EurotestIM

MI 3110

Instruction manual

Version 1.2.3, Code no. 20 752 063

METREL®

Distributor:

Manufacturer:

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DATA BACKUP AND LOSS:

It is the user's responsibility to ensure the integrity and security of the data carrier and to regularly backup and validate the integrity of backups of the data. METREL HAS NO OBLIGATION OR LIABILITY FOR ANY LOSS, ALTERATION, DESTRUCTION, DAMAGE, CORRUPTION OR RECOVERY OF USER DATA, REGARDLESS OF WHERE THE DATA IS STORED.

CE Mark on your equipment certifies that it meets requirements of all subjected EU regulations.

Hereby, Metrel d.d. declares that the MI 3110 is in compliance with subjected EU directive. The full text of the EU declaration of conformity is available at the following internet address https://www.metrel.si/DoC.

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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 a professional, multifunctional, hand-held test instrument intended to perform all the measurements on a.c. electrical LV IT installations.

The following measurements and tests can be performed on a.c. electrical LV IT installations:

- voltage and frequency,
- line impedance / Voltage drop,
- first fault current,
- testing of Insulation monitoring devices (IMD),
- auto-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 measurements in general and their typical applications in IT supply system it is advisable to read Metrel handbook *Measurements on IT power supply systems*.

Model versions 3.x.xx supports operation with new commanders A 1314 and A 1401.

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

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:

General warnings related to safety:

- **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!**
- **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- **In case a fuse has blown follow the instructions in this manual to replace it!**
- **Do not use the instrument in AC supply systems with voltages higher than 550 V a.c.**
- **Service, repairs or adjustment of instruments and accessories is only allowed to be carried out by 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 have removable caps. If they are removed the protection falls to CAT II. Check markings on accessories!**
- **The instrument comes supplied with rechargeable Ni-MH battery cells. The cells should only be replaced with the same type as defined on the battery compartment label or as described in this manual. Do not use standard alkaline battery cells while the power supply adapter is connected, otherwise they may explode!**
- **Hazardous voltages exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before removing battery compartment cover.**

- **All normal safety precautions must be taken in order to avoid risk of electric shock while working on electrical installations!**

Warnings related to safety of measurement functions:

Testing PE terminal

- PE test probe (TEST key) is activated, but does not inhibit selected test if voltage is detected.

Notes related to measurement functions:

General

- The  indicator means that the selected measurement cannot be performed because of irregular conditions on input terminals.
- 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.

Z-LINE / Voltage drop

- High fluctuations of mains voltage influence the measurement results. The noise sign  is displayed in the message field in this case. Repeat the measurement.
- Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement.
- If the reference impedance is not set the value of Zref is considered as 0.00 Ω.
- The Zref is cleared (set to 0.00 Ω) if pressing CAL key while instrument is not connected to a voltage source.
- If the measured voltage is outside the ranges, ΔU result will not be calculated.

Testing of Insulation monitoring devices (IMD)

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

2.2 Battery and charging

The instrument uses six AA size alkaline or rechargeable 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.

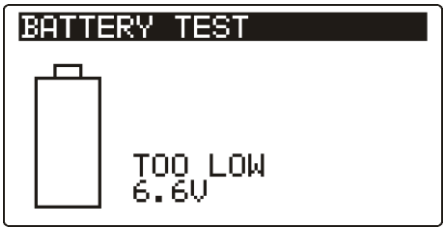


Figure 2.1: Discharged battery indication

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

Symbols:

	Indication of battery charging

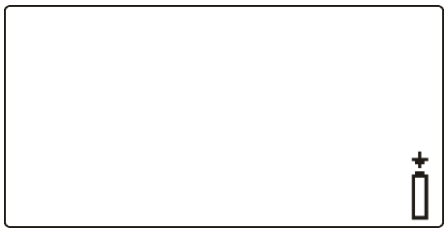


Figure 2.3: Charging indication

Warnings related to safety:

- 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.
- Do not recharge alkaline battery cells!
- Use only power supply adapter delivered from the manufacturer or distributor of the test equipment!

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).

- 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-MH batteries (size AA) can be used. Metrel recommends only using rechargeable batteries with a capacity of 2100mAh or above.
- Unpredictable chemical processes can occur during the charging of battery cells that have been left unused for a longer period (more than 6 months). In this case Metrel recommends repeating the charge / discharge cycle at least 2-4 times.
- 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. One different battery cell can cause an improper behavior of the entire battery pack!
- 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. 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 61010-2-030	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits
EN 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test
Functionality	
EN 61557	Electrical safety in low voltage distribution systems up to 1000 V_{AC} and 1500 V_{AC} – Equipment for testing, measuring or monitoring of protective measures Part 1 General requirements Part 3 Loop resistance Part 10 Combined measuring equipment
Reference standards for electrical installations and components	
EN 60364-4-41	Electrical installations of buildings Part 4-41 Protection for safety – protection against electric shock
BS 7671	IEE Wiring Regulations (17th edition)
AS/NZS 3017	Electrical installations – Verification guidelines

Note about EN and IEC standards:

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

3 Instrument description

3.1 Front panel

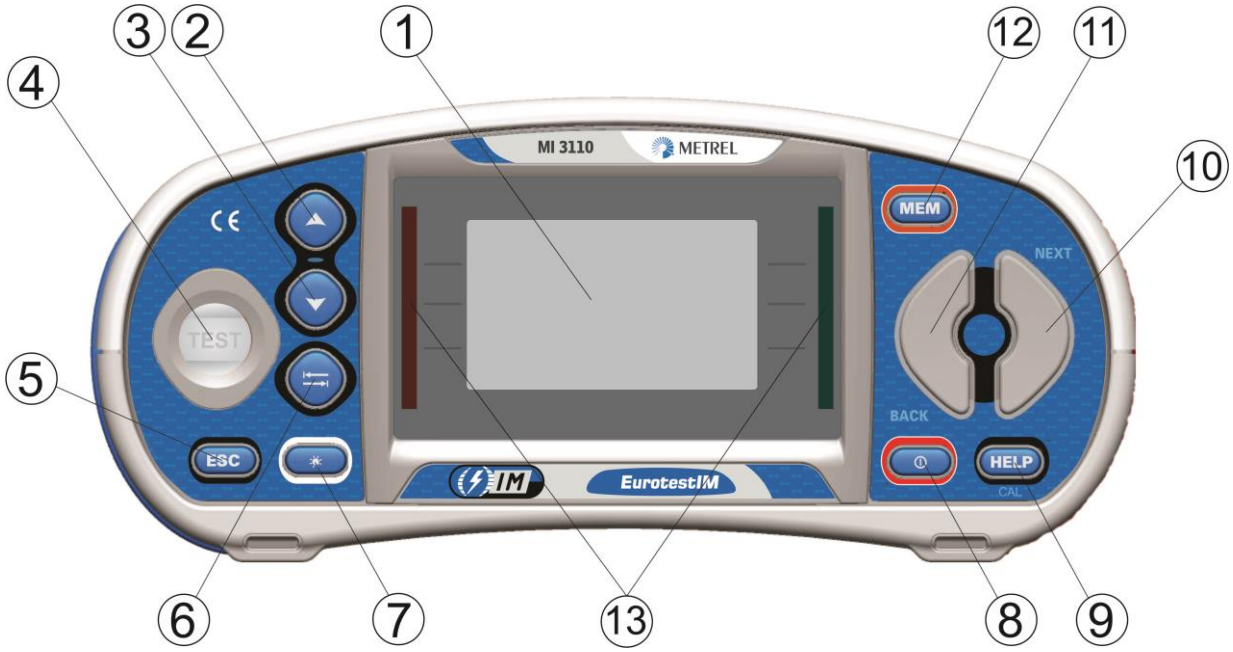


Figure 3.1: Front panel

Legend:

1	LCD	128 x 64 dots matrix display with backlight.
2	▲	Modifies selected parameter.
3	▼	
4	TEST	Starts measurements. Acts also as the PE touching electrode.
5	ESC	Goes one level back.
6	TAB	Selects the parameters in selected 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. Starts Z_{REF} measurement in Voltage drop sub-function.
10	Function selector - RIGHT	Selects test function.
11	Function selector - LEFT	
12	MEM	Stores / recalls memory of the instrument.
13	Green LED Red LED	Indicates PASS / FAIL of result.

3.2 Connector panel

Figure 3.2: Connector panel

Legend:

1	Test connector	Measuring inputs / outputs
2	Charger socket	
3	USB connector	Communication with PC USB (1.1) port
4	Protection cover	
5	PS/2 connector	Communication with PC serial port

Warnings!

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

3.3 Back side

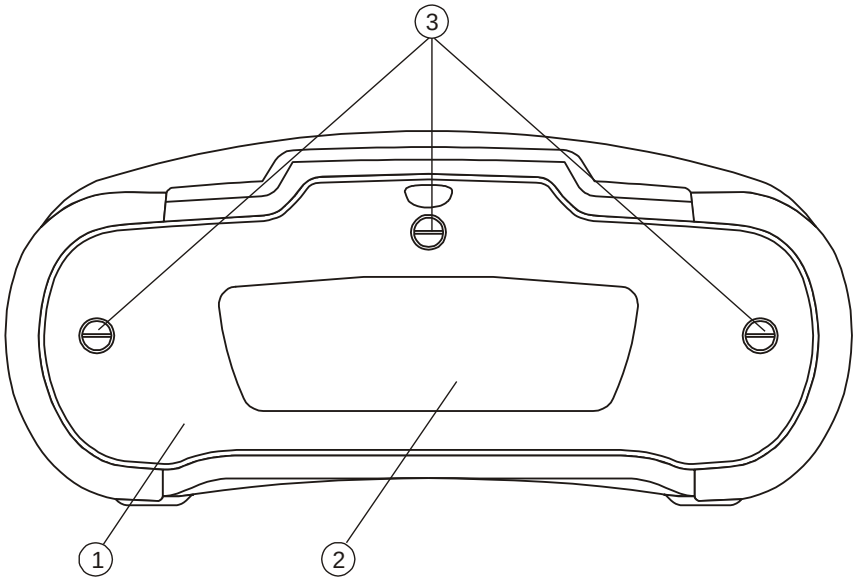


Figure 3.3: Back panel

Legend:

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

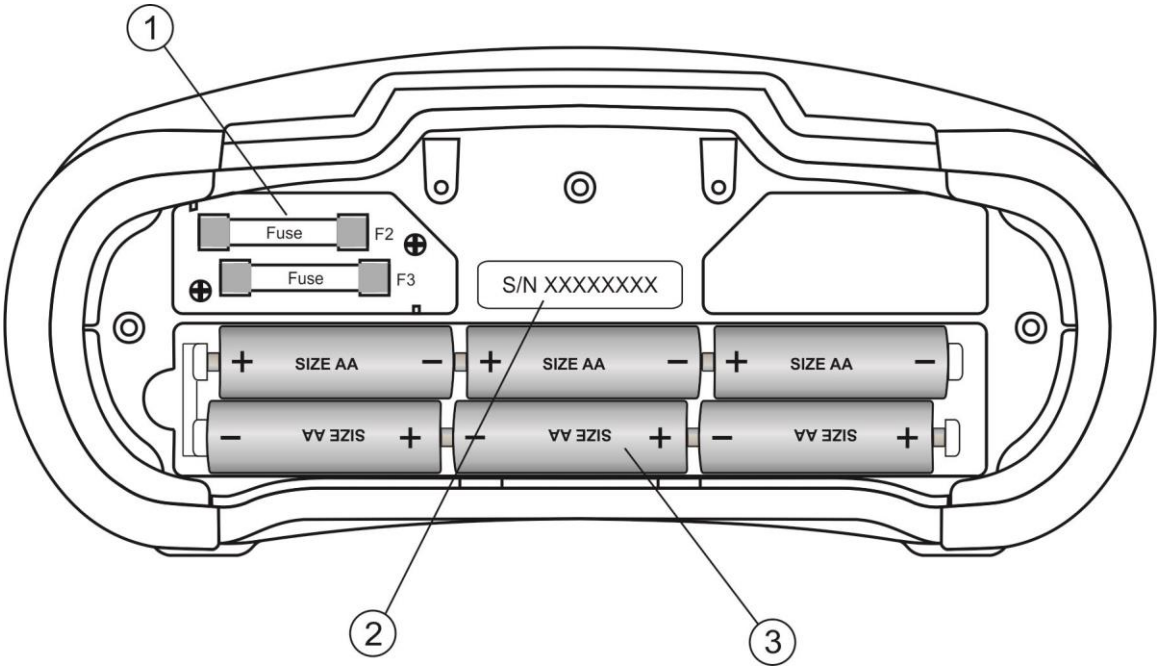


Figure 3.4: Battery and fuse compartment

Legend:

1	Fuses F2, F3	F 4 A / 500 V (Breaking capacity: 50 kA)

2	Serial number label	
3	Battery cells & holder	Size AA, alkaline / rechargeable NiMH.

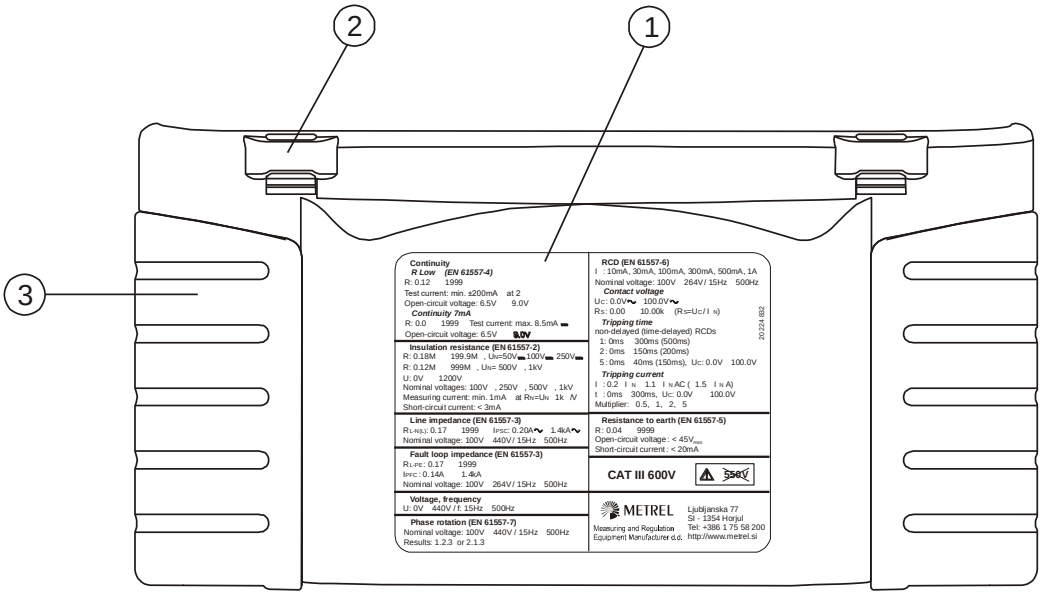


Figure 3.5: Bottom

Legend:

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

3.4 Carrying the instrument

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

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

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

3.5 Instrument set and accessories

3.5.1 Standard set MI 3110

- Instrument MI 3110 EurotestIM
- Soft carrying bag
- Mains measuring cable
- Test lead, 3 x 1.5 m
- Test probe, 3 pcs
- Crocodile clip, 3 pcs
- Set of carrying straps
- RS232-PS/2 cable
- USB cable
- Set of NiMH battery cells
- Power supply adapter
- CD with instruction manual, and “Measurements on IT installation” handbook.
- Short instruction manual
- Calibration Certificate

3.5.2 Optional accessories

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

4 Instrument operation

4.1 Display organization

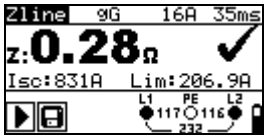


Figure 4.1: Typical function display

Zline	Function name
z:0.28Ω ✓ Isc:831A Lim:206.9A	Result field
9G 16A 35ms	Test parameter field
	Message field
L1 PE L2 117 116 232	Terminal voltage monitor
	Battery indication

4.1.1 Terminal voltage monitor

The terminal voltage monitor displays on-line the voltages on the test terminals and information about active test terminals in the a.c. installation measuring mode.

L1 PE L2 117 116 232	Online voltages are displayed together with test terminal indication. All three test terminals are used for selected measurement.
L1 PE L2 117 116 232	Online voltages are displayed together with test terminal indication. L1 and L2 test terminals are used for selected measurement.

4.1.2 Battery indication

The battery 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.
	Charging in progress (if power supply adapter is connected).

4.1.3 Messages

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.

	Instrument is overheated. The measurement is prohibited until the temperature decreases under the allowed limit.
	Result(s) can be stored.
	High electrical noise was detected during measurement. Results may be impaired.
SF	Single fault condition in IT system.
	Warning! Dangerous voltage on the PE terminal! Stop the activity immediately and eliminate the fault / connection problem before proceeding with any activity!

4.1.4 Results

	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.

4.1.5 Sound warnings

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

4.1.6 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 a.c. electrical LV IT 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:

/	Selects next / previous help screen.
ESC / HELP / Function selector	Exits help menu.

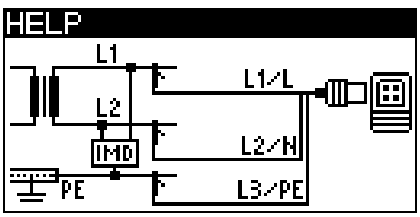


Figure 4.2: Example of help screen

4.1.7 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.

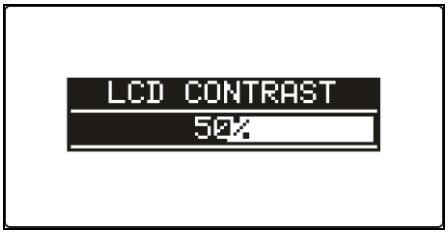


Figure 4.3: Contrast adjustment menu

Keys for contrast adjustment:

⮝	Reduces contrast.
⮟	Increases contrast.
TEST	Accepts new contrast.
ESC	Exits without changes.

4.2 Function selection

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

Keys:

Function selector	Selects test / measurement function.
⮝ **/** ⮟	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.
ESC	Exits back to main menu.

Keys in **test parameter** field:

⮝ **/** ⮟	Changes the selected parameter.
TAB	Selects the next measuring parameter.
Function selector	Toggles between the main functions.
MEM	Stores measured results / recalls stored results.

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 Measurements – a.c. LV IT installations* for more information about the operation of the instrument test functions.

4.3 Instruments main menu

In instrument's main menu the test mode can be selected. Different instrument options can be set in the **SETTINGS** menu.

- <**AUTO SEQUENCE**> automatic testing
- <**SINGLE TESTS**> a.c. LV IT installation testing
- <**SETTINGS**> Instrument settings

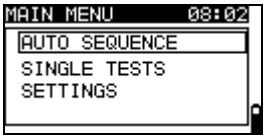


Figure 4.4: Main menu

Keys:

▲ / ▼	Selects appropriate option.
TEST	Enters selected option.

4.4 Settings

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

Options are:

- Recalling and clearing stored results
- Selection of language
- Setting the date and time
- Entering Isc factor
- Commander support
- Setting the instrument to initial values

Figure 4.5: Options in Settings menu

Keys:

▲ / ▼	Selects appropriate option.
TEST	Enters selected option.
ESC / **Function selector**	Exits back to main menu.

4.4.1 Memory

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

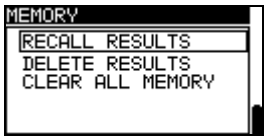


Figure 4.6: Memory options

Keys:

▲ / ▼	Selects option.
TEST	Enters selected option.
ESC	Exits back to settings menu.
Function selector	Exits back to main menu without changes.

4.4.2 Language

In this menu the language can be set.

Figure 4.7: Language selection

Keys:

▲ / ▼	Selects language.
TEST	Confirms selected language and exits to settings menu.
ESC	Exits back to settings menu.
Function selector	Exits back to main menu without changes.

4.4.3 Date and time

In this menu date and time can be set.

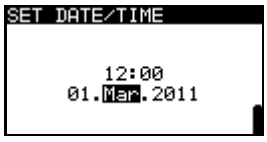


Figure 4.8: Setting date and time

Keys:

TAB	Selects the field to be changed.
▲ / ▼	Modifies selected field.
TEST	Confirms new date / time and exits.
ESC	Exits back to settings menu.
Function selector	Exits back to main menu without changes.

Warning:

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

4.4.4 Isc factor

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

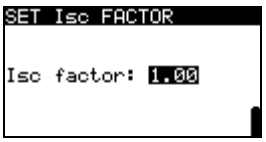


Figure 4.9: Selection of Isc factor

Keys:

▲ / ▼	Sets Isc value.
TEST	Confirms Isc value.
ESC	Exits back to settings menu.
Function selector	Exits back to main menu without changes.

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.

4.4.5 Commander support

The support for commanders can be set in this menu.

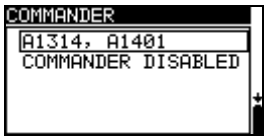


Figure 4.10: Selection of commander support

Keys:

▲ / ▼	Selects commander model or disables commander.
TEST	Confirms selected option.
Function selector	Exits back to main function menu.

Commander models (versions 3.x.xx and higher):

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

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.

4.4.6 Initial settings

In this menu the instrument settings, measurement parameters and limits can be set to initial (factory) values.

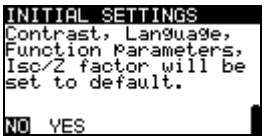


Figure 4.11: Initial settings dialogue

Keys:

⮝ / ⮟	Selects option [YES, NO].
TEST	Restores default settings (if **YES** is selected).
ESC	Exits back to settings menu.
Function selector	Exits back to main menu without changes.

Warning:

- 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**
Language	English
Contrast	As defined and stored by adjustment procedure
Isc factor	1.00
Commander*	A1314, A1401
Test mode: **Function** **Sub-function**	**Parameters / limit value**
SINGLE TESTS:	
Z - LINE VOLTAGE DROP	Fuse type: none selected ΔU: 4.0 % Z_{REF}: 0.00 Ω
ISFL	Limit: none
IMD	Type: AUTO R Min. insulation resistance: 30 kΩ Interval: 2 s
AUTO SEQUENCE:	
Z - LINE	Fuse type: C Rated current: 16 A Disconnection time: 0.2 s
ISFL	Limit: 3.0 mA
IMD	Type: AUTO R Min. insulation resistance: 35 kΩ Interval: 2 s

* versions 3.x.xx and higher

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 – a.c. LV IT installations

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. Measurements are based on the EN 61557-7 standard.*

See chapter *4.2 Function selection* for instructions on key functionality.

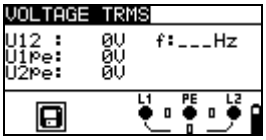


Figure 5.1: Voltage in single phase system

Test parameters for voltage measurement

There are no parameters to be set.

Connections for voltage measurement

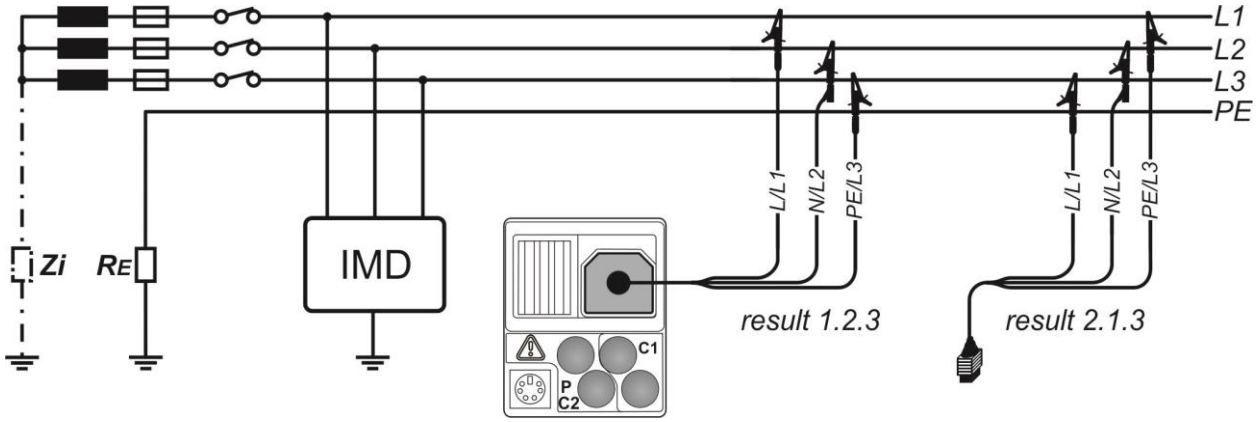


Figure 5.2: Connection of 3-wire test lead in three-phase IT system

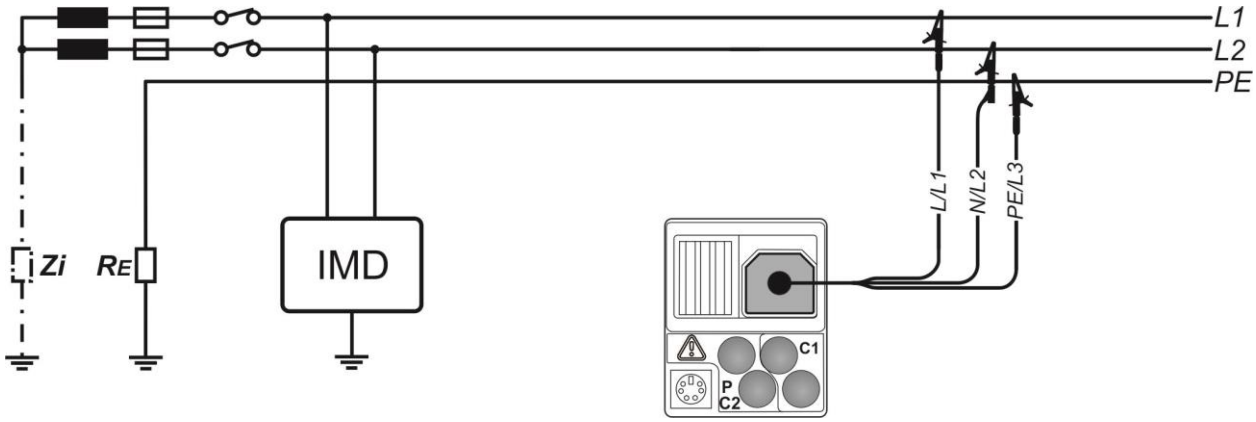


Figure 5.3: Connection of 3-wire test lead in single-phase IT system

Voltage measurement procedure

- Select the **VOLTAGE TRMS** function using the function selector keys.
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *Figure 5.2* and *Figure 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 IT system

Displayed results for single phase IT system:
U12.....voltage between phase conductors,
U1pe.....voltage between phase 1 and protective conductor,
U2pe.....voltage between phase 2 and protective conductor,
f.....frequency.

Displayed results for three-phase IT 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 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 EN 60364-5-52.

Sub-functions:

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

See chapter *4.2 Function selection* for instructions on key functionality.

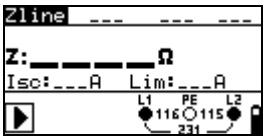


Figure 5.5: Line impedance

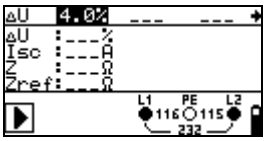


Figure 5.6: Voltage drop

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 %]**.**

5.2.1 Line impedance and prospective short circuit current

Circuits for measurement of line impedance

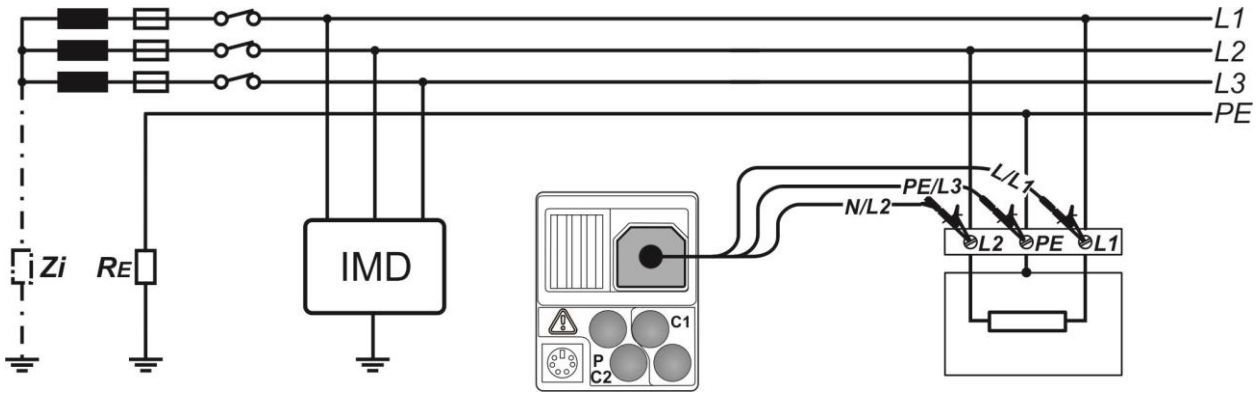


Figure 5.7: Single phase IT line impedance measurement – connection of 3-wire test lead

Line impedance measurement procedure

- Select the **Zline** sub-function.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** test leads to the item to be tested (see *Figure 5.7*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional).

Figure 5.8: Example 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 L1-L2 voltage (see table below),
ksc.....Correction factor for Isc (see chapter 4.4.4).

U_n	Input voltage range (L1-L2)
110 V	(93 V ≤ U_{L-L} < 134 V)
230 V	(185 V ≤ U_{L-L} ≤ 266 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.

5.2.2 Voltage drop

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

Circuits for measurement of voltage drop

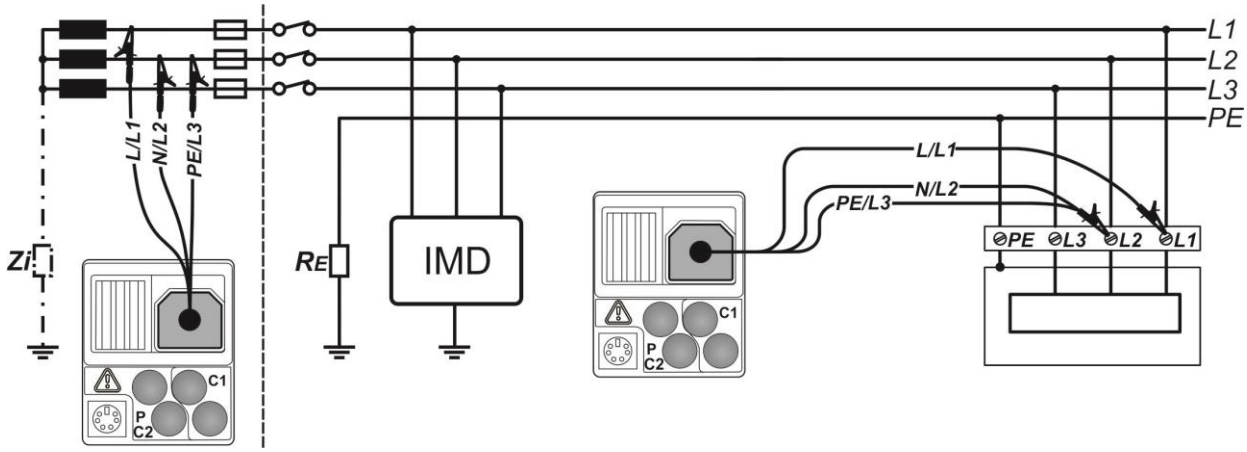


Figure 5.9: Voltage drop measurement in IT system – connection of 3-wire test lead

Voltage drop measurement procedure

Step 1: Measuring the impedance Zref at origin

- Select the **ΔU** sub-function using the function selector keys and ▲ / ▼ keys.
- Select test **parameters** (optional).
- **Connect** test cable to the instrument.
- **Connect** the test leads to the origin of electrical installation (see Figure 5.9).
- Press the **CAL** key to perform the measurement.

Step 2: Measuring the voltage drop

- Select the **ΔU** sub-function using the function selector keys and ▲ / ▼ keys.
- Select test **parameters** (Fuse type must be selected).
- **Connect** 3-wire test lead or mains measuring cable to the instrument.
- **Connect** the test leads or mains measuring cable to the tested points (see *Figure 5.9*).
- Press the **TEST** key to perform the measurement.
- **Store** the result by pressing the MEM key (optional).

Step 1 - Zref *Step 2 - Voltage drop*

Figure 5.10: Examples of voltage drop measurement result

Displayed results:
ΔU .....Voltage drop,
I_{SC}.....Prospective short-circuit current,
Z.....Line impedance at measured point,
Z_{REF} .....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 (L1-L2)
110 V	(93 V ≤ U_{L-L} < 134 V)
230 V	(185 V ≤ U_{L-L} ≤ 266 V)

Notes:

- 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 *5.2.1* 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.

5.3 First fault leakage current (ISFL)

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

See chapter *4.2 Function selection* for instructions on key functionality.

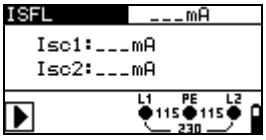


Figure 5.11: ISFL measurement

Test parameters for first fault leakage current measurement

Limit	**Maximum leakage current** [OFF, 3.0 mA ÷ 20.0 mA]

Test circuit for first fault leakage current

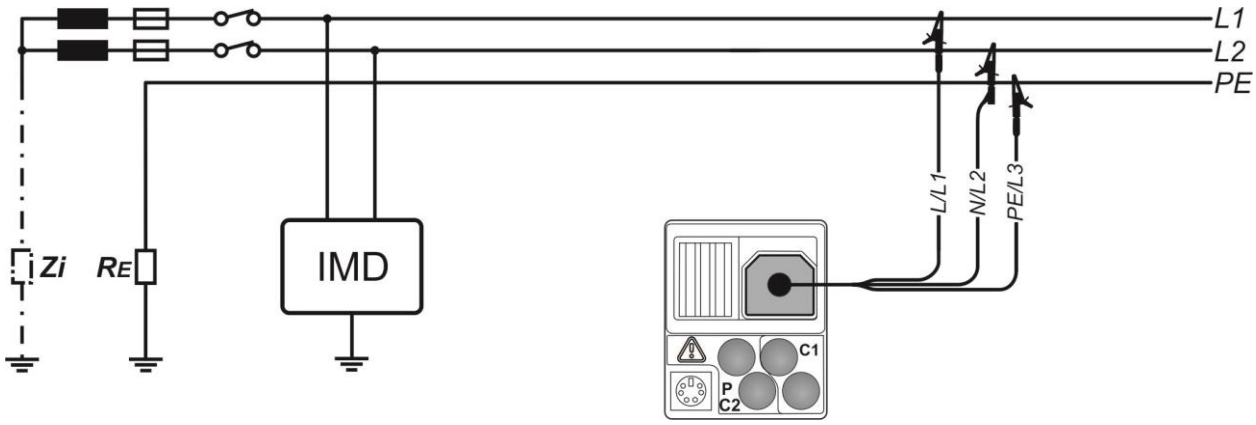


Figure 5.12: Measurement of highest first fault leakage current with 3-wire test lead

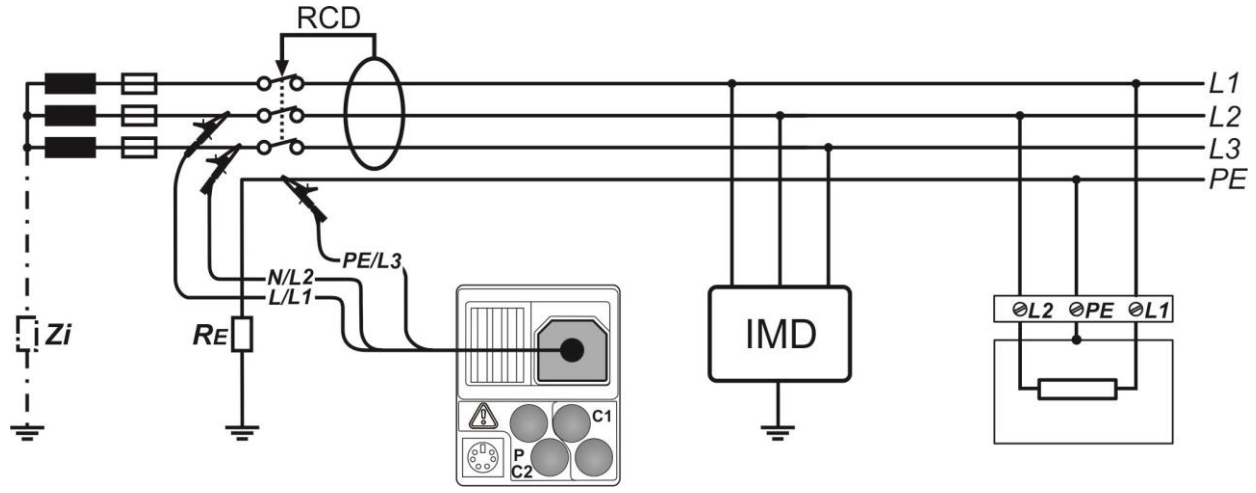


Figure 5.13: Measurement of first fault leakage current for RCD protected circuit with 3-wire test lead

First fault leakage current measuring procedure

- Select the **ISFL** function.
- Enable and set **limit** value (optional).
- **Connect** 3-wire test lead or mains measuring cable to the instrument and tested installation (see Figure 5.12 and Figure 5.13).
- Press the **TEST** key to start measurement.
- **Store** the result (optional).

Figure 5.14: Examples of measurement results for the first fault leakage current

Displayed results:
Isc1.....First fault leakage current at single fault between L1/PE,
Isc2.....First fault leakage current at single fault between L2/PE.

5.4 Testing of insulation monitoring devices (IMD)

This function is intended for checking the alarm threshold of insulation monitor devices (IMD) by applying a changeable resistance between L1/PE and L2/PE terminals.

See chapter *4.2 Function selection* for instructions on key functionality.

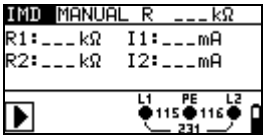


Figure 5.15: IMD test

Test parameters for IMD test

Limit	**Type** [MANUAL R, MANUAL I, AUTO R, AUTO I]
	MANUAL R: Minimum insulation resistance [OFF, 5 kΩ ÷ 640 kΩ] **MANUAL I: Maximum current** [OFF, 0.1 mA ÷ 19.9 mA] **AUTO R: Minimum insulation resistance** [OFF, 5 kΩ ÷ 640 kΩ], **Timer** [1 s ÷ 99 s] **AUTO I: Maximum current** [OFF, 0.1 mA ÷ 19.9 mA], **Timer** [1 s ÷ 99 s]

Test circuit for IMD test

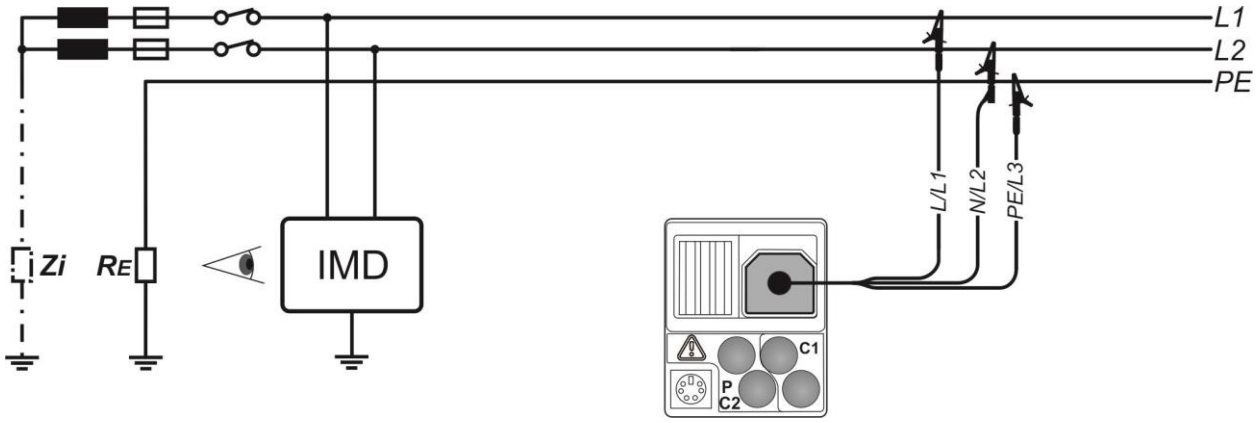


Figure 5.16: Connection with 3-wire test lead

IMD test procedure (MANUAL R, MANUAL I)

- Select the **IMD** function.
- Select MANUAL R or MANUAL I sub-function.
- Enable and set **limit** value.
- **Connect** 3-wire test lead to the instrument and tested item (see Figure 5.16).
- Press the **TEST** key for measurement.
- Press the ▲ / ▼ keys to change insulation resistance*) until IMD alarms an insulation failure for L1.
- Press the **TEST** key to change line terminal selection to L2.
  In case, when IMD switch off voltage supply, instruments automatically change line terminal selection to L2 and proceed with the test when instrument detects supply voltage.
- Press the ▲ / ▼ keys to change insulation resistance*) until IMD alarms an insulation failure for L2.
- Press the **TEST** key.
  If IMD switch off voltage supply, instrument automatically proceed to the PASS/FAIL indication.
- Use the **TAB** key to select PASS / FAIL indication.
- Press the **TEST** key to confirm selection and stop the measurement.
- **Store** the result (optional).

IMD test procedure (AUTO R, AUTO I)

- Select the **IMD** function.
- Select AUTO R or AUTO I sub-function.
- Enable and set **limit** values.
- **Connect** 3-wire test lead to the instrument and tested item (see *Figure 5.16*).
- Press the **TEST** key for measurement.
- Insulation resistance between L1-PE is decreased automatically according to limit value*) every time interval selected with timer. To speed up the test press the ▲ / ▼ keys until IMD alarms an insulation failure for L1.
- Press the **TEST** key to change line terminal selection to L2.
  In case, when IMD switch off voltage supply, instruments automatically change line terminal selection to L2 and proceed with the test when instrument detects supply voltage.
- Insulation resistance between L2-PE is decreased automatically according to limit value*) every time interval selected with timer. To speed up the test press the ▲ / ▼ keys until IMD alarms an insulation failure for L2.
- Press the TEST key.
  If IMD switch off voltage supply, instrument automatically proceed to the PASS/FAIL indication.
- Use the **TAB** key to select PASS / FAIL indication.
- Press the **TEST** key to confirm selection and stop the measurement.
- **Store** the result (optional).

*) When MANUAL R or AUTO R sub-function is selected, start value of insulation resistance is determined by $R_{start} \cong 1.5 \times R_{limit}$

When MANUAL I or AUTO I sub-function is selected, start value of insulation resistance is determined by $R_{start} \cong 1.5 \times \frac{U_{L1-L2}}{I_{limit}}$

Figure 5.17: Examples of IMD test results

Displayed results:
R1.....threshold indicative insulation resistance for L1,
R2.....threshold indicative insulation resistance for L2,
I1 .....calculated first fault leakage current for R1,
I2 .....calculated first fault leakage current for R2.

Calculated first fault leakage current at threshold insulation resistance is given as:

$$I_{1(2)} = \frac{U_{L1-L2}}{R_{1(2)}}$$

U_{L1-L2} is line-line voltage. The calculated first fault current is the maximum current that would flow when insulation resistance decreases to the same value as the applied test resistance, and a first fault is assumed between opposite line and PE.

5.5 Automatic measurement procedure

The auto function is intended to perform a complete test of IT supply system:

- Voltage,
- Line impedance,
- First fault leakage current (ISFL),
- Testing of insulation resistance measurement (IMD).

The test is carried out in one set of automatic tests, guided by the instrument.

See chapter *4.2 Function selection* for instructions on key functionality.

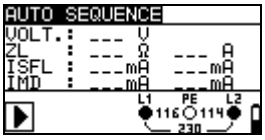


Figure 5.18: Automatic measurement starting screen

Test parameters for automatic measurement

Test parameters for line impedance measurement

FUSE type	Selection of **fuse type** [OFF, 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 - Fuse table* for reference fuse data.

Test parameters for first fault leakage current measurement

Limit	**Maximum leakage current** [OFF, 3.0 mA ÷ 20.0 mA]

Test parameters for IMD test

Limit	**Type** [MANUAL R, MANUAL I, AUTO R, AUTO I]
	MANUAL R: Minimum insulation resistance [OFF, 5 kΩ ÷ 640 kΩ] **MANUAL I: Maximum current** [OFF, 0.1 mA ÷ 19.9 mA] **AUTO R: Minimum insulation resistance** [OFF, 5 kΩ ÷ 640 kΩ], **Timer** [1 s ÷ 99 s] **AUTO I: Maximum current** [OFF, 0.1 mA ÷ 19.9 mA], **Timer** [1 s ÷ 99 s]

Test circuit for automatic measurement

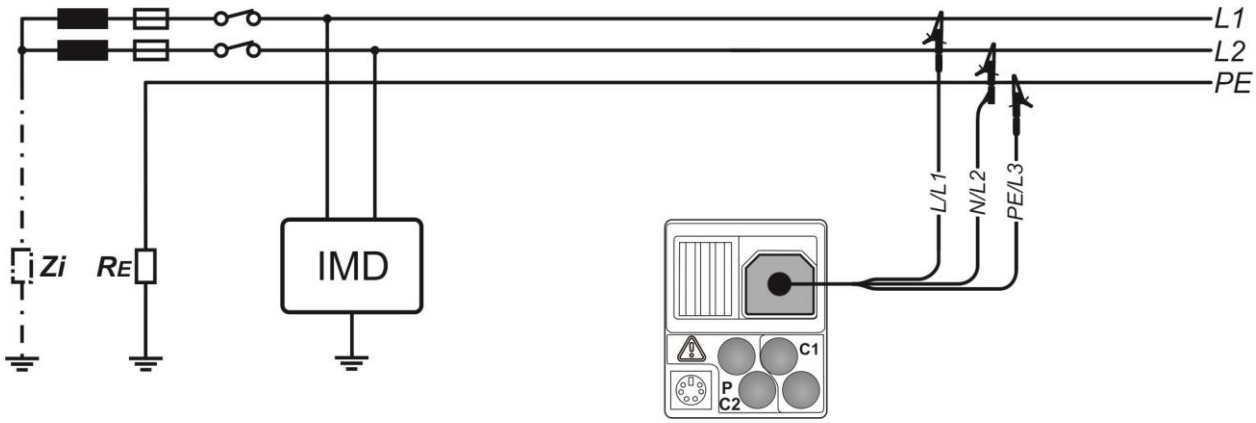


Figure 5.19: Connection for automatic measurement

Automatic measurement procedure

- Select **AUTO SEQUENCE** mode from main menu.
- Use **TAB** and **/** keys to enable and set **limit** values (optional).
- **Connect** 3-wire test lead or mains measuring cable to the instrument and tested item (see *Figure 5.19*).
- Press the **TEST** key to start the auto-sequence.
- Voltage, line impedance and ISFL tests are performed automatically. When auto-sequence enters IMD testing function, follow IMD test procedure (see chapter *5.4 Testing of insulation monitoring devices (IMD)).*
- **Store** the result by pressing the **MEM** key (optional).

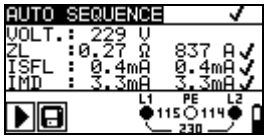


Figure 5.20: Example of automatic measurement result

Displayed results during auto-sequence and saved results:

Voltage:
U12.....voltage between phases L1 and L2,
U1pe.....voltage between phase L1 and PE,
U2pe.....voltage between phase L2 and PE,
f.....frequency,

Line impedance:
Z.....Line impedance,
Isc.....Prospective short-circuit current,

First fault leakage current (ISFL):
Isc1.....First fault leakage current at single fault between L1/PE,
Isc2.....First fault leakage current at single fault between L2/PE,

Testing of insulation monitoring devices (IMD):
R1.....Threshold indicative insulation resistance for phase 1,
I1 .....First fault leakage current at single fault between L1/PE,
R2.....Threshold indicative insulation resistance for phase 2
I2 .....First fault leakage current at single fault between L2/PE,

Displayed results after auto-sequence terminated and recalled results:

Voltage:
U12..... Voltage between phases L1 and L2,

Line impedance:
Z.....Line impedance,
Isc.....Prospective short-circuit current,

First fault leakage current (ISFL):
Isc1.....First fault leakage current at single fault between L1/PE (left value on screen),
Isc2.....First fault leakage current at single fault between L2/PE (right value on screen),

Testing of insulation monitoring devices (IMD):
R1.....Threshold indicative insulation resistance for phase 1 (left value on screen),
R2.....Threshold indicative insulation resistance for phase 2 (right value on screen)

Note:

- Before starting the auto-sequence measurement all settings of parameters should be checked.

5.6 PE test terminal

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

Example for application of PE test terminal

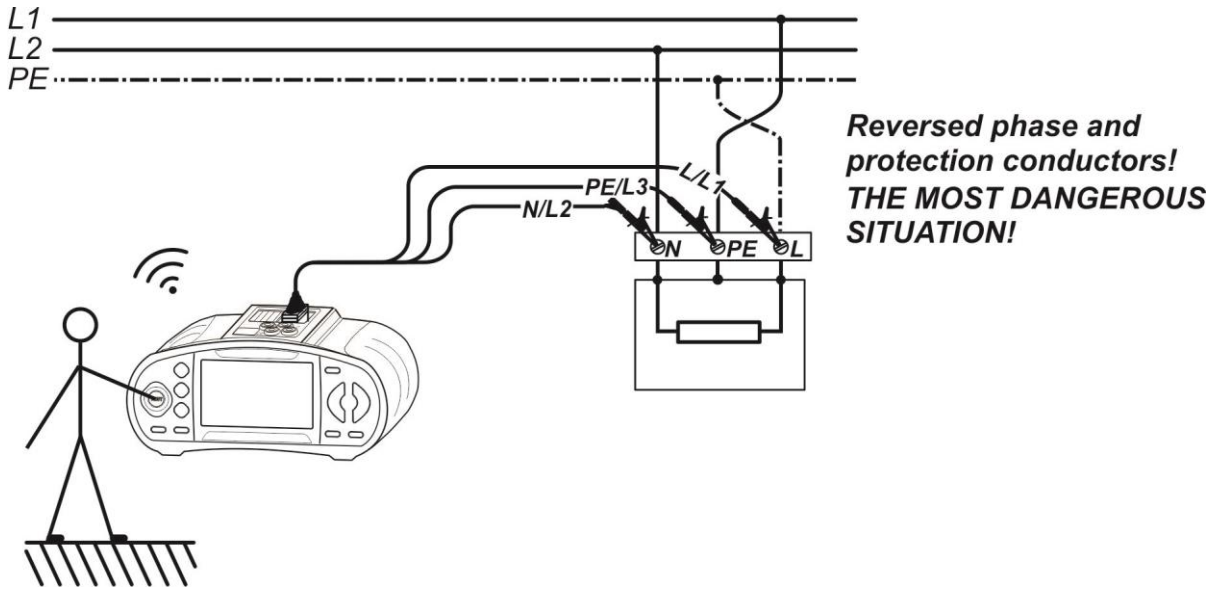


Figure 5.21: Reversed L and PE conductors (application of 3-wire test lead)

PE terminal test procedure

- **Connect** 3-wire test lead or mains measuring cable to the instrument.
- **Connect** 3-wire test lead or mains measuring cable to the item to be tested (see *Figure 5.21*).
- 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 and instrument buzzer is activated.

Warning:

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

Notes:

- PE test terminal is active in Zline and ΔU functions, but does not inhibit selected test if voltage is detected.
- PE test terminal does not operate in case the operator's body is completely insulated from floor or walls!

6 Data handling

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 3 levels each containing 199 locations.
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) 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 and block and fuse).
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.
- 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.

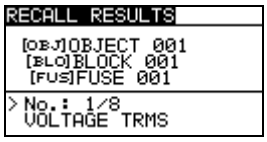


Figure 6.1: Data structure and measurement fields

Data structure field

RECALL RESULTS	Memory operation menu
OBJECT: 001 BLOCK: 001 FUSE: 001	Data structure field
OBJECT: 001	❑ **1st level:** **OBJECT**: Default location name (object and its successive number).
BLOCK: 001	❑ **2nd level:** **BLOCK**: Default location name (block and its successive number).
FUSE: 001	❑ **3rd level:** **FUSE**: Default location name (fuse and its successive number). ❑ **001**: 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

Zline	Type of stored measurement in the selected location.
No.: 2/5	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.

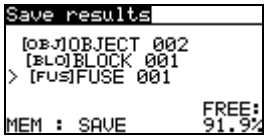


Figure 6.2: Save test menu

`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)
⮝ / ⮟	Selects number of selected location element (1 to 199)
MEM	Saves test results to the selected location and returns to the measuring function screen.
Function selector / TEST	Exits back to measuring function screen without save.

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.

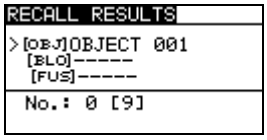


Figure 6.3: Recall menu - installation structure field selected

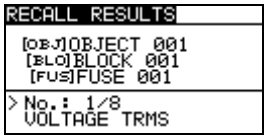


Figure 6.4: Recall menu - measurements field selected

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

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

Keys in recall memory menu (measurements field):

⮝ / ⮟	Selects the stored measurement.
TAB / ESC	Returns to installation structure field.
Function selector	Exits back to main function menu.
TEST	View selected measurement results.

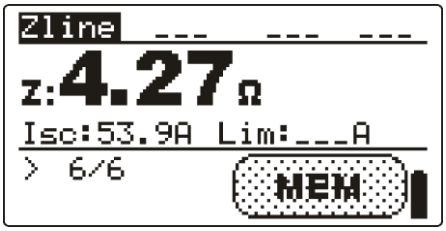


Figure 6.5: Example of recalled measurement result

Keys in recall memory menu (measurement results are displayed)

⮝ / ⮟	Displays measurement results stored in selected location
MEM / ESC	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.

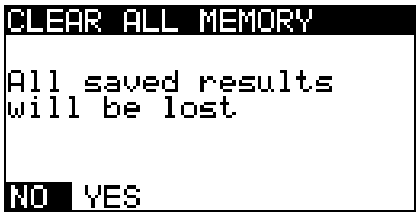


Figure 6.6: Clear all memory

Keys in clear all memory menu

TEST	Confirms clearing of complete memory content (**YES** must be selected with ▲ / ▼ keys).
ESC	Exits back to memory menu without changes.
Function selector	Exits back to main menu without changes.

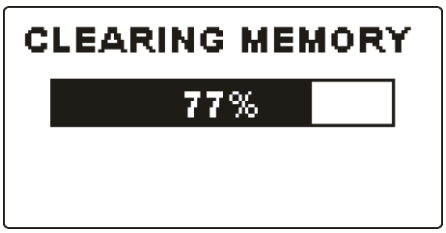
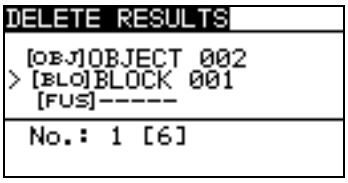


Figure 6.7: Clearing memory in progress

6.5.2 Clearing measurement(s) in selected location

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



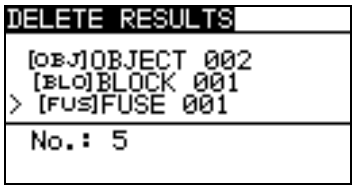


Figure 6.8: Clear measurements menu (data structure field selected)

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

TAB	Selects the location element (Object / Block / Fuse).
▲ / ▼	Selects number of selected location element (1 to 199)
Function selector	Exits back to main menu.
ESC	Exits back to memory menu.
TEST	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:

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

6.5.3 Clearing individual measurements

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

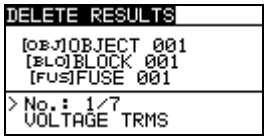


Figure 6.9: Menu for clearing individual measurement (installation structure field selected)

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

TAB	Selects the location element (Object / Block / Fuse).
⮝ / ⮟	Selects number of selected location element (1 to 199)
Function selector	Exits back to main menu.
ESC	Exits back to memory menu.
MEM	Enters measurements field for deleting individual measurements.

Keys in delete results menu (measurements field selected):

⮝ / ⮟	Selects measurement.
TEST	Opens dialog box for confirmation to clear selected measurement.
TAB / ESC	Returns to installation structure field.
Function selector	Exits back to main menu without changes.

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

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

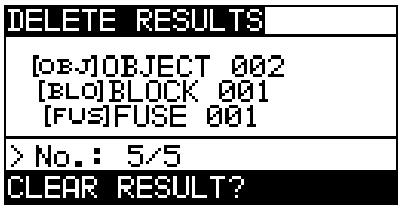


Figure 6.10: Dialog for confirmation

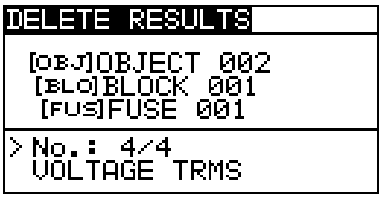


Figure 6.11: Display after measurement was cleared

6.5.4 Renaming installation structure elements (upload from PC)

Default installation structure elements are “Object”, “Block” and “Fuse”.
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.

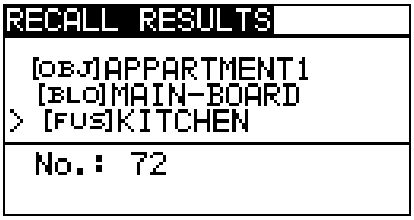


Figure 6.12: Example of menu with customized installation structure names

6.6 Communication

Stored results can be transferred to a PC. A special communication program on the PC automatically identifies the instrument and enables data transfer between the instrument and the PC.
There are two communication interfaces available on the instrument: USB or RS 232.
The instrument automatically selects the communication mode according to detected interface. USB interface has priority.

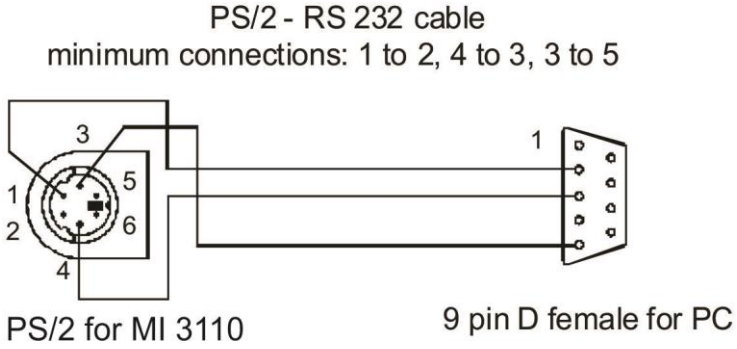


Figure 6.13: Interface connection for data transfer over PC COM port

How to transfer stored data:

- 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 *Eurolink-PRO* program*.*
- The PC and the instrument will automatically recognize each other.
- The instrument is prepared to download data to the PC.

The program *EUROLink PRO* 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.

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 a help of special upgrading software and the communication cable as shown on *Figure 6.13*. Please contact your dealer for more information.

8 Maintenance

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

8.1 Fuse replacement

There are two fuses under back cover of the EurotestIM instrument.

- F2, F3
  F 4 A / 500 V, 32×6.3 mm (Breaking capacity: 50 kA)
  General input protection fuses of test terminals L1 and L2.

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

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!

8.2 Cleaning

No special maintenance is required for the housing. To clean the surface of the instrument or accessory use a soft cloth slightly moistened with soapy water or alcohol. Then leave the instrument or accessory 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 Voltage, frequency, and phase rotation

9.1.1 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

9.1.2 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

9.1.3 Online terminal voltage monitor

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

9.1.4 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

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

Line impedance
Measuring range according to EN 61557 is 0.25 Ω ÷ 99.9 Ω.

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

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	
1.00 k ÷ 99.99 k	10	
100 k ÷ 199 k	1000	

Prospective short-circuit current is calculated only within measuring range.

Test current (at 230 V)..... 6.5 A (10 ms)
Nominal voltage ranges..... 93 V ÷ 134 V (45 Hz ÷ 65 Hz)
185 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 *5.2.2* Voltage drop for more information about calculation of voltage drop result.

9.3 First fault leakage current (ISFL)

Measuring range (mA)	Resolution (mA)	Accuracy
0.0 ÷ 19.9	0.1	±(5 % of reading + 3 digits)

Measuring resistance..... approx. 390 Ω
Nominal voltage ranges..... 93 V ≤ U_{L1-L2} < 134 V
185 V ≤ U_{L1-L2} ≤ 266 V

9.4 Calibrated resistance for IMD testing

Threshold indicative insulation resistance

Measuring range (kΩ)	Resolution (kΩ)	Note
5 ÷ 640	5	Indicative values Up to 128 steps

Nominal voltage ranges..... 93 V ≤ U_{L1-L2} < 134 V
185 V ≤ U_{L1-L2} ≤ 266 V

First fault leakage current at threshold insulation resistance

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

*)See chapter *5.4 Testing of insulation monitoring devices (IMD)* for more information about calculation of first fault leakage current at threshold insulation resistance.

9.5 General data

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)
Measuring category ..... 600 V CAT III
300 V CAT IV
Protection classification ..... double insulation
Pollution degree..... 2
Protection degree ..... IP 40

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

Dimensions (w × h × d)..... 23 cm × 10.3 cm × 11.5 cm
Weight ..... 1.1 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)

Communication transfer speed ..... RS 232 57600 baud
..... USB 256000 baud

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

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
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
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	
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
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 (UK)

Fuse type B

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

Fuse type C

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

Fuse type D

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

Fuse type BS 88-3 (system C)

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
5		8,36	12,264
16		1,936	3,288
20		1,632	2,704
32		0,768	1,312
45			0,832
63			0,576
80			0,424
100			0,32

Fuse type BS 88-2 (systems E and G)

Rated current (A)	Disconnection time [s]		
		0.4	5
	Max. loop impedance (Ω)		
6		6,568	10,24
10		3,912	5,752
16		2,048	3,344
20		1,416	2,36
25		1,08	1,84
32		0,832	1,472
40			1,08
50			0,832
63			0,656
80			0,456
100			0,368
125			0,272
160			0,224
200			0,152

Fuse type BS 1362

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

Fuse type BS 3036

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

All impedances are scaled with factor 0.8.

Appendix B - Accessories for specific measurements

The table below presents recommended standard and optional accessories required for specific measurement. 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….)**
Voltage, frequency	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)
Line impedance Voltage Drop	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)
ISFL	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)
IMD	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)
Auto sequence	❑ Test lead, 3 x 1.5 m ❑ Mains measuring cable ❑ Plug commander (A 1314) ❑ Tip commander (A 1401)

Appendix C – Commanders (A 1314, A 1401)

C.1 ⚠ Warnings related to safety

Measuring category of commanders:
Plug commander A 1314 …… 300 V CAT II
Tip commander A1401
(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!**

C.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.

C.3 Description of commanders

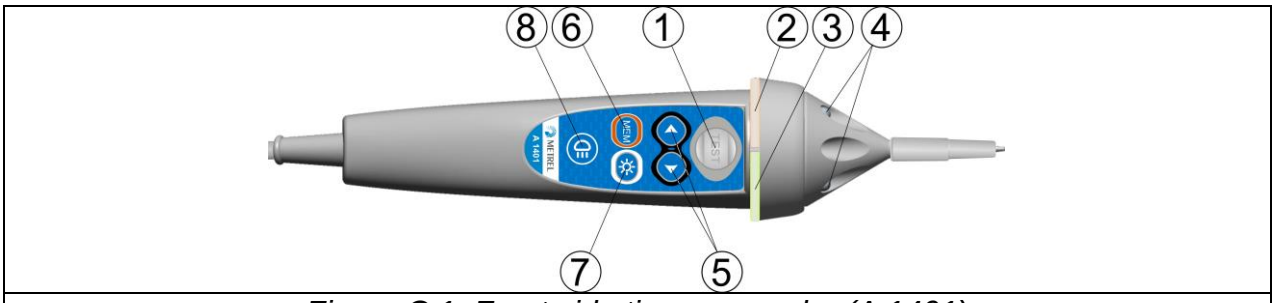


Figure C.1: Front side tip commander (A 1401)

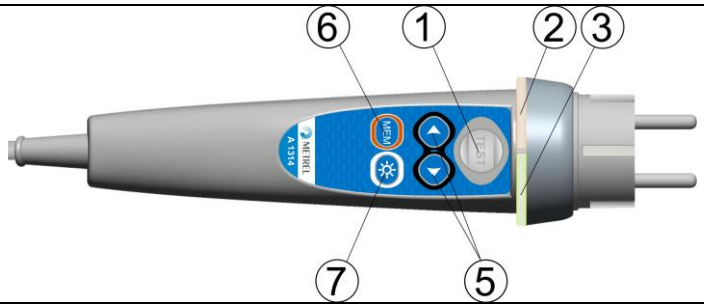


Figure C.2: Front side plug commander (A 1314)

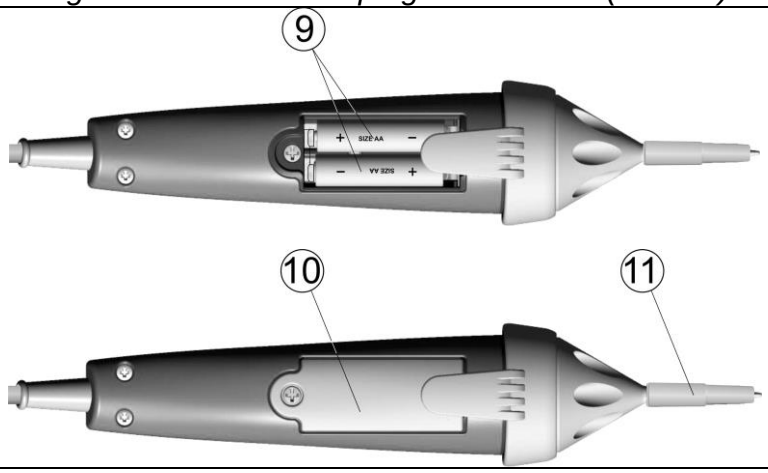


Figure C.3: Back side

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)	

C.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 C.4*).
- 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 and instrument's buzzer is activated.

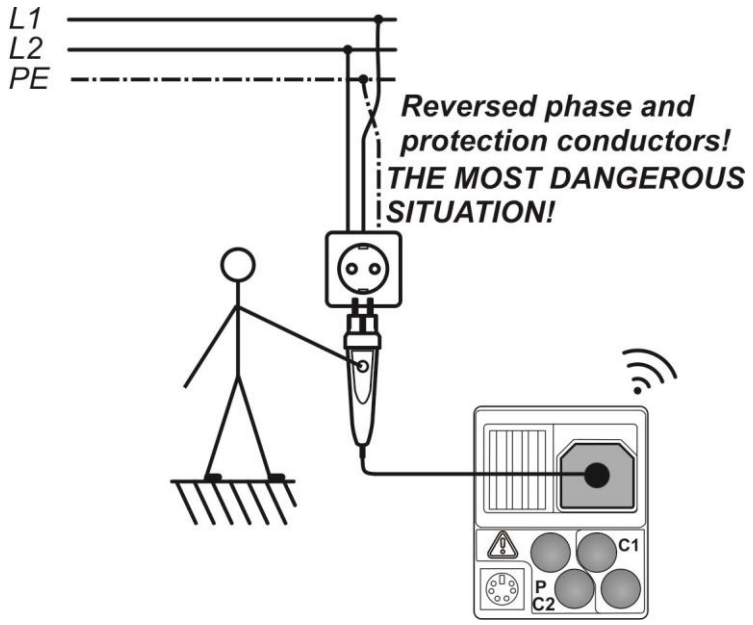


Figure C.4: Reversed L and PE conductors (application of plug commander)

Warning:

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

Notes:

- PE test terminal is active in Zline and ΔU functions, but does not inhibit selected test if voltage is detected.
- PE test terminal does not operate in case the operator's body is completely insulated from floor or walls!