EurotestCOMBO

MI 3125

MI 3125 BT

Instruction manual

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Distributor:

Manufacturer:

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

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

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1 Preface

Congratulations on your purchase of the 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,
- Earthing resistance tests,
- RCD testing,
- Fault loop / RCD trip-lock impedance measurements,
- Line impedance / Voltage drop,
- Phase sequence.

The graphic display with backlight offers easy reading of results, indications, measurement parameters and messages. Two LED Pass/Fail indicators are placed at the sides of the LCD.
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.
In order for operator to be familiar enough with performing measurements in general and their typical applications it is advisable to read Metrel handbook *Guide for testing and verification of low voltage installations*.

The model MI 3125 BT has inbuilt Bluetooth interface for easy communication with PC and Android devices.

The instrument is equipped with the entire necessary accessory for comfortable testing.

Note:
For some national specific instrument implementations some details in the below description can differ from the actual instrument implementation. Check the national specific notes in Appendix C or ask your local dealer.

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 protection category of some accessories is lower than of the instrument. Test tips and Tip commander have removable caps. If they are removed the protection falls to CAT II. Check markings on accessories!**
(cap off, 18 mm tip)…CAT II up to 1000 V
(cap on, 4 mm tip)… CAT II 1000 V / CAT III 600 V / CAT IV 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 the battery compartment cover.**
- **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!
- 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 600 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) is detected between test terminals, the insulation resistance measurement will not be performed. If voltages of higher than 10 V (AC or DC) is detected between test terminals, the insulation resistance measurement will not be performed.
- The instrument automatically discharge tested object after finished measurement.
- A double click of TEST key starts a continuous measurement.

Continuity functions

- If voltages of higher than 10 V (AC or DC) is 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.

Z-LOOP

- 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.
- The measuring accuracy and immunity against noise are higher if parameter in Zs rcd is set to standard "Std".
- 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. In this case setting parameter in measuring function Zs rcd to "Low" can help.

Z-LINE / VOLTAGE DROP

- In case of measurement of $Z_{Line-Line}$ with the instrument test leads PE and N connected together the instrument will display a warning of dangerous PE voltage. The measurement will be performed anyway.
- Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement.
- L and N test terminals are reversed automatically according to detected terminal voltage (except in UK version).

2.2 Battery and charging

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

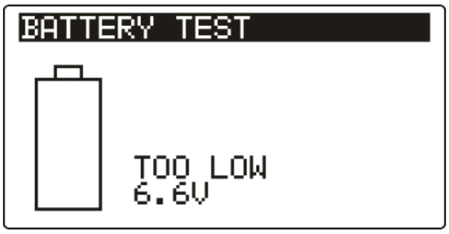


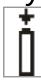
Figure 2.1: Discharged battery indication

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

Figure 2.2: Power supply socket polarity

The instrument automatically recognizes the connected power supply adapter and begins charging.

Symbols:

	Indication of battery charging

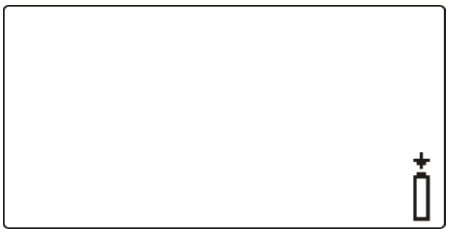


Figure 2.3: Charging indication

- ⚠ 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 2100 mAh or above.
- Do not recharge alkaline battery cells!
- Use only power supply adapter delivered from the manufacturer or distributor of the test equipment to avoid possible fire or electric shock!

2.2.1 New battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during the charging of new battery cells or cells that have been left unused for a longer period (more than 3 months). Ni-MH and Ni-Cd cells can be subjected 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:

Procedure	**Notes**
➢ Completely charge the battery.	At least 14 h with in-built charger.
➢ Completely discharge the battery.	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.	Four cycles are recommended in order to restore the batteries to their normal capacity.

Notes:

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

2.3 Standards applied

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

Electromagnetic compatibility (EMC)	
EN 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements Class B (Hand-held equipment used in controlled EM environments)
Safety (LVD)	
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
EN 61010-031	Safety requirements for hand-held probe assemblies for electrical measurement and test
EN 61010-2-030	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits.
Functionality	
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 Part 6: Residual current devices (RCDs) in TT and TN systems Part 7: Phase sequence Part 10: Combined measuring equipment
Other reference standards for testing RCDs	
EN 61008	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses
EN 61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses
EN 60364-4-41	Electrical installations of buildings Part 4-41 Protection for safety – protection against electric shock
IEC 60364-5-52	Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems
BS 7671	IEE Wiring Regulations (18th edition)
AS / NZ 3760	In-service safety inspection and testing of electrical equipment

Note about EN and IEC standards:

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

3 Instrument description

3.1 Front panel

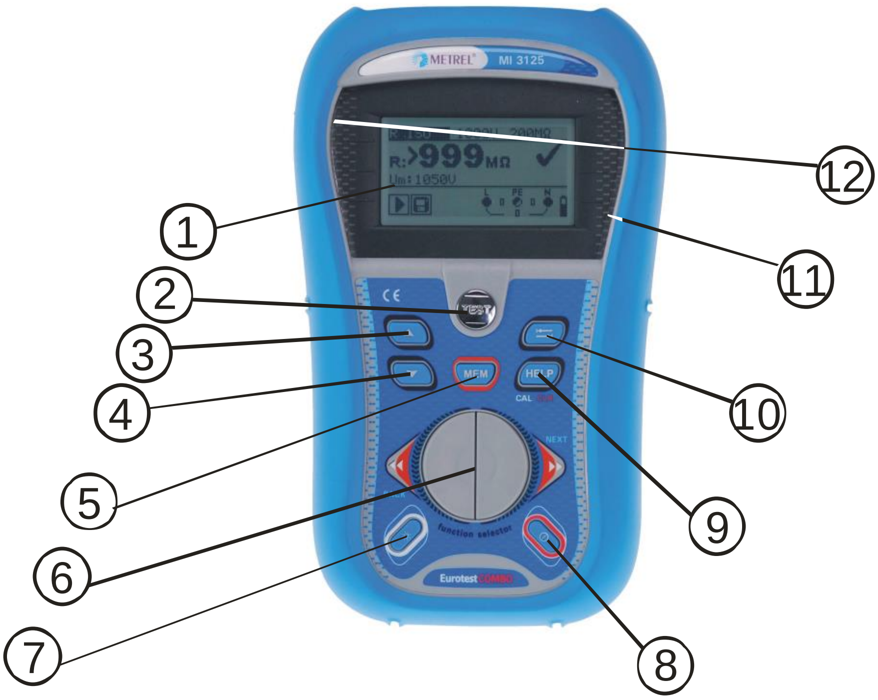


Figure 3.1: Front panel (picture of MI 3125 BT)

Legend:
* Model MI 3125 BT
** Model MI 3125

1	LCD	128 x 64 dots matrix display with backlight.	
2	TEST	TEST	Starts measurements.
			Acts also as the PE touching electrode.
3	UP	Modifies selected parameter.	
4	DOWN		
5*	MEM	Store / recall / clear tests in memory of instrument.	
5**	CAL	Calibrates test leads in Continuity functions. Starts Z_{REF} measurement in Voltage drop sub-function.	
6	Function selectors	Selects test function.	
7	Backlight, Contrast	Changes backlight level and contrast.	
8	ON / OFF	Switches the instrument power on or off.	
		The instrument automatically turns off 15 minutes after the last key was pressed.	

9*	HELP / CAL	Accesses help menus.	
		In RCD Auto toggles between top and bottom parts of results field.	
		Calibrates test leads in Continuity functions.	
		Starts Z_{REF} measurement in Voltage drop sub-function.	
9**	HELP	Accesses help menus.	
		In RCD Auto toggles between top and bottom parts of results field.	
10	TAB	Selects the parameters in selected function.	
11	PASS	Green indicator	Indicates PASS/ FAIL of result.
12	FAIL	Red indicator	

3.2 Connector panel

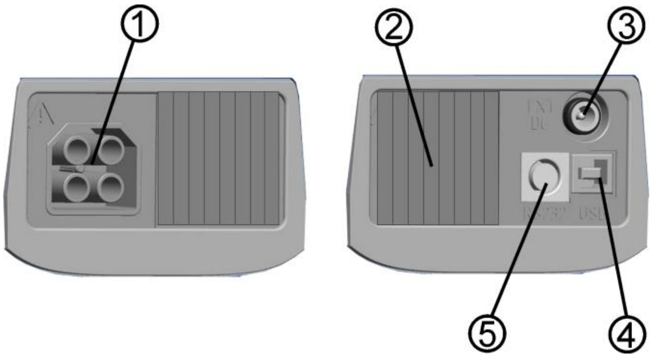


Figure 3.2: Connector panel (picture of MI 3125 BT)

Legend:
* Model MI 3125 BT
** Model MI 3125

1	Test connector	Measuring inputs / outputs
2	Protection cover	
3	Charger socket	
4*	USB connector	Communication with PC USB (1.1) port.
5*	PS/2 connector	Communication with PC serial port and connection to optional accessories.
5**	PS/2 connector	Serial port for upgrading the instrument.

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

3.3 Back side

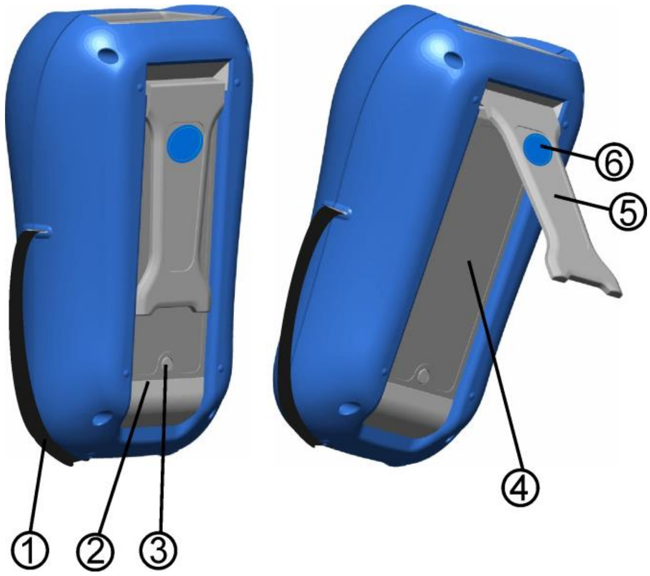


Figure 3.3: Back side

Legend:

1	Side belt
2	Battery compartment cover
3	Fixing screw for battery compartment cover
4	Back panel information label
5	Holder for inclined position of the instrument
6	Magnet for fixing instrument close to tested item (optional)

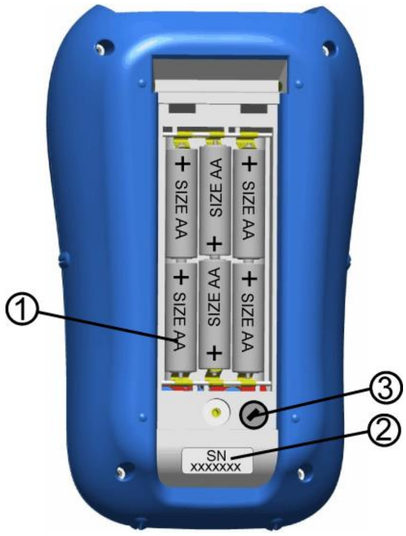


Figure 3.4: Battery compartment

Legend:

1	Battery cells	Size AA, alkaline or rechargeable NiMH / NiCd
2	Serial number label	
3	Fuse	M 0.315 A, 250 V

3.4 Display organization

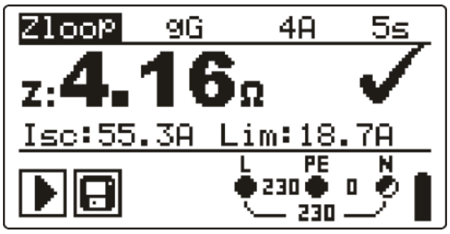


Figure 3.5: Typical function display

	Function name
	Result field
	Test parameter field
	Message field
	Terminal voltage monitor
	Battery indication

3.4.1 Terminal voltage monitor

The terminal voltage monitor displays on-line the voltages on the test terminals and information about active test terminals.

	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.
	L and PE are active test terminals; N terminal should also be connected for correct input voltage condition.

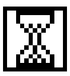
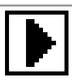
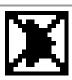
3.4.2 Battery indication

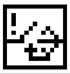
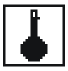
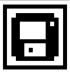
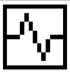
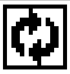
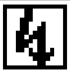
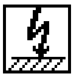
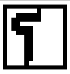
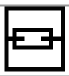
The indication indicates the charge condition of battery and connection of external charger.

	Battery capacity indication.
	Low battery. Battery is too weak to guarantee correct result. Replace or recharge the battery cells.
	Recharging in progress (if power supply adapter is connected).

3.4.3 Message field

In the message field warnings and messages are displayed.

	Measurement is running, consider displayed warnings.
	Conditions on the input terminals allow starting the measurement; consider other displayed warnings and messages.
	Conditions on the input terminals do not allow starting the measurement, consider displayed warnings and messages.

	RCD tripped-out during the measurement (in RCD functions).
	Instrument is overheated. The measurement is prohibited until the temperature decreases under the allowed limit.
	Result(s) can be stored. (model MI 3125 BT)
	High electrical noise was detected during measurement. Results may be impaired.
	L and N are changed.
	**Warning!** High voltage is applied to the test terminals.
	**Warning!** Dangerous voltage on the PE terminal! Stop the activity immediately and eliminate the fault / connection problem before proceeding with any activity!
	Test leads resistance in Continuity measurement is not compensated.
	Test leads resistance in Continuity measurement is compensated.
	High resistance to earth of test probes. Results may be impaired.
	Fuse F1 is broken.

3.4.4 Result field

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

3.4.5 Sound warnings

Continuous sound	**Warning!** Dangerous voltage on the PE terminal is detected.

3.4.6 Help screens

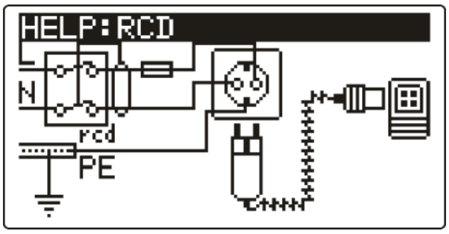
HELP	Opens help screen.

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.

Keys in help menu:

UP / DOWN	Selects next / previous help screen.
HELP	Scrolls through help screens.

Function selectors / TEST	Exits help menu.



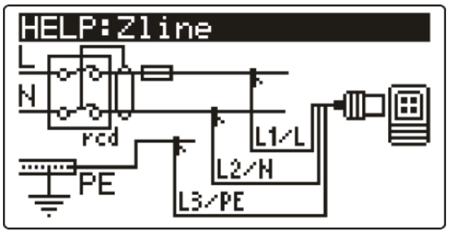


Figure 3.6: Examples of help screens

3.4.7 Backlight and contrast adjustments

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

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

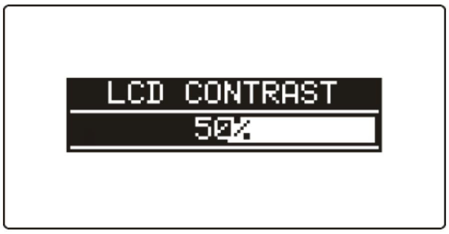


Figure 3.7: Contrast adjustment menu

Keys for contrast adjustment:

DOWN	Reduces contrast.
UP	Increases contrast.
TEST	Accepts new contrast.
Function selectors	Exits without changes.

3.5 Instrument set and accessories

3.5.1 Standard set MI 3125

- Instrument
- Short instruction manual
- Calibration Certificate
- Mains measuring cable
- Test lead.,3 x 1.5 m
- Test probe, 3 pcs
- Crocodile clip, 3 pcs
- Set of NiMH battery cells
- Power supply adapter
- CD with instruction manual, and “Guide for testing and verification of low voltage installations” handbook
- Set of carrying straps

3.5.2 Standard set MI 3125 BT

- Instrument
- Short instruction manual
- Calibration Certificate
- Mains measuring cable
- Test lead, 3 x 1.5 m
- Test probe, 3 pcs
- Crocodile clip, 3 pcs
- Set of NiMH battery cells
- Power supply adapter
- CD with instruction manual, and “Guide for testing and verification of low voltage installations” handbook and PC software EuroLink PRO
- Set of carrying straps
- RS232 - PS/2 cable
- USB cable

3.5.3 Optional accessories

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

4 Instrument operation

4.1 Function selection

For selecting test function the **FUNCTION SELECTOR** shall be used.

Keys:

FUNCTION SELECTOR	Select test / measurement function: ❑ <**VOLTAGE TRMS**> Voltage and frequency and phase sequence. ❑ <**R ISO**> Insulation resistance. ❑ <**R LOWΩ**> Resistance of earth connections and bondings. ❑ <**Zline**> Line impedance ❑ <**Zloop**> Fault loop impedance. ❑ <**RCD**> RCD testing. ❑ <**EARTH RE**> Resistance to earth ❑ <**SETTINGS**> General instrument settings.
UP/DOWN	Selects sub-function in selected measurement function.
TAB	Selects the test parameter to be set or modified.
TEST	Runs selected test / measurement function.
MEM	Stores measured results / recalls stored results (model MI 3125 BT).

Keys in **test parameter** field:

UP/DOWN	Changes the selected parameter.
TAB	Selects the next measuring parameter.
FUNCTION SELECTOR	Toggles between the main functions.
MEM	Stores measured results / recalls stored results (model MI 3125 BT).

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

Parameter	**OFF**	No limit values, indication: _ _ _.
	ON	**Value(s)** – results will be marked as PASS or FAIL in accordance with selected limit.

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

4.2 Settings

Different instrument options can be set in the **SETTINGS** menu.

All models:
- Selection of language,
- Setting the instrument to initial values,
- Selection of reference standard for RCD test,
- Entering Isc factor,
- Commander support.

Model MI 3125 BT:
- Recalling and clearing stored results,
- Setting the date and time

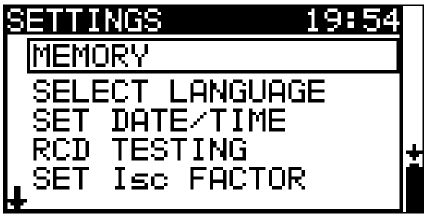


Figure 4.1: Options in Settings menu

Keys:

UP / DOWN	Selects appropriate option.
TEST	Enters selected option.
Function selectors	Exits back to main function menu.

4.2.1 Memory (model MI 3125 BT)

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

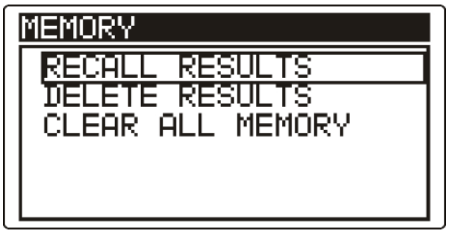


Figure 4.2: Memory options

Keys:

UP / **DOWN**	Selects option.
TEST	Enters selected option.
Function selectors	Exits back to main function menu.

4.2.2 Language

In this menu the language can be set.

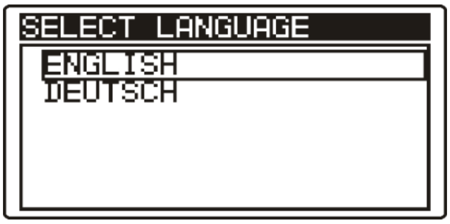


Figure 4.3: Language selection

Keys:

UP / DOWN	Selects language.
TEST	Confirms selected language and exits to settings menu.
Function selectors	Exits back to main function menu.

4.2.3 Date and time (model MI 3125 BT)

In this menu date and time can be set.

Figure 4.4: Setting date and time

Keys:

TAB	Selects the field to be changed.
UP / **DOWN**	Modifies selected field.
TEST	Confirms new setup and exits.
Function selectors	Exits back to main function menu.

Warning:
- If the batteries are removed for more than 1 minute the set time and date will be lost.

4.2.4 RCD testing

In this menu the used standard for RCD tests can be set.

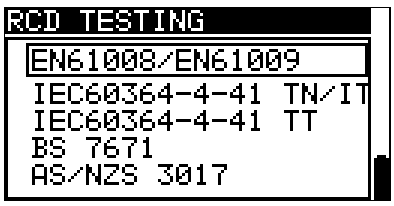


Figure 4.5: Selection of RCD test standard

Keys:

UP / DOWN	Selects standard.
TEST	Confirms selected standard.
Function selectors	Exits back to main function menu.

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

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

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

Test according to standard IEC/HD 60364-4-41 has two selectable options:
- **IEC 60364-4-41 TN/IT** and
- **IEC 60364-4-41 TT**

The options differ to maximum disconnection times as defined in IEC/HD 60364-4-41 Table 41.1.

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

	U_0 ***)	$½×I_{\Delta N}$ *)	$I_{\Delta N}$	$2×I_{\Delta N}$	$5×I_{\Delta N}$
TN / IT	≤ 120 V	t_Δ > 800 ms	t_Δ ≤ 800 ms	t_Δ < 150 ms	t_Δ < 40 ms
	≤ 230 V	t_Δ > 400 ms	t_Δ ≤ 400 ms		
TT	≤ 120 V	t_Δ > 300 ms	t_Δ ≤ 300 ms		
	≤ 230 V	t_Δ > 200 ms	t_Δ ≤ 200 ms		

Trip-out times according to BS 7671:

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

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

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

*) Minimum test period for current of $½×I_{\Delta N}$, RCD shall not trip-out.
**) Test current and measurement accuracy correspond to AS/NZS 3017 requirements.
***) U_0 is nominal U_{LPE} voltage.

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

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

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

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

4.2.5 Isc factor

In this menu the Isc factor for calculation of short circuit current in Z-LINE and Z-LOOP measurements can be set.

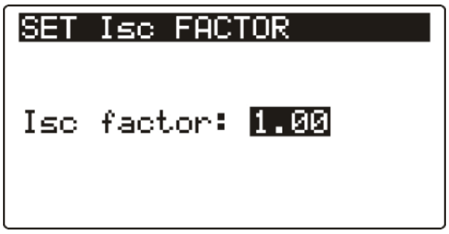


Figure 4.6: Selection of Isc factor

Keys:

UP / DOWN	Sets Isc value.
TEST	Confirms Isc value.
Function selectors	Exits back to main function menu.

Short circuit current Isc in the supply system is important for selection or verification of protective circuit breakers (fuses, over-current breaking devices, RCDs).
The default value of Isc factor (ksc) is 1.00. The value should be set according to local regulative.
Range for adjustment of the Isc factor is 0.20 ÷ 3.00.

4.2.6 Commander support

The support for commanders can be set in this menu.

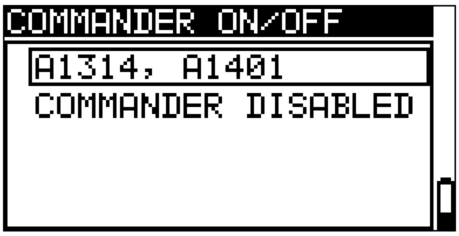


Figure 4.7: Selection of commander support

Keys:

UP / DOWN	Selects commander model. Disables commander support.
TEST	Confirms selected option.
Function selectors	Exits back to main function menu.

Commander models

- A1314, A1401: new commanders (more information can be found in Appendix E)

Note:
- Commander disabled 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.

4.2.7 Initial settings

In this menu the instrument settings and measurement parameters and limits can be set to initial (factory) values.
Internal Bluetooth module is initialized. (MI 3125 BT only)

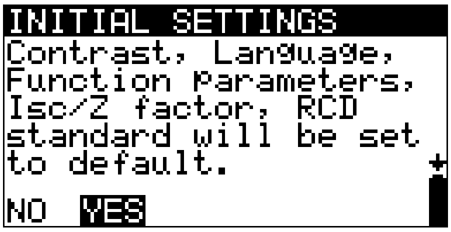


Figure 4.8: Initial settings dialogue

Keys:

TEST	Restores default settings (YES must be selected with ∧/∨ keys).
Function selectors	Exits back to main function menu without changes.

Warnings:

- Customized settings will be lost when this option is used!
- If the batteries are removed for more than 1 minute the custom made settings will be lost.

The default setup is listed below:

Instrument setting	Default value
Contrast	As defined and stored by adjustment procedure
Isc factor	1.00
RCD standards	EN 61008 / EN 61009
Language	English
Commander	A1314, A1401
Internal bluetooth	Initialization of internal Bluetooth module. (MI 3125 BT only)

Function **Sub-function**	**Parameters / limit value**
EARTH RE	No limit
R ISO	No limit Utest = 500 V
Low Ohm Resistance R LOWΩ CONTINUITY	 No limit No limit
Z - LINE VOLTAGE DROP	Fuse type: none selected ΔU: 4.0 % Z_{REF}: 0.00 Ω
Z - LOOP	Fuse type: none selected
Zs rcd	Test current: standard Fuse type: none selected
RCD	RCD t Nominal differential current: $I_{\Delta N}$=30 mA RCD type: AC ☐ non-delayed Test current starting polarity: ∿ (0°) Limit contact voltage: 50 V Current multiplier: ×1

Note:

- Initial settings (reset of the instrument) can be recalled also if the TAB key is pressed while the instrument is switched on.

5 Measurements

5.1 Voltage, frequency and phase sequence

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

See chapter *4.1 Function selection* for instructions on key functionality.

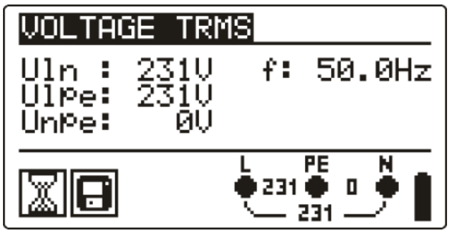


Figure 5.1: Voltage in single phase system

Test parameters for voltage measurement

There are no parameters to set.

Connections for voltage measurement

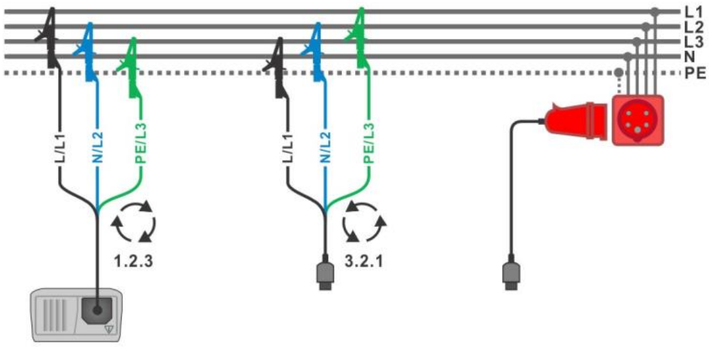


Figure 5.2: Connection of 3-wire test lead and optional adapter in three-phase system

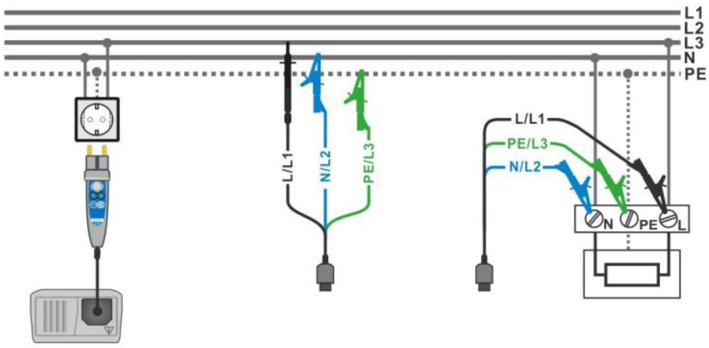


Figure 5.3: Connection of plug commander and 3-wire test lead in single-phase system

Voltage measurement procedure

* model MI 3125 BT

- Select the **VOLTAGE TRMS** function using the function selector switch.
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *figures 5.2 and 5.3*).
- **Store** voltage measurement result by pressing the MEM key (optional)*.

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

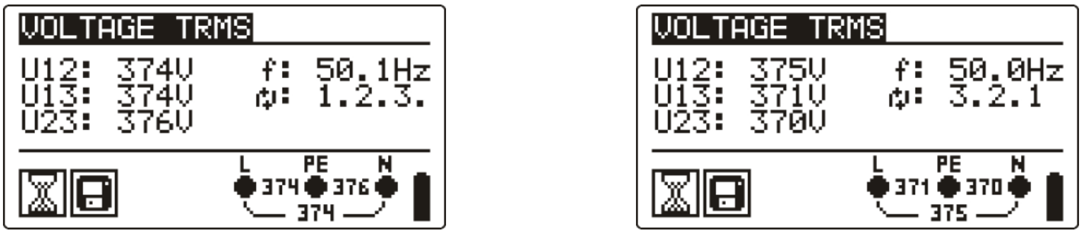


Figure 5.4: Examples of voltage measurement in three-phase system

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

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

5.2 Insulation resistance

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

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

See chapter *4.1 Function selection* for instructions on key functionality.

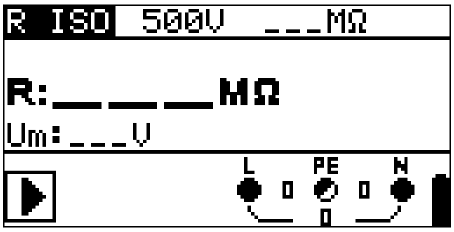


Figure 5.5: Insulation resistance

Test parameters for insulation resistance measurement

Uiso	**Test voltage** [50 V, 100 V, 250 V, 500 V, 1000 V]
Limit	**Minimum insulation resistance** [OFF, 0.01 MΩ ÷ 200 MΩ]

Test circuits for insulation resistance

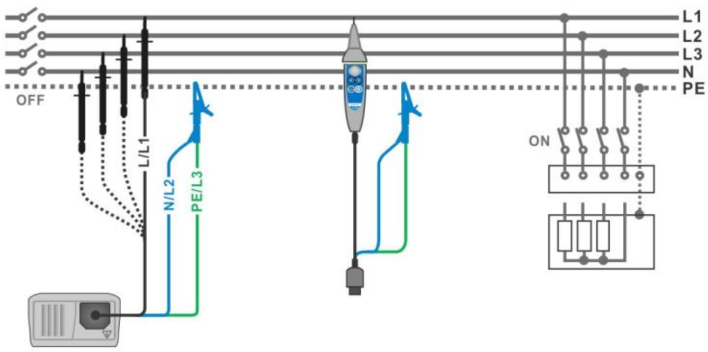


Figure 5.6: Connections for insulation measurement

Insulation resistance measuring procedure

* model MI 3125 BT

- Select the **INS** function using the function selector switch.
- Set the required **test voltage**.
- Enable and set **limit** value (optional).
- **Disconnect** tested installation from mains supply (and discharge insulation as required).
- **Connect** test cable to the instrument and to the item to be tested (see figure 5.6).
- Press the **TEST** key to perform the measurement (double click for continuous measurement and later press to stop the measurement).
- After the measurement is finished wait until tested item is fully discharged.
- **Store** the result by pressing the MEM key (optional)*.

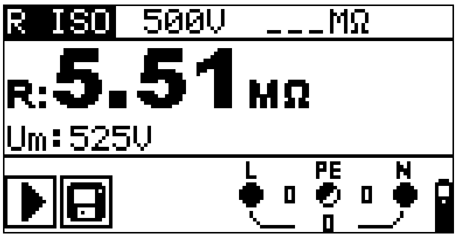


Figure 5.7: Example of insulation resistance measurement result

Displayed results:

R........................Insulation resistance
Um.....................Test voltage – actual value.

5.3 Resistance of earth connection and equipotential bonding

The resistance measurement is performed in order to ensure that the protective measures against electric shock through earth connections and bondings are effective. Two sub-functions are available:

- R LOWΩ - Earth bond resistance measurement according to EN 61557-4 (200 mA),
- CONTINUITY - Continuous resistance measurement performed with 7 mA.

See chapter *4.1 Function selection* for instructions on key functionality.

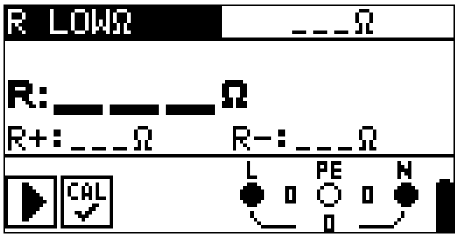


Figure 5.8: 200 mA RLOW Ω

Test parameters for resistance measurement

TEST	Resistance measurement **sub-function** [R LOWΩ, CONTINUITY]
Limit	**Maximum resistance** [OFF, 0.1 Ω ÷ 20.0 Ω]

5.3.1 R LOWΩ, 200 mA resistance measurement

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

Test circuit for R LOWΩ measurement

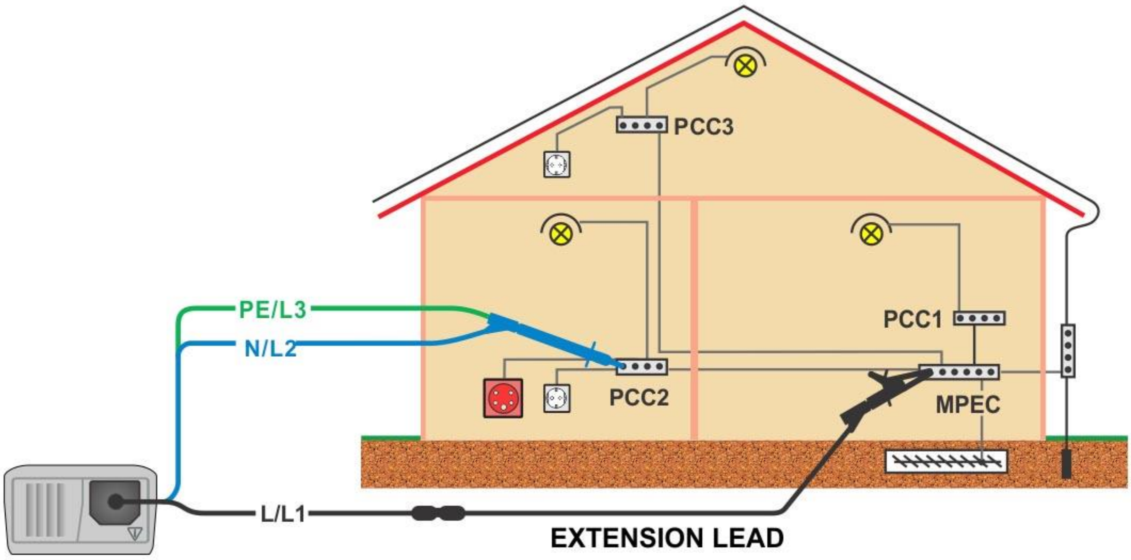


Figure 5.9: Connection of 3-wire test lead plus optional extension lead

Resistance to earth connection and equipotential bonding measurement procedure

* model MI 3125 BT

- Select continuity function using the function selector switch.
- Set sub-function to **R LOWΩ**.
- Enable and set **limit** (optional).
- **Connect** test cable to the instrument.
- **Compensate** the test leads resistance (if necessary, see *section 5.3.3*).
- **Disconnect** from mains supply and discharge installation to be tested.
- **Connect** the test leads to the appropriate PE wiring (see *figure 5.9*).
- Press the **TEST** key to perform the measurement.
- After the measurement is finished **store** the result by pressing the MEM button (optional)*.

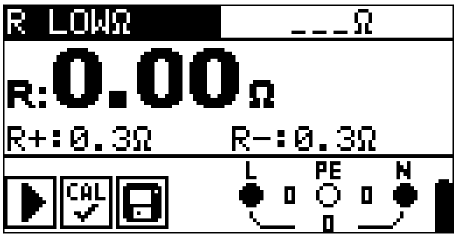


Figure 5.10: Example of RLOW result

Displayed result:

R................R LOWΩ resistance.
R+..............Result at positive polarity
R-...............Result at negative test polarity

5.3.2 Continuous resistance measurement with low current

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

Test circuit for continuous resistance measurement

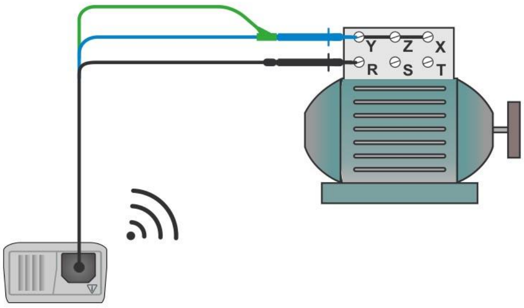


Figure 5.11: 3-wire test lead application

Continuous resistance measurement procedure

* model MI 3125 BT

- ❑ Select continuity function using the function selector switch.
- ❑ Set sub-function **CONTINUITY.**
- ❑ Enable and set the **limit** (optional).
- ❑ Enable **sound** (optional).
- ❑ **Connect** test cable to the instrument.
- ❑ **Compensate** test leads resistance (if necessary, see *section 5.3.3*).
- ❑ **Disconnect** from mains supply and discharge the object to be tested.
- ❑ **Connect** test leads to the tested object (see *figure 5.11*).
- ❑ Press the **TEST** key to begin performing a continuous measurement.
- ❑ Press the **TEST** key to stop measurement.
- ❑ After the measurement is finished, **store** the result (optional)*.

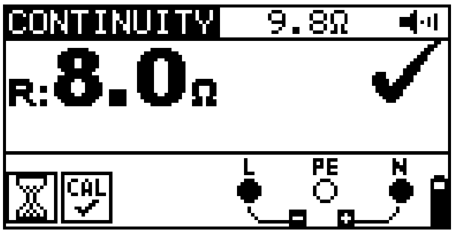


Figure 5.12: Example of continuous resistance measurement

Displayed result:

R............Resistance

Notes:

- Continuous buzzer sound indicates that measured resistance PASS the limit.
- There is no sound if the limit is disabled (---Ω).

5.3.3 Compensation of test leads resistance

This chapter describes how to compensate the test leads resistance in both continuity functions, R LOWΩ and CONTINUITY. Compensation is required to eliminate the influence of test leads resistance and the internal resistances of the instrument on the measured resistance. The lead compensation is therefore a very important feature to obtain correct result.

R LOWΩ and CONTINUITY has common compensation.  symbol is displayed if the compensation was carried out successfully.

Circuits for compensating the resistance of test leads

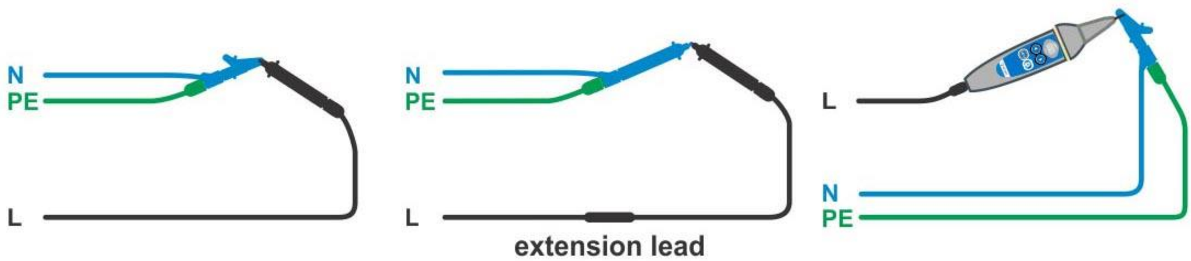


Figure 5.13: Shorted test leads

Compensation of test leads resistance procedure

- Select R LOWΩ or CONTINUITY function.
- **Connect** test cable to the instrument and short the test leads together (see *figure 5.13*).
- Press **TEST** to perform resistance measurement.
- Press the **CAL** key to compensate leads resistance.

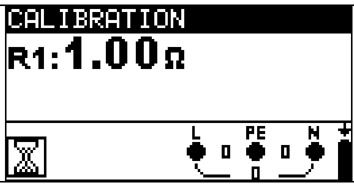
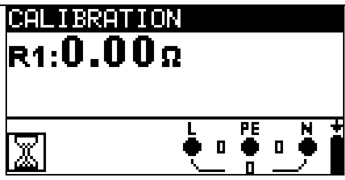
	

Figure 5.14: Results with old calibration values	*Figure 5.15: Results with new calibration values*

Note:

- The highest value for lead compensation is 5 Ω. If the resistance is higher the compensation value is set back to default value.
   is displayed if no calibration value is stored.

5.4 Testing RCDs

Various test and measurements are required for verification of RCD(s) in RCD protected installations. Measurements are based on the EN 61557-6 standard.
The following measurements and tests (sub-functions) can be performed:

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

See chapter *4.1 Function selection* for instructions on key functionality.

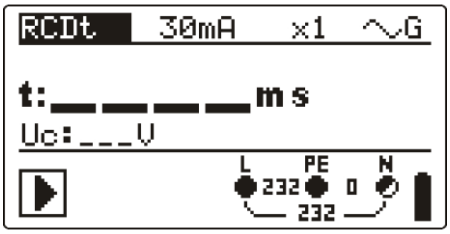


Figure 5.16: RCD test

Test parameters for RCD test and measurement

TEST	RCD **sub-function** test [RCDt, RCD I, AUTO, Uc].
$I_{\Delta N}$	**Rated** RCD residual current sensitivity $I_{\Delta N}$, $I_{\Delta N(DC)}$, [6 mA**, 30/6 mA**, 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA].
type	RCD **type** [AC, A, F, B*, B+*, EV**], starting **polarity** [∿, ∿, ∿–, ∿–, ⊕*, ⊖*], selective S or general non-delayed □ characteristic
MUL	**Multiplication** factor for test current [½, 1, 2, 5 $I_{\Delta N}$].
Ulim	Conventional touch voltage **limit** [25 V, 50 V].

* Model MI 3125 BT
** EV RCD

Notes:

- Ulim can be selected in the Uc sub-function only.
- Selective (time delayed) RCDs have delayed response characteristics. As the contact voltage pre-test or other RCD tests influence the time delayed RCD it takes a certain period to recover into normal state. Therefore a time delay of 30 s is inserted before performing trip-out test by default.
- The a.c. part of EV RCDs is tested according to EN 61008 / EN 61009 as general (non-delayed) RCDs.
- The d.c. part of EV RCDs is tested with a DC test current. The Pass limit is between 0.5 and 1.0 $I_{\Delta N(DC)}$.

Connections for testing RCD

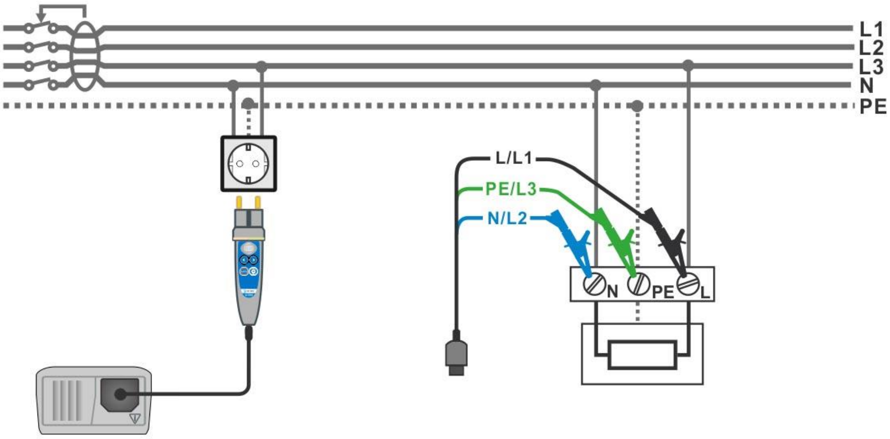


Figure 5.17: Connecting the plug commander and the 3-wire test lead

5.4.1 Contact voltage (RCD Uc)

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

Contact voltage measurement procedure

* model MI 3125 BT

- Select the **RCD** function using the function selector switch.
- Set sub-function **Uc.**
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *figure 5.17*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.

The contact voltage result relates to the rated nominal residual current of the RCD and is multiplied by an appropriate factor (depending on RCD type and type of test current). The 1.05 factor is applied to avoid negative tolerance of result. See table 5.1 for detailed contact voltage calculation factors.

RCD type		**Contact voltage Uc proportional to**	**Rated $I_{\Delta N}$**	
AC	□	$1.05 \times I_{\Delta N}$	any	All models
AC	S	$2 \times 1.05 \times I_{\Delta N}$		
A, F	□	$1.4 \times 1.05 \times I_{\Delta N}$	≥ 30 mA	
A, F	S	$2 \times 1.4 \times 1.05 \times I_{\Delta N}$		
A, F	□	$2 \times 1.05 \times I_{\Delta N}$	< 30 mA	
A, F	S	$2 \times 2 \times 1.05 \times I_{\Delta N}$		
EV (a.c. part)	□	$1.05 \times I_{\Delta N}$	any	Model MI 3125 BT
B, B+	□	$2 \times 1.05 \times I_{\Delta N}$		
B, B+	S	$2 \times 2 \times 1.05 \times I_{\Delta N}$		

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

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

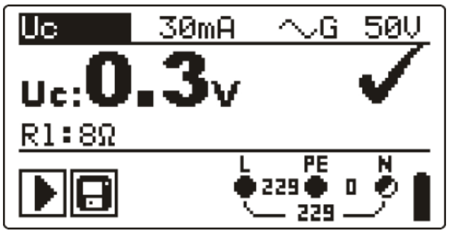


Figure 5.18: Example of contact voltage measurement results

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

5.4.2 Trip-out time (RCDt)

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

Trip-out time measurement procedure

* model MI 3125 BT

- Select the **RCD** function using the function selector switch.
- Set sub-function **RCDt.**
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *figure 5.17*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.

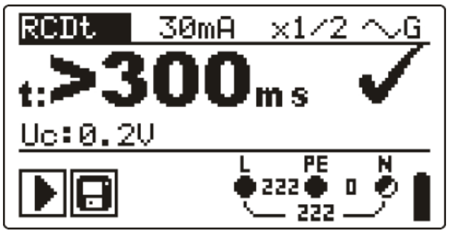


Figure 5.19: Example of trip-out time measurement results

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

5.4.3 Trip-out current (RCD I)

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

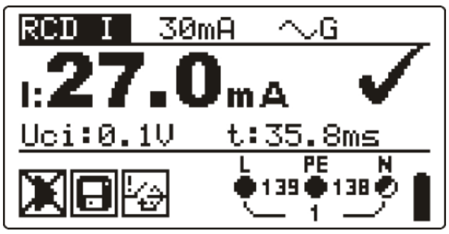
RCD type	Slope range		Waveform	Note
	Start value	**End value**		
AC	$0.2\times I_{\Delta N}$	$1.1\times I_{\Delta N}$	Sine	All models
A, F ($I_{\Delta N} \geq 30$ mA)	$0.2\times I_{\Delta N}$	$1.5\times I_{\Delta N}$	Pulsed	
A, F ($I_{\Delta N} = 10$ mA)	$0.2\times I_{\Delta N}$	$2.2\times I_{\Delta N}$		
EV (a.c. part)	$0.2\times I_{\Delta N}$	$1.1\times I_{\Delta N}$	Sine	Model MI 3125 BT
B, B+	$0.2\times I_{\Delta N}$	$2.2\times I_{\Delta N}$	DC	
EV (d.c. part)	$0.2\times I_{\Delta N(DC)}$	$1.0\times I_{\Delta N(DC)}$		

Maximum test current is I_{Δ} (trip-out current) or end value in case the RCD didn't trip-out.

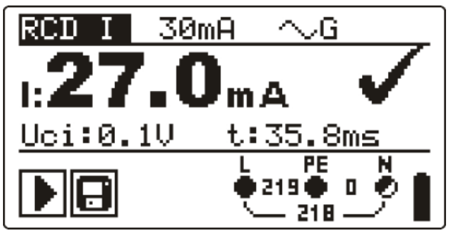
Trip-out current measurement procedure

* model MI 3125 BT

- Select the **RCD** function using the function selector switch.
- Set sub-function **RCD I**.
- Set test **parameters** (if necessary).
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *figure 5.17*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.



Trip-out



After the RCD is turned on again

Figure 5.20: Trip-out current measurement result example

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

5.4.4 RCD Autotest

RCD autotest function is intended to perform a complete RCD test (trip-out time at different residual currents, trip-out current and contact voltage) in one set of automatic tests, guided by the instrument.

Additional key:

HELP / DISPLAY	Toggles between top and bottom part of results field.

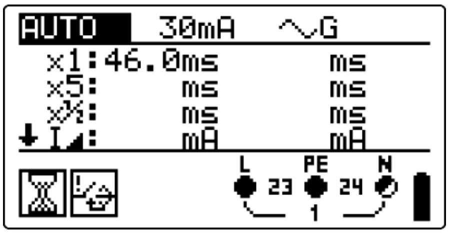
RCD autotest procedure

* model MI 3125 BT

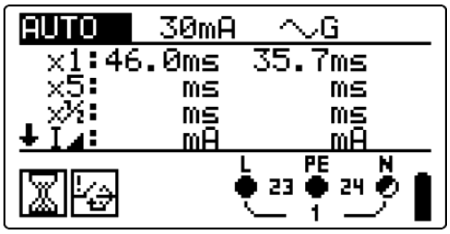
RCD Autotest steps	Notes
❑ Select the **RCD** function using the function selector switch. ❑ Set sub-function **AUTO.** ❑ Set test **parameters** (if necessary). ❑ **Connect** test cable to the instrument. ❑ **Connect** test leads to the item to be tested (see *figure 5.17*). ❑ Press the **TEST** key to perform the test.	 Start of test
❑ Test with $I_{\Delta N}$, 0° (step 1).	RCD should trip-out
❑ **Re-activate** RCD. ❑ Test with $I_{\Delta N}$, 180° (step 2).	 RCD should trip-out
❑ **Re-activate** RCD. ❑ Test with 5×$I_{\Delta N}$, 0° (step 3).	 RCD should trip-out
❑ **Re-activate** RCD. ❑ Test with 5×$I_{\Delta N}$, 180° (step 4).	 RCD should trip-out
❑ **Re-activate** RCD. ❑ Test with ½×$I_{\Delta N}$, 0° (step 5). ❑ Test with ½×$I_{\Delta N}$, 180° (step 6).	 RCD should not trip-out RCD should not trip-out
❑ Trip-out current test, 0° (step 7).	RCD should trip-out
❑ **Re-activate** RCD. ❑ Trip-out current test, 180° (step 8).	 RCD should trip-out
❑ **Re-activate RCD**. ❑ Test with $I_{\Delta N(DC)}$, +DC (step 9). [1)]	 RCD should trip-out
❑ **Re-activate RCD**. ❑ Test with $I_{\Delta N(DC)}$, -DC (step 10). [1)]	 RCD should trip-out
❑ **Re-activate** RCD. ❑ **Store** the result by pressing the MEM key (optional)*.	 End of test

[1)] Steps 9 and 10 are performed for EV RCD only.

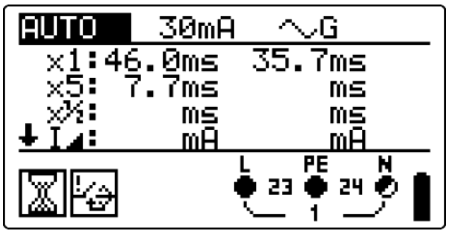
Result examples:



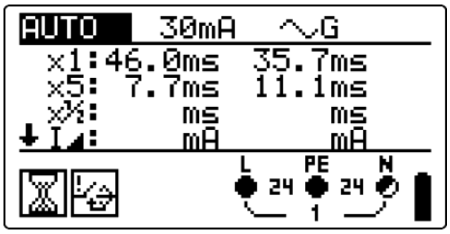
Step 1



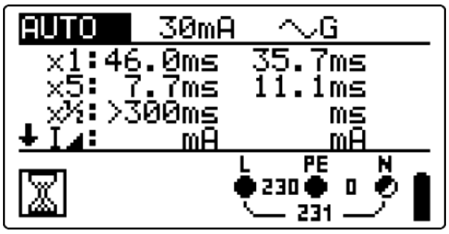
Step 2



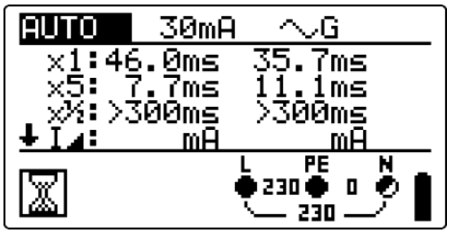
Step 3



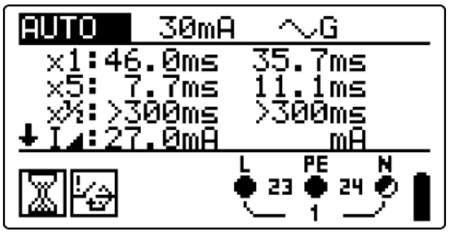
Step 4



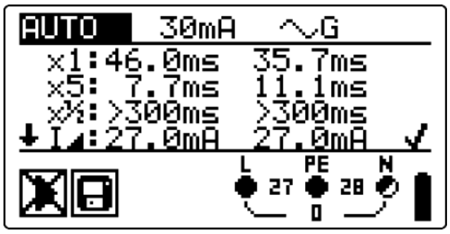
Step 5



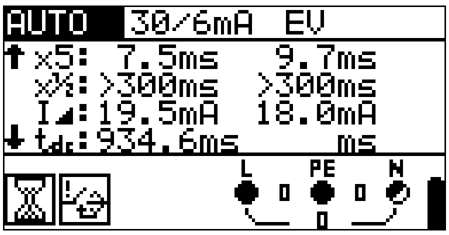
Step 6



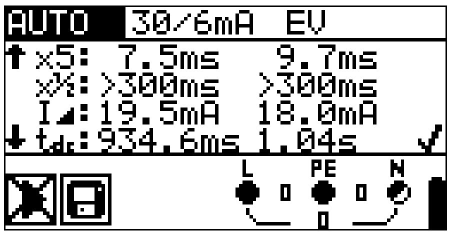
Step 7



Step 8

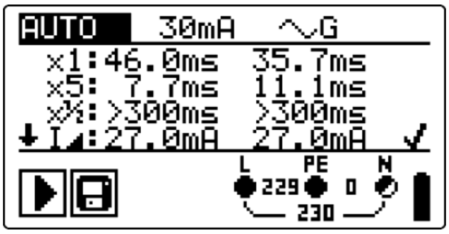


Step 9

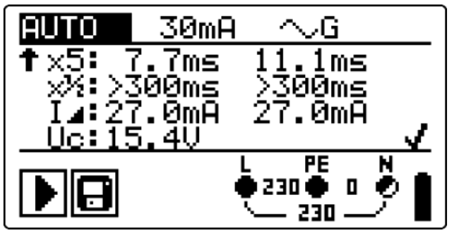


Step 10

Figure 5.21: Individual steps in RCD autotest



Top



Bottom

Figure 5.22: Two parts of result field in RCD autotest

Displayed results:
x1 ....Step 1 trip-out time (, IΔN, 0º),
x1 ....Step 2 trip-out time (, IΔN, 180º),
x5 ....Step 3 trip-out time (, 5×IΔN, 0º),
x5 ....Step 4 trip-out time (, 5×IΔN, 180º),
x½ ....Step 5 trip-out time (, ½×IΔN, 0º),
x½ ....Step 6 trip-out time (, ½×IΔN, 180º),
I◢ ....Step 7 trip-out current (0º),
I◢ ....Step 8 trip-out current (180º),
tdc ....Step 9 trip-out time (+ DC),
tdc ....Step 10 trip-out time (- DC),
Uc........Contact voltage for rated IΔN.

Notes:

- The autotest sequence is immediately stopped if any incorrect condition is detected, e.g. excessive Uc or trip-out time out of bounds.
- Auto test is finished without x5 tests in case of testing the RCD types A, F with rated residual currents of IΔn = 300 mA, 500 mA, and 1000 mA. In this case auto test result passes if all other results pass, and indications for x5 are omitted.
- Tests for sensitivity (I_Δ, steps 7 and 8) are omitted for selective type RCD.
- Trip out time measurement for B and B+ type RCDs in AUTO function is made with sine-wave test current, while trip-out current measurement is made with DC test current (MI 3125 BT only).
- AC part for EV type RCDs in AUTO function is tested with sine-wave test current using trip-out time measurement and trip-out current measurement, while trip-out time measurement for DC part is made with DC test current (MI 3125 BT only).

5.5 Fault loop impedance and prospective fault current

Fault loop is a loop comprised by mains source, line wiring and PE return path to the mains source. The instrument measures the impedance of the loop and calculates the short circuit current. The measurement is covered by requirements of the EN 61557-3 standard.

See chapter *4.1 Function selection* for instructions on key functionality.

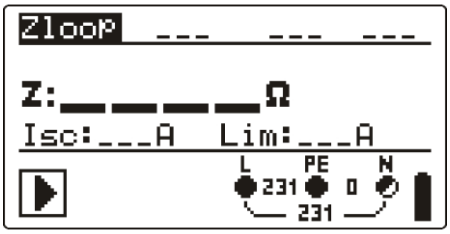


Figure 5.23: Fault loop impedance

Test parameters for fault loop impedance measurement

Test	Selection of fault loop impedance **sub-function** [Zloop, Zs rcd]
I test*	Selection of test current [Std, Low]
Fuse type	Selection of **fuse type** [---, NV, gG, B, C, K, D]
Fuse I	**Rated current** of selected fuse
Fuse T	Maximum **breaking time** of selected fuse
Lim	Minimum short circuit **current** for selected fuse.

*Applicable only in Zs rcd (some models)
See Appendix A for reference fuse data.

Circuits for measurement of fault loop impedance

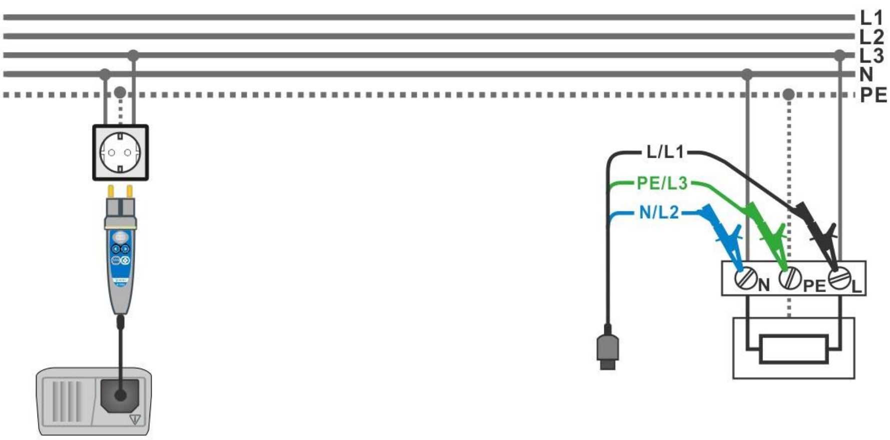


Figure 5.24: Connection of plug commander and 3-wire test lead

Fault loop impedance measurement procedure

* model MI 3125 BT

- Select the **Zloop** or **Zs rcd** sub-function using the function selector switch and ⋀/⋎ keys
- Select test **parameters** (optional).
- **Connect** test cable to the Eurotest Combo**.**
- **Connect** test leads to the item to be tested (see *figure 5.24 and 5.17*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.

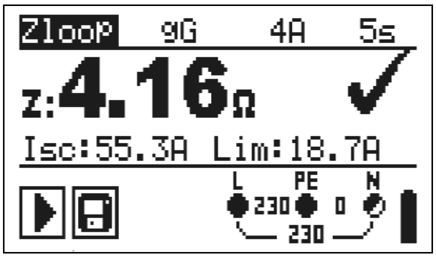


Figure 5.25: Examples of loop impedance measurement result

Displayed results:
Z.............. Fault loop impedance,
ISC............ Prospective fault current,
Lim .... Low limit prospective fault loop current value or high limit fault loop impedance value for the UK version.

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

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

where:
Un........ Nominal U_{L-PE} voltage (see table below),
ksc .... Correction factor for Isc (see chapter *4.2.5*).

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

Notes:

- High fluctuations of mains voltage can influence the measurement results (the noise sign is displayed in the message field). In this case it is recommended to repeat few measurements to check if the readings are stable.
- This measurement will trip-out the RCD in RCD-protected electrical installation if test Zloop is selected.
- Select Zs rcd to prevent trip-out of RCD in RCD protected installation.

5.6 Line impedance and prospective short-circuit current / Voltage drop

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

Sub-functions:

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

See chapter *4.1 Function selection* for instructions on key functionality.

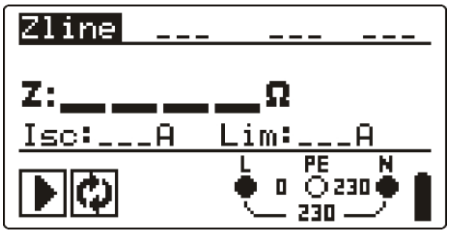


Figure 5.26: Line impedance

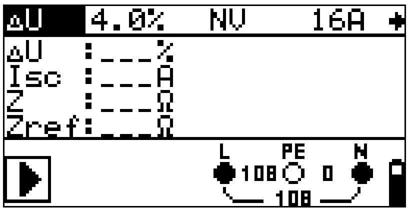


Figure 5.27: Voltage drop

Test parameters for line impedance measurement

Test	Selection of line impedance [Zline] or voltage drop [ΔU] **sub-function**
FUSE type	Selection of **fuse type** [---, NV, gG, B, C, K, D]
FUSE I	**Rated current** of selected fuse
FUSE T	Maximum **breaking time** of selected fuse
Lim	Minimum short circuit **current** for selected fuse.

See Appendix A for reference fuse data.

Additional test parameters for voltage drop measurement

ΔU_{MAX}	Maximum **voltage drop** [3.0 % ÷ 9.0 %]**.**

Line impedance and prospective short circuit current

Circuits for measurement of line impedance

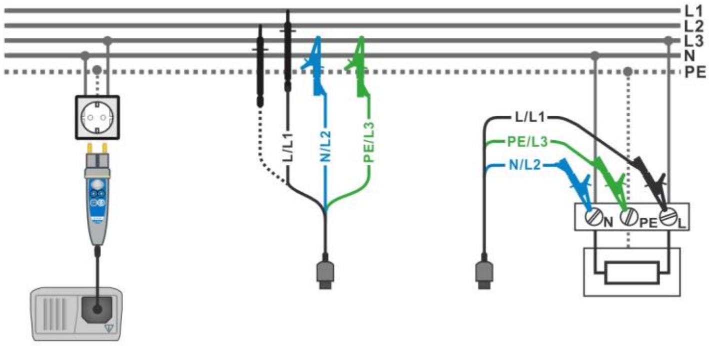
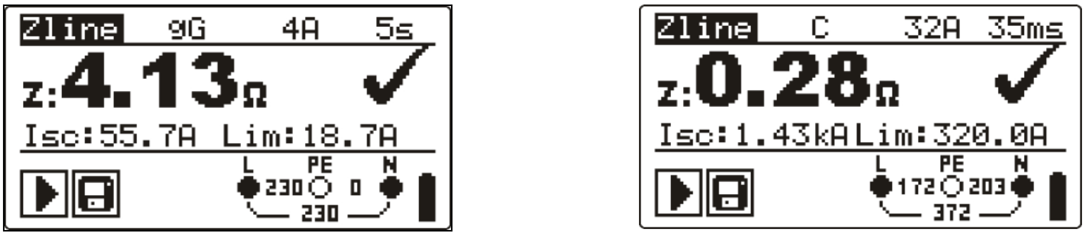


Figure 5.28: Phase-neutral or phase-phase line impedance measurement – connection of plug commander and 3-wire test lead

Line impedance measurement procedure

* model MI 3125 BT

- Select the **Z-LINE** sub-function.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *figure 5.28*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.



Line to neutral *Line to line*

Figure 5.29: Examples of line impedance measurement result

Displayed results:
Z..............Line impedance,
Isc............Prospective short-circuit current,
Lim ....Low limit prospective short-circuit current value.

Prospective short circuit current is calculated as follows:

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

where:
Un........Nominal L-N or L1-L2 voltage (see table below),
ksc ....Correction factor for Isc (see chapter *4.2.5*).

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

Note:

- High fluctuations of mains voltage can influence the measurement results (the noise sign is displayed in the message field). In this case it is recommended to repeat few measurements to check if the readings are stable.

5.6.1 Voltage drop

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

Circuits for measurement for voltage drop

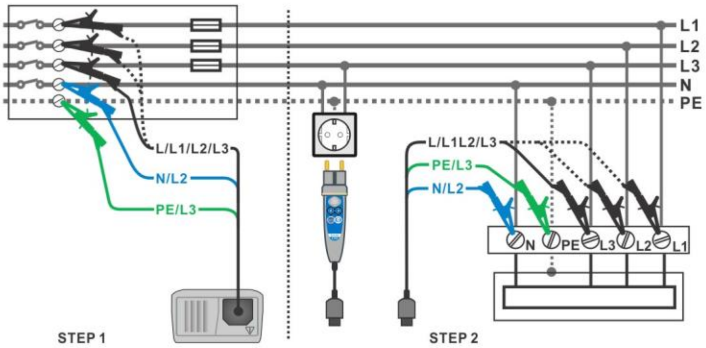


Figure 5.30: Phase-neutral or phase-phase voltage drop measurement – connection of plug commander and 3-wire test lead

Voltage drop measurement procedure

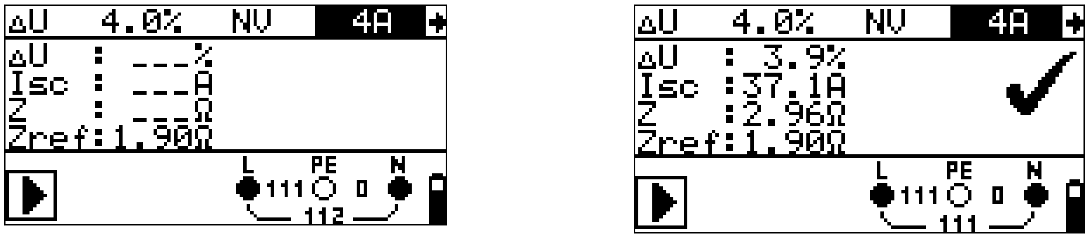
Step 1: Measuring the impedance Zref at origin

- Select the **ΔU** sub-function using the function selector switch and ∧/∨ keys.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** the test leads to the origin of electrical installation (see *figure 5.30*).
- Press the **CAL** key to perform the measurement.

Step 2: Measuring the voltage drop

- Select the **ΔU** sub-function using the function selector switch and ∧/∨ keys.
- Select test **parameters** (Fuse type must be selected).
- **Connect** test cable or plug commander to the instrument.
- **Connect** the test leads to the tested points (see *figure 5.30*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.

* model MI 3125 BT



Step 1 - Zref *Step 2 - Voltage drop*

Figure 5.31: Examples of voltage drop measurement result

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

Voltage drop is calculated as follows:

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

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

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

Note:

- If the reference impedance is not set the value of Z_{REF} is considered as 0.00 Ω.
- The Z_{REF} is cleared (set to 0.00 Ω) if pressing CAL key while instrument is not connected to a voltage source.
- I_{SC} is calculated as described in chapter 5.6.1 Line impedance and prospective short circuit current.
- If the measured voltage is outside the ranges described in the table above the ΔU result will not be calculated.
- High fluctuations of mains voltage can influence the measurement results (the noise sign is displayed in the message field). In this case it is recommended to repeat few measurements to check if the readings are stable.

5.7 Earth resistance

Earth resistance is one of the most important parameters for protection against electric shock. Main earthing arrangements, lightning systems, local earthings, etc can be verified with the earthing resistance test. The measurement conforms to the EN 61557-5 standard.

See chapter *4.1 Function selection* for instructions on key functionality.

Figure 5.32: Earth resistance

Test parameters for earth resistance measurement

Limit	**Maximum resistance** OFF, 1 Ω ÷ 5 kΩ

Connections for earth resistance measurement

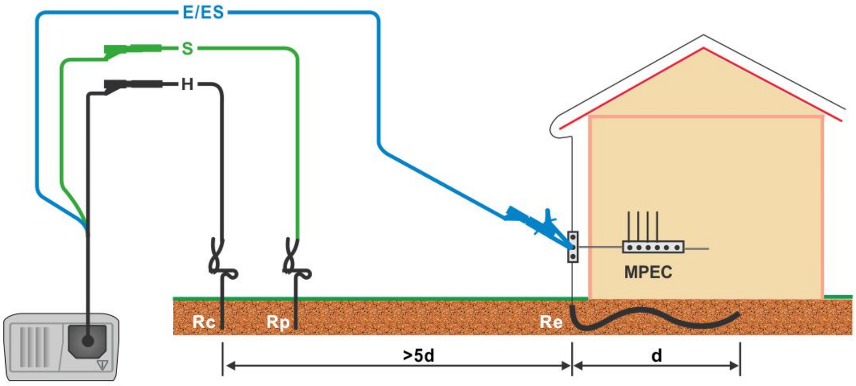


Figure 5.33: Resistance to earth, measurement of main installation earthing

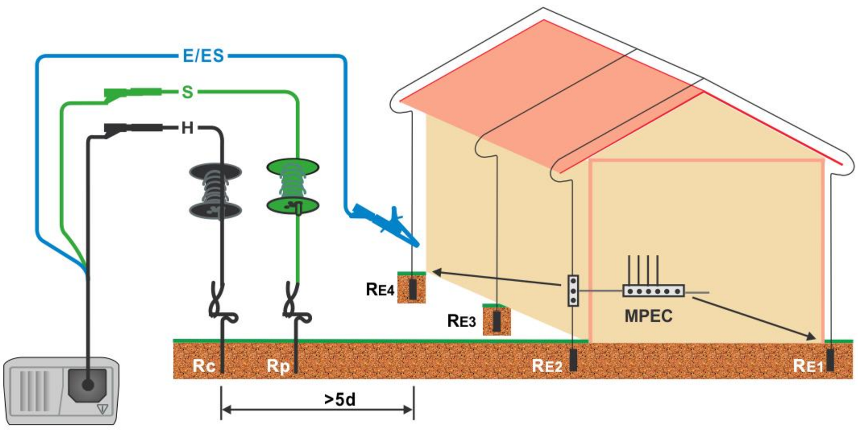


Figure 5.34: Resistance to earth, measurement of a lightning protection system

Earth resistance measurements, common measurement procedure

* model MI 3125 BT

- Select **EARTH** function using the function selector switch.
- Enable and set **limit** value (optional).
- **Connect** test leads to the instrument
- **Connect** the item to be tested (see Figure 5.33 and Figure 5.34).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional)*.

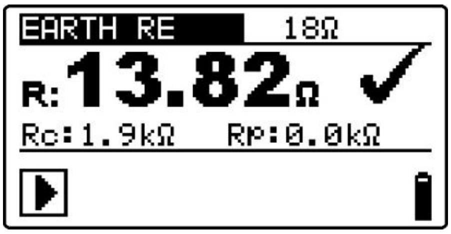


Figure 5.35: Example of earth resistance measurement result

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

Notes:
- High resistance of S and H probes could influence the measurement results. In this case, “Rp” and “Rc” warnings are displayed. There is no pass / fail indication in this case.
- High noise currents and voltages in earth could influence the measurement results. The tester displays the “noise” warning in this case.
- Probes must be placed at sufficient distance from the measured object.

5.8 PE test terminal

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

Examples for application of PE test terminal

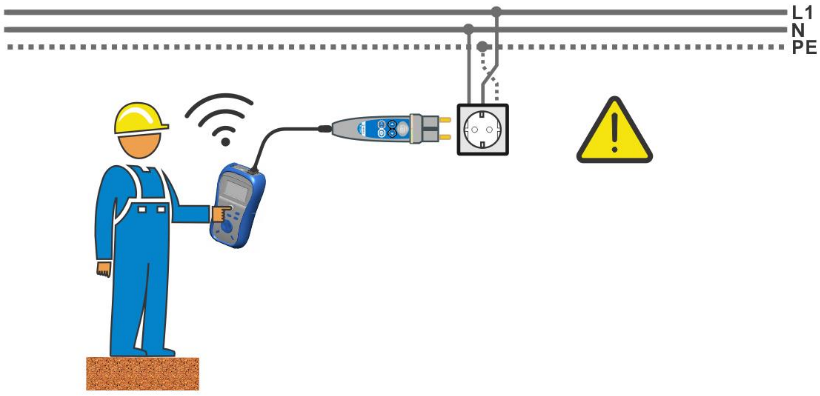


Figure 5.36: Reversed L and PE conductors (application of plug commander)

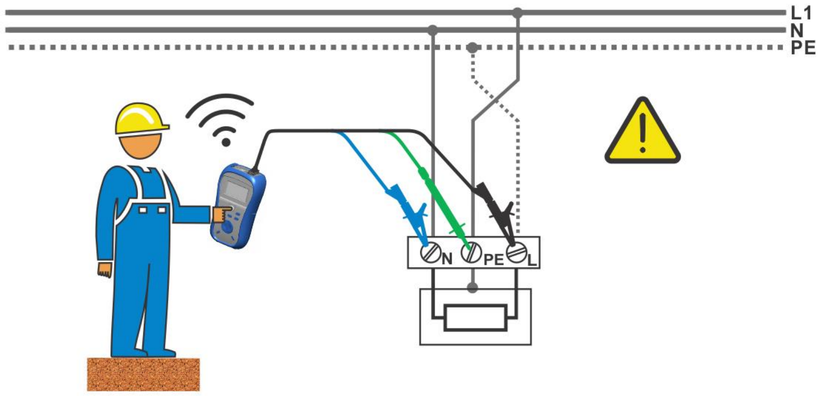


Figure 5.37: Reversed L and PE conductors (application of 3-wire test lead)

Reversed phase and protection conductors! The most dangerous situation!

PE terminal test procedure

- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see Figure 5.36 and Figure 5.37).
- Touch PE test probe (the **TEST** key) for at least one second.
- If PE terminal is connected to phase voltage the warning message is displayed, instrument buzzer is activated, and further measurements are disabled in Z-LOOP and RCD functions.

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

Notes:
- In the SETTINGS and VOLTAGE TRMS menus the PE terminal is not tested.
- PE test terminal does not operate in case the operator's body is completely insulated from floor or walls!

6 Data handling (model MI 3125 BT)

6.1 Memory organization

Measurement results together with all relevant parameters can be stored in the instrument's memory. After the measurement is completed, results can be stored to the flash memory of the instrument, together with the sub-results and function parameters.

6.2 Data structure

The instrument's memory place is divided into two 4 level data structures. The number of measurements that can be stored into one location is not limited.

The **data structure field** describes the location of the measurement (which object, block, fuse, connection or which EVSE, sublevel) and where can be accessed.
In the **measurement field** there is information about type and number of measurements that belong to the selected structure element (object, block, fuse, connection, EVSE, level).
The main advantages of this system are:

- Test results can be organized and grouped in a structured manner that reflects the structure of typical electrical installations and EVSEs.
- Customized names of data structure elements can be uploaded from EurolinkPRO PCSW.
- Simple browsing through structure and results.
- Test reports can be created with no or little modifications after downloading results to a PC.

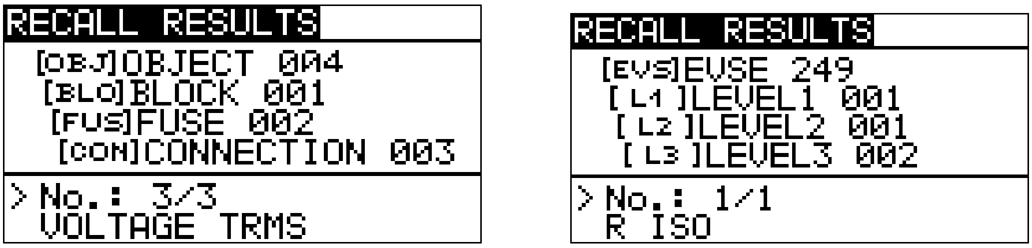


Figure 6.1: Object and EVSE data structure fields

Note:

- The descriptions in this Instruction manual mainly refer to an Object data structure. Operation is the same if working with an EVSE data structure.

Data structure field

RECALL RESULTS	Memory operation menu
[OBJ]OBJECT 004 [BLO]BLOCK 001 [FUS]FUSE 002 [CON]CONNECTION 003	Data structure field
[OBJ]OBJECT 004	❑ **1st level:** **OBJECT**: Default location name (object and its successive number). **004**: No. of selected element.
[BLO]BLOCK 001	❑ **2nd level:** **BLOCK**: Default location name (block and its successive number). **001**: No. of selected element.
[FUS]FUSE 002	❑ **3rd level:** **FUSE**: Default location name (fuse and its successive number). ❑ **002**: No. of selected element.
[CON]CONNECTION 003	❑ **4th level:** **CONNECTION**: Default location name (connection and its successive number). **003**: No. of selected element.
No.: 20 [112]	No. of measurements in selected location [No. of measurements in selected location and its sub-locations].

Measurement field

VOLTAGE TRMS	Type of stored measurement in the selected location.
> No.: 3/3	No. of selected test result / No. of all stored test results in selected location.

6.3 Storing test results

After the completion of a test the results and parameters are ready for storing (icon is displayed in the information field). By pressing the **MEM** key, the user can store the results.

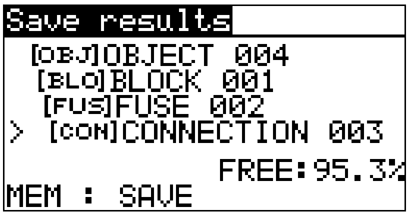


Figure 6.2: Save test menu

Memory free: 99.6% Memory available for storing results.

Keys in save test menu - data structure field:

TAB	Selects the location element (Object / Block / Fuse / Connection).
UP / DOWN	Selects number of selected location element (1 to 199).
MEM	Saves test results to the selected location and returns to the measuring menu.
Function selector / TEST	Exits back to main function menu.

Notes:

- The instrument offers to store the result to the last selected location by default.
- If the measurement is to be stored to the same location as the previous one just press the **MEM** key twice

6.4 Recalling test results

Press the **MEM** key in a main function menu when there is no result available for storing or select **MEMORY** in the **SETTINGS** menu.

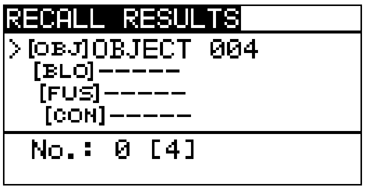


Figure 6.3: Recall menu - installation structure field selected

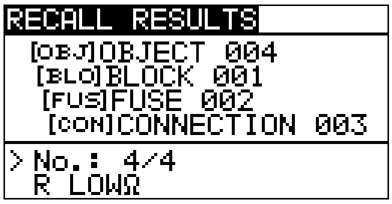


Figure 6.4: Recall menu - measurements field selected

Keys in recall memory menu (installation structure field selected):

TAB	Selects the location element (Object / Block / Fuse / Connection).
UP / DOWN	Selects number of selected location element (1 to 199).
Function selector / TEST	Exits back to main function menu.
MEM	Enters measurements field.

Keys in recall memory menu (measurements field):

UP / DOWN	Selects the stored measurement.
TAB	Returns to installation structure field.
Function selector / TEST	Exits back to main function menu.
MEM	View selected measurement results.

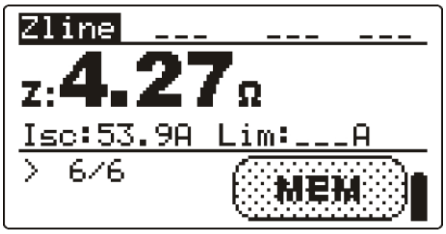


Figure 6.5: Example of recalled measurement result

Keys in recall memory menu (measurement results are displayed)

UP / DOWN	Displays measurement results stored in selected location.
MEM	Returns to measurements field.
Function selector / TEST	Exits back to main function menu.

6.5 Clearing stored data

6.5.1 Clearing complete memory content

Select **CLEAR ALL MEMORY** in **MEMORY** menu. A warning will be displayed.

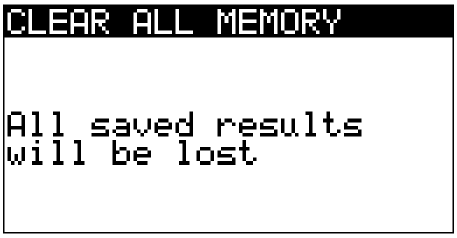


Figure 6.6: Clear all memory

Keys in clear all memory menu

TEST	Confirms clearing of complete memory content.
Function selector	Exits back to main function menu without changes.

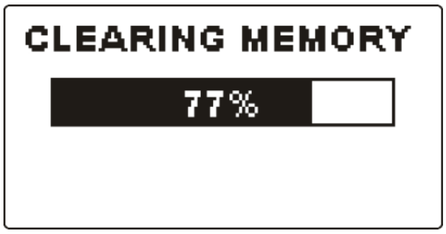


Figure 6.7: Clearing memory in progress

6.5.2 Clearing measurement(s) in selected location

Select **DELETE RESULTS** in **MEMORY** menu.

Figure 6.8: Clear measurements menu (data structure field selected)

Keys in delete results menu (installation structure field selected):

TAB	Selects the location element (Object / Block / Fuse / Connection).
UP / DOWN	Selects number of selected location element (1 to 199).
Function selector / TEST	Exits back to main function menu.
HELP	Enters dialog box for deleting all measurements in selected location and its sub-locations.

Keys in dialog for confirmation to clear results in selected location:

HELP	Deletes all results in selected location.
TAB / MEM	Exits back to delete results menu without changes.
Function selector / TEST	Exits back to main function menu without changes.

6.5.3 Clearing individual measurements

Select **DELETE RESULTS** in **MEMORY** menu.

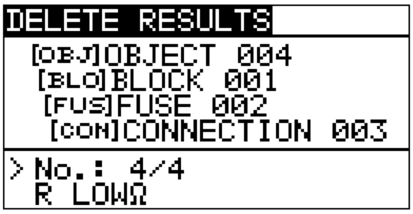


Figure 6.9: Menu for clearing individual measurement (installation structure field selected)

Keys in delete results menu (installation structure field selected):

TAB	Selects the location element (Object / Block / Fuse / Connection).
UP / DOWN	Selects number of selected location element (1 to 199).
Function selector / TEST	Exits back to main function menu.
MEM	Enters measurements field for deleting individual measurements.

Keys in delete results menu (measurements field selected):

UP / DOWN	Selects measurement.
HELP	Opens dialog box for confirmation to clear selected measurement.
TAB	Returns to installation structure field.
Function selector / TEST	Exits back to main function menu without changes.

Keys in dialog for confirmation to clear selected result(s):

HELP	Deletes selected measurement result.
MEM / TAB	Exits back to measurements field without changes.
Function selector / TEST	Exits back to main function menu without changes.

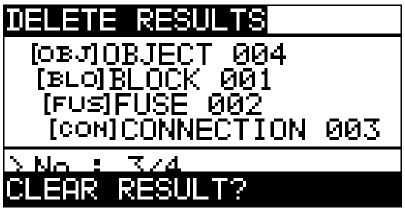


Figure 6.10: Dialog for confirmation

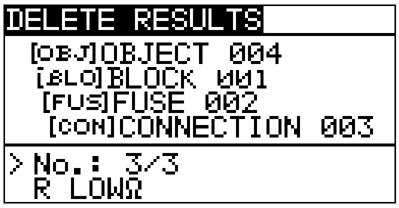


Figure 6.11: Display after measurement was cleared

6.5.4 Renaming installation structure elements (upload from PC)

Default installation structure elements are “Object”, “Block”, “Fuse” and “Connection”.
In the PCSW package Eurolink-PRO default names can be changed with customized names that corresponds the installation under test. Refer to PCSW Eurolink-PRO HELP for information how to upload customized installation names to the instrument.

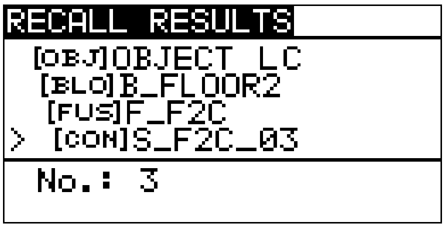


Figure 6.12: Example of menu with customized installation structure names

6.5.5 Renaming installation structure elements with serial barcode reader or RFID reader

Default installation structure elements are “Object”, “Block”, “Fuse” and “Connection”.
When the instrument is in the Save results menu location ID can be scanned from a barcode label with the barcode reader or can be read from a RFID tag with the RFID reader.

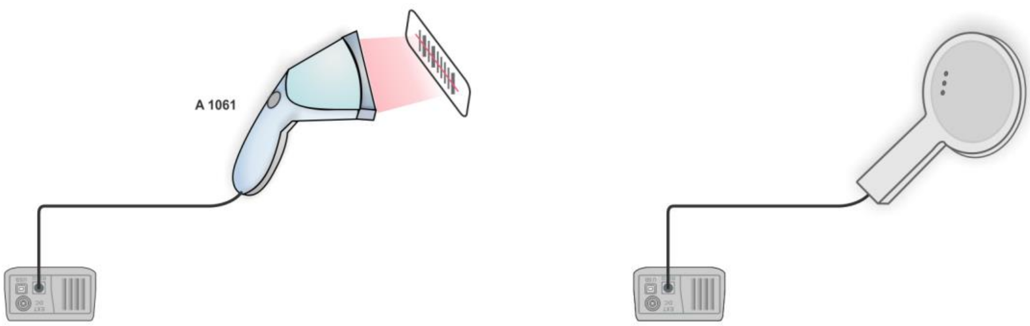


Figure 6.13: Connection of the barcode reader and RFID reader

How to change the name of memory location

- Connect the barcode reader or RFID reader to the instrument.
- In Save menu select memory location to be renamed.
- A new location name (scanned from a barcode label or a RFID tag) will be accepted by the instrument. A successful receive of the barcode or RFID tag is confirmed by two short confirmation beeps.

Note:
- Use only barcode readers and RFID readers delivered by Metrel or authorized distributor.

6.6 Communication (model MI 3125 BT)

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

6.6.1 USB and RS232 communication

The instrument automatically selects the communication mode according to detected interface. USB interface has priority.

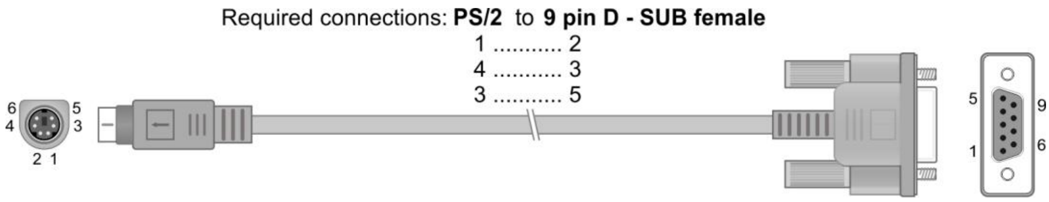


Figure 6.14: Interface connection for data transfer over PC COM port

How to establish an USB or RS232 link:

- RS-232 communication: connect a PC COM port to the instrument PS/2 connector using the PS/2 **-** RS232 serial communication cable;
- USB communication: connect a PC USB port to the instrument USB connector using the USB interface cable.
- Switch **on** the PC and the instrument.
- **Run** the *EurolinkPRO* program***.***
- The PC and the instrument will automatically recognize each other.
- The instrument is prepared to communicate with the PC.

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

Note:

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

6.6.2 Bluetooth communication

The internal Bluetooth module enables easy communication via Bluetooth with PC and Android devices.

How to configure a Bluetooth link between instrument and PC

- Switch On the instrument.
- On PC configure a Standard Serial Port to enable communication over Bluetooth link between instrument and PC. No code for pairing the devices is needed.
- Run the *EurolinkPRO* program***.***
- The PC and the instrument will automatically recognize each other.
- The instrument is prepared to communicate with the PC.

How to configure a Bluetooth link between instrument and Android device

- Switch On the instrument.
- Some Android applications automatically carry out the setup of a Bluetooth connection. It is preferred to use this option if it exists.
  This option is supported by Metrel's Android applications.
- If this option is not supported by the selected Android application then configure a Bluetooth link via Android device's Bluetooth configuration tool. No code for pairing the devices is needed.
- The instrument and Android device are ready to communicate.

Notes:

- Sometimes there will be a demand from the PC or Android device to enter the code. Enter code 'NNNN' to correctly configure the Bluetooth link.
- The name of correctly configured Bluetooth device must consist of the instrument type plus serial number, eg. *MI 3125 BT-12240429I*. If the Bluetooth module got another name, the configuration must be repeated.
- Model MI 3125 BT doesn't support operation with Bluetooth dongle A 1436.
- In case of serious troubles with the Bluetooth communication it is possible to reinitialize the internal Bluetooth module. The initialization is carried out during the Initial settings procedure. In case of a successful initialization "INTERNAL BLUETOOTH SEARCHING OK!" is displayed at the end of the procedure. See chapter *4.2.7 Initial settings*.

7 Upgrading the instrument

The instrument can be upgraded from a PC via the RS232 communication port. This enables to keep the instrument up to date even if the standards or regulations change. The upgrade can be carried with help of a special upgrading software and the communication cable as shown on Figure 6.14. Please contact your dealer for more information.

8 Maintenance

Unauthorized persons are not allowed to open the Eurotest Combo instrument. There are no user replaceable components inside the instrument, except the battery and fuse under rear cover.

8.1 Fuse replacement

There is a fuse under back cover of the Eurotest Combo instrument.

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

Warnings:

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

Position of fuse can be seen in Figure 3.4 in chapter *3.3 Back side.*

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

8.4 Service

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

9 Technical specifications

9.1 Insulation resistance

Insulation resistance (nominal voltages 50 V_{DC}, 100 V_{DC} and 250 V_{DC})
Measuring range according to EN61557 is 0.15 MΩ ÷ 199.9 MΩ.

Measuring range (MΩ)	**Resolution (MΩ)**	**Accuracy**
0.00 ÷ 19.99	0.01	±(5 % of reading + 3 digits)
20.0 ÷ 99.9	0.1	±(10 % of reading)
100.0 ÷ 199.9		±(20 % of reading)

Insulation resistance (nominal voltages 500 V_{DC} and 1000 V_{DC})
Measuring range according to EN61557 is 0.15 MΩ ÷ 1 GΩ.

Measuring range (MΩ)	**Resolution (MΩ)**	**Accuracy**
0.00 ÷ 19.99	0.01	±(5 % of reading + 3 digits)
20.0 ÷ 199.9	0.1	±(5 % of reading)
200 ÷ 999	1	±(10 % of reading)

Voltage

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

Nominal voltages ....50 V_{DC}, 100 V_{DC}, 250 V_{DC}, 500 V_{DC}, 1000 V_{DC}
Open circuit voltage ....-0 % / +20 % of nominal voltage
Measuring current..............................min. 1 mA at $R_N=U_N\times1$ kΩ/V
Short circuit current........................... max. 3 mA
The number of possible tests............ > 1200, with a fully charged battery
Auto discharge after test.
Specified accuracy is valid if 3-wire test lead is used while it is valid up to 100 MΩ if tip commander is used.
Specified accuracy is valid up to 100 MΩ if relative humidity > 85 %.
In case the instrument gets moistened, the results could be impaired. In such case, it is recommended to dry the instrument and accessories for at least 24 hours.
The error in operating conditions could be at most the error for reference conditions (specified in the manual for each function) ±5 % of measured value.

9.2 Continuity

9.2.1 Resistance R LOWΩ

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

Measuring range R (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(3 % of reading + 3 digits)
20.0 ÷ 199.9	0.1	±(5 % of reading)
200 ÷ 999	1	
1000 ÷ 1999	1	±(10 % of reading)

Open-circuit voltage...........................6.5 VDC ÷ 9 VDC
Measuring current..............................min. 200 mA into load resistance of 2 Ω
Test lead compensation.....................up to 5 Ω
The number of possible tests ....> 2000, with a fully charged battery
Automatic polarity reversal of the test voltage.

9.2.2 Resistance CONTINUITY

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.0 ÷ 19.9	0.1	±(5 % of reading + 3 digits)
20 ÷ 1999	1	

Open-circuit voltage...........................6.5 VDC ÷ 9 VDC
Short-circuit current ....max. 8.5 mA
Test lead compensation.....................up to 5 Ω

9.3 RCD testing

Note:
All data (marked with "*") regarding B, B+ and EV type RCDs is valid for model MI 3125 BT only.

9.3.1 General data

Nominal residual current (A, F,AC)....10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA
Nominal residual current (EV)............30 mA a.c., 6 mA d.c.*
Nominal residual current accuracy.....-0 / +0.1·IΔ; IΔ = IΔN, 2×IΔN, 5×IΔN
-0.1·IΔ / +0; IΔ = 0.5×IΔN
AS / NZ selected: ± 5 %
Test current shape……………………..Sine-wave (AC, EV a.c.), pulsed (A, F), smooth DC (B, B+, EV d.c.)*
DC offset for pulsed test current ....< 2 mA (typical)
RCD type ....(non-delayed), S (time-delayed), EV
Test current starting polarity .... 0 º or 180 º
Voltage range ....93 V ÷ 134 V (45 Hz ÷ 65 Hz)
185 V ÷ 266 V (45 Hz ÷ 65 Hz)

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

×...not applicable
✓...applicable
AC type..sine wave test current
A, F types…… ....pulsed current
B*, B+* types ....smooth DC current

	IΔN × 1/2 (mA)	IΔN × 1 (mA)	IΔN × 1 (mA)	IΔN × 2 (mA)	IΔN × 5 (mA)	RCD IΔ	
IΔN (mA)	EV a.c.	EV a.c.	EV d.c.	EV a.c.	EV a.c.	EV a.c.	EV d.c.
30 a.c.	15	30	×	60	150	✓	×
6 d.c.	×	×	6	×	×	×	✓

×...not applicable
✓...applicable
EV type (a.c. part). ....sine wave test current
EV type (d.c. part)..............................smooth DC current

9.3.2 Contact voltage RCD-Uc

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

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

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

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

9.3.3 Trip-out time

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

Measuring range* (s)	Resolution (ms)	Accuracy
0.0 m ÷ 40.0 m	0.1	±1 ms
40.1 m ÷ 999.9 m	0.1	±3 ms
1.00 ÷ 10.00	10	±10 ms

* For max. time see normative references in *4.2.4* – this specification applies to max. time >40 ms.

Test current .... ½×$I_{\Delta N}$, $I_{\Delta N}$, 2×$I_{\Delta N}$, 5×$I_{\Delta N}$
5×$I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD type AC) or $I_{\Delta N} \geq$ 300 mA (RCD types A, F, B*, B+*).
2×$I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types A, F) or $I_{\Delta N} \geq$ 300 mA (RCD types B, B+)*.
1×$I_{\Delta N}$ is not available for $I_{\Delta N}$=1000 mA (RCD types B, B+)*.
Specified accuracy is valid for complete operating range.

9.3.4 Trip-out current

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

Measuring range I_Δ	Resolution I_Δ	Accuracy
0.2×$I_{\Delta N}$ ÷ 1.1×$I_{\Delta N}$ (AC, EV a.c. types)	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$
0.2×$I_{\Delta N}$ ÷ 1.5×$I_{\Delta N}$ (A, F types, $I_{\Delta N}$ ≥30 mA)	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$
0.2×$I_{\Delta N}$ ÷ 2.2×$I_{\Delta N}$ (A, F types, $I_{\Delta N}$ <30 mA)	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$
0.2×$I_{\Delta N}$ ÷ 2.2×$I_{\Delta N}$ (B, B+ types)*	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$
0.2×$I_{\Delta N}$ ÷ 1.0×$I_{\Delta N}$ (EV d.c. type)*	0.05×$I_{\Delta N}$	±0.1×$I_{\Delta N}$

Trip-out time

Measuring range (s)	Resolution (ms)	Accuracy
0.0 m ÷ 999.9 m	0.1	±3 ms
1.00 ÷ 10.00	10	±10 ms

Contact voltage

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

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

9.4 Fault loop impedance and prospective fault current

9.4.1 No disconnecting device or FUSE selected

Fault loop impedance
Measuring range according to EN61557 is 0.25 Ω ÷ 9.99kΩ.

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

Prospective fault current (calculated value)

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

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

Test current (at 230 V)...................... 6.5 A (10 ms)
Nominal voltage range.......................93 V ÷ 134 V (45 Hz ÷ 65 Hz)
185 V ÷ 266 V (45 Hz ÷ 65 Hz)

9.4.2 RCD selected

Fault loop impedance
Measuring range according to EN61557 is 0.46 Ω ÷ 9.99 kΩ for I test = “Std” and 0.48 Ω ÷ 9.99 kΩ for I test = “Low”.

Measuring range (Ω)	Resolution (Ω)	Accuracy I test = “Std”	Accuracy I test = “Low”
0.00 ÷ 9.99	0.01	±(5 % of reading + 10 digits)	±(5 % of reading + 12 digits)
10.0 ÷ 99.9	0.1		
100 ÷ 999	1	± 10 % of reading	± 10 % of reading
1.00k ÷ 9.99k	10		

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

Prospective fault current (calculated value)

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

Nominal voltage range.......................93 V ÷ 134 V (45 Hz ÷ 65 Hz)
185 V ÷ 266 V (45 Hz ÷ 65 Hz)

No trip out of RCD.

9.5 Line impedance and prospective short-circuit current / Voltage drop

Line impedance
Measuring range according to EN61557 is 0.25 Ω ÷ 9.99kΩ.

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

Prospective short-circuit current (calculated value)

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

Test current (at 230 V)...................... 6.5 A (10 ms)
Nominal voltage range.......................93 V ÷ 134 V (45 Hz ÷ 65 Hz)
185 V ÷ 266 V (45 Hz ÷ 65 Hz)
321 V ÷ 266 V (45 Hz ÷ 65 Hz)

Voltage drop (calculated value)

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

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

*See chapter *5.6.2 Voltage drop* for more information about calculation of voltage drop result.

9.6 Resistance to earth

Measuring range according to EN61557-5 is 2.00 Ω ÷ 9999 Ω.

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	±(5% of reading + 5 digits)
20.0 ÷ 199.9	0.1	
200 ÷ 9999	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.. < 15 VAC
Short circuit current... < 30 mA
Test voltage frequency .... 125 Hz
Test voltage shape .... sinusoidal
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 Voltage, frequency, and phase rotation

9.7.1 Phase rotation

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

9.7.2 Voltage

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

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

9.7.3 Frequency

Measuring range (Hz)	Resolution (Hz)	Accuracy
0.00 ÷ 9.99	0.01	±(0.2 % of reading + 1 digit)
10.0 ÷ 499.9	0.1	

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

9.7.4 Online terminal voltage monitor

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

9.8 General data

Models MI 3125 and MI 3125 BT:

Power supply voltage........................ 9 V_{DC} (6×1.5 V battery or accu, size AA)
Operation.. typical 20 h
Charger socket input voltage .... 12 V ± 10 %
Charger socket input current .... 400 mA max.
Battery charging current .... 250 mA (internally regulated)
Overvoltage category........................ 600 V CAT III / 300 V CAT IV
Plug commander
overvoltage category................ 300 V CAT II
Protection classification .... double insulation
Pollution degree................................ 2
Protection degree .... IP 40

Display .... 128x64 dots matrix display with backlight

Dimensions (w × h × d)..................... 14 cm × 8 cm × 23 cm
Weight .... 1.0 kg, without battery cells

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

Operation conditions
Working temperature range .... 0 °C ÷ 40 °C

Maximum relative humidity .... 95 %RH (0 °C ÷ 40 °C), non-condensing

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

Model MI 3125 BT:

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

Memory size.....................................1700 results

Bluetooth module: Class 2

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

A Appendix A - Fuse table

A.1 Fuse table - IPSC

Fuse type NV

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

Fuse type gG

Rated current (A)	Disconnection time [s]				
	35m	0.1	0.2	0.4	5
	Min. prospective short- circuit current (A)				
2	32.5	22.3	18.7	15.9	9.1
4	65.6	46.4	38.8	31.9	18.7
6	102.8	70	56.5	46.4	26.7
10	165.8	115.3	96.5	80.7	46.4
13	193.1	144.8	117.9	100	56.2
16	206.9	150.8	126.1	107.4	66.3
20	276.8	204.2	170.8	145.5	86.7
25	361.3	257.5	215.4	180.2	109.3
32	539.1	361.5	307.9	271.7	159.1
35	618.1	453.2	374	308.7	169.5
40	694.2	464.2	381.4	319.1	190.1

50	919.2	640	545	464.2	266.9
63	1217.2	821.7	663.3	545	319.1
80	1567.2	1133.1	964.9	836.5	447.9
100	2075.3	1429	1195.4	1018	585.4

Fuse type B

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

Fuse type C

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

Fuse type K

Rated current (A)	Disconnection time [s]				
	35m	0.1	0.2	0.4	
	Min. prospective short- circuit current (A)				
0.5	7.5	7.5	7.5	7.5	
1	15	15	15	15	

1.6	24	24	24	24	
2	30	30	30	30	
4	60	60	60	60	
6	90	90	90	90	
10	150	150	150	150	
13	195	195	195	195	
15	225	225	225	225	
16	240	240	240	240	
20	300	300	300	300	
25	375	375	375	375	
32	480	480	480	480	

Fuse type D

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

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

Type B

Rated current (A)	Disconnection time [s]		
		0.4	
	Max. loop impedance (Ω)		
6		9.6	
10		5.8	
16		3.6	
20		2.9	
25		2.3	
32		1.8	
40		1.4	
50		1.2	
63		0.9	
80		0.7	
100		0.6	
125		0.5	
160		0.4	
200		0.3	

Type C

Rated current (A)	Disconnection time [s]		
		0.4	
	Max. loop impedance (Ω)		
6		5.1	
10		3.1	
16		1.9	
20		1.5	
25		1.2	
32		1.0	
40		0.8	
50		0.6	
63		0.5	
80		0.4	
100		0.3	
125		0.2	
160		0.2	
200		0.2	

Type D

Rated current (A)	Disconnection time [s]		
		0.4	
	Max. loop impedance (Ω)		
6		3.1	
10		1.8	
16		1.2	
20		0.9	
25		0.7	
32		0.6	
40		0.5	
50		0.4	
63		0.3	
80		0.2	
100		0.2	
125		0.1	
160		0.1	
200		0.1	

Fuse

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
6		11.5	15.3
10		6.4	9.2
16		3.1	5.0
20		2.1	3.6
25		1.6	2.7
32		1.3	2.2
40		1.0	1.6
50		0.7	1.3
63		0.6	0.9
80		0.4	0.7
100		0.3	0.5
125		0.2	0.4
160		0.2	0.3
200		0.1	0.2

All impedances are scaled with factor 1.00.

B Appendix B - Accessories for specific measurements

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

Function	Suitable accessories (Optional with ordering code A….)
Insulation resistance	❑ Test lead, 3 x 1.5 m ❑ Tip commander (A 1401)
R LOWΩ resistance	❑ Test lead, 3 x 1.5 m ❑ Tip commander (A 1401) ❑ Test lead, 4 m (A 1154)
Continuous resistance measurement	❑ Test lead, 3 x 1.5 m ❑ Tip commander (A 1401) ❑ Test lead, 4 m (A 1154)
Line impedance	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401) ❑ Three-phase adapter (A 1110) ❑ Three-phase adapter with switch (A 1111)
Fault loop impedance	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401) ❑ Three-phase adapter (A 1110) ❑ Three-phase adapter with switch (A 1111)
RCD testing	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Three-phase adapter (A 1110) ❑ Three-phase adapter with switch (A 1111)
Earth resistance	❑ Test lead, 3 x 1.5 m ❑ Earth test set, 3-wire, 20 m (S 2026) ❑ Earth test set, 3-wire, 50 m (S 2027)
Phase sequence	❑ Test lead, 3 x 1.5 m ❑ Three-phase adapter (A 1110) ❑ Three-phase adapter with switch (A 1111)
Voltage, frequency	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)

C Appendix C – Country notes

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

C.1 List of country modifications

The following table contains current list of applied modifications.

Country	Related chapters	Modification type	Note
HUN	5.5, 5.6, C.2.1 Appendix A	Appended	Added gR fuse type
AT	5.4, 9.3, C.2.2	Appended	Special G type RCD
NO, DK, SW	4.2, C.2.3	Appended	IT supply system
AUS / NZ	4.2, 4.2.5, 4.2.8, 5.5, 5.6, Appendix A	Appended	AUS / NZ fuse table added

C.2 Modification issues

C.2.1 HUN modification – gR fuse types

Modifications of the chapter 5.5

Test parameters for fault loop impedance measurement

Test	Selection of fault loop impedance **sub-function** [Zloop, Zs_{rcd}]
Fuse type	Selection of **fuse type** [---, gR, NV, gG, B, C, K, D]
Fuse I	**Rated current** of selected fuse
Fuse T	Maximum **breaking time** of selected fuse
Lim	Minimum short circuit **current** for selected fuse.

See Appendix A and Appendix C for reference fuse data.

Modifications of the chapter 5.6

Test parameters for line impedance measurement

Test	Selection of line impedance [Zline] or voltage drop [ΔU] **sub-function**
FUSE type	Selection of **fuse type** [---, gR, NV, gG, B, C, K, D]
FUSE I	**Rated current** of selected fuse
FUSE T	Maximum **breaking time** of selected fuse
Lim	Minimum short circuit **current** for selected fuse.

See Appendix A and Appendix C for reference fuse data.

C.2.1.1 Modification of Appendix A

In addition to fuse data given in Appendix A gR fuses are added.

Fuse type gR

Rated current (A)	Disconnection time [s]				
	35m	0.1	0.2	0.4	5
	Min. prospective short- circuit current (A)				
2	31.4	14	10	8	5
4	62.8	28	20	16	10
6	94.2	42	30	24	15
10	157	70	50	40	25
13	204	91	65	52	32.5
16	251	112	80	64	40
20	314	140	100	80	50
25	393	175	125	100	62.5
32	502	224	160	128	80
35	550	245	175	140	87.5
40	628	280	200	160	100
50	785	350	250	200	125
63	989	441	315	252	157.5
80	1256	560	400	320	200
100	1570	700	500	400	250
125	1963	875	625	500	313
160	2510	1120	800	640	400
200	3140	1400	1000	800	500
250	3930	1750	1250	1000	625
315	4950	2210	1575	1260	788
400	6280	2800	2000	1600	1000
500	7850	3500	2500	2000	1250
630	9890	4410	3150	2520	1575
710	11150	4970	3550	2840	1775
800	12560	5600	4000	3200	2000
1000	15700	7000	5000	4000	2500
1250	19630	8750	6250	5000	3130

C.2.2 AT modification - G type RCD

Modified is the following related to the mentioned in the chapter *5.4*:
- Added G type RCD,
- Time limits are the same as for general type RCD,
- Contact voltage is calculated the same as for general type RCD.

Modifications of the chapter 5.4

Test parameters for RCD test and measurement

TEST	RCD **sub-function** test [RCDt, RCD I, AUTO, Uc].
$I_{\Delta N}$	**Rated** RCD residual current sensitivity $I_{\Delta N}$, $I_{\Delta N(DC)}$, [6 mA**,30/6 mA**, 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA].
type	RCD **type** [AC, A, F, B*, B+*, EV**] starting **polarity** [∿, ∿, ⌒–, ⌄–, ⊕⎓*, ⊖⎓*], selective [S], general non-delayed [ ], delayed [G] characteristic**.**
MUL	**Multiplication** factor for test current [½, 1, 2, 5 $I_{\Delta N}$].
Ulim	Conventional touch voltage **limit** [25 V, 50 V].

* Model MI 3125 BT
** EV RCD

Notes:

- Ulim can be selected in the Uc sub-function only.
- Selective (time delayed) RCDs and RCDs with (G) - time delayed characteristic demonstrate delayed response characteristics. They contain residual current integrating mechanism for generation of delayed trip out. However, contact voltage pre-test in the measuring procedure also influences the RCD and it takes a period to recover into idle state. Time delay of 30 s is inserted before performing trip-out test to recover [S] type RCD after pre-tests and time delay of 5 s is inserted for the same purpose for [G] type RCD.
- The a.c. part of EV RCDs is tested according to EN 61008 / EN 61009 as general (non-delayed) RCDs.
- The d.c. part of EV RCDs is tested with a DC test current. The Pass limit is between 0.5 and 1.0 $I_{\Delta N(DC)}$.

Modification of the chapter 5.4.1

RCD type		**Contact voltage Uc proportional to**	**Rated $I_{\Delta N}$**	
AC	[ ], [G]	$1.05 \times I_{\Delta N}$	any	All models
AC	[S]	$2 \times 1.05 \times I_{\Delta N}$		
A,F	[ ], [G]	$1.4 \times 1.05 \times I_{\Delta N}$	≥ 30 mA	
A,F	[S]	$2 \times 1.4 \times 1.05 \times I_{\Delta N}$		
A,F	[ ], [G]	$2 \times 1.05 \times I_{\Delta N}$	< 30 mA	
A,F	[S]	$2 \times 2 \times 1.05 \times I_{\Delta N}$		
EV a.c. part	[ ]	$1.05 \times I_{\Delta N}$	any	Model MI 3125 BT
B, B+	[ ]	$2 \times 1.05 \times I_{\Delta N}$		
B, B+	[S]	$2 \times 2 \times 1.05 \times I_{\Delta N}$		

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

Technical specifications remain the same.

C.2.3 NO, DK, SW modification – IT supply system

C.2.3.1 Modification of chapter 4.2

Different instrument options can be set in the **SETTINGS** menu, additional option is added:

- Selection of power supply system.

C.2.3.2 New chapter

For selection of proper supply system, the chapter 4.2.9 is added.

4.2.9. Supply earthing system

In this menu the tested supply system can be selected.

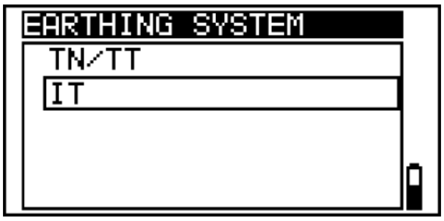


Figure 4.9: Selection of supply system

Keys:

UP / DOWN	Selects distribution supply system.
TEST	Confirms selected system and exits to settings menu.
Function selector	Exits back to main function menu.

C.2.3.3 New appendix D for IT supply system

C.2.4 AUS / NZ modification – Fuse types according to AS/NZS 3017

Modifications of the chapter 4.2

I_{SC} factor *is replaced with* Z factor.

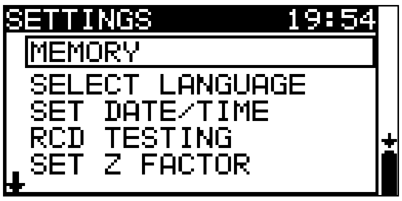


Figure 4.1: Options in Settings menu

Modifications of the chapter 4.2.5

C.2.4.1 Z Factor

In this menu the Z factor can be set.

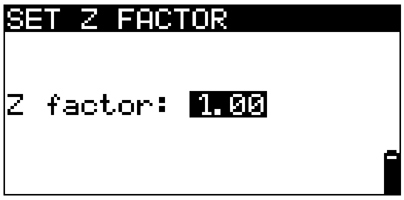


Figure 4.6: Selection of Z factor

Keys:

UP / DOWN	Sets Z value.
TEST	Confirms Z value.
Function selectors	Exits back to main function menu.

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

Modifications of the chapter 4.2.8

The default setup is listed below:

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

Modifications of the chapter 5.5

Modified test parameters for fault loop impedance measurement

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

See Appendix A.2 for reference fuse data.

Figure 5.25: Examples of loop impedance measurement result

Displayed results:

Z fault loop impedance
Isc .... prospective fault current,
Lim .... high limit fault loop impedance value.

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

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

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

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

Modifications of the chapter 5.6

Modified test parameters for line impedance measurement

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

See Appendix A.2 for reference fuse data.

Line to neutral Line to line

Figure 5.29: Examples of line impedance measurement result

Displayed results:
- **Z** line impedance
- **Isc**...........prospective short-circuit current
- **Lim**..........high limit line impedance value.

Prospective short circuit current I_{PFC} is calculated from measured impedance as follows:

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

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

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

D Appendix D - IT supply systems

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

D.1 Standard references

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

D.2 Fundamentals

In IT systems live parts are insulated from earth or connected to earth through sufficiently high impedance.

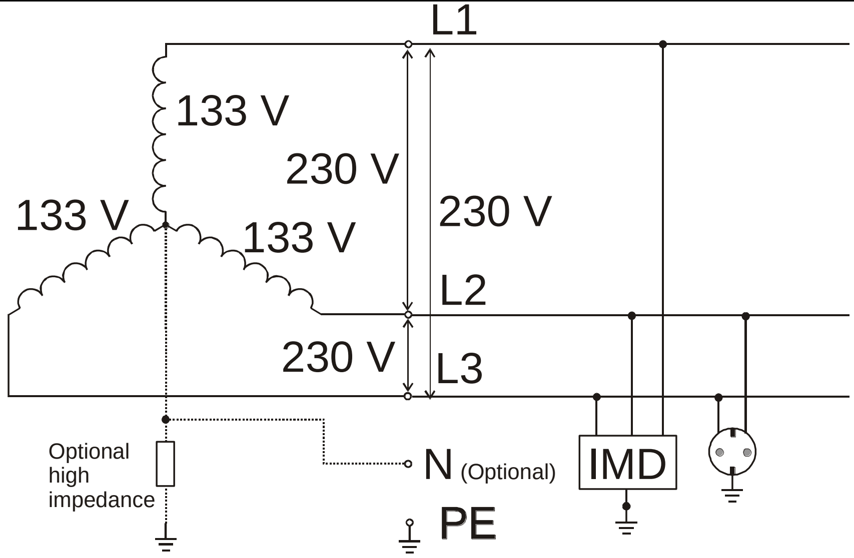


Figure D.1: General IT supply system with reference designations

- Three phase star connection, optional delta connection.
- Optional neutral line.
- Single-phase connection is also possible.
- Various system voltages possible.
- 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.

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

D.3 Measurement guides

The user has to select the IT supply system in the instrument before testing it. The procedure for selecting the IT supply system is defined in chapter *4.2.9 Supply earthing system.* Once the IT system is selected the instrument can be used immediately. The instrument keeps selected IT system when it is turned off. Displayed designations correspond to IT system, *see figure D.1*.

MI 3125 / MI 3125 BT test functions and IT systems

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

IT system functions	**Note**
Voltage	
Voltage	Symbols modified for IT system, see *figure D.2.*
Phase rotation	For three phase system only, automatic detection.
RCD functions	Partially applicable.
RCD - Uc	Not applicable.
RCD - Trip out Time t	
RCD - Tripping Current	Applicable with bypassing the test current.
RCD – Automatic test	
Loop functions	Not applicable.
Fault Loop Impedance	
Fault Loop Prospective Short-circuit Current	
Line functions	
Line Impedance	Impedance Z_{L1-L2}.
Line Prospective Short-circuit Current	I_{SC} for rated U_{L1-L2}.
Continuity functions	Independent of selected supply system.
Insulation Resistance	Independent of selected supply system.
Earth resistance	Independent of selected supply system.
PE test probe	Active, but does not inhibit selected test if voltage is detected.

Voltage measurements

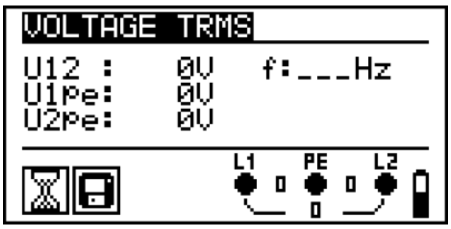


Figure D.2: Voltage measurements

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

Line impedance

See chapter *5.6*, the measurement is the same; only terminal voltage monitor indication corresponds to IT system.

RCD testing

RCD testing is performed in the same way as in TN/TT system (See chapter *5.4*), with the following exception:

- U_C measurement is relevant only in case of first fault.

Test circuit with bypassing principle should correspond to that on figure *D.3*.

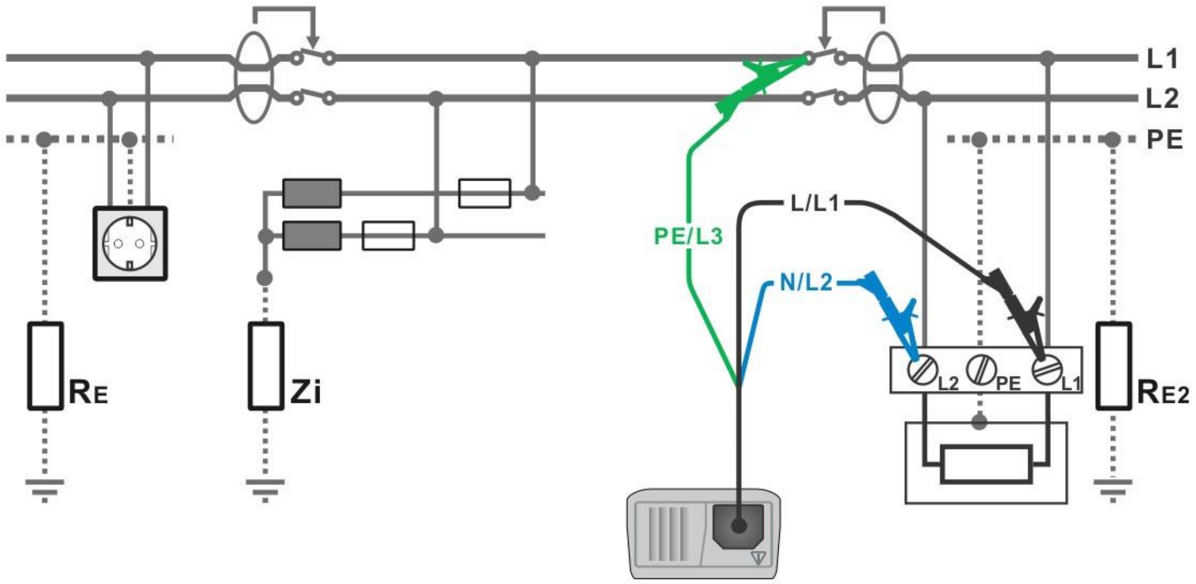


Figure D.3: RCD testing in IT system with bypassing RC

E Appendix E – Commanders (A 1314, A 1401)

E.1 ⚠ Warnings related to safety

Measuring category of commanders:
Plug commander A 1314 ………… 300 V CAT II
Tip commander A 1401
(cap off, 18 mm tip) 1000 V CAT II / 600 V CAT II / 300 V CAT II
(cap on, 4 mm tip)…1000 V CAT II / 600 V CAT III / 300 V CAT IV

- **Measuring category of commanders can be lower than protection category of the instrument.**
- **If dangerous voltage is detected on the tested PE terminal, immediately stop all measurements, find and remove the fault!**
- **When replacing battery cells or before opening the battery compartment cover, disconnect the measuring accessory from the instrument and installation.**
- **Service, repairs or adjustment of instruments and accessories is only allowed to be carried out by a competent authorized personnel!**

E.2 Battery

The commander uses two AAA size alkaline or rechargeable Ni-MH battery cells. Nominal operating time is at least 40 h and is declared for cells with nominal capacity of 850 mAh.

Notes:
- If the commander is not used for a long period of time, remove all batteries from the battery compartment.
- Alkaline or rechargeable Ni-MH batteries (size AA) can be used. Metrel recommends only using rechargeable batteries with a capacity of 800 mAh or above.
- Ensure that the battery cells are inserted correctly otherwise the commander will not operate and the batteries could be discharged.

E.3 Description of commanders

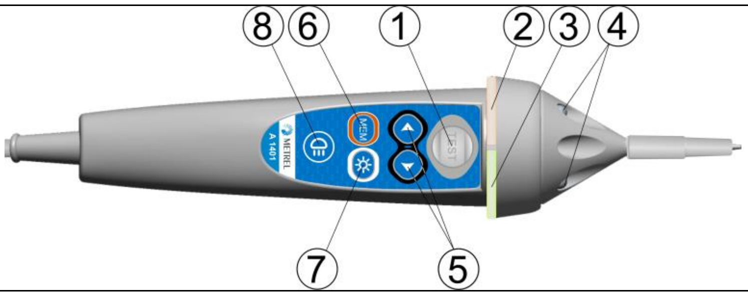


Figure E.1: Front side tip commander (A 1401)

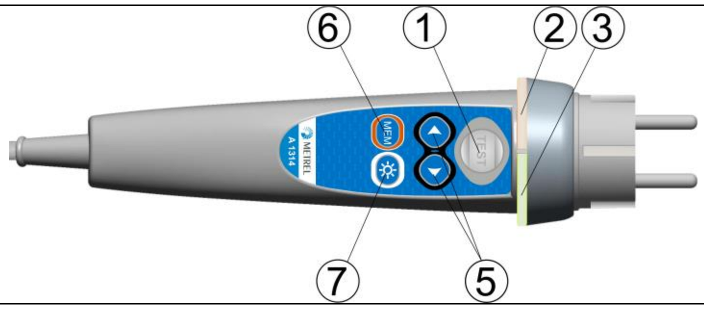


Figure E.2: Front side plug commander (A 1314)

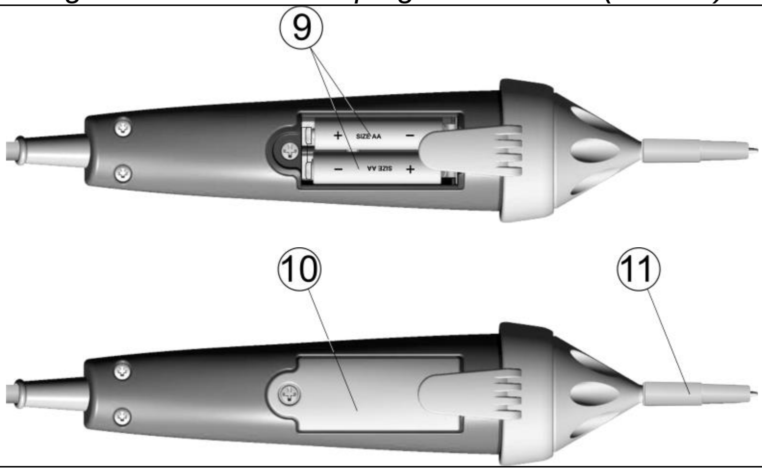


Figure E.3: Back side

Legend:

1	TEST	TEST: Starts measurements. Acts also as the PE touching electrode.
2	LED	Left status RGB LED
3	LED	Right status RGB LED
4	LEDs	Lamp LEDs (Tip commander)
5	Function selector	Selects test function.
6	MEM	Store / recall / clear tests in memory of instrument.
7	BL	Switches On / Off backlight on instrument
8	Lamp key	Switches On / Off lamp (Tip commander)
9	Battery cells	Size AAA, alkaline / rechargeable NiMH
10	Battery cover	Battery compartment cover
11	Cap	Removable CAT IV cap (Tip commander)

E.4 Operation of commanders

Both LED yellow	**Warning!** Dangerous voltage on the commander’s PE terminal!
Right LED red	Fail indication
Right LED green	Pass indication
Left LED blinks blue	Commander is monitoring the input voltage

Left LED orange	Voltage between any test terminals is higher than 50 V
Both LEDs blink red	Low battery
Both LEDs red and switch off	Battery voltage too low for operation of commander

PE terminal test procedure

- **Connect** commander to the instrument.
- **Connect** commander to the item to be tested (see *figure E.4 and E.5*).
- Touch PE test probe (the **TEST** key) on commander for at least one second.
- If PE terminal is connected to phase voltage both LEDs will light yellow, the warning message on the instrument is displayed, instrument's buzzer is activated, and further measurements are disabled in Zloop and RCD functions.

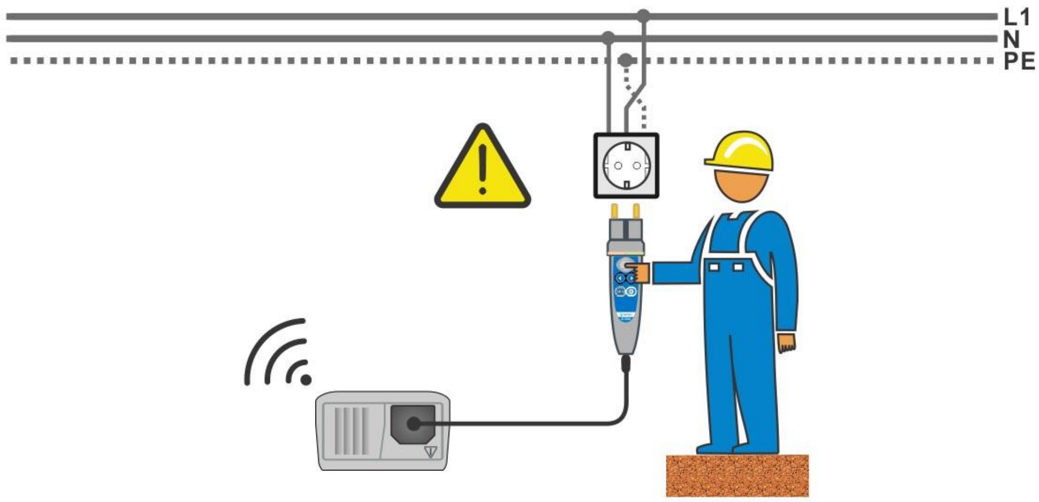


Figure E.4: Reversed L and PE conductors (application of plug commander)

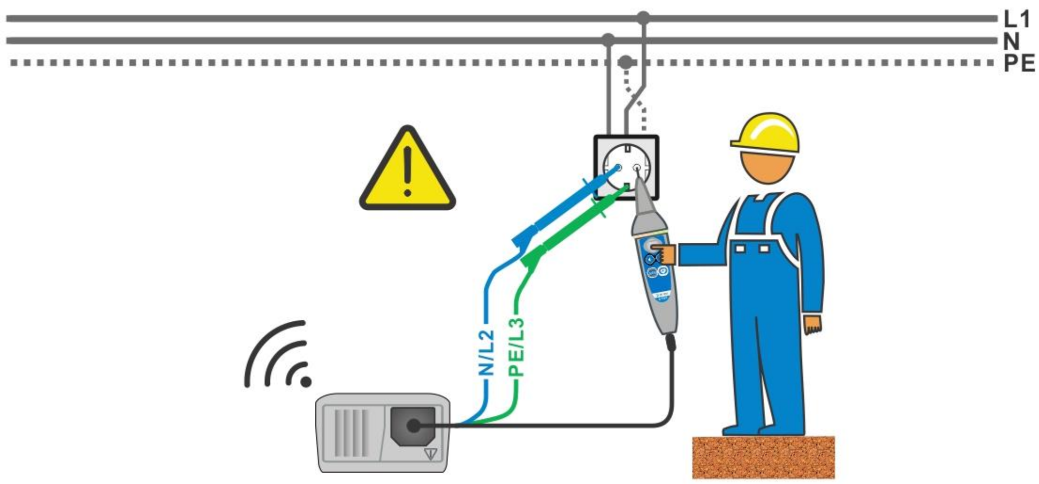


Figure E.5: Reversed L and PE conductors (application of tip commander)

Reversed phase and protection conductors! The most dangerous situation!