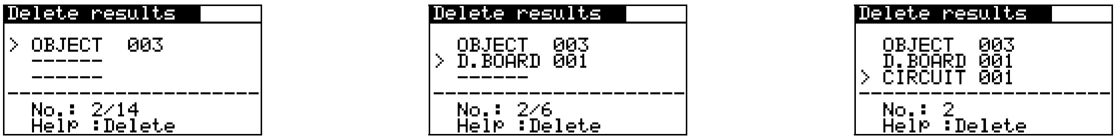


Figure 6.8: Examples of menus for selection of memory location

Step 2 To delete saved result(s) the memory location must be selected first:
The ***Object*** line can be selected with the ▲/▼ keys. Use the ◄/► keys to select the appropriate 'Object 'memory location (three-digit number).
In the lower part of the display, two numbers will be displayed (e.g. No.:2/16 see figure 6.8):

- the first number is the number of measurements stored in the selected 'Object' memory location.
- the second number is the number of measurements stored in the selected 'Object' memory location and its sub-locations (i.e. D.board, Circuit, Earth Electrode, Bonding memory locations).

The ***D. Board*** line can be selected with the ▲/▼ keys. Use the ◄/► keys to select appropriate 'D. Board memory location (three-digit number).
In the lower part of the display, two numbers will be displayed (e.g. 6/16 see figure 6.8):

- the first number is the number of measurements stored in the selected 'D. Board' memory location.

- the second number is the number of measurements stored in the selected 'D. Board' memory location and its sub-locations (Circuit, Electrode, Bonding memory locations).

The **Circuit** / **Earth Electrode** / **Bonding** line can be selected with the ⮝/⮟ keys.
The appropriate memory location ('Circuit' or 'Earth Electrode'or 'Bonding') can be selected with the TEST key.
If the ***Circuit*** is selected, use the ⮜/⮞ keys to select the appropriate 'Circuit' memory location.(three-digit number). In the lower part of the display (**No.** line) the number of measurements stored in the selected 'Circuit' memory location is shown.
If the ***Bonding*** is selected, use the ⮜/⮞ keys to select appropriate 'Bonding' memory location (e.g. Water/ Oil/ Lightning/ Gas/ Str.Steel/ Earth.cond.). In the lower part of the display the number of measurements stored in the selected 'Bonding' memory location is shown.
If the ***Earth Electrode*** is selected, the number of measurements stored in the selected 'Electrode' memory location will be displayed in the lower part of the display.

To exit the ***Delete results*** menu without deleting any results, rotate the function switch.

How to delete individual saved results

Step 1 After the memory location (Object, D. Board, Electrode, Bonding, Circuit) has been selected, press the **MEM** key. The cursor will jump down to the ***No***. line

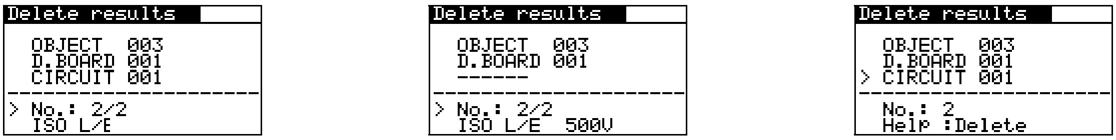


Figure 6.8: Menus for deleting individual results

Step 2 Use the ⮜/⮞ keys to select the results you want to delete and press the TEST key. Press the TEST key again to confirm that the results require deletion or press MEM key to return to the menu for the selection of different memory location (without deleting any results).

How to delete all saved results in a memory location and its sub-locations

Step 1 After the memory location (Object, D. Board, Earth Electrode, Bonding, Circuit) has been selected, press the HELP key. A warning will appear at the bottom of the screen asking for confirmation.

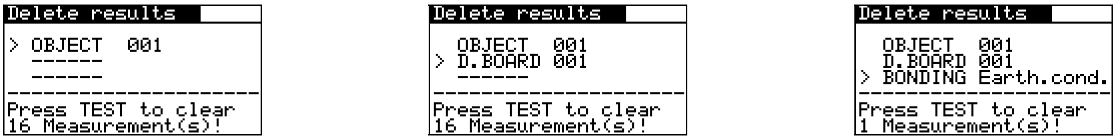


Figure 6.9: Menus for deleting all results in memory location and its subitems

Step 2 Press the TEST key to delete the results in the selected memory location and all of the associated sub-locations. Press the TEST key again for confirmation or press MEM key to return to the menu for selection of memory location without changes.

How to delete all saved results

Step 1 Select ***Clear memory*** in ***Memory*** menu by using the ⮝ and ⮟ keys and press the TEST key to confirm. The following menu is displayed:

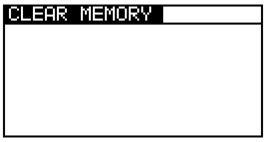


Figure 6.9: Clear memory menu

Step 2 Press the TEST key again to confirm that all results require deleting or press any cursor key (or MEM key) to return to the ***Memory*** menu without deleting any saved results.

7 RS232 / USB communication

The MI3102 EurotestXE and MI3002 Eurotest DL include both RS232 and USB communication ports. These ports can be used to send stored results through to a PC for reviewing, editing and report building.

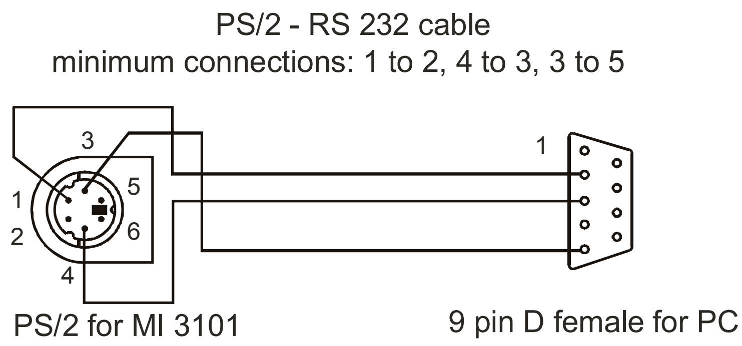


Figure 7.1: Interface connection for data transfer over PC COM port

7.1 EuroLinkPRO PC software

The EuroLinkPRO software allows the following activities:

- Data downloading,
- Creation of Verification documents,
- Export of measured data to a spreadsheet.

The EuroLinkPRO is a PC software running on Windows 2000 and Windows XP and Windows Vista operating systems.

How to download saved results to the PC

Step 1 Connect the Eurotest instrument to PC using either the RS232 or USB cable. Make sure that the correct communication port is selected and that the Eurotest instrument is switched on. Refer to chapter *4.5.4 Communication port selection*.

Step 2 Run EuroLinkPRO software on the PC.

Step 3 Select the ***Receive results*** icon or ***Instrument / Receive results*** option from the menu. The system will begin to download results saved in the instruments memory onto the PC. After the result have been downloaded, the following memory structure will be displayed.

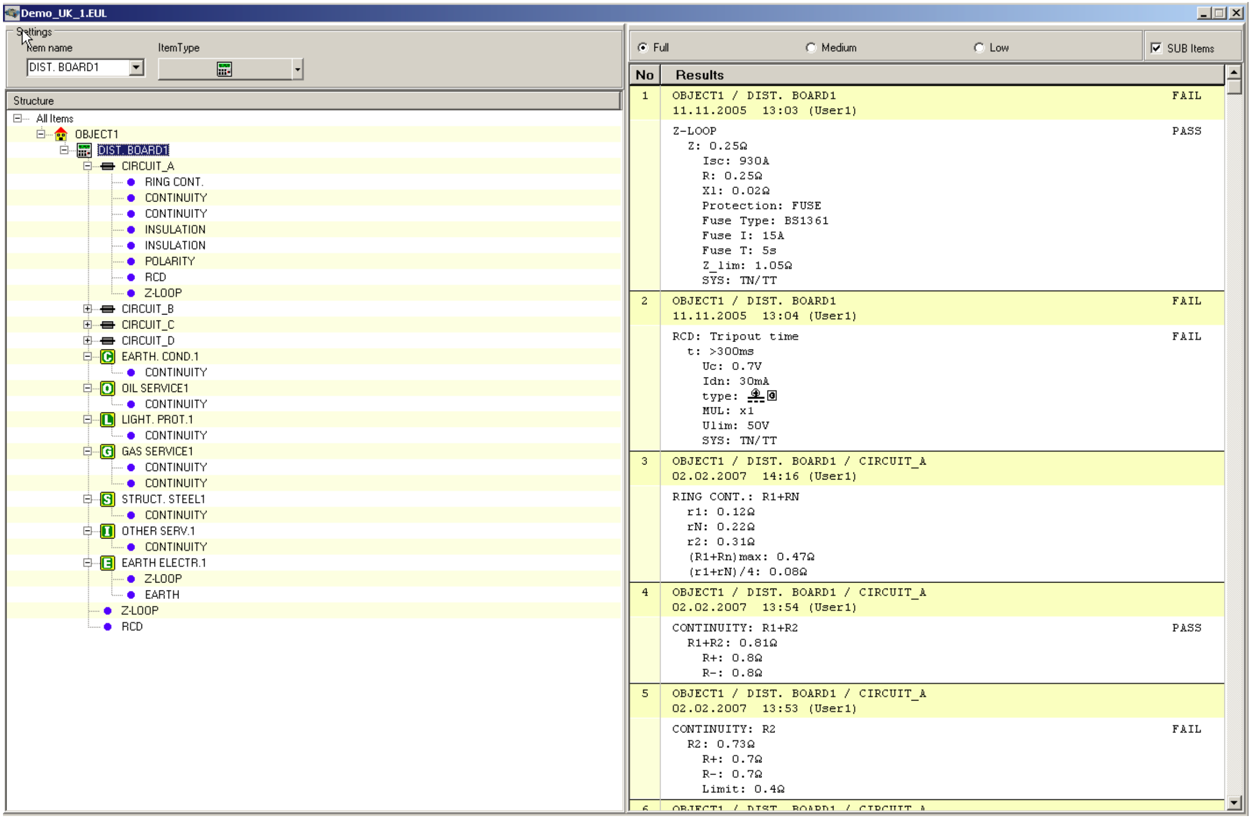


Figure 7.2: Example of downloaded results

Step 4 The software allows a variety of tasks to be performed including editting the downloaded structure for documentation purposes, saving results / parameters to an *.eul file or proceed to creation of appropriate Report / Certificate.

Note:

- The USB drivers must be installed on PC before using the USB interface is used. See accompanying CD for further instructions about USB installation.
- For more information about the operation of the software application, please see the help files available from the HELP option in the EurolinkPRO software.

8 Maintenance

8.1 Replacing fuses

There are three fuses under back battery cover of the Eurotest instrument.

- F1
  M 0.315 A / 250 V, 20×5 mm
  This fuse protects internal circuitry of low-value resistance function if test probes are connected to the mains supply voltage by mistake.
- F2, F3
  F 4 A / 500 V, 32×6.3 mm
  General input protection fuses for the L/L1 and N/L2 test terminals.

Warnings:

- ⚠ Disconnect any measuring accessory from the instrument and ensure that the instrument is turned off before opening the battery/fuse compartment cover, hazardous voltage can exist inside this compartment!
- Replace any blown fuses with exactly the same type of fuse. The instrument can be damaged and/or operator's safety impaired if this is not performed!

The Position of fuses can be seen in figure 3.4 in chapter 3.3 Back panel.

8.2 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!

8.3 Periodic calibration

It is essential that the test instrument is regularly calibrated in order for the technical specification listed in this manual to be guaranteed. We recommend an annual calibration. The calibration should be done by an authorised technical person only. Please contact your dealer for further information.

8.4 Service

For repairs under warranty, or at any other time, please contact your distributor. Unauthorised person(s) are not allowed to open the Eurotest instrument. There are no user replaceable components inside the instrument, except for the three fuses inside the battery compartment, refer to chapter *8.1 Replacing fuses*.

9 Technical specifications

9.1 Insulation resistance

Insulation resistance (nominal voltages 100 V_{DC} and 250 V_{DC})
Measuring range according to EN61557-2 is 0.017 MΩ ÷ 199.9 MΩ.

Measuring range (MΩ)	Resolution (MΩ)	Accuracy
0.000 ÷ 1.999	0.001	±(5 % of reading + 3 digits)
2.00 ÷ 99.99	0.01	
100.0 ÷ 199.9	0.1	

Insulation resistance (nominal voltages 500 V_{DC} and 1000 V_{DC})
Measuring range according to EN61557-2 is 0.015 MΩ ÷ 999 MΩ.

Measuring range (MΩ)	Resolution (MΩ)	Accuracy
0.000 ÷ 1.999	0.001	±(2 % of reading + 3 digits)
2.00 ÷ 99.99	0.01	
100.0 ÷ 199.9	0.1	
200 ÷ 999	1	±(10 % of reading)

Voltage

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

Nominal voltages .... 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 $R_N=U_N\times1$ kΩ/V
Short circuit current........................... max. 3 mA
Specified accuracy is valid if universal test cable is used, while it is valid up to 200 MΩ if tip commander is used.
The number of possible tests
with a new set of batteries .... up to 1800
Auto discharge after test.
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.

9.2 Continuity resistance

Measuring range according to EN61557-4 is 0.16 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(3 % of reading + 3 digits)
20.0 ÷ 99.9	0.1	±(5 % of reading)
100 ÷ 1999	1	

Open-circuit voltage.......................... 6.5 V_{DC} ÷ 9 V_{DC}
Measuring current............................. min. 200 mA into load resistance of 2 Ω
Test lead compensation.................... up to 5 Ω

The number of possible tests
with a new set of batteries .... up to 5500
Automatic polarity reversal of the test voltage.

9.3 RCD testing

9.3.1 General data

Nominal residual current................... 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA
Nominal residual current accuracy.... -0 / +0.1·I_Δ; $I_\Delta = I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
-0.1·I_Δ / +0; I_Δ = ½×$I_{\Delta N}$
Test current shape............................ Sine-wave (AC), pulsed (A)
RCD type .... general (G, non-delayed), selective (S, time-delayed)
Test current starting polarity .... 0^0 or 180^0
Voltage range .... 100 V ÷ 264 V (45 Hz ÷ 65 Hz)

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

	½×$I_{\Delta N}$		1×$I_{\Delta N}$		2×$I_{\Delta N}$		5×$I_{\Delta N}$		RCD IΔ	
$I_{\Delta N}$ (mA)	AC	A	AC	A	AC	A	AC	A	AC	A
10	5	3,5	10	20	20	40	50	100	✓	✓
30	15	10,5	30	42	60	84	150	212	✓	✓
100	50	35	100	141	200	282	500	707	✓	✓
300	150	105	300	424	600	848	1500	*)	✓	✓
500	250	175	500	707	1000	1410	2500	*)	✓	✓
1000	500	350	1000	1410	2000	*)	*)	*)	✓	✓

*) not available

9.3.2 Contact voltage

Measuring range according to EN61557-6 is 3.0 V ÷ 49.0 V for limit contact voltage 25 V.
Measuring range according to EN61557-6 is 3.0 V ÷ 99.0 V for limit contact voltage 50 V.

Measuring range (V)	Resolution (V)	Accuracy
0.0 ÷ 9.9	0.1	(-0 % / +10 %) of reading + 2 digits
10.0 ÷ 99.9	0.1	(-0 % / +10 %) of reading

Accuracy applies for 1 year in reference conditions. Temperature coeficient ouside these limits is +1 digit.

Test current .... max. 0.5×$I_{\Delta N}$
Limit contact voltage......................... 25 V, 50 V

Fault loop resistance at contact voltage is calculated as $R_L = \frac{U_C}{I_{\Delta N}}$.

9.3.3 Trip-out time

Complete measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

General (non-delayed) RCDs

Measuring range (ms)	Resolution (ms)	Accuracy
0 ÷ 300 (½×$I_{\Delta N}$, $I_{\Delta N}$)	1	±3 ms
0 ÷ 150 (2×$I_{\Delta N}$)	1	
0 ÷ 40 (5×$I_{\Delta N}$)	1	

Selective (time-delayed) RCDs

Measuring range (ms)	Resolution (ms)	Accuracy
0 ÷ 500 (½×$I_{\Delta N}$, $I_{\Delta N}$)	1	±3 ms
0 ÷ 200 (2×$I_{\Delta N}$)	1	
0 ÷ 150 (5×$I_{\Delta N}$)	1	

Test current .... ½×$I_{\Delta N}$, $I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
Multiplier 5 is not available if $I_{\Delta N}$=1000 mA (AC type RCDs) or $I_{\Delta N} \geq$ 300 mA (A type RCDs).
Multiplier 2 is not available if $I_{\Delta N}$=1000 mA (A type RCDs).

9.3.4 Trip-out current

Trip-out current ($I_{\Delta N}$=10 mA)
Measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

Measuring range I_Δ	Resolution I_Δ	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×$I_{\Delta N}$ ÷ 2.2×$I_{\Delta N}$ (A type)	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$

Trip-out current ($I_{\Delta N}$≥30 mA)
Measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

Measuring range I_Δ	Resolution I_Δ	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 type)	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 ÷ 9.9	0.1	(-0 % / +10 %) of reading + 2 digits
10.0 ÷ 99.9	0.1	(-0 % / +10 %) of reading

9.4 Fault loop impedance and prospective fault current

Zs sub-function
Measuring range according to EN61557-3 is 0.25 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(5 % of reading + 5 digits)
20.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

Prospective fault current (calculated value)

Measuring range (A)	Resolution (A)	Accuracy
0.00 ÷ 19.99	0.01	Consider accuracy of fault loop resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

Test current (at 230 V)...................... 7.5 A (10 ms ≤ t_{LOAD} ≤ 15 ms)
Nominal voltage range...................... 100 V ÷ 264 V (45 Hz ÷ 65 Hz)

Zs(rcd) trip-lock sub-function
Measuring range according to EN61557 is 0.46 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy *)
0.00 ÷ 19.99	0.01	±(5 % of reading + 10 digits)
20.0 ÷ 99.9	0.1	± 10 % of reading
100 ÷ 1999	1	± 10 % 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 ÷ 19.99	0.01	Consider accuracy of fault loop resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

No trip out of RCD.

9.5 Line impedance and prospective short-circuit current

Line impedance
Measuring range according to EN61557-3 is 0.25 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(5 % of reading + 5 digits)
20.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

Prospective short-circuit current (calculated value)

Measuring range (A)	Resolution (A)	Accuracy
0.00 ÷ 19.99	0.01	Consider accuracy of line resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

Test current (at 230 V)...................... 7.5 A (10 ms ≤ t_{LOAD} ≤ 15 ms)
Nominal voltage range 100 V ÷ 440 V (45 Hz ÷ 65 Hz)

9.6 Resistance to earth (MI 3102 only)

Measuring range according to EN61557-5 is 0.15 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(2 % of reading + 3 digits)
20.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

Max. auxiliary earth electrode
resistance R_C .... 100×R_E or 50 kΩ (whichever is lower)
Max. probe resistance R_P .... 100×R_E or 50 kΩ (whichever is lower)

Additional probe resistance error
at R_{Cmax} or $R_{Pmax.}$ .... ±(10 % of reading + 10 digits)

Additional error
at 3 V voltage noise (50 Hz) .... ±(5 % of reading + 10 digits)

Open circuit voltage.................................. < 45 V_{AC}
Short circuit voltage .... < 20 mA
Test voltage frequency .... 125 Hz
Test voltage shape .... rectangular
Noise voltage indication threshold .... 1 V (< 50 Ω, worst case)

Automatic measurement of auxiliary electrode resistance and probe resistance.
Automatic measurement of voltage noise.

9.7 TRMS current (MI 3102 only)

TRMS current or TRMS leakage current

Measuring range (A)	Resolution (A)	Accuracy
0.0 ÷ 99.9 mA	0.1 mA	±(5 % of reading + 3 digits)
100 ÷ 999 mA	1 mA	±(5 % of reading)
1.00 ÷ 19.99 A	0.01 A	

Input resistance ....100 Ω
Maximal continuous input current .... 30 mA (=30 A @ current clamp with ratio 1000:1)

Measurement principle ....current clamp, ratio 1000:1
Nominal frequency....................................45 Hz ÷ 65 Hz
Additional clamp error has to be considered.

9.8 Illumination (MI 3102 only)

9.8.1 Illumination (LUXmeter type B)

Specified accuracy is valid for complete operating range.

Measuring range (lux)	**Resolution (lux)**	**Accuracy**
0.01 ÷ 19.99	0.01	±(5 % of reading + 2 digits)
0.1 ÷ 199.9	0.1	±(5 % of reading)
200 ÷ 1999	1	
2.00 ÷ 19.99 k	10	

Measurement principle .... silicon photodiode with V(λ) filter
Spectral response error .... < 3.8 % according to CIE curve
Cosine error... < 2.5 % up to an incident angle of ± 85^O
Overall accuracy...................................... matched to DIN 5032 class B standard

9.8.2 Illumination (LUXmeter type C)

Specified accuracy is valid for complete operating range.

Measuring range (lux)	**Resolution (lux)**	**Accuracy**
0.01 ÷ 19.99	0.01	±(10 % of reading + 3 digits)
0.1 ÷ 199.9	0.1	±(10 % of reading)
200 ÷ 1999	1	
2.00 ÷ 19.99 k	10	

Measurement principle .... silicon photodiode
Cosine error... < 2.5 % up to an incident angle of ± 85^O
Overall accuracy...................................... matched to DIN 5032 class C standard

9.9 Phase rotation

Nominal mains voltage range .... 100 V_{AC} ÷ 440 V_{AC}
Nominal frequency range.................. 45 Hz ÷ 65 Hz
Result displayed .... 1.2.3 or 2.1.3

9.10 Voltage and frequency

Measuring range (V)	**Resolution (V)**	**Accuracy**
0 ÷ 500	1	±(2 % of reading + 2 digits)

Nominal frequency range.................. 0 Hz, 45 Hz ÷ 65 Hz

Measuring range (Hz)	Resolution (Hz)	Accuracy
45.0 ÷ 65.0	0.1	± 2 digits

Nominal voltage range...................... 10 V ÷ 500 V

9.11 Online voltage monitor

Measuring range (V)	Resolution (V)	Accuracy
0 ÷ 500	1	±(2 % of reading + 2 digits)

Nominal frequency range.................. 0 Hz, 45 Hz ÷ 65 Hz

If voltage greater than 500 V is applied to the test terminals, online voltage monitor is used as voltage indicator only.

9.12 General data

Power supply voltage........................ 9 V_{DC} (6×1.5 V battery cells, size AA)
Power supply adapter....................... 12 V ÷ 15 V / 400 mA
Battery charging current .... < 250 mA (internally regulated)
Operation... typical 15 h

Overvoltage category........................ CAT III / 600 V; CAT IV / 300 V
Plug commander (optional)
overvoltage category .... CAT III / 300 V

Protection classification .... double insulation
Pollution degree................................ 2
Protection degree .... IP 42

Display .... 128×64 dots matrix display with backlight

Dimensions (w × h × d)..................... 23 cm × 10.3 cm × 11.5 cm
Weight (without battery).................... 1.31 kg

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

Operating 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 ^{O}C ÷ +40 ^{O}C)
80 %RH (40 ^{O}C ÷ 60 ^{O}C)

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.

A Fuse base tables

Fuse type B

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
3		12,264	12,264
6		6,136	6,136
10		3,68	3,68
16		2,296	2,296
20		1,84	1,84
25		1,472	1,472
32		1,152	1,152
40		0,92	0,92
50		0,736	0,736
63		0,584	0,584
80		0,456	0,456
100		0,368	0,368
125		0,296	0,296

Fuse type C

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
6		3,064	3,064
10		1,84	1,84
16		1,152	1,152
20		0,92	0,92
25		0,736	0,736
32		0,576	0,576
40		0,456	0,456
50		0,368	0,368
63		0,288	0,288
80		0,232	0,232
100		0,184	0,184
125		0,144	0,144

Fuse type D

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
6		1,536	1,536
10		0,92	0,92
16		0,576	0,576
20		0,456	0,456
25		0,368	0,368
32		0,288	0,288
40		0,232	0,232
50		0,184	0,184
63		0,144	0,144
80		0,112	0,112
100		0,088	0,088
125		0,072	0,072

Fuse type BS 1361

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
5		8,36	13,12
15		2,624	4
20		1,36	2,24
30		0,92	1,472
45			0,768
60			0,56
80			0,4
100			0,288

Fuse type BS 88

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
6		6,816	10,8
10		4,088	5,936
16		2,16	3,344
20		1,416	2,328
25		1,152	1,84
32		0,832	1,472
40			1,08
50			0,832
63			0,656
80			0,456
100			0,336
125			0,264
160			0,2
200			0,152

Fuse type BS 1362

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
3		13,12	18,56
13		1,936	3,064

Fuse type BS 3036

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
5		7,664	14,16
15		2,04	4,28
20		1,416	3,064
30		0,872	2,112
45			1,272
60			0,896
100			0,424

All impedances are scaled with factor 0.8.

B IT supply systems

In order for the operator to be familiar with the measurements and their typical applications on IT supply systems, it is advisable to read Metrel's handbook *Measurements on IT power supply systems*.

B.1 Standard references

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

B.2 Fundamentals

An IT supply system is a mains supply system that is insulated from ground (PE) (i.e. it is ungrounded supplying system). The system either has no direct connection to ground or the connection is provided through a relatively high impedance. IT systems mainly occur in areas where additional protection against electric shock is required. Typical places are medical surgery rooms.
IT supply systems also has no grounding currents except leakages, and in this way they are not suceptable to problems with step voltages, (e.g. voltage drops in a step) or high energy sparking in extrinsic areas.

In normal situations, a high impedance to ground exists and is formed by the capacitances of the supply wires to ground and the capacitances between the primary and secondary windings of the IT supply transformer. A minor part of the capacitance is formed by Y capacitors (EMC) in the mains section of any connected equipment. Selecting the appropriate transformer, installation cabling and the selection of an optional high impedance connection to ground can control the maximum leakage current of the system.
Depending on the application, additional impedances to ground can be applied or can occur through special loading equipment (as presented in *figure B.1)*. The value of the impedance should be greater than 100 Ω.

The IT system can provide an additional level of protection against electric shock. In the situation where a failure occurs in any of the insulation between the line conductors and PE (e.g. through equipment failure, wrong application or procedure), this system will remain safe but will be converted into a TN / TT type system. However, additional failure can be hazardous, which means that the insulation must be continuously checked and repaired immediately after a failure has been detected.
Supplementary to other protection devices, an IT system normally contains insulation monitoring devices (IMD) or systems that sound alarms when insulation resistance or impedance drops below set threshold. The threshold value usually depends on environment and the application. (e.g. Typical value for a medical installations is 55 kΩ). In some countries, it is not enough to trace the insulation resistance of the IT supply system to 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 at 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.

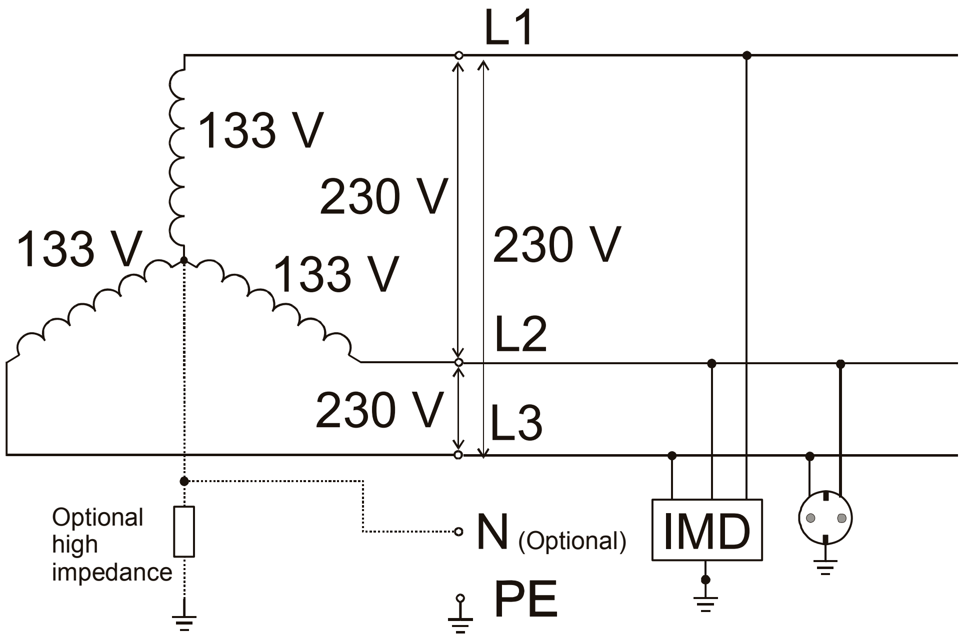


Figure B.1: General IT supply system

- 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.

B.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 *4.5.1 Supply system setup*. Once the IT system is selected the instrument can be used immediately. The instrument keeps selected IT system when it is turned off.

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

IT system functions	Notes
Contunuity functions	
RLOWΩ	Independent of selected supply system.
Continuity	
Insulation	Independent of selected supply system.
Line impedance	
Line impedance	Impedance Z_{L1-L2}.
Prospective short circuit current	I_{PSC} for rated U_{L1-L2}.
Fault loop impedance	Independent of selected supply system
Fault loop impedance	
Prospective fault current	
Voltage, frequency	Symbols modified for IT system.
Phase rotation	Three-phase system automatic detected.
RCD functions	Independent of selected supply system
Contact voltage U_C	
Trip-out time	
Trip-out current	Bypassing principle shown in figure B.3.
Automatic test	
Earth resistance	Independent of selected supply system.
PE test probe	Active, but does not inhibit selected test if voltage is detected.

B.3.1 Voltage

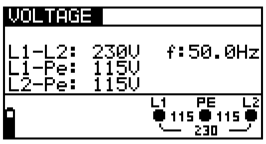


Figure B.2: Example of voltage and frequency measurements

Displayed results for **single phase** system:

L1-L2......Voltage between line conductors,
L1-pe......Voltage between line 1 and protective conductor,
L2-pe......Voltage between line 2 and protective conductor.

B.3.2 Line impedance

See chapter *5.5 Line impedance and prospective short-circuit current*, the measurement is the same; only terminal voltage monitor indication corresponds to IT system.

B.3.3 RCD testing

RCD testing is performed in the same way as in TN/TT system (See chapter *5.3 Testing RCDs*), with the following exception:

- Contact voltage measurement is not relevant.

Test circuit with bypassing principle should correspond to that in figure *B.3*.

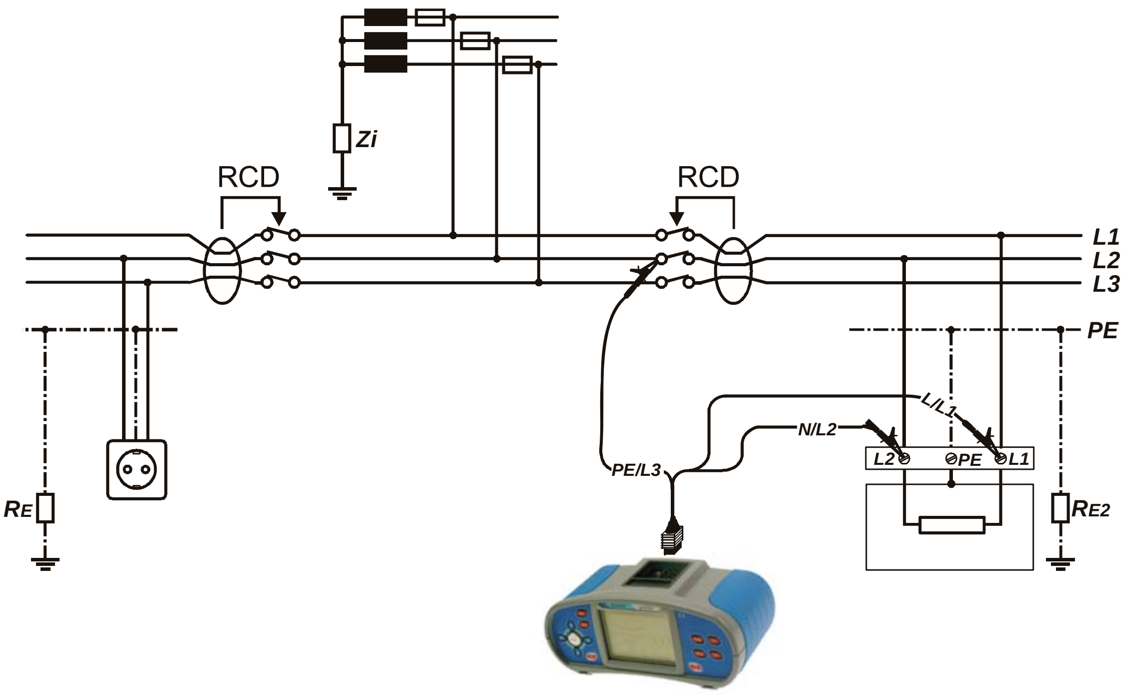


Figure B.3: RCD testing in IT system

B.3.4 First fault leakage current (ISFL) (MI 3102 only)

First fault leakage current measurement is performed in order to verify the maximum current that could leak into PE from observed line. This current flows through the insulation resistance and reactance (capacitance) between the other lines and PE.

How to perform first fault current measurement

Step 1 Select the **Insulation** function with the function selector switch and use the ⮝/⮟ keys to select **ISFL (first fault current)** function. The following menu is displayed:

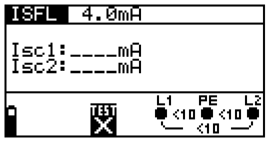


Figure B.4: First fault current measurement menu

Step 2 Set the following limit value:

- First fault current high limit value.

Step 3 Connect test cable to the instrument and to the item under test. Follow the connection diagram shown in figure B.5 to perform first fault current measurement. Use the **Help** function if necessary.

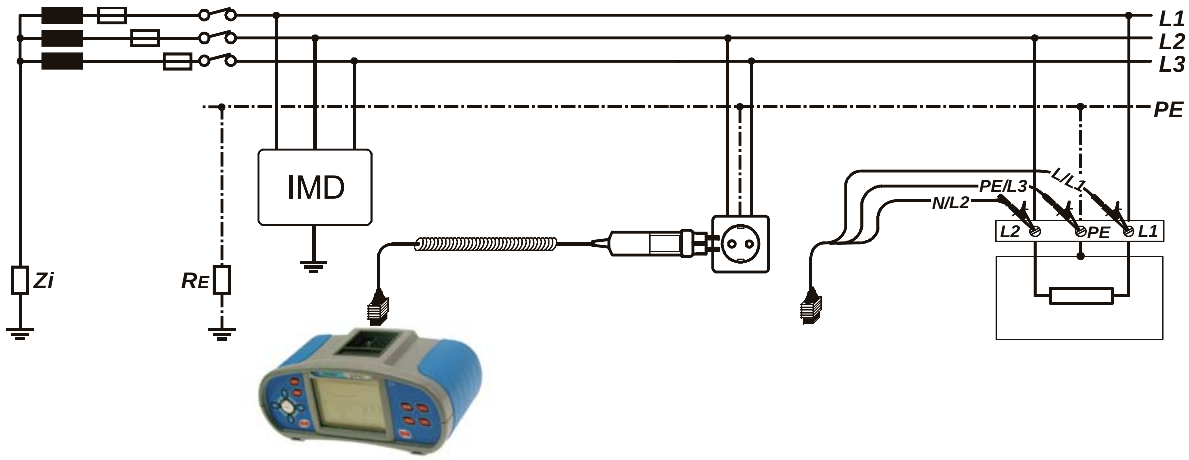


Figure B.5: Connection with plug commander and universal test cable

Step 4 Check the displayed warnings and online voltage/terminal monitor before starting measurement. If OK, press the TEST key. After performing the measurement results appear on the display together with the PASS/FAIL indication (if applicable).

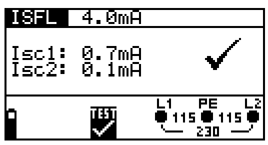


Figure B.6: Example of first fault current measurement results

Displayed results:

I_{SC1}..........First fault current between L1-PE,
I_{SC2}..........First fault current between L2-PE.

Save displayed results for documentation purposes. Refer to chapter *6.1. Saving results*.

B.3.5 Insulation monitoring device testing (MI 3102 only)

How to check insulation monitoring device

Step 1 Select the **Insulation** function with the function selector switch and use the ⮝/⮟ keys to select **IMD check** function. The following menu is displayed:

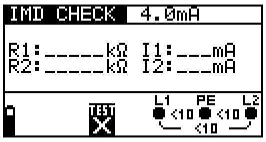


Figure B.7: IMD check menu

Step 2 Set the following limit value:

- o Fault resistance (indicative)
- o Calculated first fault current high limit value.

Step 3 Connect test cable to the instrument and to the item under test. Follow the connection diagram shown in figure B.5 to check insulation monitor device. Use the **Help** function if necessary.

Step 4 Check the displayed warnings and online voltage/terminal monitor before starting the measurement. If OK, press the TEST key. Use the ⮜/⮞ keys to decrease indicative insulation resistance until insulation monitor device alarms bad insulation. Indicative insulation resistance and calculated first fault current between first live conductor (e.g. L1) and PE conductor are displayed. After performing the measurement results with PASS/FAIL indication appear on the display.

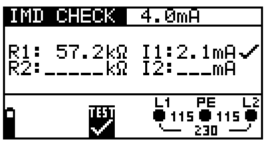


Figure B.8: First fault condition between L1 and PE

Step 5 Use the ⮟ key to select second live line (e.g. L2). Use the ⮜/⮞ keys to decrease indicative insulation resistance until insulation monitor device

alarms bad insulation. Indicative insulation resistance and calculated first fault current between second live conductor (e.g. L2) and PE conductor are displayed.
To complete measurement press the TEST key again.
After performing the measurement results with PASS/FAIL indication appear on the display.

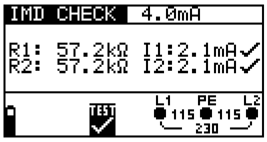


Figure B.9: First fault condition between L2 and PE

Displayed results:

R1...........Threshold indicative insulation resistance for L1,
I1 ....Calculated first fault leakage current at treshold insulation resistance for L1,
R2...........Threshold indicative insulation resistance for L2,
I2 ....Calculated first fault leakage current at treshold indicative insulation resistance for L2.

First fault leakage currents I_1 and I_2 are calculated as follows:

$$I_1 = \frac{U_{L1-L2}}{R_1}\ ,\ I_2 = \frac{U_{L1-L2}}{R_2}$$

where:
U_{L1-L2}.......Measured voltage between L1 and L2,
R_1............Threshold insulation resistance for L1,
R_2............Threshold insulation resistance for L2.

The calculated first fault current is the maximum current that would flow when insulation resistance decreases to the same value as the applied test resistance, and a first fault is assumed between opposite line and PE.

Save displayed results for documentation purposes. Refer to chapter *6.1. Saving results*.

Note:

- It is recommended to disconnect all appliances from the tested supply net to receive regular test results. Any connected appliance will influence the insulation resistance threshold test.
- The displayed resistances and currents are indicative only. Displayed resistance can significantly differ from the actual resistance the Eurotest simulates. If IMD's with very low test currents (below 1mA) are checked the displayed resistance value is typically lower (and current higher) than the actual simulated resistance. The difference is lower for lower set resistances.

B.4 Technical specifications (MI 3102 only)

Only technical specifications that are different to the specifications from chapter *9* of this document are listed below.

B.4.1 First fault leakage current (ISFL)

Measuring range (mA)	Resolution (mA)	Accuracy
0.0 ÷ 9.9	0.1	±(5 % of reading + 3 digits)
10 ÷ 19	1	±(5 % of reading)

Measuring resistance........................ approx. 1000 Ω

B.4.2 Calibrated resistances for IMD testing

Test resistance range..................................... 20 kΩ to 650 kΩ (indicative values), 64 steps
Absolute maximum overload voltage............ 265 V

Calculated insulation leakage current

Measuring range (mA)	Resolution (mA)	Note
0.0÷ 19.9	0.1	calculated value

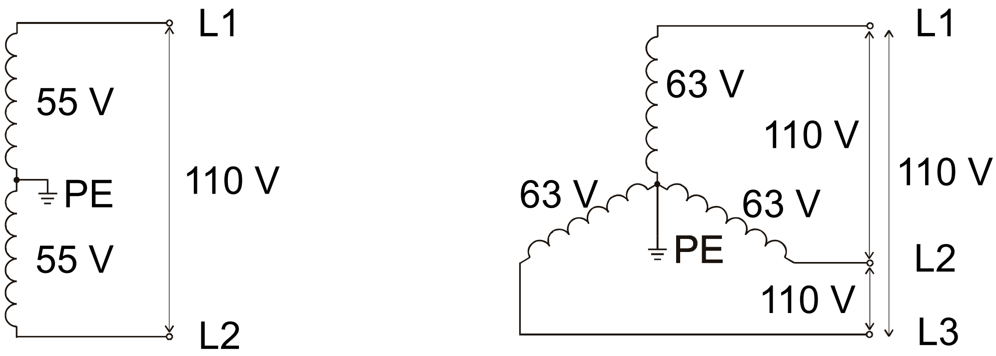
C Reduced low voltage supply systems

C.1 Standard reference

- BS7671

C.2 Fundamentals

Special supply systems are applied where inherent protection against 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 C.1: General reduced low voltage supply systems

C.3 Measurement 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 *4.5.1 Supply system setup*. 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.

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

Reduced low voltage system functions	Notes
Contunuity functions	
RLOWΩ	Independent of selected supply system.
Continuity	
Insulation	Independent of selected supply system.
Line resistance	
Line resistance	Resistance R_{L1-L2}.
Prospective short circuit current	I_{PSC} for U_{L1-L2} = 110 V.
Fault loop resistance	
Fault loop resistance	Both fault loops, R_1 (L1-PE) and R_2 (L2-PE).
Prospective fault current	I_{SC1} and I_{SC2} for both fault loops.
Voltage, frequency	Symbols modified for reduced low voltage system.
Phase rotation	Three-phase system automatic detected.
RCD functions	
Contact voltage U_C	For both posibilities, U_1 (L1-PE) and U_2 (L2-PE).
Trip-out time	Maximum nominal differential current limited to 1 A.
Trip-out current	
Automatic test	
Earth resistance	Independent of selected supply system.
PE test probe	Disabled.

C.3.1 Voltage

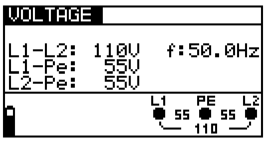


Figure C.2: Example of voltage and frequency measurements

Displayed results for single phase system:

L1-L2 ......Voltage between line conductors,
L1-pe ......Voltage between line 1 and protective conductors,
L2-pe ......Voltage between line 2 and protective conductors.

C.3.2 RCD testing

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

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

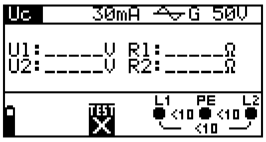


Figure C.3: RCD contact voltage test

C.3.3 Line resistance and prospective short circuit current

Measured resistance represents Line-Line resistance (R_{L1-L2}). Nominal system voltage for calculation of I_{PSC} is set to 110 V.
Nominal system voltage range for line resistance 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 .

C.3.4 Fault loop resistance and prospective fault current

The definition of the nominal system voltage for calculating the I_{PFC} changes to:

- 55 V for single-phase centre-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.

Nominal input voltages are:

Nominal input voltage U_N	**Voltage range**
Single-phase 55 V system	(44 V ≤ U < 61 V),
Three-phase 63 V system	(56 V ≤ U ≤ 70 V),

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

C.4 Technical specifications

Only those technical specifications are listed below that are different to specifications from chapter *9* of this document.

C.4.1 RCD testing
C.4.2
C.4.3 General data

Nominal residual current.................. 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA
Nominal residual current accuracy.... -0 / +0.1·I_Δ; I_Δ = $I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
-0.1·I_Δ / +0; I_Δ = ½×$I_{\Delta N}$
Maximum nominal differential
current for declared accuracy .... 1000 mA for $I_{\Delta N}$
500 mA for 2×$I_{\Delta N}$
100 mA for 5×$I_{\Delta N}$
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 .... general (G, non-delayed), selective (S, time-delayed)
Test current starting polarity .... 0^0 or 180^0
Nominal input voltage .... 55 V / 63 V (45 Hz ÷ 65 Hz)

C.4.4 Contact voltage

Measuring range according to EN61557-6 is 3.0 V ÷ 32.6 V for limit contact voltage 25 V.
Measuring range according to EN61557-6 is 3.0 V ÷ 66.0 V for limit contact voltage 50 V.

Measuring range (V)	Resolution (V)	Accuracy
0.0 ÷ 9.9	0.1	(-0 % / +15 %) of reading + 2 digits
10.0 ÷ 99.9	0.1	(-0 % / +15 %) of reading

Accuracy applies for 1 year in reference conditions. Temperature coeficient ouside these limits is +1 digit.

Test current .... max. 0.5×$I_{\Delta N}$
Limit contact voltage .... 25 V or 50 V
The contact voltage is calculated to.. $I_{\Delta N}$ (general type) or to 2×$I_{\Delta N}$ (selective type)

Fault loop resistance at contact voltage is calculated as $R_L = \frac{U_C}{I_{\Delta N}}$.

Trip-out time

Complete measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

General (non-delayed) RCDs

Measuring range (ms)	Resolution (ms)	Accuracy
0 ÷ 300 (½×$I_{\Delta N}$, $I_{\Delta N}$)	1	±3 ms
0 ÷ 150 (2×$I_{\Delta N}$)	1	
0 ÷ 40 (5×$I_{\Delta N}$)	1	

Selective (time-delayed) RCDs

Measuring range (ms)	Resolution (ms)	Accuracy
0 ÷ 500 (½×$I_{\Delta N}$, $I_{\Delta N}$)	1	±3 ms
0 ÷ 200 (2×$I_{\Delta N}$)	1	
0 ÷ 150 (5×$I_{\Delta N}$)	1	

Test current .... ½×$I_{\Delta N}$, $I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
5×$I_{\Delta N}$ is not applicable for $I_{\Delta N}$≥100 mA (RCD types AC,A)
2×$I_{\Delta N}$ is not applicable for $I_{\Delta N}$≥500 mA (RCD type AC) or $I_{\Delta N}$≥300 mA (RCD type A)
$I_{\Delta N}$ is not applicable for $I_{\Delta N}$=1000 mA (RCD type AC) or $I_{\Delta N}$≥500 mA (RCD type A)

Trip-out current

Trip-out current ($I_{\Delta N}$=10 mA)
Measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

Measuring range I_Δ	Resolution I_Δ	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×$I_{\Delta N}$ ÷ 2.2×$I_{\Delta N}$ (A type)	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$

Trip-out current ($I_{\Delta N}$≥30 mA)
Measurement range corresponds to EN61557-6 requirements. Specified accuracies are valid for complete operating range.

Measuring range I_Δ	Resolution I_Δ	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 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 ÷ 9.9	0.1	(-0 % / +15 %) of reading + 2 digits
10.0 ÷ 99.9	0.1	(-0 % / +15 %) of reading

C.4.5 Fault loop resistance and prospective fault current

Rs sub-function
Measuring range according to EN61557-3 is 0.32 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy*)
0.00 ÷ 19.99	0.01	±(10 % of reading + 5 digits)
20.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

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

Prospective fault current (calculated value)

Measuring range (A)	Resolution (A)	Accuracy
0.00 ÷ 19.99	0.01	Consider accuracy of fault loop resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

IPFC calculation................................ $I_{PFC}=U_N \times k_{SC} / Z_{L-PE}$
U_N = 55 V, (44 V ≤ U < 61 V) for selected 55 V single-phase system
U_N = 63 V, (56 V ≤ U < 70 V) for selected 63 V three-phase system
Test current .... 1.9 A (10 ms)
Nominal input voltage .... 55 V / 63 V (45 Hz ÷ 65 Hz)
Test posibilities .... L1-PE and L2-PE

Rs(rcd) trip-lock sub-function
Measuring range according to EN61557 is 0.85 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy *)
0.00 ÷ 19.99	0.01	±(10 % of reading + 15 digits)
20.0 ÷ 99.9	0.1	±10 % of reading
100 ÷ 1999	1	±10 % 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 ÷ 19.99	0.01	Consider accuracy of fault loop resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

IPFC calculation................................ $I_{PFC}=U_N \times k_{SC} / Z_{L-PE}$
U_N = 55 V, (44 V ≤ U < 61 V) for selected 55 V single-phase system
U_N = 63 V, (56 V ≤ U < 70 V) for selected 63 V three-phase system
Nominal input voltage .... 55 V / 63 V (45 Hz ÷ 65 Hz)
Test posibilities .... L1-PE and L2-PE
No trip out of RCD.

C.4.6 Line resistance and prospective short-circuit current

Line resistance
Measuring range according to EN61557-3 is 0.25 Ω ÷ 1999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy*)
0.00 ÷ 19.99	0.01	±(5 % of reading + 5 digits)
20.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

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

Prospective short-circuit current (calculated value)

Measuring range (A)	Resolution (A)	Accuracy
0.00 ÷ 19.99	0.01	Consider accuracy of line resistance measurement
20.0 ÷ 99.9	0.1	
100 ÷ 999	1	
1.00k ÷ 9.99k	10	
10.0 ÷ 24.4k	100	

IPFC calculation................................ $I_{PSC}=U_N \times k_{SC} / Z_{L-N}$
U_N = 110 V, (90 V ≤ U < 121 V)
Test current .... 3.1 A (10 ms)
Nominal input voltage .... 110 V (45 Hz ÷ 65 Hz)