EurotestXC

MI 3152

EurotestXC 2,5 kV

MI 3152H

Quick Guide

Version 1.10.14, Code no. 20 752 414

METREL®

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

Note
This document is not a supplement to the Instruction manual.

Table of Contents

1 General description

1.1 Warnings and notes

1.1.1 Safety warnings

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

- **Read this Instruction manual carefully, otherwise the use of the instrument may be dangerous for the operator, the instrument or for the equipment under test!**
- **Consider warning markings on the instrument (see next chapter for more information).**
- **If the test equipment is used in a manner not specified in this Instruction manual, the protection provided by the equipment could be impaired!**
- **Do not use the instrument or any of the accessories if any damage is noticed!**
- **Regularly check the instrument and accessories for correct functioning to avoid hazard that could occur from misleading results.**
- **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- **Always check for the presence of dangerous voltage on PE test terminal of installation by touching the TEST key on the instrument or by any other method before starting single test and Auto Sequence® measurements. Make sure that the TEST key is grounded thorough human body resistance without any insulated material between (gloves, shoes, insulated floors, pens,...). PE test could otherwise be impaired and results of a single test or Auto Sequence® can mislead. Even detected dangerous voltage on PE test terminal cannot prevent running of a single test or Auto Sequence®. All such behaviour is regarded as misuse. Operator of the instrument must stop the activity immediately and eliminate the fault/connection problem before proceeding with any activity!**
- **Use only standard or optional test accessories supplied by your distributor!**
- **In case a fuse has blown follow the instructions in this manual in order to replace it! Use only fuses that are specified!**
- **Service, calibration or adjustment of instruments and accessories is only allowed to be carried out by a competent authorized person!**
- **Do not use the instrument in AC supply systems with voltages higher than 550 Va.c.**
- **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-MH battery cells. The cells should only be replaced with the same type as defined on the battery compartment label or as described in this manual. Do not use standard alkaline battery cells while the power supply adapter is connected, otherwise they may explode!**
- **Hazardous voltages exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before removing battery compartment cover.**
- **Do not connect any voltage source on C1/C2 inputs. It is intended only for connection of current clamps. Maximal input voltage is 3 V!**

1.1.2 Markings on the instrument

- **Read the Instruction manual with special care to safety operation«. The symbol requires an action!**
- **Do not use the instrument in AC supply systems with voltages higher than 550 Va.c.!**
- **Mark on your equipment certifies that this equipment meets requirements of all subjected EU regulations.**
- **This equipment shall be recycled as electronic waste.**

1.1.3 Warnings related to safety of batteries

- When connected to an installation, the instruments battery compartment can contain hazardous voltage inside! When replacing battery cells or before opening the battery/fuse compartment cover, disconnect any measuring accessory connected to the instrument and turn off the instrument,
- Ensure that the battery cells are inserted correctly otherwise the instrument will not operate and the batteries could be discharged.
- Do not recharge alkaline battery cells!
- Use only power supply adapter delivered from the manufacturer or distributor of the test equipment!

1.1.4 Warnings related to safety of 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!

Continuity functions

- Continuity measurements should only be performed on de-energized objects!

1.2 Testing potential on PE terminal

In certain instances, faults on the installation's PE wire or any other accessible metal bonding parts can become exposed to live voltage. This is a very dangerous situation since the parts connected to the earthing system are considered to be free of potential. In order to properly check the installation against this fault the  key should be used as an indicator prior to performing live tests.

Examples for application of PE test terminal

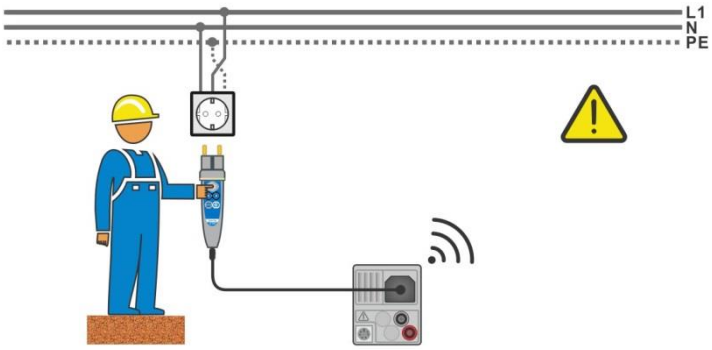


Figure 1.1: Reversed L and PE conductors (plug commander)

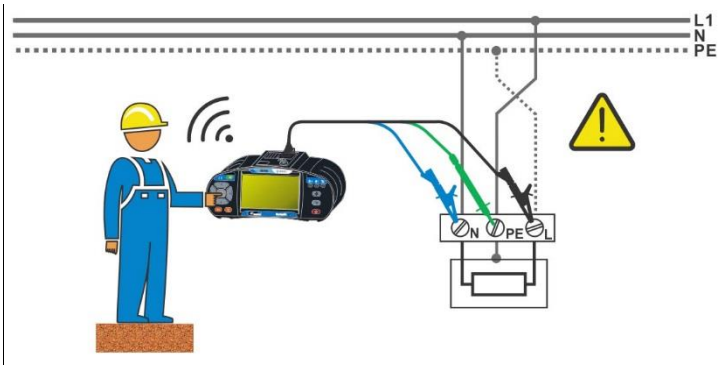


Figure 1.2: Reversed L and PE conductors (application of 3-wire test lead)

Warning!

⚠	**Reversed phase and protection conductors! The most dangerous situation!** If dangerous 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!

Test procedure

- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 1.1*** and ***Figure 1.2***.
- Touch  test probe for at least 2 seconds.
  If PE terminal is connected to phase voltage the warning message is displayed, display is yellow coloured, instrument buzzer is activated and further measurements are disabled in RCD tests, Rpe, Z loop, Zs rcd, Z auto, AUTO TT, AUTO TN, AUTO TN (rcd) and Auto Sequences®.

Notes

- PE test terminal is active in the RCD tests, Rpe, Z loop, Zs rcd, Z auto, Z line, ΔU, Voltage, AUTO TT, AUTO TN, AUTO TN (rcd) measurements and Auto Sequences® only!
- In case of detection of phase voltage on PE terminal in IT earthing system, the tests can be enabled/disabled according to setting of parameter 'Ignore PE warning (IT)'.
- For correct testing of PE terminal, the  key has to be touched for at least 2 seconds.
- Make sure that the TEST key is grounded thorough human body resistance without any insulated material between (gloves, shoes, insulated floors, pens, ...). PE test could otherwise be impaired and results of a single test or Auto Sequence® can mislead. Even detected dangerous voltage on PE test terminal cannot prevent running of a single test or Auto Sequence®. All such behaviour is regarded as misuse. Operator of the instrument must stop the activity immediately and eliminate the fault/connection problem before proceeding with any activity!

2 Instrument description

2.1 Front panel

Figure 2.1: Front panel

1	**4,3“ COLOR TFT DISPLAY WITH TOUCH SCREEN**
2	**SAVE key** Stores actual measurement result(s)
3	**CURSOR keys** Navigate in menus
4	**RUN key** Start / stop selected measurement. Enter selected menu or option. View available values for selected parameter / limit.
5	**OPTIONS key** Show detailed view of options.
6	**ESC key** Back to previous menu.
7	**ON / OFF key** Switch instrument on / off. The instrument automatically switches off after 10 minutes of idle state (no key pressed or any touchscreen activity) Press and hold the key for 5 s to switch off the instrument.
8	**GENERAL SETTINGS key** Enter General settings menu.
9	**BACKLIGHT key** Toggle screen brightness between high and low intensity.
10	**MEMORY ORGANIZER key** Shortcut key to enter Memory organizer menu.
11	**SINGLE TESTS key** Shortcut key to enter Single Tests menu.
12	**AUTO SEQUENCE® key**

	Shortcut key to enter Auto Sequences® menu.

2.2 Connector panel

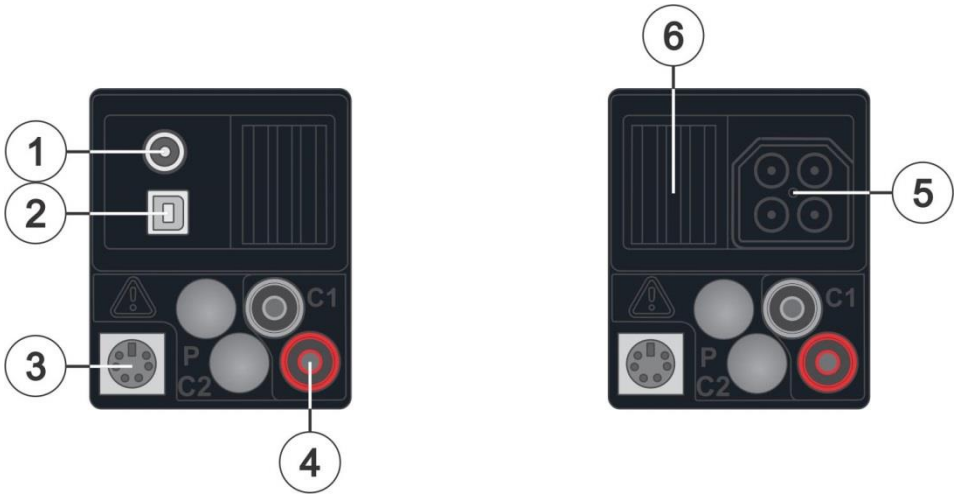


Figure 2.2: Connector panel

1	**Charger socket**
2	**USB communication port** Communication with PC USB (2.0) port
3	**PS/2 communication port** Communication with PC RS232 serial port Connection to optional measuring adapters Connection to barcode / RFID reader
4	**C1 inputs** Current clamp measuring input
5	**Test connector**
6	**Protection cover**

Warnings!

- Maximum allowed voltage between any test terminal and ground is 550 V!
- Maximum allowed voltage between test terminals on test connector is 550 V!
- Maximum allowed voltage on test terminal C1 is 3 V!
- Maximum short-term voltage of external power supply adapter is 14 V!

2.3 Back side

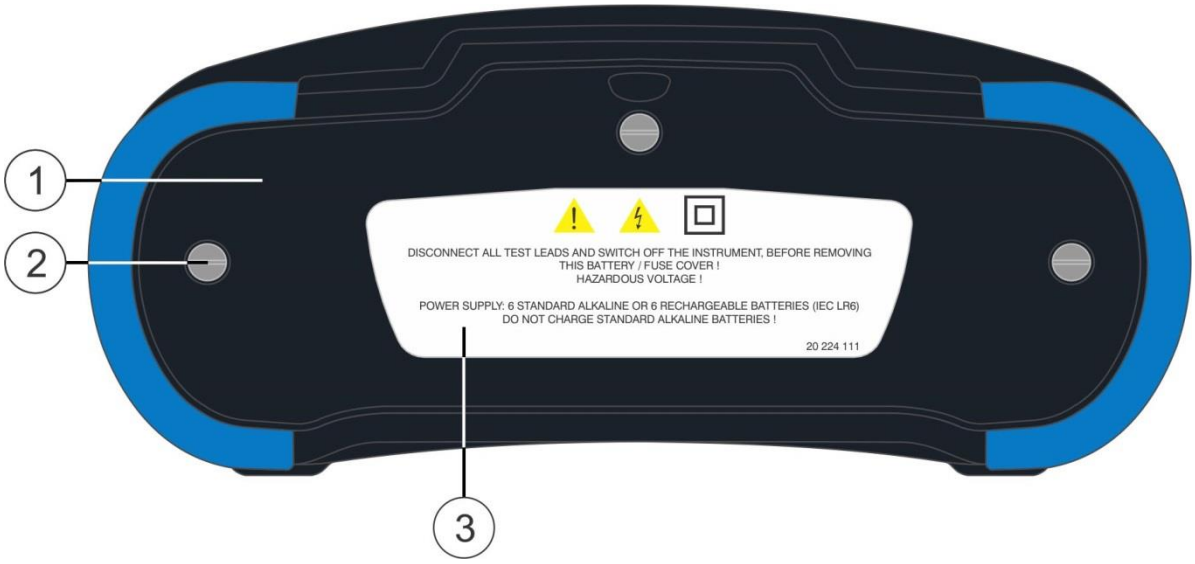


Figure 2.3: Back view

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

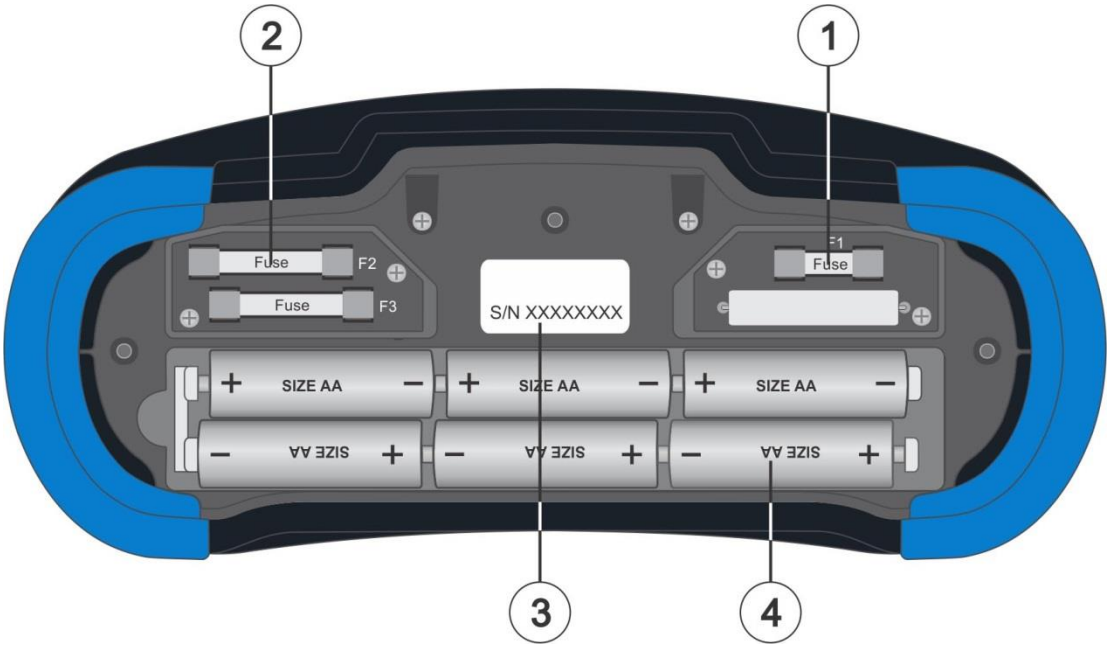


Figure 2.4: Battery and fuse compartment

1	**Fuse F1** M 315 mA / 250 V
2	**Fuses F2 and F3** F 4 A / 500 V (breaking capacity 50 kA)
3	**Serial number label**
4	**Battery cells** Size AA, alkaline / rechargeable NiMH

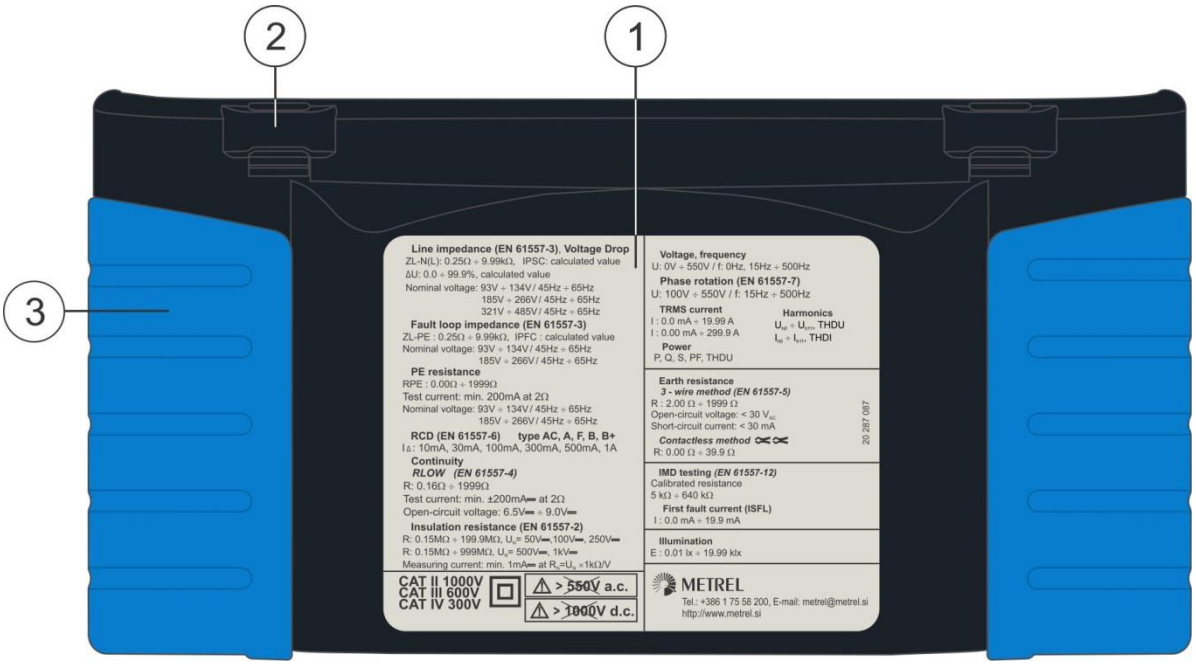


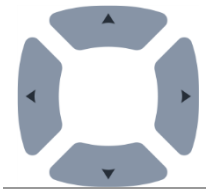
Figure 2.5: Bottom view

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

3 Instrument operation

The EurotestXC instrument can be manipulated via a keypad or touch screen.

3.1 General meaning of keys

	Cursor keys are used to: ‣ select appropriate option.
	Run key is used to: ‣ confirm selected option; ‣ start and stop measurements; ‣ test PE potential.
	Escape key is used to: ‣ return to previous menu without changes; ‣ abort measurements.
	Option key is used to: ‣ expand column in control panel.
	Save key is used to: ‣ store test results.
	Single Tests key is used as: ‣ shortcut key to enter Single Tests menu.
	Auto Sequence® key is used as: ‣ shortcut key to enter Auto Sequences® menu.
	Memory Organizer key is used as: ‣ shortcut key to enter Memory Organizer menu.
	Backlight key is used to: ‣ toggle screen brightness between High and Low intensity.
	General Settings key is used to: ‣ enter General Settings menu.
	On / Off key is used to: ‣ switch On / Off the instrument; ‣ switch Off the instrument if pressed and held for 5 s.

3.2 General meaning of touch gestures

	Tap (briefly touch surface with fingertip) is used to: ‣ select appropriate option; ‣ confirm selected option; ‣ start and stop measurements.
	Swipe (press, move, lift) up / down is used to: ‣ scroll content in same level; ‣ navigate between views in same level.
 **long**	Long press (touch surface with fingertip for at least 1 s) is used to: ‣ select additional keys (virtual keyboard); ‣ enter cross selector from single test screens.
	Tap Escape icon is used to: ‣ return to previous menu without changes; ‣ abort measurements.

3.3 Virtual keyboard

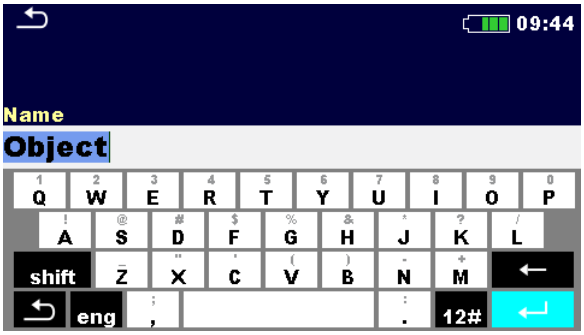


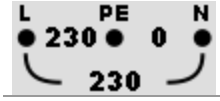
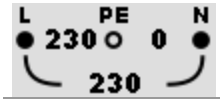
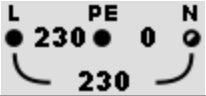
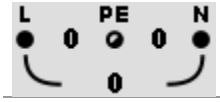
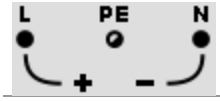
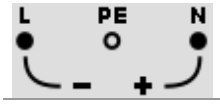
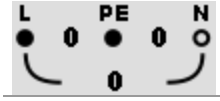
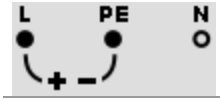
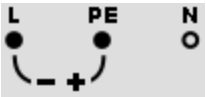
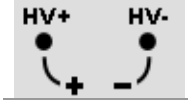
Figure 3.1: Virtual keyboard

shift	Toggle case between lowercase and capital letters. Active only when keyboard layout with alphabetical characters is selected.
←	Backspace Clears last character or all characters if selected. (If held for 2 s, all characters are selected).
↵	Enter confirms new text.
12#	Activates numeric / symbols layout.
ABC	Activates alphabetic characters.
eng	English keyboard layout.
GR	Greek keyboard layout.
RU	Russian keyboard layout.
⮌	Returns to the previous menu without changes.

3.4 Display and sound

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 in the a.c. installation measuring mode.

	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.
	L and N are active test terminals. PE terminal should also be connected for correct input voltage condition.
 	Polarity of test voltage applied to the output terminals, L and N.
	L and PE are active test terminals.
 	Polarity of test voltage applied to the output terminals, L and PE.
	2.5 kV Insulation measurement terminal screen. (MI 3152H only)

3.4.2 Battery indication

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

	Battery capacity indication. Battery is in good condition.
	Battery is full.
	Low battery. Battery is too weak to guarantee correct result. Replace or recharge the battery cells.
	Empty battery or no battery.
	Charging in progress (if power supply adapter is connected).
	Charging finished.

3.4.3 Bluetooth

	Bluetooth communication inactive.
	Bluetooth communication active.

3.4.4 Measurement actions and messages

	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.
	Proceeds to next step of the measurement.
	Stop the measurement.
	Result(s) can be stored.
	Starts test leads compensation in Rlow / continuity measurement. Starts Zref line impedance measurement at origin of electrical installation in Voltage Drop measurement. Zref value is set to 0.00 Ω if pressing this touch key while instrument is not connected to a voltage source.
	Alternates between A 1507 3-Phase Active Switch and Plug/Tip Commander. This option is available only if A 1507 is enabled in Settings menu.

P	Use A 1199 Specific earth resistance adapter for this test.
Z	Use MI 3143 Euro Z 440 V, MI 3144 Euro Z 800 V or A 1143 Euro Z 290 A adapter for this test.
LUX	Use A 1172 or A 1173 Illumination sensor for this test.
3ph	A 1507 3-Phase Active Switch not connected to the instrument. Connect A 1507 test cable to the instrument. Test / Measurement cannot be performed using A 1507.
3ph	3-Phase Active Switch connected to the instrument via test cable. Test / Measurement can be performed using A 1507.
2	Count down timer (in seconds) within measurement.
	Measurement is running, consider displayed warnings.
	RCD tripped-out during the measurement (in RCD functions).
	Instrument is overheated. The measurement is prohibited until the temperature decreases under the allowed limit.
	High electrical noise was detected during measurement. Results may be impaired. Indication of noise voltage above 5 V between H and E terminals during earth resistance measurement.
	L and N are changed. In most instrument profiles L and N test terminals are reversed automatically according to detected voltages on input terminal. In instrument profiles for countries where the position of phase and neutral connector is defined the selected feature is not working.
	Warning! High voltage is applied to the test terminals. The instrument automatically discharge tested object after finished insulation measurement. When an insulation resistance measurement has been performed on a capacitive object, automatic discharge may not be done immediately! The warning symbol and the actual voltage are displayed during discharge until voltage drops below 30 V.
	Warning! Dangerous voltage on the PE terminal! Stop the activity immediately and eliminate the fault / connection problem before proceeding with any activity! Continuous sound warning and yellow coloured screen is also present.
CAL	Test leads resistance in R low / Continuity measurement is not compensated.
CAL	Test leads resistance in R low / Continuity measurement is compensated.

Rc	High resistance to earth of current test probes. Results may be impaired.
Rp	High resistance to earth of potential test probes. Results may be impaired.
Rc Rp	High resistance to earth of potential and current test probes. Results may be impaired.
< I	Too small current for declared accuracy. Results may be impaired. Check in Current Clamp Settings if sensitivity of current clamp can be increased. In Earth 2 Clamp measurement results are very accurate for resistances below 10 Ω. At higher values (several 10 Ω) the test current drops to few mA. The measuring accuracy for small currents and immunity against noise currents must be considered!
CLIPP I	Measured signal is out of range (clipped). Results are impaired.
SF	Single fault condition in IT system. (MI 3152 only)
	Fuse F1 is broken.

3.4.5 Result indication

	Measurement result is inside the set limits (PASS).
	Measurement result is outside the set limits (FAIL).
	Measurement is aborted. Consider displayed warnings and messages.

3.4.6 Auto Sequence® result indication

	All Auto Sequence® results or single tests with the set limits are inside the set limits (PASS).
	At least one Auto Sequence® single test result with the set limits is outside the set limits (FAIL).
	All applied single tests in the Auto Sequence® are without the set limits and results without PASS / FAIL indication.

–	All single tests in Auto Sequence® were skipped and/or aborted.
	Measurement result is inside the set limits (PASS).
	Measurement result is outside the set limits (FAIL).
	Measurement result without PASS / FAIL indication.
	Measurement not performed.

4 Tests and measurements

4.1 Voltage, frequency and phase sequence

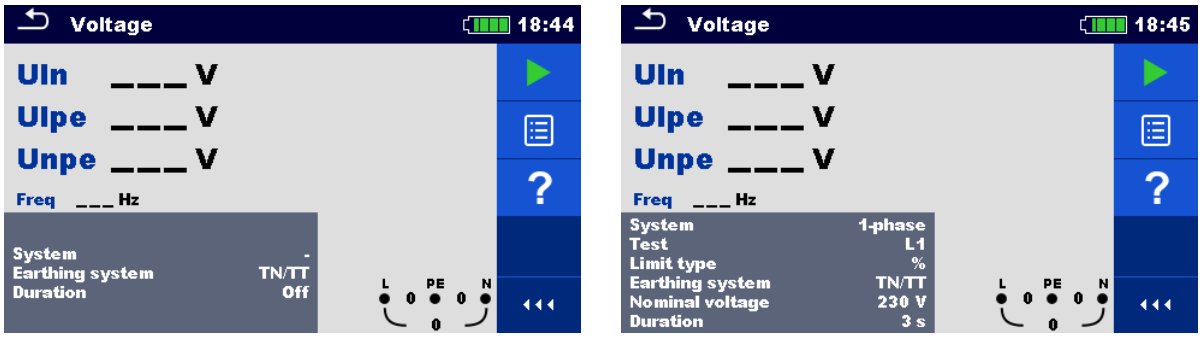


Figure 4.1: Voltage measurement menu

Measurement parameters

System [1]	**Voltage system** [-, 1-phase,3-phase]
Test [3]	**Phase to be tested** [-, L1, L2, L3]
Limit type	**Type of limit** [Voltage, %]
Earthing system	**Earthing system** [TN/TT, IT]
Nominal voltage [2]	**Nominal voltage** [Custom, 110V, 115V, 190V, 200V, 220V, 230V, 240V, 380V, 400V, 415V]
Reference field [4]	**Correct phase rotation** [-, 1.2.3, 3.2.1]
Duration	**Test duration** [Off, Custom, 1 s, 3 s, 5 s]

[1] There are no limits to set if System parameter is set to '–'.
[2] Active only if limit type is set to %.
[3] Active only when System is set to 1-phase.
[4] Active only when System is set to 3-phase; set parameter (1.2.3 or 3.2.1) to verify correct phase sequence during Voltage test.

Measurement limits for TN/TT earthing system:

Low limit Uln[5]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit Uln[5]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit Uln[6]	**Min. voltage** [Off, Custom, -20% … 20%]
High limit Uln[6]	**Max. voltage** [Off, Custom, -20% … 20%]
Low limit Ulpe[5,6]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit Ulpe[5,6]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit Unpe[5,6]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit Unpe[5,6]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U12[7]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U12[7]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U13[7]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U13[7]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U23[7]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U23[7]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit Ull[8]	**Min. voltage** [Off, Custom, -20% … 20%]
High limit Ull[8]	**Max. voltage** [Off, Custom, -20% … 20%]

[5] In case of 1-phase voltage system and limit type set to voltage.

[6] In case of 1-phase voltage system and limit type set to %.
[7] In case of 3-phase voltage system and limit type set to voltage.
[8] In case of 3-phase voltage system and limit type set to %.

Measurement limits for IT earthing system:

Low limit U12[9,11]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U12[9,11]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U12[10]	**Min. voltage** [Off, Custom, -20% … 20%]
High limit U12[10]	**Max. voltage** [Off, Custom, -20% … 20%]
Low limit U1pe[9,10]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U1pe[9,10]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U2pe[9,10]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U2pe[9,10]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U13[11]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U13[11]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit U23[11]	**Min. voltage** [Off, Custom, 0 V … 499 V]
High limit U23[11]	**Max. voltage** [Off, Custom, 0 V … 499 V]
Low limit Ull[12]	**Min. voltage** [Off, Custom, -20% … 20%]
High limit Ull[12]	**Max. voltage** [Off, Custom, -20% … 20%]

[9] In case of 1-phase voltage system and limit type set to voltage.
[10] In case of 1-phase voltage system and limit type set to %.
[11] In case of 3-phase voltage system and limit type set to voltage.
[12] In case of 3-phase voltage system and limit type set to %.

Connection diagrams

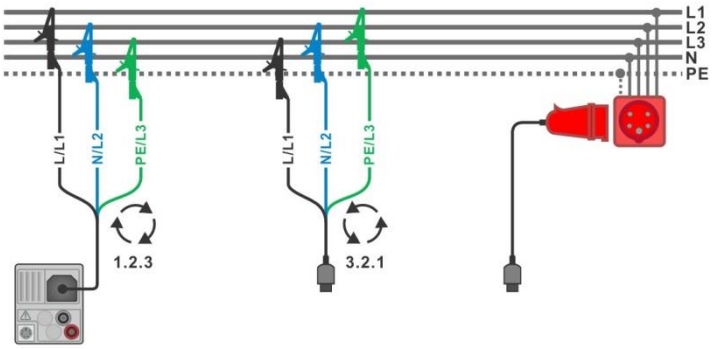


Figure 4.2: Connection of 3-wire test lead and optional adapter in three-phase system

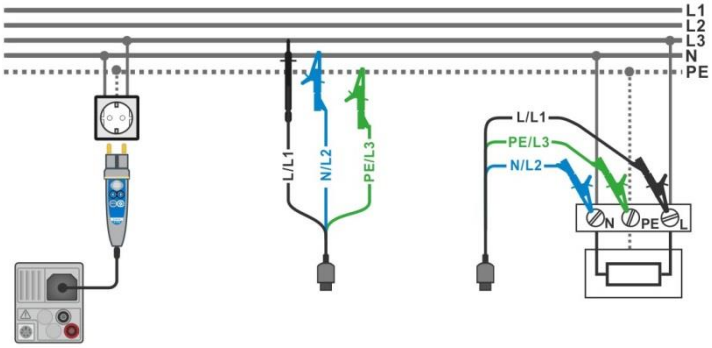


Figure 4.3: Connection of Plug commander and 3-wire test lead in single-phase system

Measurement procedure

- Enter the **Voltage** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to object under test (see ***Figure 4.2*** and ***Figure 4.3***).
- Start the measurement.
- Stop the measurement, if Duration is set to Off.
- Save results (optional).

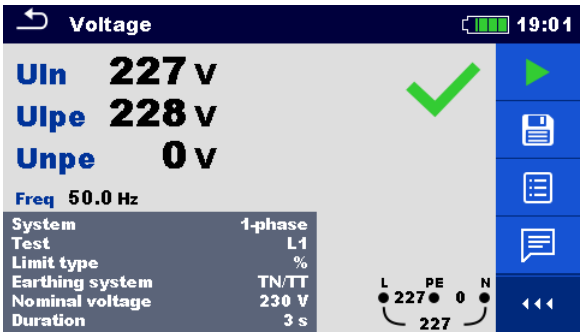


Figure 4.4: Example of Voltage measurement in single-phase system

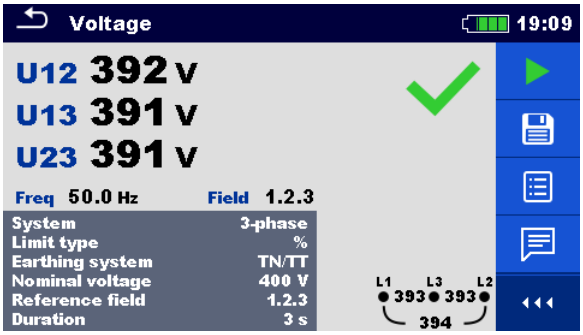


Figure 4.5: Examples of Voltage measurement in three-phase system

Measurement results / sub-results

Single-phase TN/TT system

Uln	voltage between phase and neutral conductors
Ulpe	voltage between phase and protective conductors
Unpe	voltage between neutral and protective conductors
Freq	frequency

Single-phase IT earthing system

U12	voltage between phases L1 and L2
U1pe	voltage between phase L1 and PE
U2pe	voltage between phase L2 and PE
Freq	frequency

Three-phase TN/TT and IT system

U12	voltage between phases L1 and L2
U13	voltage between phases L1 and L3
U23	voltage between phases L2 and L3
Freq	frequency
Field[1)]	3-phase rotation sequence

[1)] For Pass test result, Field result must be equal to setting of Reference field parameter (1.2.3 or 3.2.1).

4.2 R iso – Insulation resistance

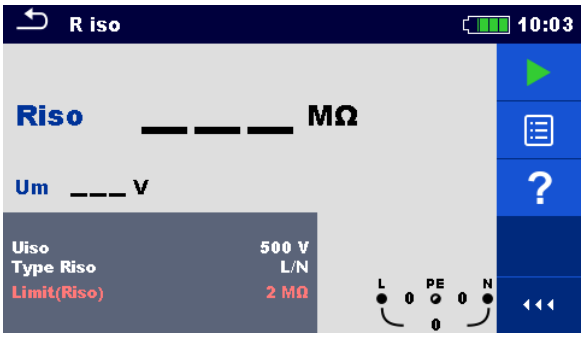


Figure 4.6: Insulation resistance measurement menu

Measurement parameters / limits

Uiso	**Nominal test voltage** [50 V, 100 V, 250 V, 500 V, 1000 V, 2500 V[1)]]
Type Riso[2)]	**Type of test** [-, L/PE, L/N, N/PE, L/L, L1/L2, L1/L3, L2/L3, L1/N, L2/N, L3/N, L1/PE, L2/PE, L3/PE]
Limit(Riso)	**Min. insulation resistance** [Off, Custom, 0.01 MΩ ... 100 MΩ]

[1)] Nominal test voltage 2500 V is available on MI 3152H only.

[2)] With Plug test cable or Plug commander Insulation is always measured between L/L1 and N/L2 test lead regardless of the setting. The parameter is meant for documentation.

Connection diagrams

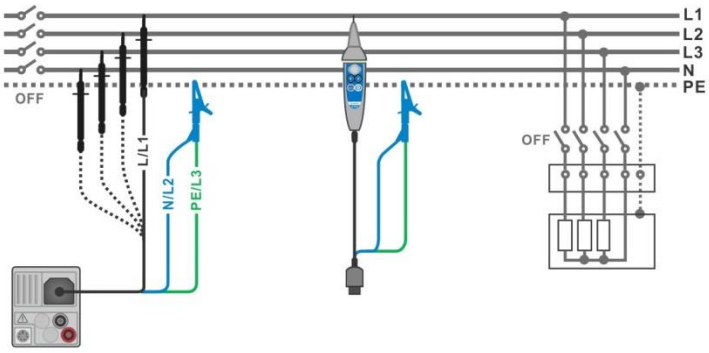


Figure 4.7: Connection of 3-wire test lead and Tip commander ($U_N \leq 1$ kV)

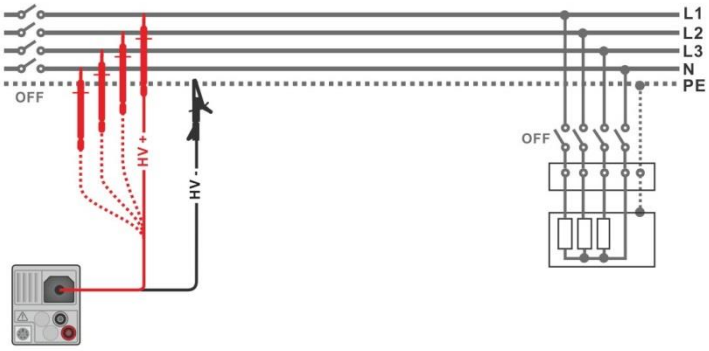


Figure 4.8: Connection of 2.5 kV test lead (U_N =2.5 kV)

Measurement procedure

- Enter the **R iso** function.
- Set test parameters / limits.
- Disconnect tested installation from mains supply and discharge installation as required.
- Connect test cable to the instrument.
- Connect test leads to object under test (see ***Figure 4.7*** and ***Figure 4.8***).
  Different test cable must be used for testing with nominal test voltage $U_N \leq 1000$ V and U_N= 2500 V. Also different test terminals are used.
  The standard 3-wire test lead, Schuko test cable or Plug / Tip commanders can be used for the insulation test with nominal test voltages ≤ 1000 V. For the 2500 V insulation test the two wire 2.5 kV test lead should be used.
- Start the measurement. A longer press on TEST key or a longer press on “Start test” option on touch screen starts a continuous measurement.
- Stop the measurement. Wait until object under test is fully discharged.
- Save results (optional).

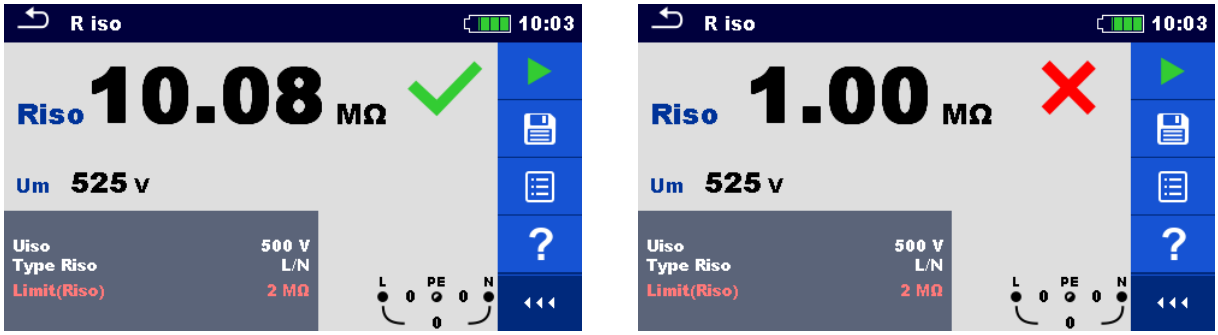


Figure 4.9: Examples of Insulation resistance measurement result

Measurement results / sub-results

Riso	Insulation resistance
Um	Actual test voltage

4.2.1 Load pretest

High Insulation voltage can potentially damage the connected appliances during the Insulation measurement. This misuse can be prevented by enabling Load pretest functionality in Settings menu. Load pretest measures the impedance on test terminals with low and safe a.c. voltage. If impedance lower than 50 kΩ is detected, warning message is displayed, allowing to disconnect the appliances before test voltage is applied (see ***Figure 4.10***). Insulation measuring voltage is applied to the test terminals only after YES is selected. NO will abort the measurement.
If impedance higher than 50 kΩ is measured during the Load pretest, Insulation test will follow automatically.

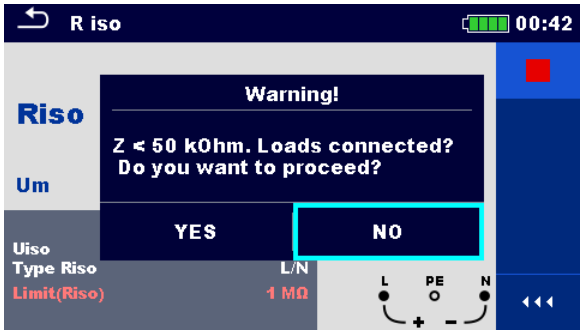


Figure 4.10: Load pretest warning message

Note:

- Load pretest is carried out between L/L1 and N/L2 terminals regardless of the Type Riso parameter setting.
- Load pretest is carried out only when parameter Uiso ≤ 1000 V.

4.3 The DAR and PI diagnostic (MI 3152H only)

DAR (**D**ielectric **A**bsorption **R**ation) is ratio of insulation resistance values measured after 15 seconds and after 1 minute. The DC test voltage is present during the whole period of the measurement.

$$DAR = \frac{R_{ISO}(1\ \mathrm{min})}{R_{ISO}(15\ \mathrm{s})}$$

PI (**P**olarization **I**ndex) is the ratio of insulation resistance values measured after 1 minute and after 10 minutes. The DC test voltage is present during the whole period of the measurement

$$PI = \frac{R_{ISO}(10\ \mathrm{min})}{R_{ISO}(1\ \mathrm{min})}$$

For additional information regarding PI and DAR diagnostic, please refer to Metrel's handbook **Modern insulation testing**.

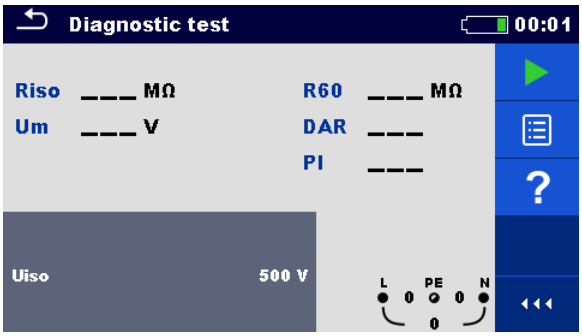


Figure 4.11: Diagnostic test menu

Measurement parameters / limits

Uiso	**Nominal test voltage** [500 V, 1000 V, 2500 V]

Connection diagrams

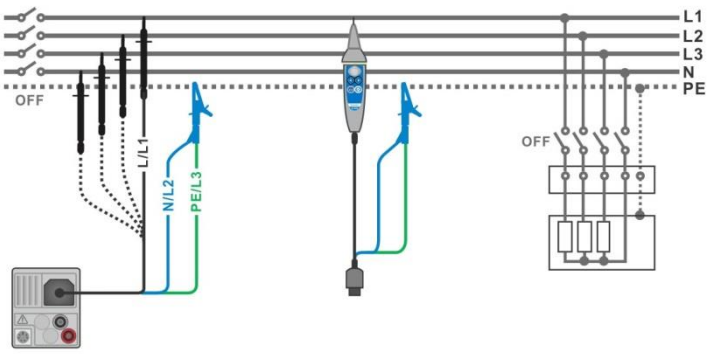


Figure 4.12: Connection of 3-wire test lead and Tip commander ($U_N \leq 1$ kV)

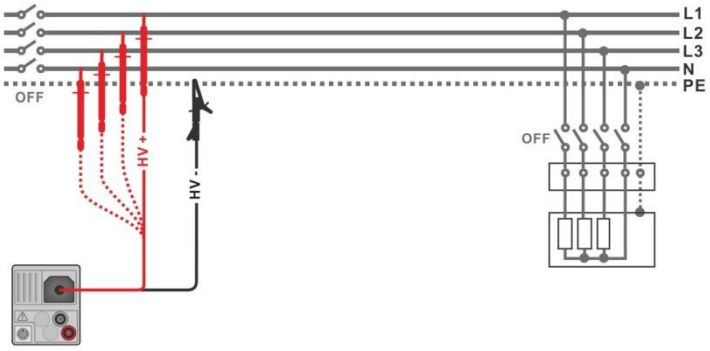


Figure 4.13: Connection of 2.5 kV test lead (U_N = 2.5 kV)

Measurement procedure

- Enter the **Diagnostic test** function.
- Set test parameters / limits.
- Disconnect tested installation from mains supply and discharge installation as required.
- Connect test cable to the instrument.
- Connect test leads to object under test (see ***Figure 4.12*** and ***Figure 4.13***).
  Different test cable must be used for testing with nominal test voltage U_N ≤ 1000 V and U_N= 2500 V. Also different test terminals are used.
  The standard 3-wire test lead, Schuko test cable or Plug / Tip commanders can be used for the insulation test with nominal test voltages ≤ 1000 V. For the 2500 V insulation test the two wire 2.5 kV test lead should be used.
- Start the measurement. Internal timer begins to increment. When internal timer reaches 1 min R60 and DAR factor are displayed and short beep is generated. Measurement can be interrupted at any time.
- When internal timer reaches 10 min also PI factor is displayed and measurement is completed. Wait until object under test is fully discharged.
- After the measurement is finished wait until tested item is fully discharged.
- Save results (optional).

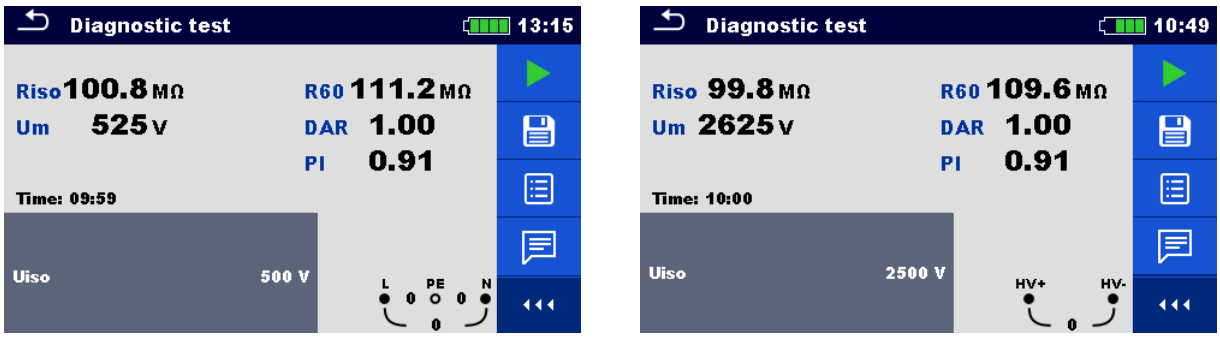


Figure 4.14: Examples of Diagnostic test result

Measurement results / sub-results

Riso	Insulation resistance
Um	Actual test voltage
R60	Resistance after 60 seconds
DAR	Dielectric absorption ratio
PI	Polarization index

4.4 Varistor test

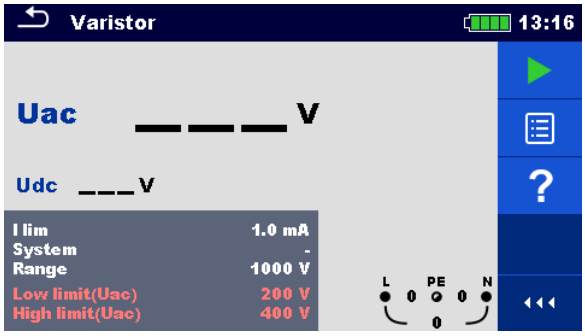


Figure 4.15: Varistor test main menu

Measurement parameters / limits

I lim	**Current limit** [1.0 mA]
System	**System** [-, TT, TN, TN-C, TN-S]
Range	**Test voltage range** [1000 V, 2500 V*]
Low limit (Uac)	**Low breakdown limit value** @ **1000 V** range [Off, 50 V … 620 V] @ **2500 V** range [Off, 50 V … 1550 V]*
High limit (Uac)	**High breakdown limit value** @ **1000 V** range [Off, 50 V … 620 V] @ **2500 V** range [Off, 50 V … 1550 V]*

* For MI 3152H only

Test circuit for Varistor test

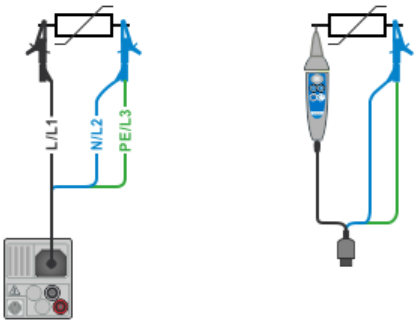


Figure 4.16: Connection of 3-wire test lead ($U_N \leq$ 1 kV)

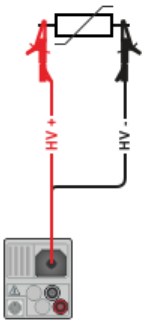


Figure 4.17: Connection of 2.5 kV test lead (Range: 2500 V)

Measurement procedure

- Enter the **Varistor test** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to object under test (see ***Figure 4.16*** and ***Figure 4.17***).
  Different test cable must be used for testing with MI 3152 where end voltage is 1000 V and MI 3152H where end voltage is 2500 V. Also different test terminals are used.
  The standard 3-wire test lead, Plug test cable or Plug / Tip commander can be used for the Varistor test with end voltage 1000 V. For the 2500 V Varistor test the two wire 2.5 kV test lead should be used.
- Start the measurement.
  A voltage ramp starts from 50 V and rises with a slope of 100 V/s (Range parameter set to 1000 V) or 350 V/s (Range parameter set to 2500 V). The measurement ends when the defined end voltage is reached or if the test current exceeds the value of 1 mA.
- After the measurement is finished wait until tested item is fully discharged.
- Save results (optional).

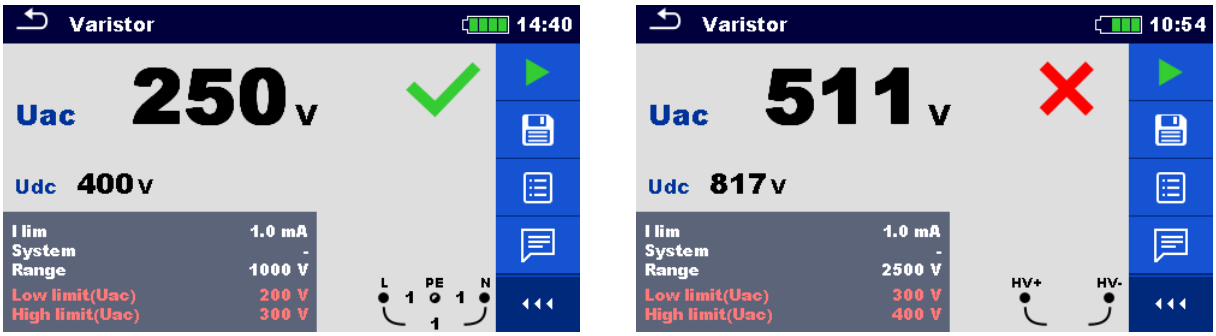


Figure 4.18: Examples of Varistor test result

Measurement results / sub-results

Uac	Calculated a.c. breakdown voltage
Udc	Breakdown voltage

Meaning of the Uac voltage

Protection devices intended for a.c. network are usually dimensioned approx. 15 % above peak value of the nominal mains voltage. The relation between Udc and Uac is following:

$$Uac \approx \frac{Udc}{1.15 \times \sqrt{2}}$$

Uac voltage may be directly compared with the voltage declared on tested protection device.

4.5 R low – Resistance of earth connection and equipotential bonding

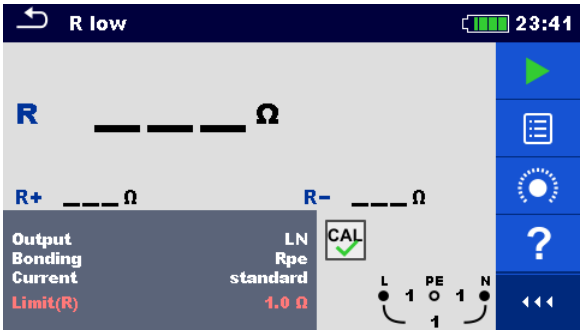


Figure 4.19: R low measurement menu

Measurement parameters / limits

Output[1)]	[LN, LPE]
Bonding	[Rpe, Local]
Current	[standard, ramp]
Limit(R)	**Max. resistance** [Off, Custom, 0.05 Ω ... 20.0 Ω]

[1)] R low measurement depends on Output parameter setting, see table below.

Output	Test terminals
LN	L and N
LPE	L and PE

Connection diagram

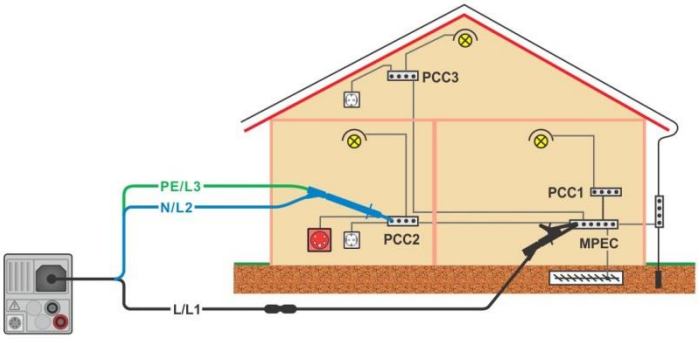


Figure 4.20: Connection of 3-wire test lead plus optional Extension lead

Measurement procedure

- Enter the **R low** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Compensate the test leads resistance if necessary, see section ***4.6.1 Compensation of test leads resistance***.
- Disconnect tested installation from mains supply and discharge insulation as required.
- Connect test leads, see ***Figure 4.20***.
- Start the measurement.
- Save results (optional).

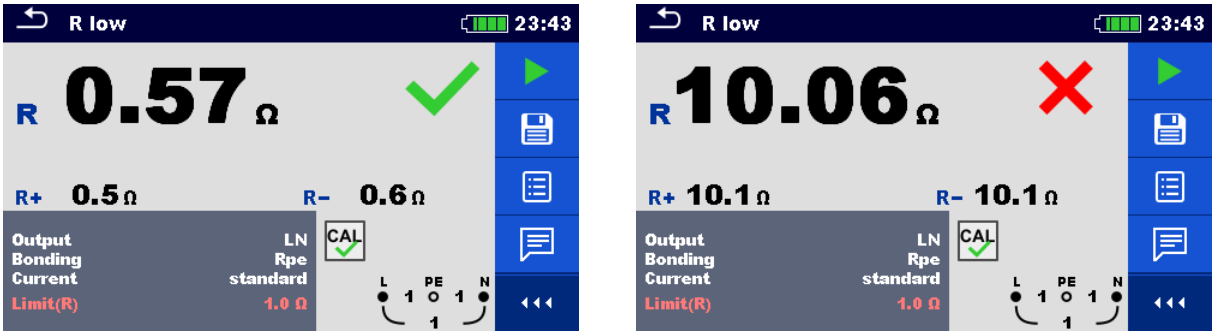


Figure 4.21: Examples of R low measurement result

Measurement results / sub-results

R	Resistance
R+	Result at positive test polarity
R-	Result at negative test polarity

4.6 Continuity – Continuous resistance measurement with low current

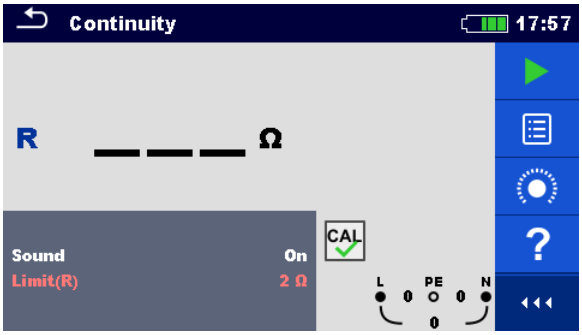


Figure 4.22: Continuity resistance measurement menu

Measurement parameters / limits

Sound	[On*, Off]
Limit(R)	**Max. resistance** [Off, Custom, 0.1 Ω ... 20.0 Ω]

*Instrument sounds if resistance is lower than the set limit value.

Connection diagrams

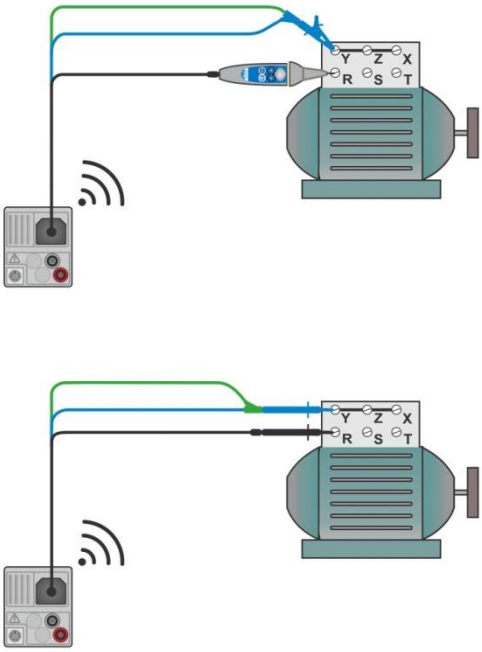


Figure 4.23: Tip commander and 3-wire test lead applications

Measurement procedure

- Enter the **Continuity** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Compensate the test leads resistance if necessary, see section ***4.6.1 Compensation of***

test leads resistance.

- Disconnect device under test from mains supply and discharge it as required.
- Connect test leads to device under test, see ***Figure 4.23.***
- Start the measurement.
- Stop the measurement.
- Save results (optional).

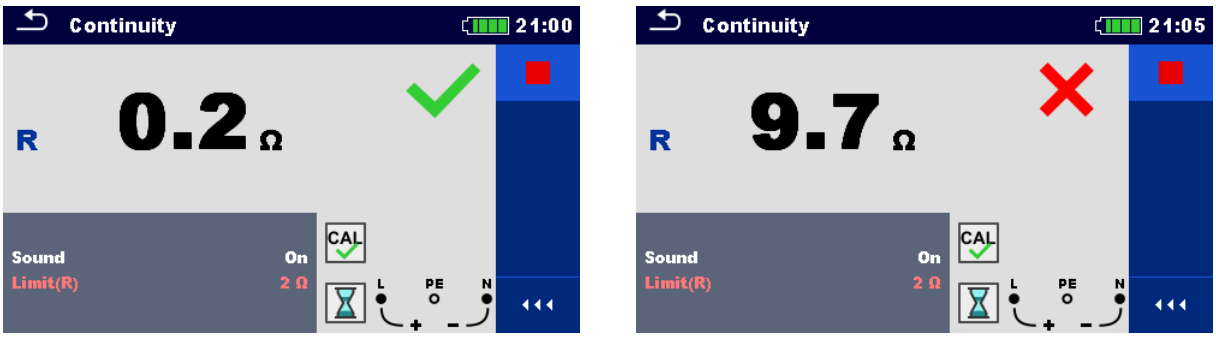


Figure 4.24: Examples of Continuity resistance measurement result

Measurement results / sub-results

R	Resistance

4.6.1 Compensation of test leads resistance

This chapter describes how to compensate the test leads resistance in **R low** and **Continuity** functions. 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.
CAL symbol is displayed if the compensation was carried out successfully.

Connections for compensating the resistance of test leads

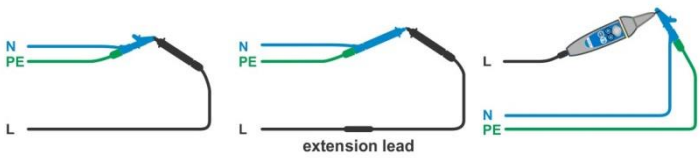


Figure 4.25: Shorted test leads

Compensation of test leads resistance procedure

- Enter **R low** or **Continuity** function.
- Connect test cable to the instrument and short the test leads together, see ***Figure 4.25***.
- Touch the key to compensate leads resistance.

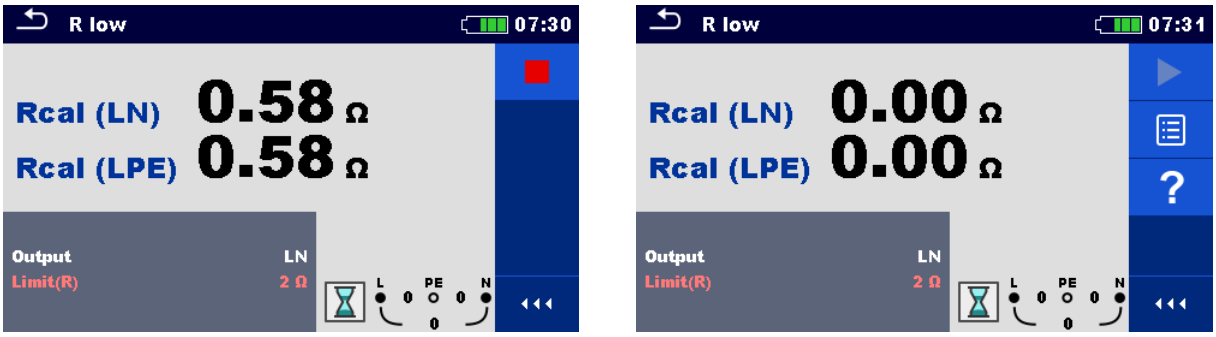


Figure 4.26: Result with old and new calibration values

4.7 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 and
- RCD Auto test.

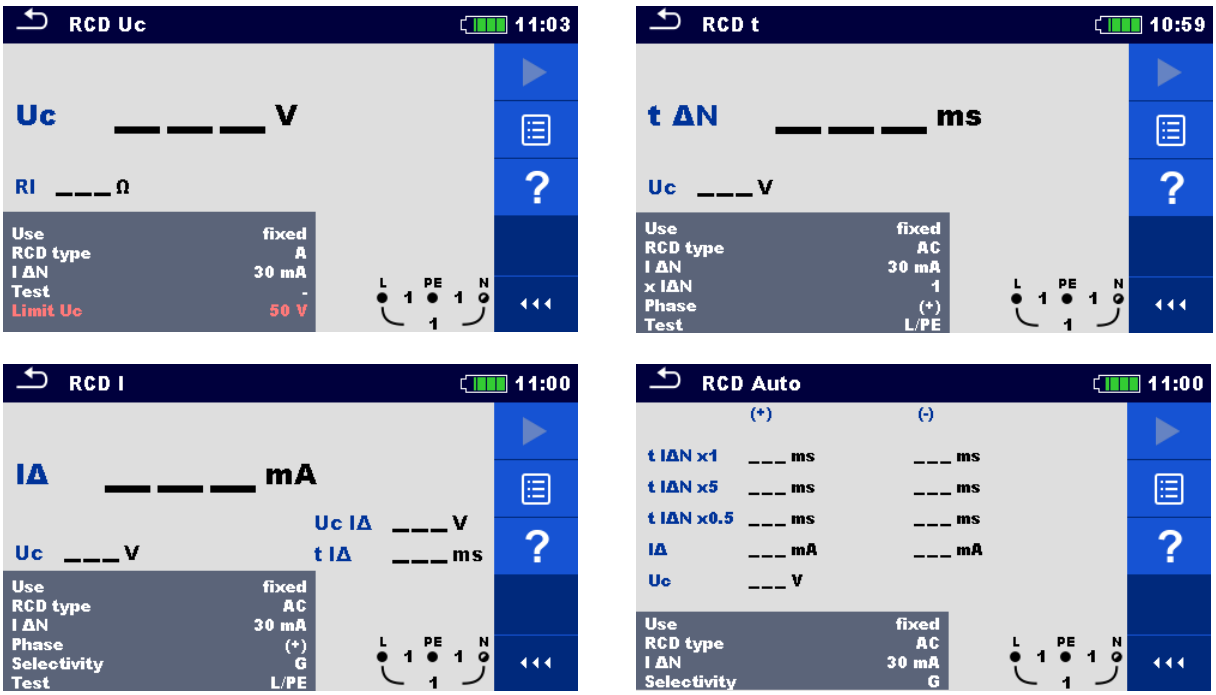


Figure 4.27: RCD menus

Test parameters / limits

I ΔN	**Rated RCD residual current sensitivity** [10 mA, 15 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]
I ΔN/ I ΔNdc	**Rated RCD residual current sensitivity for special RCDs types** [30 mA / 6 mA d.c., - / 6 mA d.c.] [1)]
Type	**RCD type** [AC, A, F, B*, B+*, EV RCD[1)], MI RCD[1)], EV RCM[1)]]
Use	**RCD / PRCD selection** [fixed, PRCD, PRCD-2p, PRCD-3p, PRCD-S, PRCD-S+, PRCD-K, other]
Selectivity	**Characteristic** [G, S]
x IΔN	**Multiplication factor for test current** [0.5, 1, 2, 5]
x IΔN d.c.	**Multiplication factor for d.c. test current** [0.5, 1, 10, 33.33, 50] [1)]
Phase	**Starting polarity** [(+), (-), (+,-)]
Limit Uc	**Conventional touch voltage limit** [Custom, 12 V, 25 V, 50 V]
Test	**Test current shape** [a.c., d.c.][1), 3)]
Test	**Test** [-, L/PE, L1/PE, L2/PE, L3/PE] [2)]
Sensitivity	**Sensitivity** [standard, Ipe monitoring] [4)]
RCD standard	Refer to *Instruction manual* for more information.
EV RCD/RCM Standard	**Standard for EV RCD, EV RCM** [IEC 62752, IEC 62955]
Earthing system	Refer to *Instruction manual* for more information.

* Model MI 3152 only.

1) Parameter is available only when parameter Use is set to other (for Electrical Vehicle (EV) RCDs/RCMs and Mobile installations (MI) RCDs).
2) With Plug test cable or Plug commander RCD tests are measured in the same way regardless of the setting. The parameter is meant for documentation.
3) Parameter is available only when RCD I or RCD t test is selected and parameter Use is set to other.
4) Parameter is available only when parameter 'Use' is set to PRCD, PRCD-3p, PRCD-S+ or PRCD-K.

Connection diagram

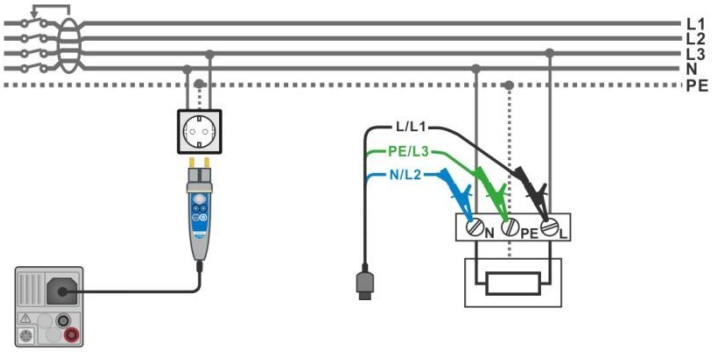


Figure 4.28: Connecting the Plug commander and the 3-wire test lead

4.7.1 RCD Uc – Contact voltage

Test procedure

- Enter the **RCD Uc** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.28***.
- Start the measurement.
- Save results (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 4.1*** for detailed contact voltage calculation factors.

RCD type		Contact voltage Uc proportional to	Rated $I_{\Delta N}$	Notes
AC, EV, MI (a.c. part)	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	$2 \times 2 \times 1.05 \times I_{\Delta N}$		
B, B+	G	$2 \times 1.05 \times I_{\Delta N}$	any	Model MI 3152 only
B, B+	S	$2 \times 2 \times 1.05 \times I_{\Delta N}$		

Table 4.1: Relation between Uc and $I_{\Delta N}$

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

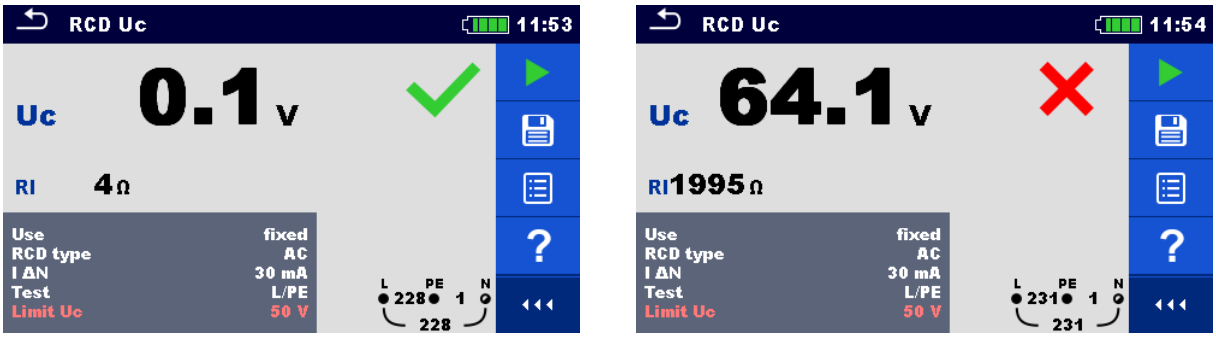


Figure 4.29: Examples of Contact voltage measurement result

Test result / sub-results

Uc	Contact voltage
RI	Calculated fault loop resistance

4.7.2 RCD t – Trip-out time

Test procedure

- Enter the **RCD t** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.28***.
- Start the measurement.
- Save results (optional).

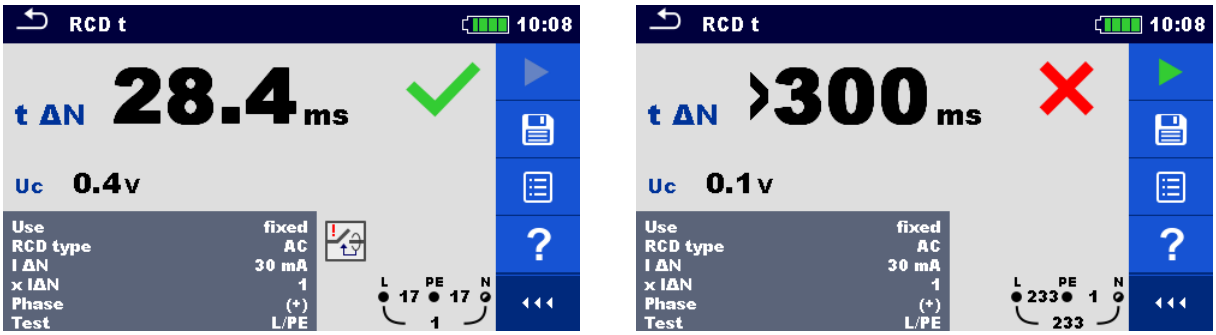


Figure 4.30: Examples of Trip-out time measurement result

Test results / sub-results

t ΔN	Trip-out time
Uc	Contact voltage for rated $I_{\Delta N}$

4.7.3 RCD I – Trip-out current

The instrument increases the test current in small steps through appropriate range as follows:

RCD type	Slope range		Waveform	Notes
	Start value	End value		
AC	$0.2\times I_{\Delta N}$	$1.1\times I_{\Delta N}$	Sine	All models
IEC 62752: **EV RCD, EV RCM, MI RCD (a.c. part)**	$0.2\times I_{\Delta N}$	$1.0\times I_{\Delta N}$	Sine	
IEC 62955: **EV RCD, EV RCM, MI RCD (a.c. part)**	$0.2\times I_{\Delta N}$	$1.0\times I_{\Delta N}$	Sine	
A, F ($I_{\Delta N}\geq$ 30 mA)	$0.2\times I_{\Delta N}$	$1.5\times I_{\Delta N}$	Pulsed	
A, F ($I_{\Delta N}$ = 10 mA)	$0.2\times I_{\Delta N}$	$2.2\times I_{\Delta N}$		
IEC 62752: **EV RCD, EV RCM, MI RCD (d.c. part)**	1.2 mA	6.0 mA	DC	
IEC 62955: **EV RCD, EV RCM, MI RCD (d.c. part)**	1.2 mA	6.0 mA	DC	
B, B+	$0.2\times I_{\Delta N}$	$2.2\times I_{\Delta N}$	DC	Model MI 3152 only

Table 4.2: Relationship between RCD type, slope range and test current

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

Test procedure

- Enter the **RCD I** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.28***.
- Start the measurement.
- Save results (optional).

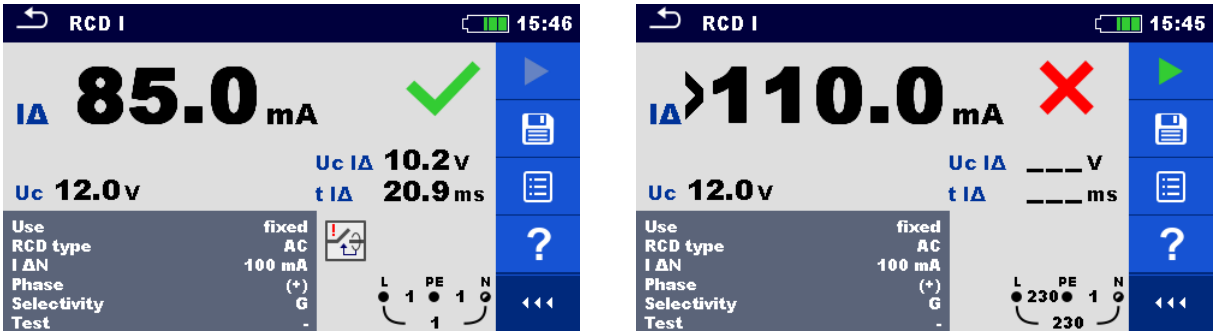


Figure 4.31: Examples of Trip-out current measurement result

Test results / sub-results

IΔ	Trip-out current
Uc	Contact voltage
Uc IΔ	Contact voltage at trip-out current IΔ or no value if the RCD didn't trip
t IΔ	Trip-out time at trip-out current IΔ

4.8 RCD Auto – RCD Auto test

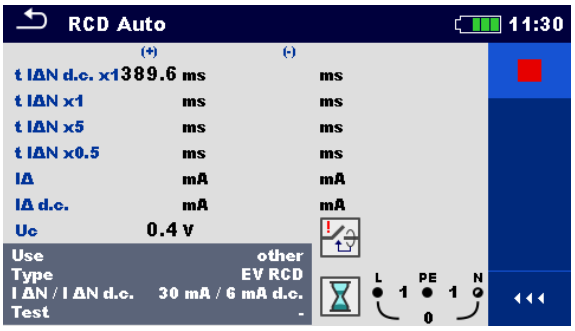
RCD Auto test function performs a complete RCD test (trip-out time at different residual currents, trip-out current and contact voltage) in one set of automatic tests, guided by the instrument.

RCD Auto test procedure

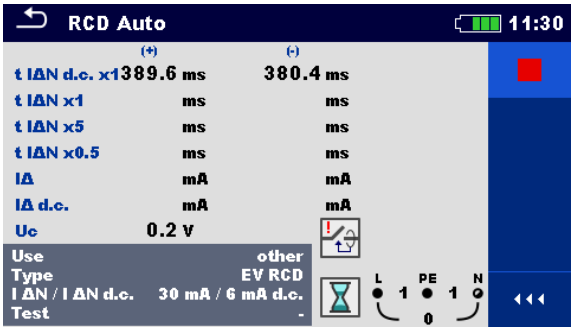
RCD Auto test steps	Notes
‣ Enter the **RCD Auto** function. ‣ Set test parameters / limits. ‣ Connect test cable to the instrument. ‣ Connect test leads or Plug commander to the object under test, see ***Figure 4.28***	
‣ Start the measurement.	Start of test
Test with $I_{\Delta N}$ d.c., (+) positive polarity (step 1) [1].	RCD should trip-out
‣ **Re-activate RCD**. Test with $I_{\Delta N}$ d.c., (-) negative polarity (step 2) [1].	RCD should trip-out
‣ **Re-activate RCD**.	
Test with $I_{\Delta N}$, (+) positive polarity (step 3) [2].	RCD should trip-out RCD should not trip-out during non-operating time for a.c. residual current (IEC 62955).
‣ **Re-activate RCD** if required. Test with $I_{\Delta N}$, (-) negative polarity (step 4) [2].	RCD should trip-out RCD should not trip-out during non-operating time for a.c. residual current (IEC 62955).
‣ **Re-activate RCD** if required. Test with $5\times I_{\Delta N}$, (+) positive polarity (step 5) [2].	RCD should trip-out
‣ **Re-activate RCD**. Test with $5\times I_{\Delta N}$, (-) negative polarity (step 6) [2].	RCD should trip-out
‣ **Re-activate RCD**. Test with $½\times I_{\Delta N}$, (+) positive polarity (step 7) [2]. Test with $½\times I_{\Delta N}$, (-) negative polarity (step 8) [2].	RCD should not trip-out RCD should not trip-out
Trip-out current test, (+) positive polarity (step 9) [2].	RCD should trip-out
‣ **Re-activate RCD**. Trip-out current test, (-) negative polarity (step 10) [2].	RCD should trip-out
‣ **Re-activate RCD**[1]. Trip-out current test for d.c. part, (+) polarity (step 11).	RCD should trip-out
‣ **Re-activate RCD**[1]. Trip-out current test for d.c. part, (-) polarity (step 12).	RCD should trip-out
‣ **Re-activate RCD**. Save results (optional).	End of test

[1] Steps 1, 2 11 and 12 are performed only when parameter Use is set to ‘other’ and parameter Type is set to ‘EV RCD’, ‘EV RCM’ or ‘MI RCD’. Trip-out times are measured according to IEC 62752 or IEC 62955.

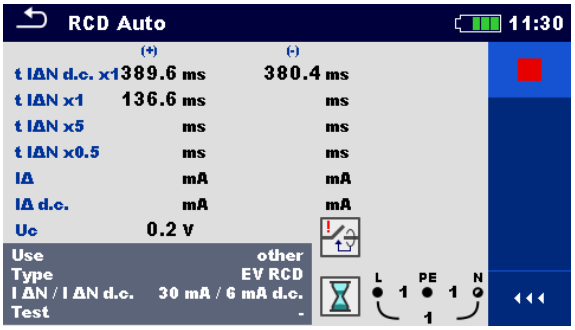
[2] When parameter Use is set to ‘other’ and parameter Type is set to ‘EV RCD’, ‘EV RCD’ or ‘MI RCD’, trip-out times or non-operating times for a.c. residual current are measured according to IEC 62752 or IEC 62955.



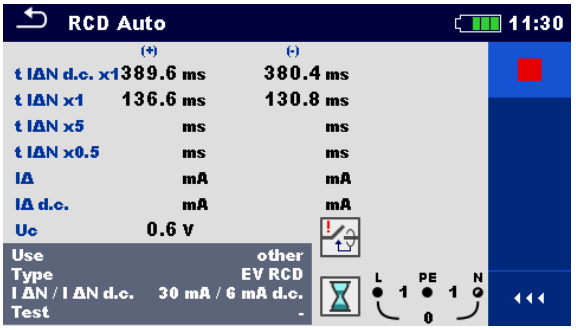
Step 1



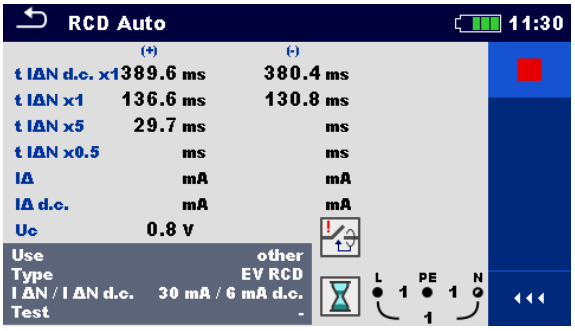
Step 2



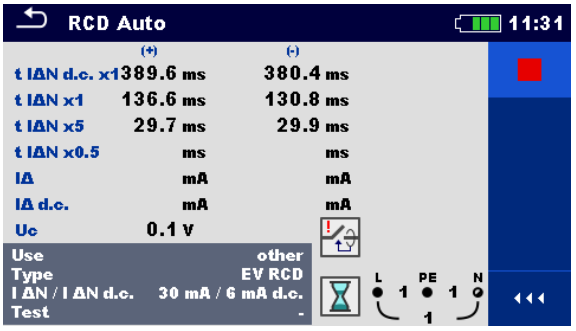
Step 3



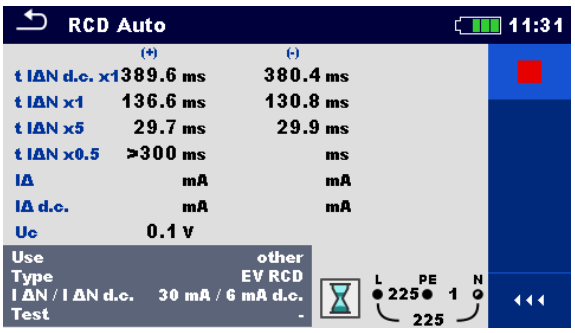
Step 4



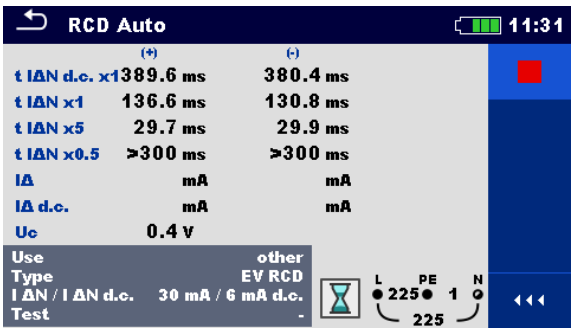
Step 5



Step 6



Step 7



Step 8

Step 9 **Step 10**

Step 11 **Step 12**

Figure 4.32: Example of individual steps in RCD Auto test, example on testing EV RCD

Test results / sub-results

t IΔN d.c. x1, (+) [1)]	Step 1 trip-out time ($I_{\Delta}=I_{\Delta N\ d.c.}$, (+) positive polarity)
t IΔN d.c. x1, (-) [1)]	Step 2 trip-out time ($I_{\Delta}= I_{\Delta N\ d.c}$, (-) negative polarity)
t IΔN x1, (+)	Step 3 trip-out time ($I_{\Delta}=I_{\Delta N}$, (+) positive polarity) Non-operating time for a.c. current (IEC 62955).
t IΔN x1, (-)	Step 4 trip-out time ($I_{\Delta}=I_{\Delta N}$, (-) negative polarity) Non-operating time for a.c. current (IEC 62955).
t IΔN x5, (+)	Step 5 trip-out time ($I_{\Delta}=5\times I_{\Delta N}$, (+) positive polarity)
t IΔN x5, (-)	Step 6 trip-out time ($I_{\Delta}=5\times I_{\Delta N}$, (-) negative polarity)
t IΔN x0.5, (+)	Step 7 trip-out time ($I_{\Delta}=½\times I_{\Delta N}$, (+) positive polarity)
t IΔN x0.5, (-)	Step 8 trip-out time ($I_{\Delta}=½\times I_{\Delta N}$, (-) negative polarity)
IΔ (+)	Step 9 trip-out current ((+) positive polarity)
IΔ (-)	Step 10 trip-out current ((-) negative polarity)
IΔ d.c. (+) [1)]	Step 11 trip-out current ((+) positive polarity)
IΔ d.c, (-) [1)]	Step 12 trip-out current ((-) negative polarity)
Uc	Contact voltage for rated $I_{\Delta N}$

[1)] Result is displayed only when parameter Use is set to ‘other’ and parameter Type to ‘EV RCD’, ‘EV RCM’ or ‘MI RCD’.

4.9 Z loop – Fault loop impedance and prospective fault current

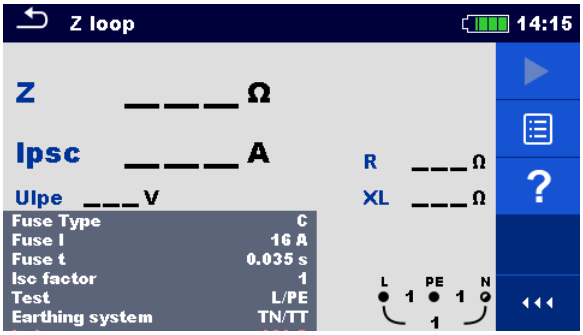


Figure 4.33: Z loop menu

Measurement parameters / limits

Fuse Type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Test	**Selection of test** [-, L/PE, L1/PE, L2/PE, L3/PE] [1)]
Earthing system	Refer to *Instruction manual* for more information.
Ia(Ipsc)	**Minimum fault current for selected fuse or custom value**

[1)] With Plug test cable or Plug commander Z loop is measured in the same way regardless of the setting. The parameter is meant for documentation.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

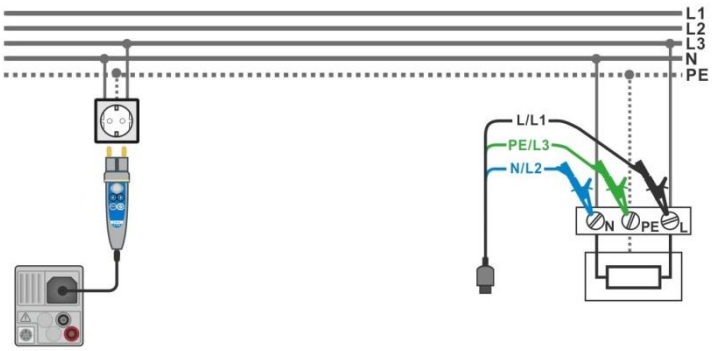


Figure 4.34: Connection of Plug commander and 3-wire test lead

Measurement procedure

- Enter the **Z loop** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.34***.
- Start the measurement.
- Save results (optional).

Figure 4.35: ***Examples of Loop impedance measurement result***

Measurement results / sub-results

Z	Loop impedance
Ipsc	Prospective fault current
Ulpe	Voltage L-PE
R	Resistance of loop impedance
XL	Reactance of loop impedance

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

$$I_{PSC} = \frac{U_N \times k_{SC}}{Z}$$

where:

U_n..... Nominal $U_{L\text{-}PE}$ voltage (see table below),

k_{SC} ..... Correction factor (Isc factor) for I_{PSC}.

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

Table 4.3: Relation between Input voltage – $U_{L\text{-}PE}$ and nominal voltage – U_n used for calculation

4.10 Zs rcd – Fault loop impedance and prospective fault current in system with RCD

Zs rcd measurement prevents trip-out of the RCD in systems with the RCD.

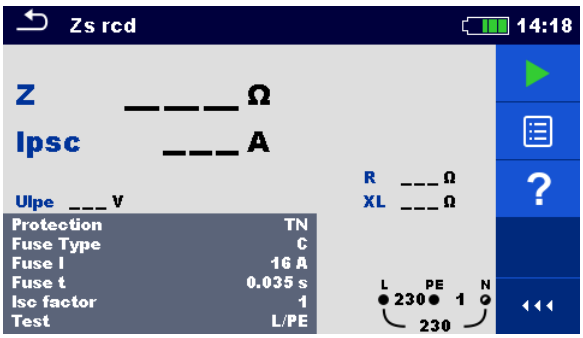


Figure 4.36: Zs rcd menu

Measurement parameters / limits

Protection	**Protection type** [TN, TTrcd]
Fuse Type [1)]	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I [1)]	**Rated current of selected fuse**
Fuse t [1)]	**Maximum breaking time of selected fuse**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Ia(Ipsc) [1)]	**Minimum fault current for selected fuse or custom value**
I ΔN[2)]	**Rated RCD residual current sensitivity** [10 mA, 15 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]
RCD type[2)]	**RCD type** [AC, A, F, B[4)], B+[4)],F]
Selectivity[2)]	**Characteristic** [G, S]
Test	**Selection of test** [-, L-PE, L1-PE, L2. PE, L3-PE] [3)]
I test	**Test current** [Standard, Low]
Limit Uc[2)]	**Contact voltage limit** [Custom, 12 V, 25 V, 50 V] [2)]

1) Parameter or limit is considered if Protection is set to TN
2) Parameter or limit is considered if Protection is set to TTrcd
3) With Plug test cable or Plug commander Zs rcd is measured in the same way regardless of the setting. The parameter is meant for documentation.
4) Model MI 3152 only

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

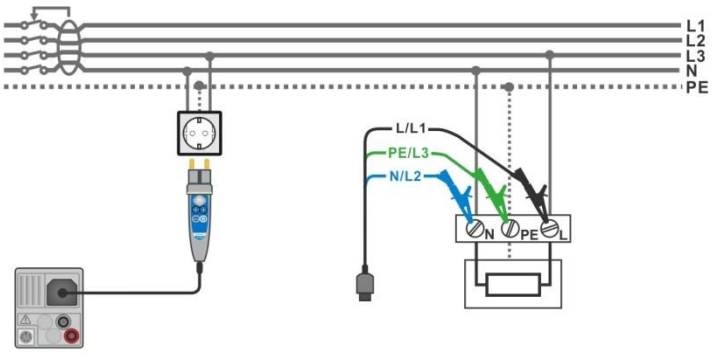


Figure 4.37: Connection of Plug commander and 3-wire test lead

Measurement procedure

- Enter the **Zs rcd** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.37***.
- Start the measurement.
- Save results (optional).

Figure 4.38: Examples of Zs rcd measurement result

Measurement results / sub-results

Z	Loop impedance
Ipsc	Prospective fault current
Ulpe	Voltage L-PE
R	Resistance of loop impedance
XL	Reactance of loop impedance
Uc [1)]	Contact voltage

[1)] Result is presented only if Protection is set to TTrcd

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

$$I_{PSC} = \frac{U_N \times k_{SC}}{Z}$$

where:

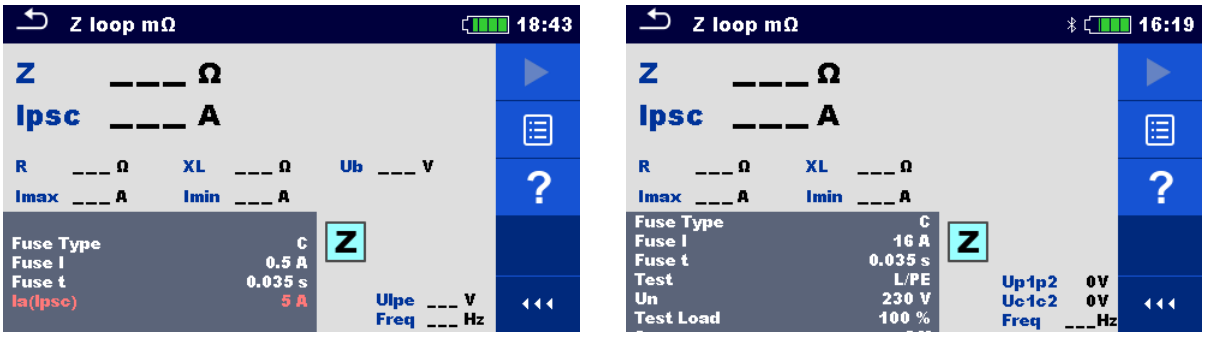
U_n ..... Nominal U_{L-PE} voltage (see table below),

k_{SC} ..... Correction factor (Isc factor) for I_{PSC}

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)

Table 4.4: Relation between Input voltage – U_{L-PE} and nominal voltage – U_n used for calculation

4.11 Z loop mΩ – High precision fault loop impedance and prospective fault current



A 1143 **MI 3143 or MI 3144**

Figure 4.39: Z loop mΩ menu

Measurement parameters / limits

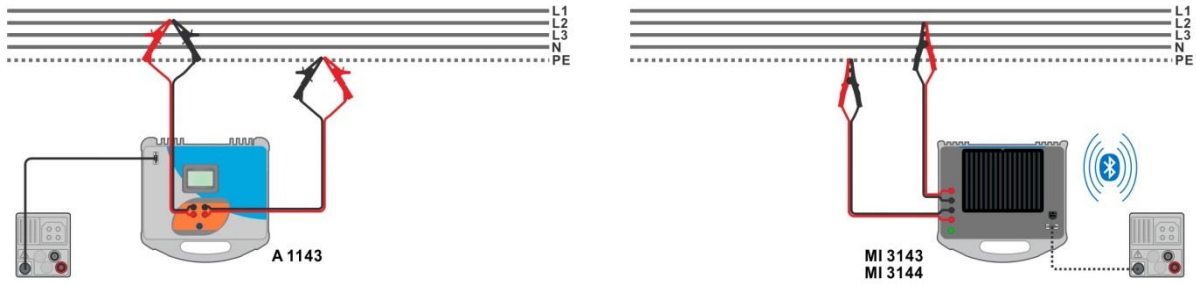
Fuse Type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
Ia(Ipsc)	**Minimum fault current for selected fuse or custom value**
Test	**Test** [-, L/PE, L1/PE, L2/PE, L3/PE] [1)]
Un[2)]	**Nominal voltage** [Custom, 110 V, 115 V, 127 V, 220 V, 230 V, 240 V, 290 V, 400 V]
Tolerance[2)]	**MI 3143 & MI 3144: Nominal voltage tolerance** [6 %, 10 %]
Test Load[2)]	**MI 3143: Test Load** [33.3 %, 66.6 %, 100 %] **MI 3144: Test Load** [16.6 %, 33.3 %, 50.0 %, 66.6 %, 83.3 %, 100 %]
Average[2)]	**MI 3143 & MI 3144: Average** [Off, 2, 4, 6]
Isc factor[2)]	**Isc factor** [Custom, 0.2 ... 3]

1) The measurement doesn't depend on the setting. The parameter is meant for documentation.

2) Parameter is available only if MI 3143 or MI 3144 Euro Z instrument is selected.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram



Connection of A 1143 **Connection of MI 3143 or MI 3144**

Figure 4.40: High precision Loop impedance measurement

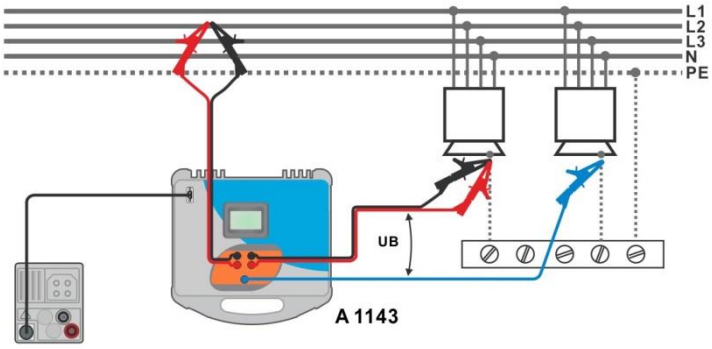
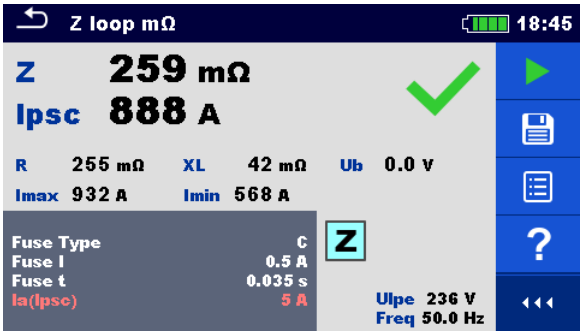


Figure 4.41: Contact voltage measurement – Connection of A 1143

Measurement procedure

- Connect MI 3152(H) instrument with A 1143, MI 3143 or MI 3144 Euro Z adapter / instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **Z loop mΩ** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3143 or MI 3144 Euro Z instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads to A 1143, MI 3143 or MI 3144 Euro Z adapter / instrument.
- Connect test leads to the object under test, see ***Figure 4.40*** and ***Figure 4.41***.
- Start the measurement using or button.
- Save results (optional).



Result screen using A 1143

Result screen using MI 3143 or MI 3144

Figure 4.42: Examples of high precision Loop impedance measurement result

Measurement results / sub-results

Z	Loop impedance
Ipsc	Standard prospective fault current
Imax	Maximal prospective fault current
Imin	Minimal prospective fault current
Ub	**A 1143 only:** Contact voltage at maximal prospective fault current (contact voltage measured against Probe S if used)
R	Resistance of loop impedance
XL	Reactance of loop impedance

Voltage monitor using A 1143:

Ulpe	Voltage L-PE
Freq	Frequency

Voltage monitor using MI 3143 or MI 3144:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***A 1143 – Euro Z 290 A, MI 3143 – Euro Z 440 V*** and ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

4.12 Z line – Line impedance and prospective short-circuit current

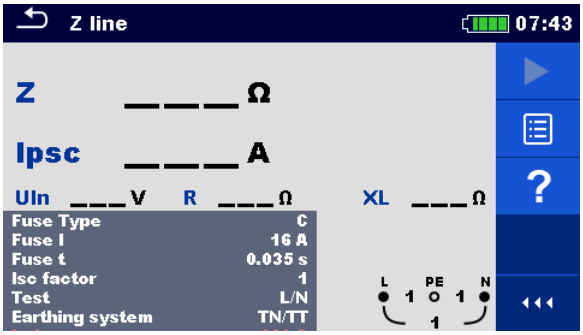


Figure 4.43: Z line measurement menu

Measurement parameters / limits

Fuse Type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Test[1)]	**Test** [-, L/N, L/L, L1/N, L2/N, L3/N, L1/L2, L1/L3, L2/L3]
Earthing system	Refer to *Instruction manual* for more information.
Ia(Ipsc)	**Minimum short-circuit current for selected fuse or custom value**

[1)] With Plug test cable or Plug commander Z line is measured in the same way regardless of the setting. The parameter is meant for documentation.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

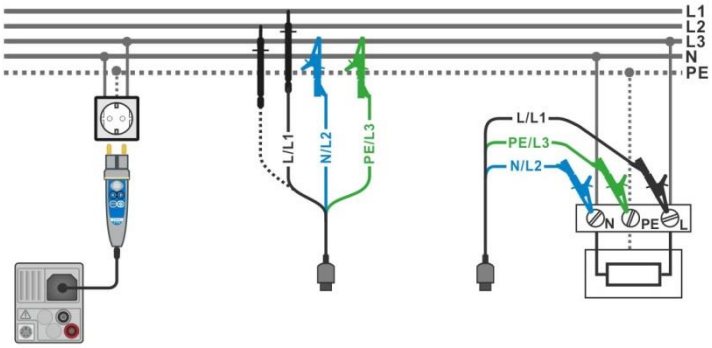


Figure 4.44: Phase-neutral or phase-phase line impedance measurement – connection of Plug commander and 3-wire test lead

Measurement procedure

- Enter the **Z line** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.44***.
- Start the measurement.
- Save results (optional).

Figure 4.45: Examples of Line impedance measurement result

Measurement results / sub-results

Z	Line impedance
Ipsc	Prospective short-circuit current
Uln	Voltage measured between L/L1 – N/L2 test terminals
R	Resistance of line impedance
XL	Reactance of line impedance
Imax3p	Maximal three-phases prospective short-circuit current
Imin3p	Minimal three-phases prospective short-circuit current
Imax2p	Maximal two-phases prospective short-circuit current
Imin2p	Minimal two-phases prospective short-circuit current
Imax	Maximal single-phase prospective short-circuit current
Imin	Minimal single-phase prospective short-circuit current

Prospective short circuit current I_{PSC} is calculated as follows:

$$I_{PSC} = \frac{U_N \times k_{SC}}{Z}$$

where:

U_n ..... Nominal U_{L-N} or U_{L-L} voltage (see table below),

k_{SC} ..... Correction factor (Isc factor) for I_{PSC}.

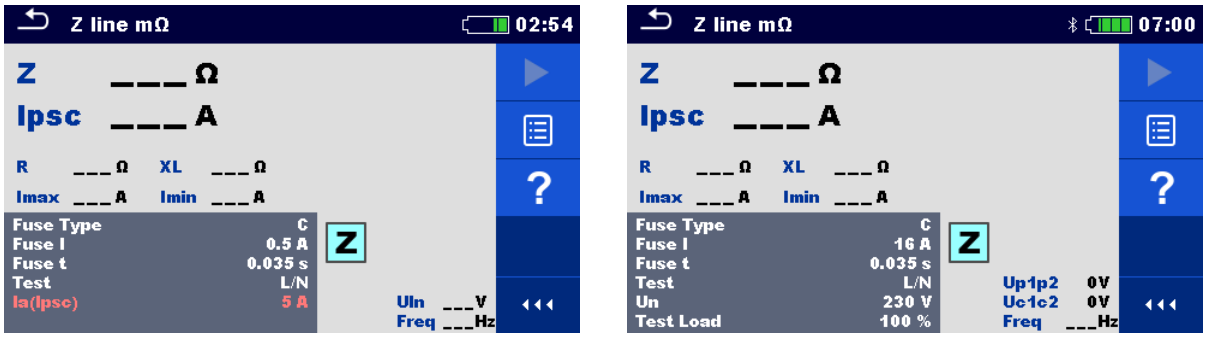
U_n	Input voltage range (L-N or L-L)
110 V	(93 V ≤ U_{L-N} ≤ 134 V)
230 V	(185 V ≤ U_{L-N} ≤ 266 V)
400 V	(321 V ≤ U_{L-L} ≤ 485 V)

Table 4.5: Relation between Input voltage – $U_{L-N(L)}$ and nominal voltage – U_n used for calculation

The prospective short-circuit currents I_{Min}, I_{Min2p}, I_{Min3p} and I_{Max}, I_{Max2p}, I_{Max3p} are calculated as follows:

$I_{Min} = \frac{C_{min} U_{N(L-N)}}{Z_{(L-N)hot}}$	where	$Z_{(L-N)hot} = \sqrt{(1.5 \times R_{(L-N)})^2 + X_{(L-N)}^2}$ $C_{min} = \begin{cases} 0.95; & U_{N(L-N)} = 230\,V \ \pm 10\,\% \\ 1.00; & otherwise \end{cases}$
$I_{Max} = \frac{C_{max} U_{N(L-N)}}{Z_{(L-N)}}$	where	$Z_{(L-N)} = \sqrt{R_{(L-N)}^2 + X_{(L-N)}^2}$ $C_{max} = \begin{cases} 1.05; & U_{N(L-N)} = 230\,V \ \pm 10\,\% \\ 1.10; & otherwise \end{cases}$
$I_{Min2p} = \frac{C_{min} U_{N(L-L)}}{Z_{(L-L)hot}}$	where	$Z_{(L-L)hot} = \sqrt{(1.5 \times R_{(L-L)})^2 + X_{(L-L)}^2}$ $C_{min} = \begin{cases} 0.95; & U_{N(L-L)} = 400\,V \ \pm 10\,\% \\ 1.00; & otherwise \end{cases}$
$I_{Max2p} = \frac{C_{max} U_{N(L-L)}}{Z_{(L-L)}}$	where	$Z_{(L-L)} = \sqrt{R_{(L-L)}^2 + X_{(L-L)}^2}$ $C_{max} = \begin{cases} 1.05; & U_{N(L-L)} = 400\,V \ \pm 10\,\% \\ 1.10; & otherwise \end{cases}$
$I_{Min3p} = \frac{C_{min} \times U_{N(L-L)}}{\sqrt{3}} \frac{2}{Z_{(L-L)hot}}$	where	$Z_{(L-L)hot} = \sqrt{(1.5 \times R_{(L-L)})^2 + X_{(L-L)}^2}$ $C_{min} = \begin{cases} 0.95; & U_{N(L-L)} = 400\,V \ \pm 10\,\% \\ 1.00; & otherwise \end{cases}$
$I_{Max3p} = \frac{C_{max} \times U_{N(L-L)}}{\sqrt{3}} \frac{2}{Z_{(L-L)}}$	where	$Z_{(L-L)} = \sqrt{R_{(L-L)}^2 + X_{(L-L)}^2}$ $C_{max} = \begin{cases} 1.05; & U_{N(L-L)} = 400\,V \ \pm 10\,\% \\ 1.10; & otherwise \end{cases}$

4.13 Z line mΩ – High precision line impedance and prospective short-circuit current



A 1143 **MI 3143 or MI 3144**

Figure 4.46: Z line mΩ menu

Measurement parameters / limits

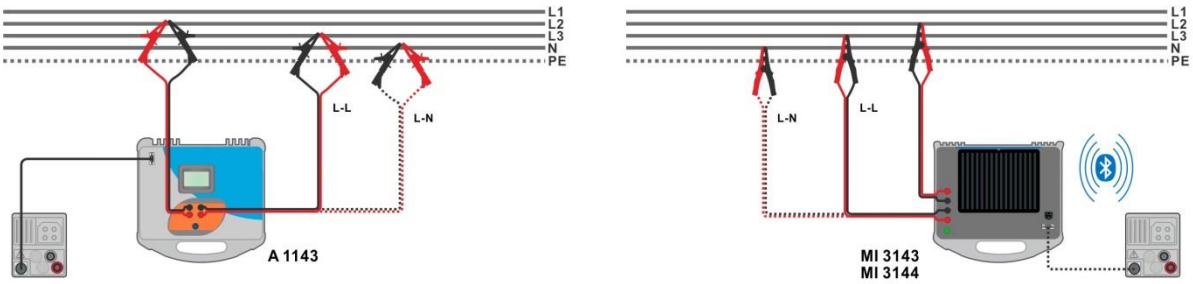
Fuse Type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
Ia(Ipsc)	**Minimum short circuit current for selected fuse or custom value**
Test [1)]	**Test** [-, L/N, L/L, L1/N, L2/N, L3/N, L1/L2, L1/L3, L2/L3]
Un[2)]	Test=[-, L/N, L1/N, L2/N, L3/N]: **Nominal voltage** [Custom, 110 V, 115 V, 127 V, 220 V, 230 V, 240 V, 290 V, 400 V] Test=[L/L, L1/L2, L1/L3, L2/L3]: **Nominal voltage** [Custom, 190 V, 200 V, 220 V, 380 V, 400 V, 415 V, 500 V, 690 V]
Tolerance[2)]	**MI 3143 & MI 3144: Nominal voltage tolerance** [6 %, 10 %]
Test Load[2)]	**MI 3143: Test Load** [33.3 %, 66.6 %, 100 %] **MI 3144: Test Load** [16.6 %, 33.3 %, 50.0 %, 66.6 %, 83.3 %, 100 %]
Average[2)]	**MI 3143 & MI 3144: Average** [Off, 2, 4, 6]
Isc factor[2)]	**Isc factor** [Custom, 0.20 ... 3.00]

1) The measuring results (for phase – neutral or phase – phase line) are set according to the setting. The parameter is meant for documentation.

2) Parameter is available only if MI 3143 or MI 3144 Euro Z instrument is selected.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

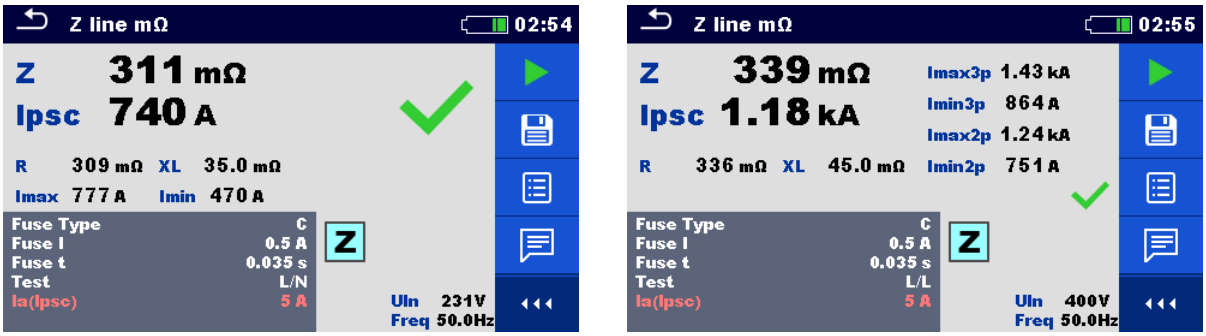


Connection of A 1143 **Connection of MI 3143 or MI 3144**

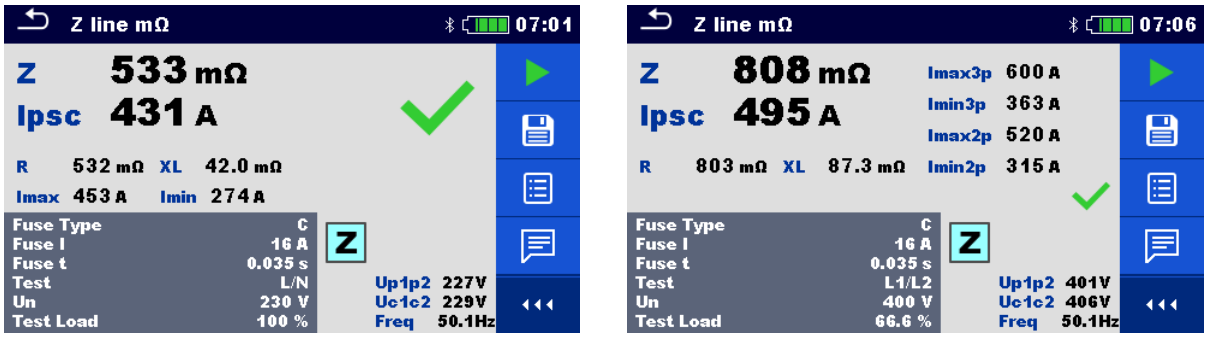
Figure 4.47: Phase-neutral or phase-phase high precision Line impedance measurement

Measurement procedure

- Connect MI 3152(H) instrument with A 1143, MI 3143 or MI 3144 Euro Z adapter / instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **Z line mΩ** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3143 or MI 3144 Euro Z instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads to A 1143, MI 3143 or MI 3144 Euro Z adapter / instrument.
- Connect test leads to the object under test, see ***Figure 4.47***.
- Start the measurement using  or  button.
- Save results (optional).



Result screens using A 1143



Result screens using MI 3143 or MI 3144

Figure 4.48: Examples of high precision Line impedance measurement result

Measurement results / sub-results

Z	Line impedance
Ipsc	Standard prospective short-circuit current
Imax	Maximal prospective short-circuit current
Imin	Minimal prospective short-circuit current
Imax2p	Maximal two-phases prospective short-circuit current
Imin2p	Minimal two-phases prospective short-circuit current
Imax3p	Maximal three-phases prospective short-circuit current
Imin3p	Minimal three-phases prospective short-circuit current
R	Resistance of line impedance
XL	Reactance of line impedance

Voltage monitor using A 1143:

Uln	Voltage L-N or L-L
Freq	Frequency

Voltage monitor using MI 3143 or MI 3144:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***A 1143 – Euro Z 290 A, MI 3143 – Euro Z 440 V*** and ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

4.14 High Current (MI 3143 and MI 3144)

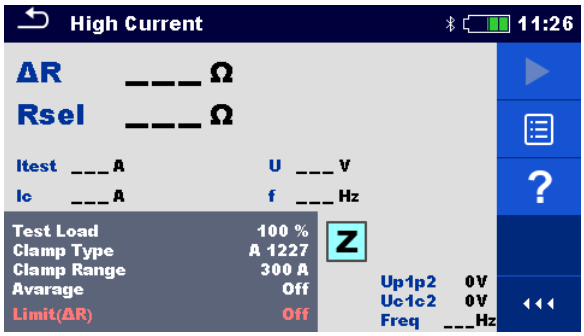


Figure 4.49: High Current menu

Measurement parameters / limits

Test Load	**MI 3143: Test load** [33.3 %, 66.6 %, 100 %] **MI 3144: Test load** [16.6 %, 33.3 %, 50.0 %, 66.6 %, 83.3 %, 100 %]
Clamp Type[1)]	**Clamp type** [A 1227, A 1281, A 1609]
Clamp Range[1)]	**Range @ A 1227, A 1609** [30 A, 300 A, 3000 A] **Range @ A 1281** [0.5 A, 5 A, 100 A, 1000 A]
Average	**Average** [Off, 2, 4, 6]
Limit (ΔR)	**Limit** [Off, Custom, 0.01 Ω … 19 Ω]

1) Measurement with current clamps is supported by **MI 3144 – Euro Z 800 V** instrument only.

Connection diagram

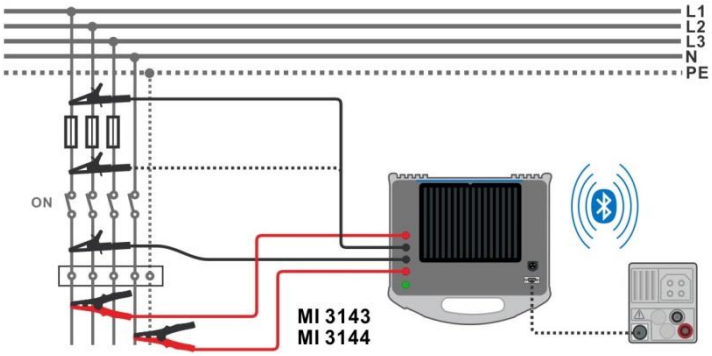


Figure 4.50: High Current resistance measurement

Measurement procedure

- Connect MI 3152(H) instrument with A 1143, MI 3143 or MI 3144 Euro Z adapter / instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **High Current** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3143 or MI 3144 Euro Z instrument is connected to MI 3152(H) instrument via Bluetooth communication.

- Connect test leads to MI 3143 or MI 3144 Euro Z instrument.
- Connect test leads to the object under test. See ***Figure 4.50***.
- Refer to ***MI 3143 – Euro Z 440 V*** or ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

- Start the measurement using ▶ or button.
- Save results (optional).

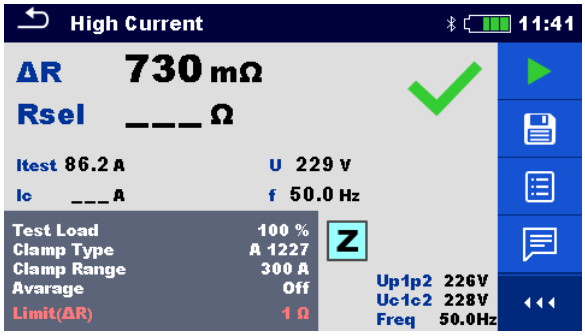


Figure 4.51: Example of High Current measurement result

Measurement results / sub-results

ΔR	Resistance
Rsel[1)]	Resistance (calculated from Clamp current)
Itest	Test current
Ic[1)]	Clamp current
U	Voltage
f	Frequency

[1)] Measurement with current clamps is supported by **MI 3144 – Euro Z 800 V** instrument only.

Voltage monitor:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***MI 3143 – Euro Z 440 V*** and ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

4.15 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).

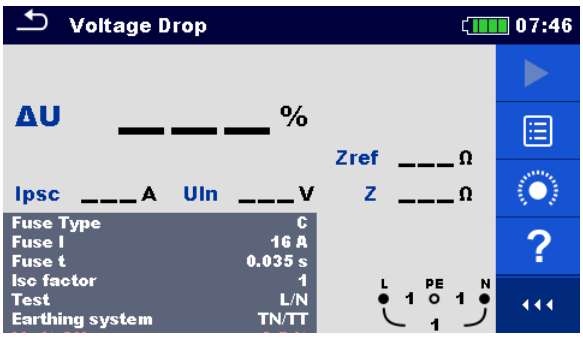


Figure 4.52: Voltage drop menu

Measurement parameters / limits

Fuse Type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Test [2)]	**Test** [Off, L-N, L/L, L1-N, L2-N, L3-N, L1-L2, L1-L3, L2-L3]
Earthing system	Refer to *Instruction manual* for more information.
Limit(ΔU)	**Maximum voltage drop** [Off, Custom, 3.0 % … 9.0 %]

1) Applicable if Fuse type is set to Off or Custom

2) With Plug test cable or Plug commander Voltage drop is measured in the same way regardless of the setting. The parameter is meant for documentation.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

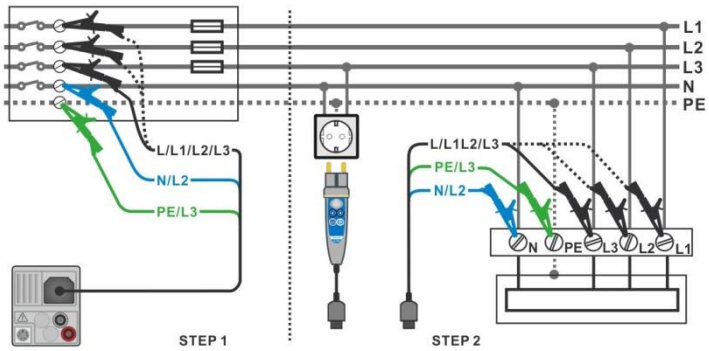


Figure 4.53: Voltage drop measurement – connection of Plug commander and 3-wire test lead

Measurement procedure

STEP 1: Measuring the impedance Zref at origin

- Enter the **Voltage Drop** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to the origin of electrical installation, see ***Figure 4.53***.
- Touch or select the icon to initiate Zref measurement.
- Press the button to measure Zref.

STEP 2: Measuring the Voltage drop

- Enter the **Voltage Drop** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the tested points, see ***Figure 4.53***.
- Start the measurement.
- Save results (optional).

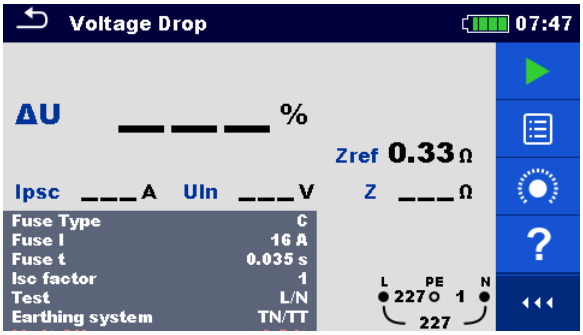


Figure 4.54: Example of Zref measurement result (STEP 1)

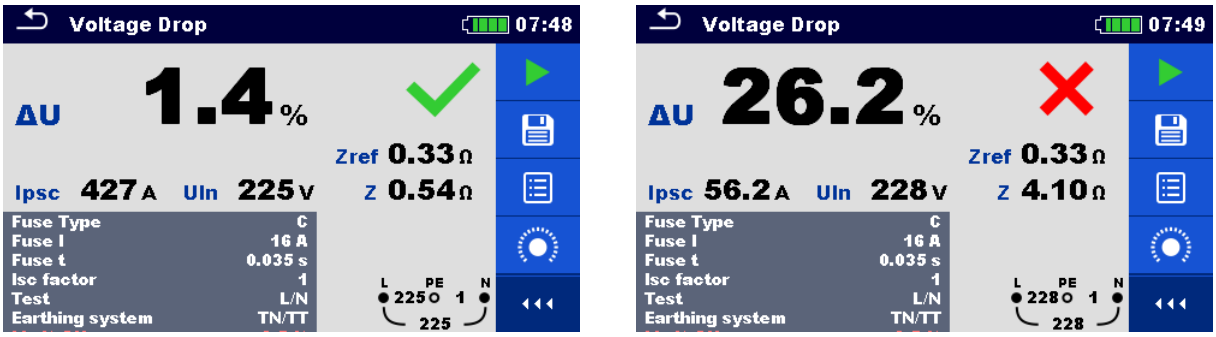


Figure 4.55: Examples of Voltage drop measurement result (STEP 2)

Measurement results / sub-results

ΔU	Voltage drop
Ipsc	Prospective short-circuit current
Un	Voltage L-N
Zref	Reference line impedance
Z	Line 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
Zref	Impedance at reference point (at origin)
Z	Impedance at test point
U_n	Nominal voltage
I_n	Rated current of selected fuse (Fuse I) or custom value I (ΔU)

U_n	**Input voltage range (L-N or L-L)**
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)

Table 4.6: Relation between Input voltage – $U_{L-N(L)}$ and nominal voltage – U_n used for calculation

4.16 Utouch – Touch voltage (MI 3143 and MI 3144)

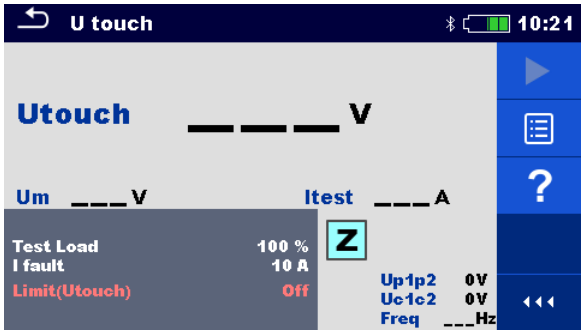


Figure 4.56: Touch voltage menu

Measurement parameters / limits

Test Load	**MI 3143: Test load** [33.3 %, 66.6 %, 100 %] **MI 3144: Test load** [16.6 %, 33.3 %, 50.0 %, 66.6 %, 83.3 %, 100 %]
I fault	**Limit** [Custom, 10 A … 200 kA]
Limit (Utouch)	**Limit** [Off, Custom, 25 V, 50 V]

Connection diagram

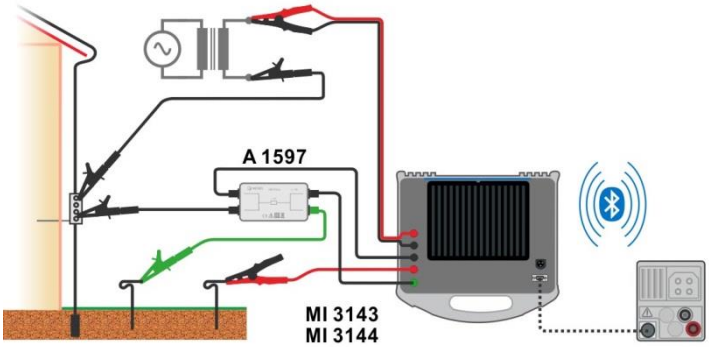


Figure 4.57: Touch voltage measurement – Connection of MI 3143 or MI 3144

Refer to ***MI 3143 – Euro Z 440 V*** and ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

Measurement procedure

- Connect MI 3152(H) instrument with MI 3143 or MI 3144 Euro Z instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **U touch** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3143 or MI 3144 Euro Z instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads and A 1597 adapter to MI 3143 or MI 3144 Euro Z instrument.
- Connect test leads to the object under test.
  Refer to ***MI 3143 Euro Z 440 V*** or ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.
- Start the measurement using  or  button.

- Save results (optional).

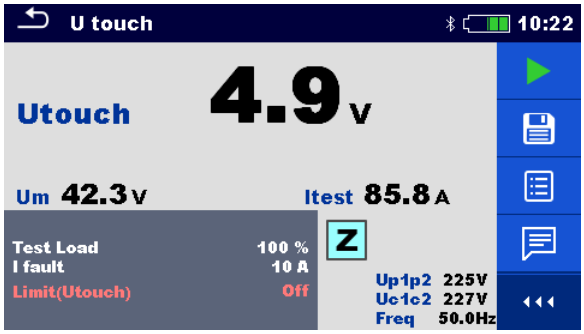


Figure 4.58: Example of Touch voltage measurement result

Measurement results / sub-results

Utouch	Calculated touch voltage
Um	Measured voltage drop
Itest	Test current

Voltage monitor:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***MI 3143 Euro Z 440 V*** and ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

4.17 Earth – Earth resistance (3-wire test)

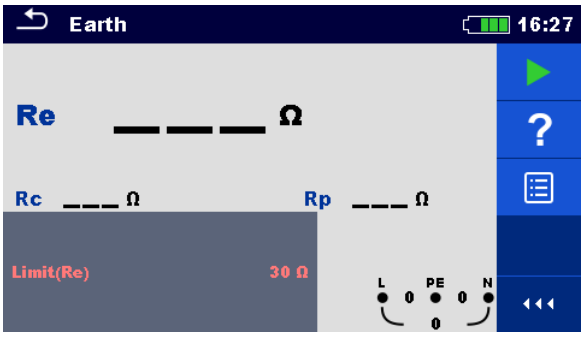


Figure 4.59: Earth menu

Measurement parameters / limits

Limit(Re)	**Maximum resistance** [Off, Custom, 1 Ω ... 5 kΩ]

Connection diagrams

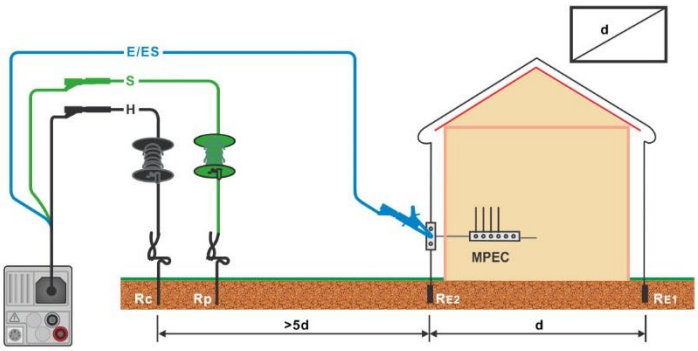


Figure 4.60: Resistance to earth, measurement of main installation earthing and lighting protection system

Measurement procedure

- Enter the **Earth** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 4.60***.
- Start the measurement.
- Save results (optional).

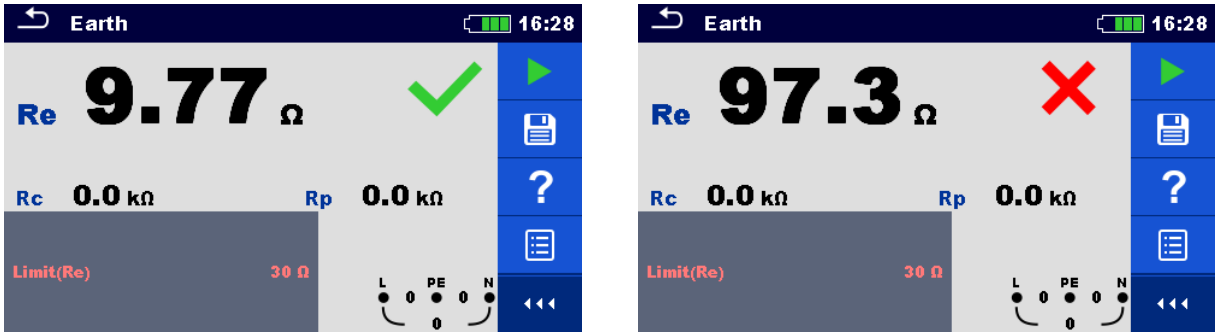


Figure 4.61: Examples of Earth resistance measurement result

Measurement results / sub-results

Re	Earth resistance
Rc	Resistance of H (current) probe
Rp	Resistance of S (potential) probe

4.18 Earth 2 clamp – Contactless earthing resistance measurement (with two current clamps)

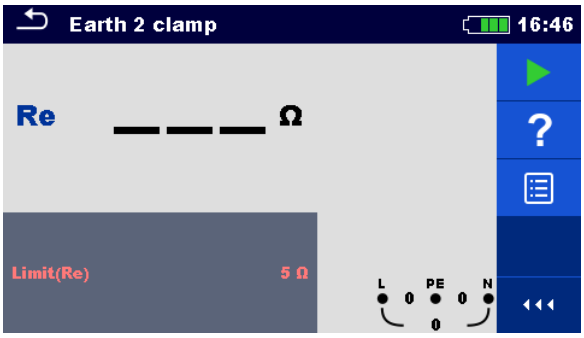


Figure 4.62: Earth 2 clamps menu

Measurement parameters / limits

Limit(Re)	**Maximum resistance** [Off, Custom, 1 Ω ... 30 Ω]

Connection diagram

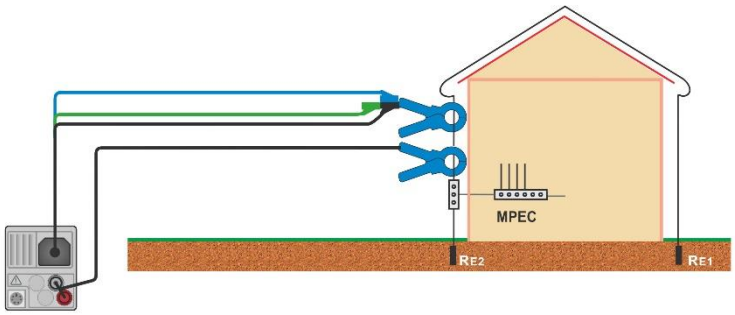


Figure 4.63: Contactless earthing resistance measurement

Measurement procedure

- Enter the **Earth 2 clamp** function.
- Set test parameters / limits.
- Connect test cable and clamps to the instrument.
- Clamp on object under test, see ***Figure 4.63***.
- Start the measurement.
- Stop the measurement.
- Save results (optional).

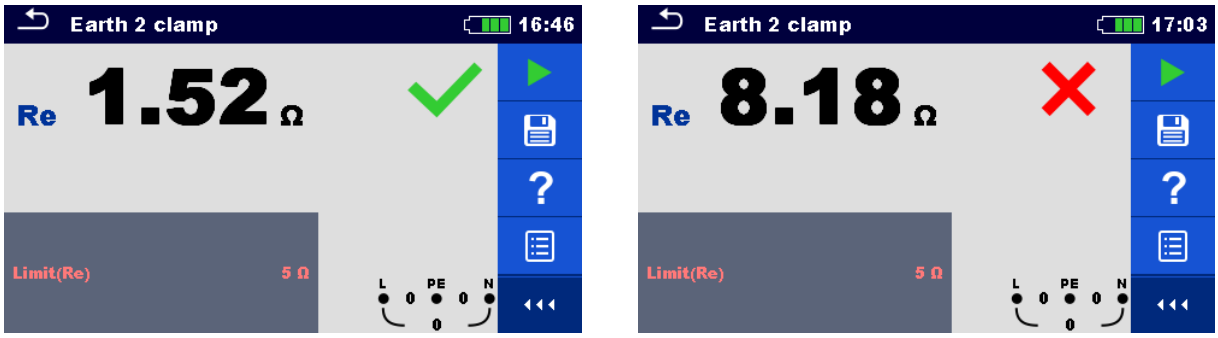


Figure 4.64: Examples of Contactless earthing resistance measurement result

Measurement results / sub-results

Re	Earth resistance

4.19 Ro – Specific earth resistance

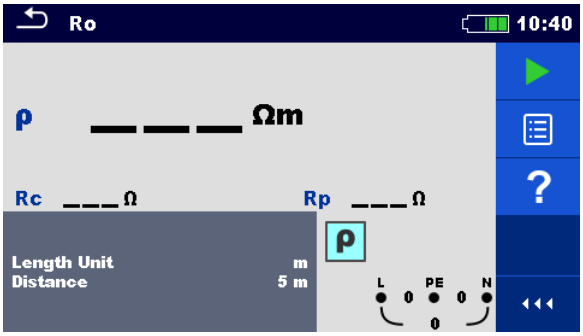


Figure 4.65: Earth Ro menu

Measurement parameters / limits

Length Unit	**Length Unit** [m, ft]
Distance	**Distance between probes** [Custom, 0.1 m ... 29.9 m or 1 ft ... 100 ft]

Connection diagram

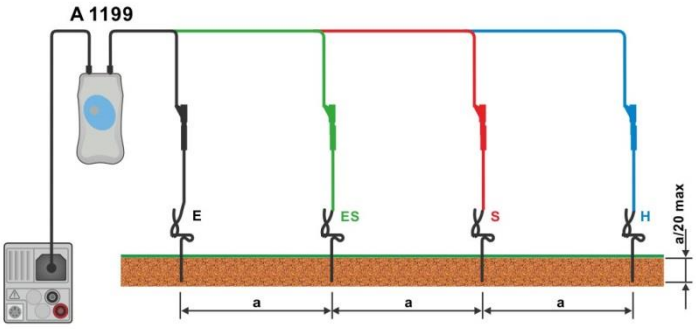


Figure 4.66: Specific earth resistance measurement

Measurement procedure

‣	Enter the **Ro** function.
‣	Set test parameters / limits.
‣	Connect A 1199 adapter to the instrument.
‣	Connect test leads to earth probes, see ***Figure 4.66***.
‣	Start the measurement.
‣	Save results (optional).

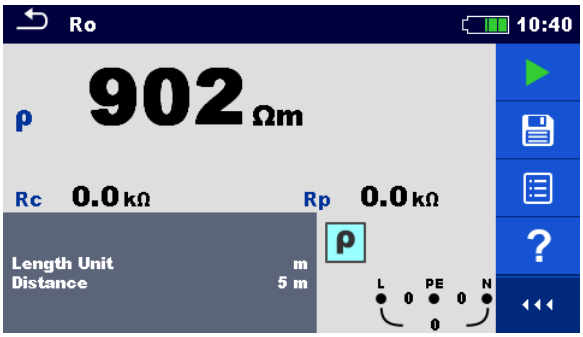


Figure 4.67: Example of Specific earth resistance measurement result

Measurement results / sub-results

ρ	Specific earth resistance
Rc	Resistance of H, E (current) probe
Rp	Resistance of S, ES (potential) probe

4.20 Power

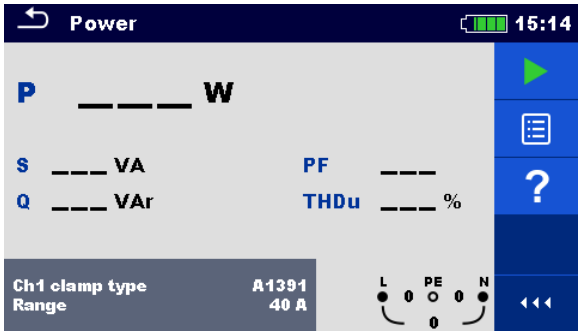


Figure 4.68: Power menu

Measurement parameters / limits

Ch1 clamp type	**Current clamp adapter** [A1018, A1019, A1391]
Range	**Range for selected current clamp adapter** A1018 [20 A] A1019 [20 A] A1391 [40 A, 300 A]

Connection diagram

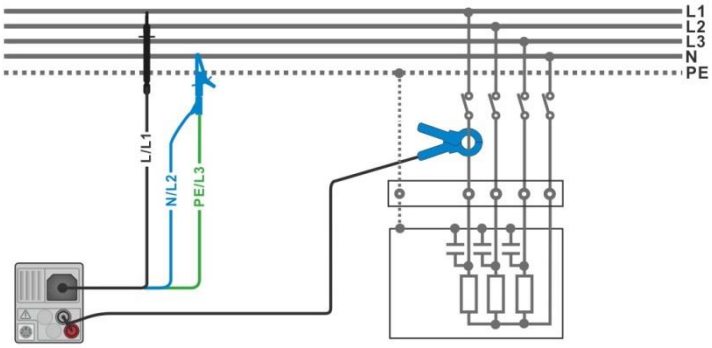


Figure 4.69: Power measurement

Measurement procedure

- Enter the **Power** function.
- Set parameters / limits.
- Connect the voltage test leads and current clamp to the instrument.
- Connect the voltage test leads and current clamp to the item to be tested (see ***Figure 4.69***).
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

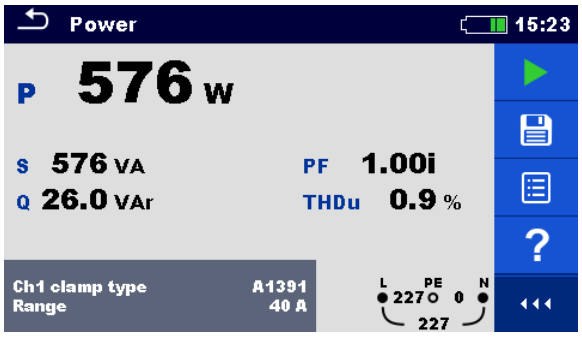


Figure 4.70: Example of Power measurement result

Measurement results / sub-results

P	Active power
S	Apparent power
Q	Reactive power (capacitive or inductive)
PF	Power factor (capacitive or inductive)
THDu	Voltage total harmonic distortion

4.21 Harmonics

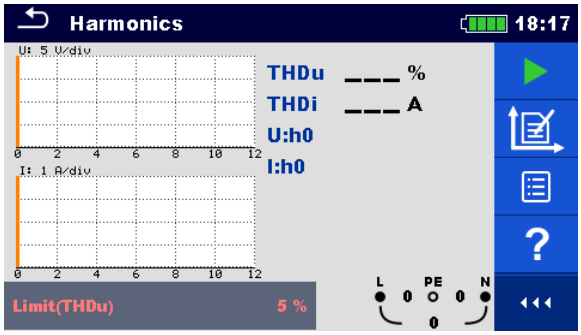


Figure 4.71: Harmonics menu

Measurement parameters / limits

Ch1 clamp type	**Current clamp adapter** [A1018, A1019, A1391]
Range	**Range for selected current clamp adapter** A1018 [20 A] A1019 [20 A] A1391 [40 A, 300 A]
Limit(THDu)	**Max. THD of voltage** [Off, Custom, 3 % ... 10 %]

Connection diagram

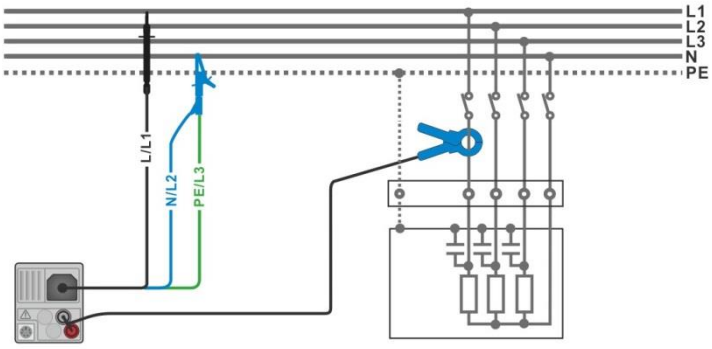
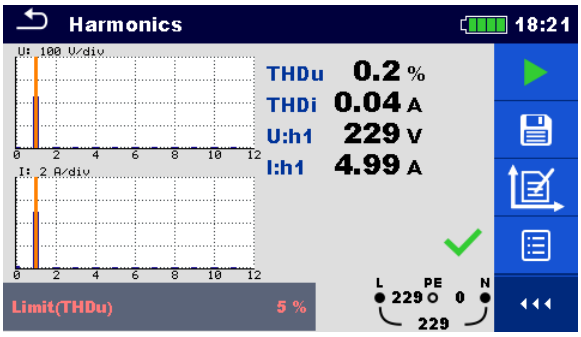


Figure 4.72: Harmonics measurement

Measurement procedure

- Enter the **Harmonics** function.
- Set parameters / limits.
- Connect voltage test leads and current clamp to the instrument.
- Connect the voltage test leads and current clamp to the item to be tested, see ***Figure 4.72***.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).



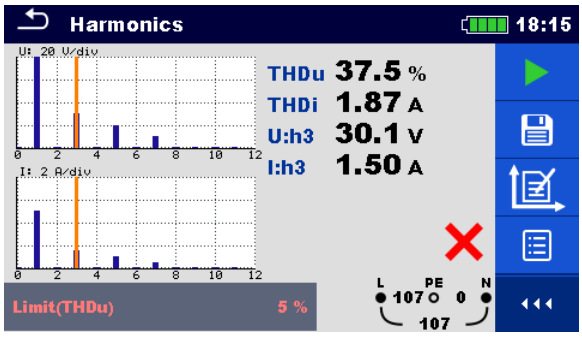


Figure 4.73: Examples of Harmonics measurement results

Measurement results / sub-results

U:h(i)	TRMS voltage of selected harmonic [h0 ... h11]
I:h(i)	TRMS current of selected harmonic [h0 ... h11]
THDu	Voltage total harmonic distortion
THDi	Current total harmonic distortion

4.22 Currents

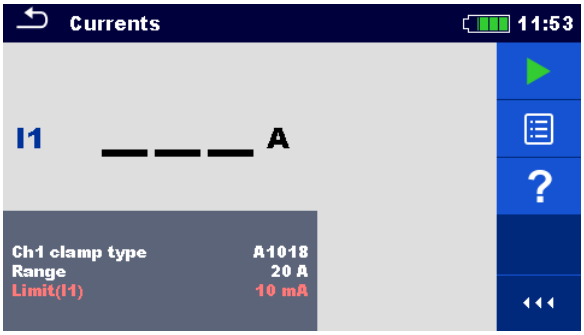


Figure 4.74: Current menu

Measurement parameters / limits

Ch1 clamp type	**Current clamp adapter** [A1018, A1019, A1391]
Range	**Range for selected current clamp adapter** A1018 [20 A] A1019 [20 A] A1391 [40 A, 300 A]
Limit(I1)	**Max. PE leakage or load current** [Off, Custom, 0.1 mA ... 100 mA]

Connection diagram

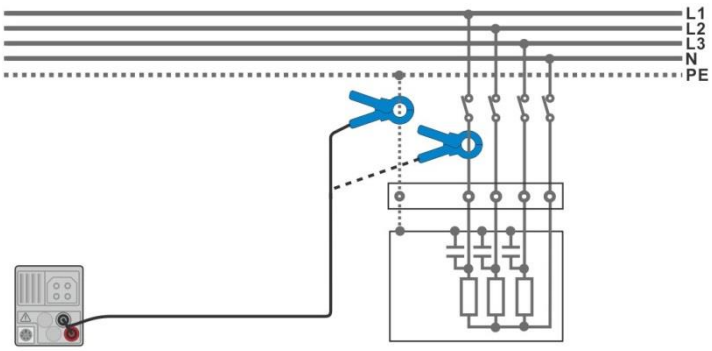


Figure 4.75: PE leakage and load current measurements

Measurement procedure

- Enter the **Currents** function.
- Set parameters / limits.
- Connect the current clamp to the instrument.
- Connect the clamp to the object under test, see ***Figure 4.75***.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

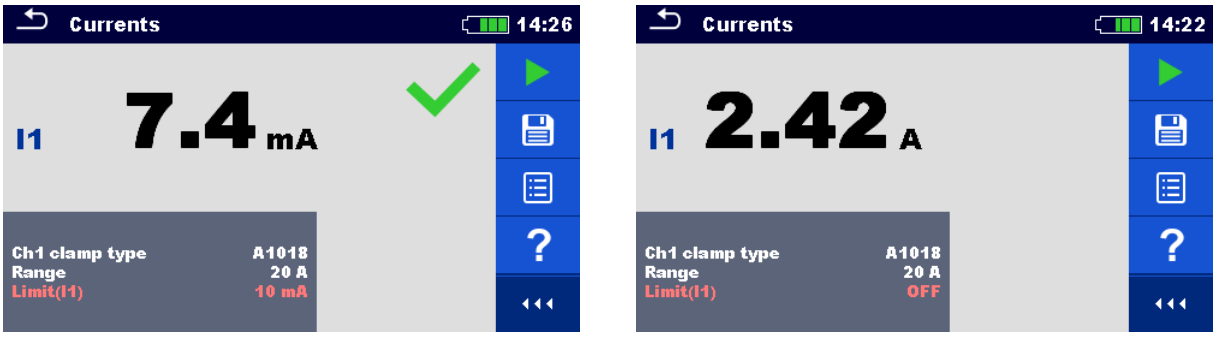


Figure 4.76: Examples of Current measurement result

Measurement results / sub-results

I1	PE leakage or load current

4.23 Current Clamp Meter (MI 3144)

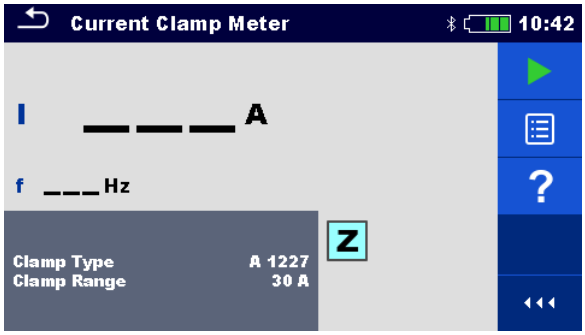


Figure 4.77: Current Clamp Meter menu

Measurement parameters / limits	
Clamp Type	**Clamp type** [A 1227, A 1281, A 1609]
Clamp Range	**Range** **Clamp type A 1227, A 1609:** [30 A, 300 A, 3000 A] **Clamp type A 1281:** [0.5 A, 5 A, 100 A, 1000 A]

Connection diagram

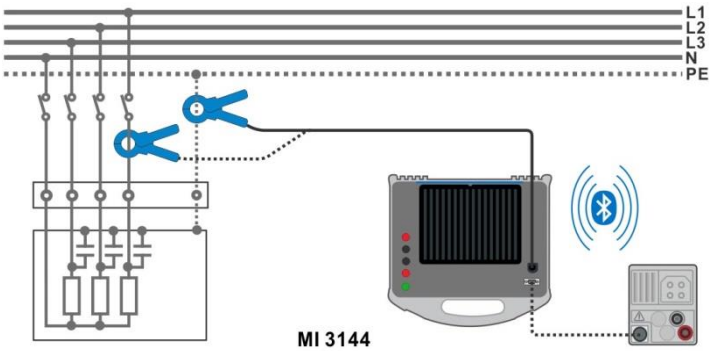


Figure 4.78: Current Clamp Meter measurement

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

Measurement procedure

- Connect MI 3152(H) instrument with MI 3144 Euro Z instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **Current Clamp Meter** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3144 Euro Z 800 V instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect current clamp to MI 3144 Euro Z 800 V instrument.
- Wrap the object under test with the measuring clamp. See ***Figure 4.78***.
  Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.
- Start the continuous measurement using  or  button.
- Stop the measurement.

- Save results (optional).

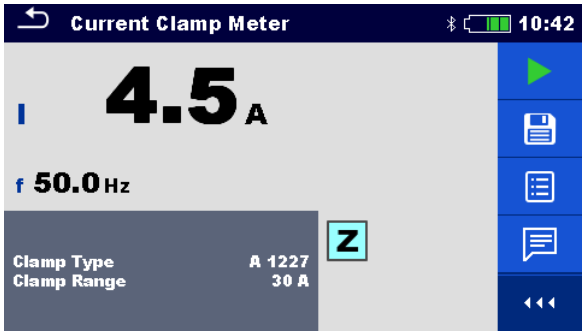


Figure 4.79: Example of Current Clamp Meter measurement result

Measurement results / sub-results

I	Current
f	Frequency

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

4.24 ISFL – First fault leakage current (MI 3152 only)

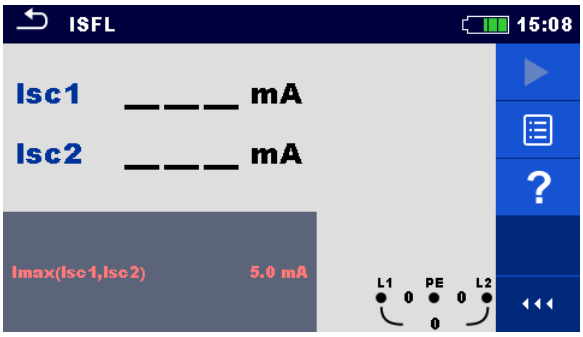


Figure 4.80: ISFL measurement menu

Measurement parameters / limits

Imax(Isc1, Isc2)	**Maximum first fault leakage current** [Off, Custom, 3.0 mA ... 19.5 mA]

Connection diagrams

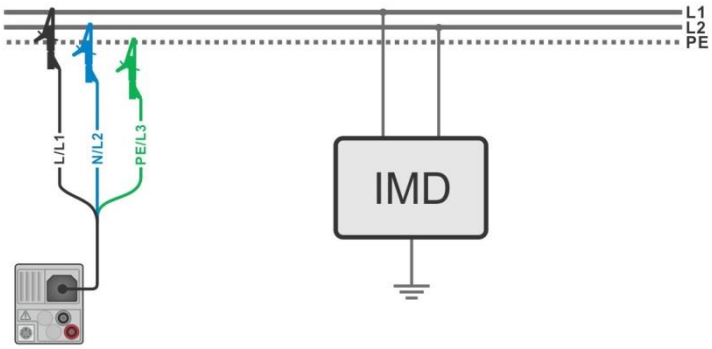


Figure 4.81: Measurement of highest First fault leakage current with 3-wire test lead

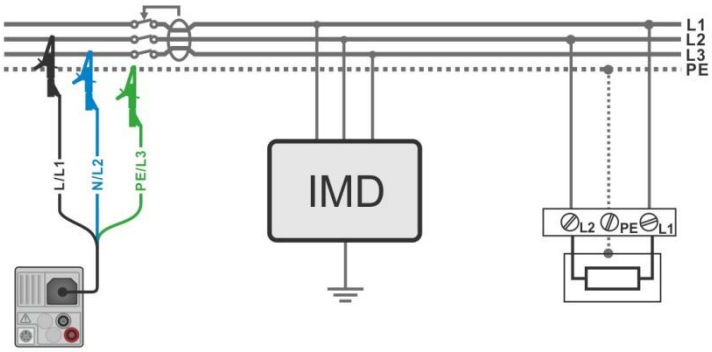


Figure 4.82: Measurement of First fault leakage current for RCD protected circuit with 3-wire test lead

Measurement procedure

- Enter the **ISFL** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 4.81*** and ***Figure 4.82***.
- Start the measurement.
- Save results (optional).

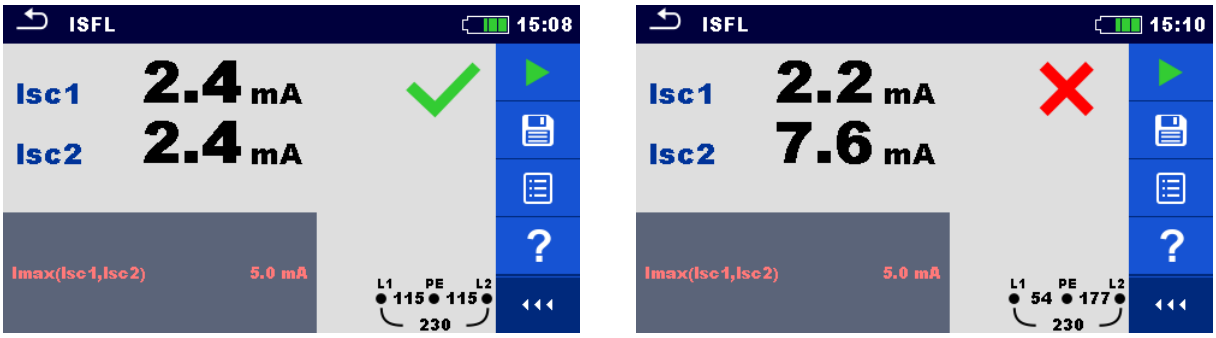


Figure 4.83: Examples of First fault leakage current measurement result

Measurement results / sub-results

Isc1	First fault leakage current at single fault between L1/PE
Isc2	First fault leakage current at single fault between L2/PE

4.25 IMD – Testing of insulation monitoring devices (MI 3152 only)

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

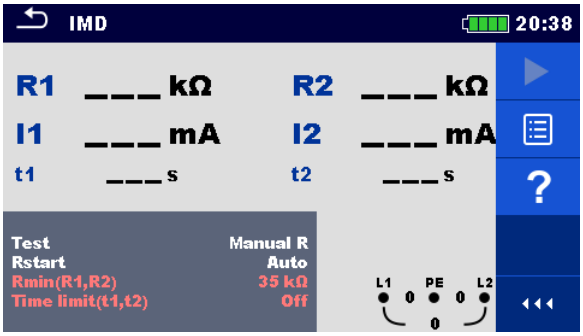


Figure 4.84: IMD test menu

Test parameters / limits

Test	**Test mode** [MANUAL R, MANUAL I, AUTO R, AUTO I]
Rstart	**Starting insulation resistance** [Auto, 5 kΩ ... 640 kΩ]
Istart	**Starting fault current** [Auto, 0.1 mA ... 19.9 mA]
t step	**Timer (AUTO R and AUTO I test modes)** [1 s ... 99 s]
Rmin(R1,R2)	**Min. insulation resistance (R_{LIMIT})** [Off, 5 kΩ ... 640 kΩ],
Imax(I1,I2)	**Max. fault current (I_{LIMIT})** [Off, 0.1 mA ... 19.9 mA]
Time limit (t1, t2)	**Max. activation / disconnection time limit** [Off, 1 s]

Connection diagram

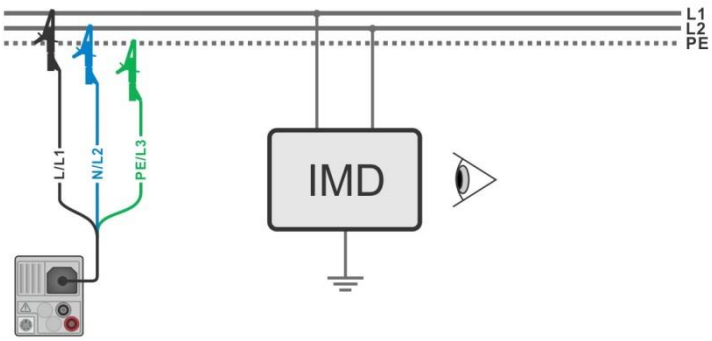


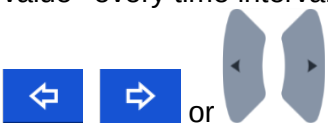
Figure 4.85: Connection with 3-wire test lead

Test procedure (MANUAL R, MANUAL I)

- Enter the **IMD** function.
- Set test parameter to MANUAL R or MANUAL I.
  Set other test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 4.85***.
- Start the measurement.
- Use the ⇦ ⇨ or ◂ ▸ keys to change insulation resistance*) until IMD alarms an insulation failure for L1.
- Press ▸▸ or the key to change line terminal selection to L2.
  (If IMD switches off voltage supply, instrument automatically changes line terminal selection to L2 and proceeds with the test when supply voltage is detected.)
- Use the ⇦ ⇨ or ◂ ▸ keys to change insulation resistance*) until IMD alarms an insulation failure for L2.
- Press the ▸▸ or the key.
  (If IMD switches off voltage supply, instrument automatically proceeds to the PASS / FAIL / NO STATUS indication.)
- Use ✓✕ to select PASS / FAIL / NO STATUS indication.
- Press ▸▸ or the key to confirm selection and complete the measurement.
- Save results (optional).

Test procedure (AUTO R, AUTO I)

- Enter the **IMD** function.
- Set test parameter to AUTO R or AUTO I.
- Set other test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 4.85***.
- Start the 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 ⇦ ⇨ or ◂ ▸ keys until IMD alarms an insulation failure for L1.
- Press ▸▸ or the key to change line terminal selection to L2.
  (If IMD switches off voltage supply, instrument automatically changes line terminal selection to L2 and proceeds with the test when supply voltage is detected.)

- 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  or the  key.
  If IMD switches off voltage supply, instrument automatically proceeds to the PASS / FAIL / NO STATUS indication.
- Use  to select PASS / FAIL / NO STATUS indication.
- Press  or the  key to confirm selection and complete the measurement.
- Save results (optional).

*) Starting and ending insulation resistances are determined by selection of IMD test sub-function and test parameters. See tables below:

Sub-function	Rstart parameter	Starting insulation resistance value	Ending insulation resistance value
MANUAL R	Auto	$R_{START} \cong 1.5 \times R_{LIMIT}$	-
	[5 kΩ ... 640 kΩ]	$R_{START} = Rstart$	-
AUTO R	Auto	$R_{START} \cong 1.5 \times R_{LIMIT}$	$R_{END} \cong 0.5 \times R_{LIMIT}$
	[5 kΩ ... 640 kΩ]	$R_{START} = Rstart$	$R_{END} \cong 0.5 \times R_{START}$

Table 4.7: Starting / ending insulation resistance values for MANUAL R and AUTO R sub-functions

Sub-function	Istart parameter	Starting insulation resistance value	Ending insulation resistance value
MANUAL I	Auto	$R_{START} \cong 1.5 \times \frac{U_{L1-L2}}{I_{LIMIT}}$	-
	[0.1 mA ... 19.9 mA]	$R_{START} \cong \frac{U_{L1-L2}}{I_{start}}$	-
AUTO I	Auto	$R_{START} \cong 1.5 \times \frac{U_{L1-L2}}{I_{LIMIT}}$	$R_{END} \cong 0.5 \times \frac{U_{L1-L2}}{I_{LIMIT}}$
	[0.1 mA ... 19.9 mA]	$R_{START} \cong \frac{U_{L1-L2}}{I_{start}}$	$R_{END} \cong 0.5 \times \frac{U_{L1-L2}}{I_{start}}$

Table 4.8: Starting / ending insulation resistance values for MANUAL I and AUTO I sub-functions

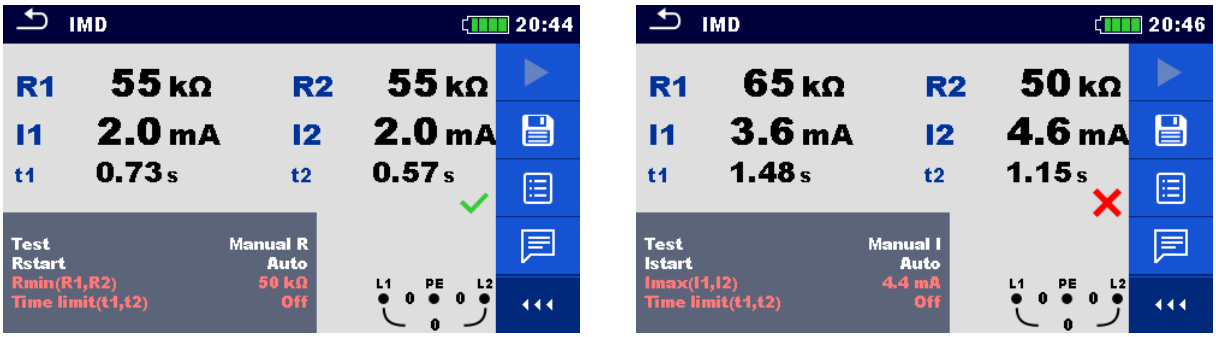


Figure 4.86: Examples of IMD test result

Test results / sub-results

R1	Threshold insulation resistance between L1-PE
I1	Calculated first fault leakage current for R1
t1	Activation / disconnection time of IMD for R1
R2	Threshold insulation resistance between L2-PE
I2	Calculated first fault leakage current for R2
t2	Activation / disconnection time of IMD for R2

Calculated first fault leakage current at threshold insulation resistance is given as $I_{1(2)} = \frac{U_{L1-L2}}{R_{1(2)}}$, where $U_{L1\text{-}L2}$ 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.

If any of the activation / disconnection time result (t1, t2) is out of set limit, overall status of the test is “failed” and cannot be modified manually. Otherwise overall status can be user defined.
If activation of IMD device is visual indication and/or audio alert, without voltage disconnection, Time limit (t1, t2) parameter should be set to “Off” to disable timing limitation.

4.26 Rpe – PE conductor resistance

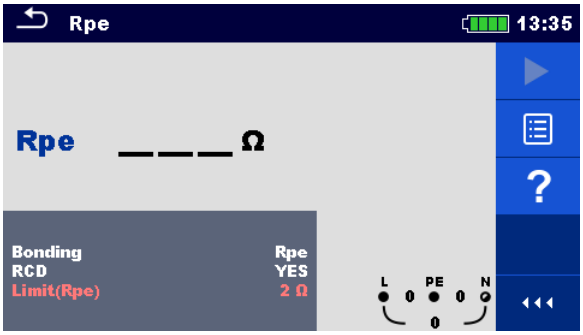


Figure 4.87: PE conductor resistance measurement menu

Measurement parameters / limits

Bonding	[Rpe, Local]
RCD	[Yes, No]
Limit(Rpe)	**Max. resistance** [Off, Custom, 0.1 Ω ... 20.0 Ω]

Connection diagram

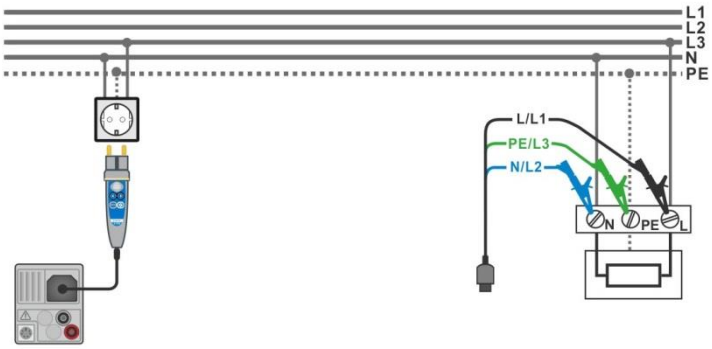


Figure 4.88: Connection of Plug commander and 3-wire test lead

Measurement procedure

- Enter the **Rpe** function.
- Set test parameters / limits.
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.88***.
- Start the measurement.
- Save results (optional).

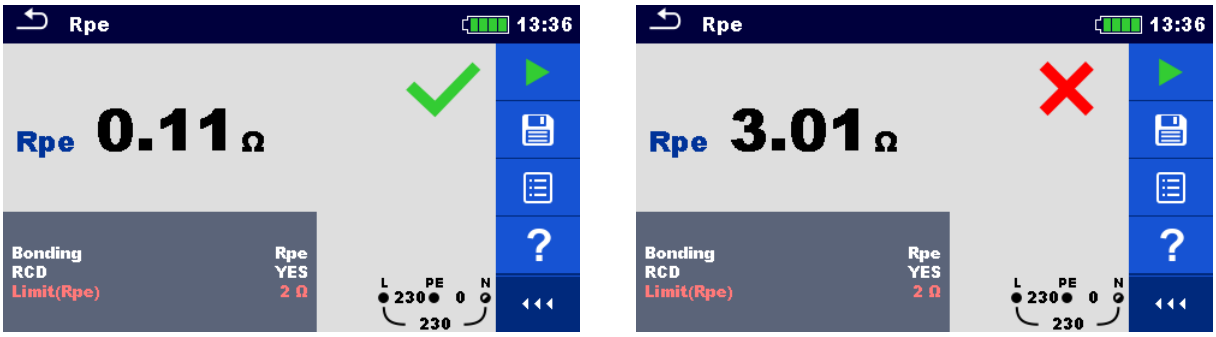


Figure 4.89: Examples of PE conductor resistance measurement result

Measurement results / sub-results

Rpe	PE conductor resistance

4.27 Ilumination

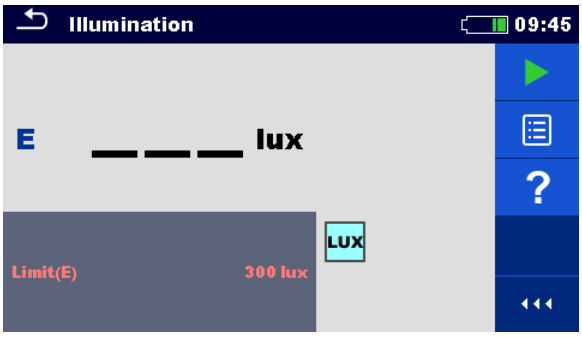


Figure 4.90: Illumination measurement menu

Measurement parameters / limits

Limit(E)	**Minimum illumination** [Off, Custom, 0.1 lux ... 20 klux]

Probe positioning

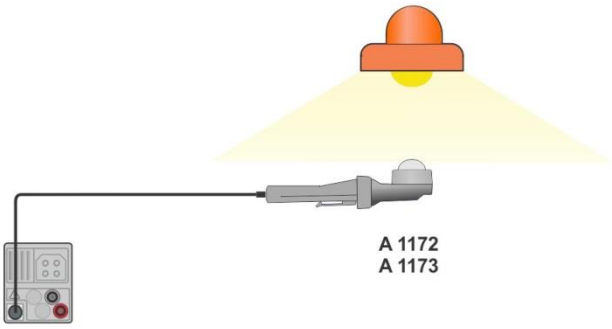


Figure 4.91: LUXmeter probe positioning

Measurement procedure

- Enter the **Illumination** function.
- Set test parameters / limits.
- Connect illumination sensor A 1172 or A 1173 to the instrument.
- Take the position of LUXmeter probe, see ***Figure 4.91***.
  Make sure that LUXmeter probe is turned on.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

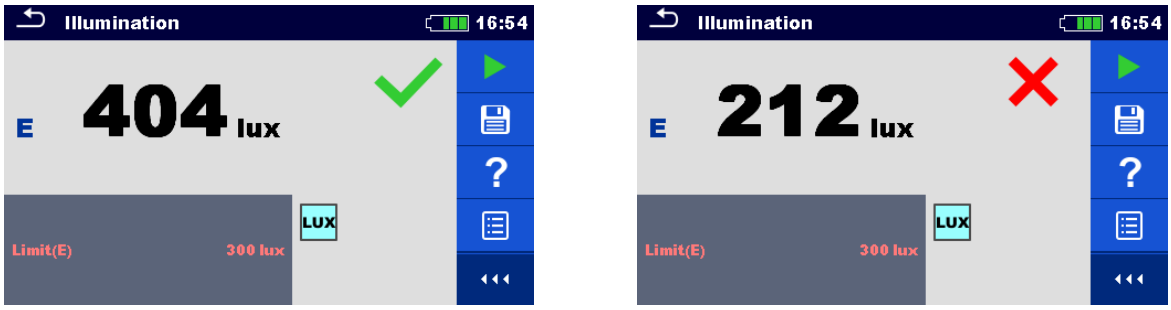


Figure 4.92: Examples of Illumination measurement result

Measurement results / sub-results

E	Illumination

4.28 AUTO TT – Auto test for TT earthing system

Tests / measurements implemented in AUTO TT

Voltage
Z line
Voltage Drop
Zs rcd
RCD Uc

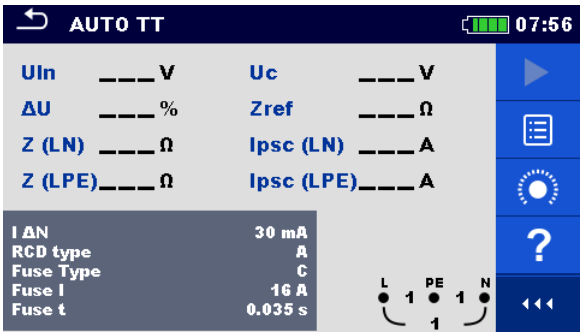


Figure 4.93: AUTO TT menu

Measurement parameters / limits

I ΔN	**Rated RCD residual current sensitivity** [10 mA, 15 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]
Type	**RCD type** [AC, A, F, B*, B+*]
Selectivity	**Characteristic** [G, S]
Fuse type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
I test	**Test current** [Standard, Low]
Limit(ΔU)	**Maximum voltage drop** [Off, Custom, 3.0 % ... 9.0 %]
Limit Uc	**Conventional touch voltage limit** [Custom, 12 V, 25 V, 50 V]
Ia(Ipsc (LN))	**Minimum short circuit current for selected fuse or custom value**

[1)] Applicable if Fuse type is set to Off or Custom.

* Model MI 3152 only.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

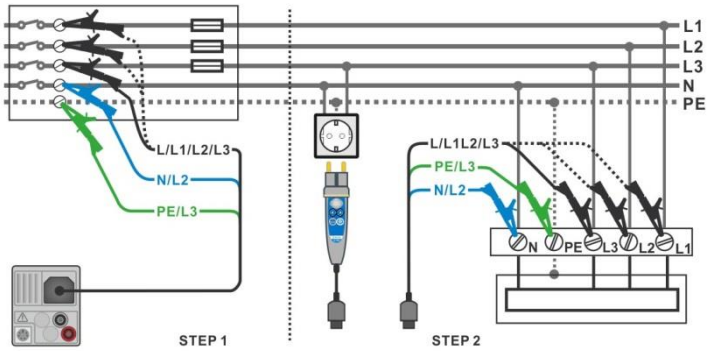


Figure 4.94: AUTO TT measurement

Measurement procedure

- Enter the **AUTO TT** function.
- Set test parameters / limits.
- Measure the impedance Zref at origin (optional), see chapter ***4.15 Voltage Drop.***
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.94***.
- Start the Auto test.
- Save results (optional).

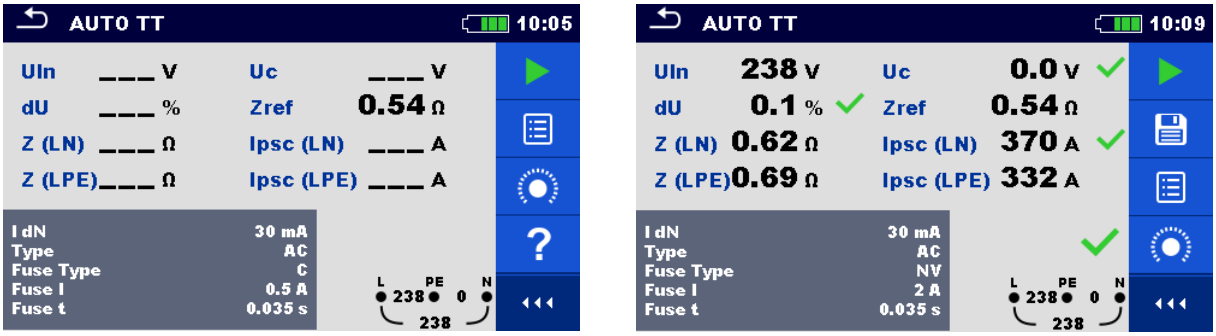


Figure 4.95: Examples of AUTO TT measurement results

Measurement results / sub-results

Uln	Voltage between phase and neutral conductors
ΔU	Voltage drop
Z (LN)	Line impedance
Z (LPE)	Loop impedance
Uc	Contact voltage
Zref	Reference Line impedance
Ipsc (LN)	Prospective short-circuit current
Ipsc (LPE)	Prospective fault current

4.29 AUTO TN (RCD) – Auto test for TN earthing system with RCD

Tests / measurements implemented in AUTO TN (RCD)

Voltage
Z line
Voltage Drop
Zs rcd
Rpe rcd

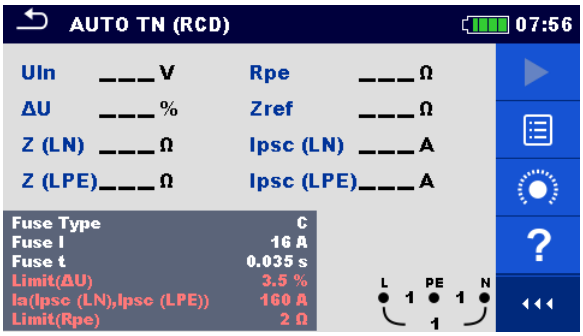


Figure 4.96: AUTO TN (RCD) menu

Measurement parameters / limits

Fuse type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
I test	**Test current** [Standard, Low]
Limit(ΔU)	**Maximum voltage drop** [Off, Custom, 3.0 % ... 9.0 %]
Limit (Rpe)	**Max. resistance** [Off, Custom, 0.1 Ω ... 20.0 Ω]
Ia(Ipsc (LN), Ipsc (LPE))	**Minimum short circuit current for selected fuse or custom value**

[1)] Applicable if Fuse type is set to Off or Custom.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

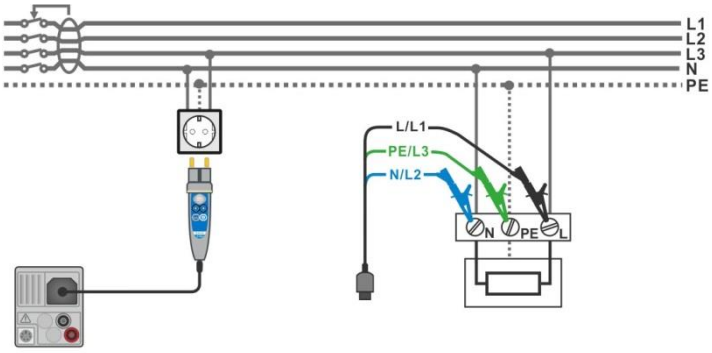


Figure 4.97: AUTO TN (RCD) measurement

Measurement procedure

- Enter the **AUTO TN (RCD)** function.
- Set test parameters / limits.
- Measure the impedance Zref at origin (optional), see chapter ***4.15 Voltage Drop.***
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.97***.
- Start the Auto test.
- Save results (optional).

Figure 4.98: Examples of AUTO TN (RCD) measurement results

Measurement results / sub-results

Uln	Voltage between phase and neutral conductors
ΔU	Voltage drop
Z (LN)	Line impedance
Z (LPE)	Loop impedance
Rpe	PE conductor resistance
Zref	Reference Line impedance
Ipsc (LN)	Prospective short-circuit current
Ipsc (LPE)	Prospective fault current

4.30 AUTO TN – Auto test for TN earthing system without RCD

Tests / measurements implemented in AUTO TN

Voltage
Z line
Voltage Drop
Z loop
Rpe

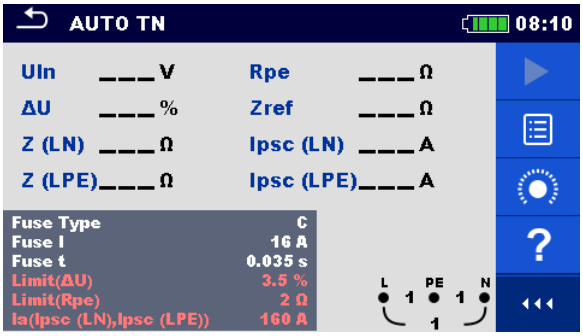


Figure 4.99: AUTO TN menu

Measurement parameters / limits

Fuse type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Limit(ΔU)	**Maximum voltage drop** [Off, Custom, 3.0 % ... 9.0 %]
Limit(Rpe)	**Max. resistance** [Off, Custom, 0.1 Ω ... 20.0 Ω]
Ia(Ipsc (LN), Ipsc (LPE))	**Minimum short circuit current for selected fuse or custom value**

[1)] Applicable if Fuse type is set to Off or Custom.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

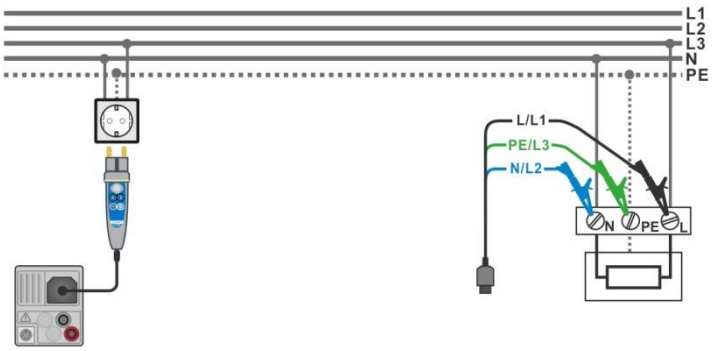


Figure 4.100: AUTO TN measurement

Measurement procedure

- Enter the **AUTO TN** function.
- Set test parameters / limits.
- Measure the impedance Zref at origin (optional), see chapter ***4.15 Voltage Drop.***
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.100***.
- Start the Auto test.
- Save results (optional).

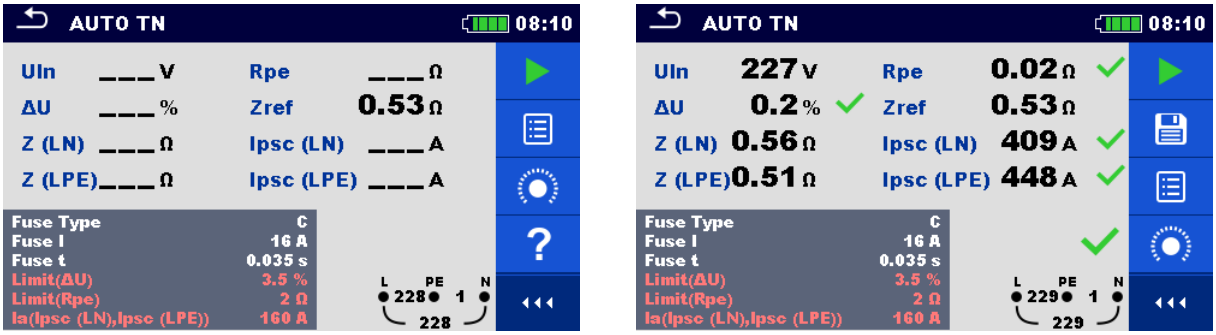


Figure 4.101: Examples of AUTO TN measurement results

Measurement results / sub-results

Uln	Voltage between phase and neutral conductors
ΔU	Voltage drop
Z (LN)	Line impedance
Z (LPE)	Loop impedance
Rpe	PE conductor resistance
Zref	Reference Line impedance
Ipsc (LN)	Prospective short-circuit current
Ipsc (LPE)	Prospective fault current

4.31 AUTO IT – Auto test for IT earthing system (MI 3152 only)

Tests / measurements implemented in AUTO IT

Voltage
Z line
Voltage Drop
ISFL
IMD

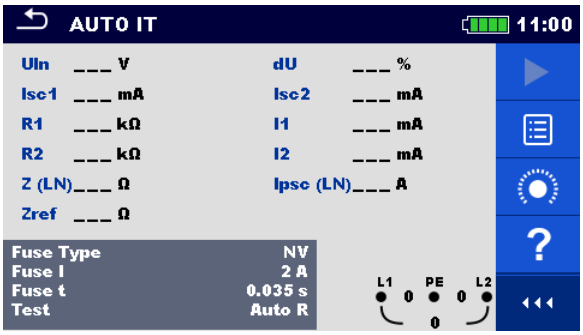


Figure 4.102: AUTO IT menu

Measurement parameters / limits

Fuse type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Test	**Test mode** [MANUAL R, MANUAL I, AUTO R, AUTO I]
t step	**Timer (AUTO R and AUTO I test modes)** [1 s … 99 s]
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
Limit(dU)	**Maximum voltage drop** [Off, Custom, 3.0 % ... 9.0 %]
Rmin(R1,R2)	**Min. insulation resistance** [Off, 5 kΩ … 640 kΩ],
Imax(I1,I2)	**Max. fault current** [Off, 0.1 mA ... 19.9 mA]
Imax(Isc1,Isc2)	**Maximum first fault leakage current** [Off, Custom, 3.0 mA ... 19.5 mA]
Ia(Ipsc (LN))	**Minimum short circuit current for selected fuse or custom value**

1) Applicable if Fuse type is set to Off or Custom.

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

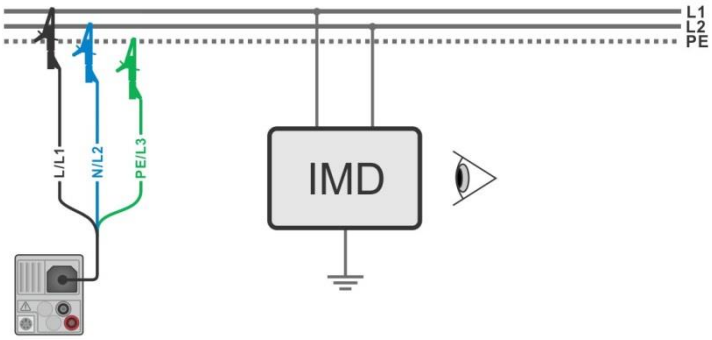
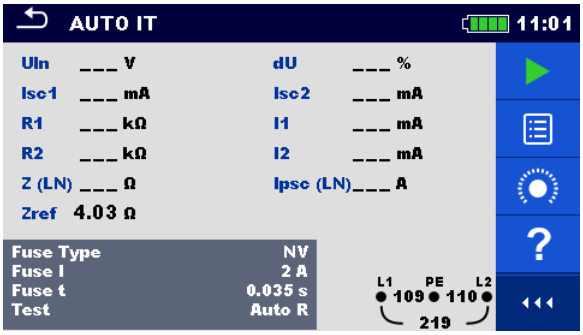


Figure 4.103: AUTO IT measurement

Measurement procedure

- Enter the **AUTO IT** function.
- Set test parameters / limits.
- Measure the impedance Zref at origin (optional), see chapter ***4.15 Voltage Drop.***
-
- Connect test cable to the instrument.
- Connect test leads to the object under test, see ***Figure 4.103***.
- Start the Auto test.
- Save results (optional).



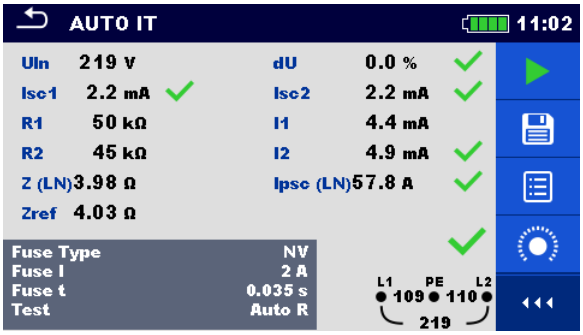


Figure 4.104: Examples of AUTO IT measurement results

Measurement results / sub-results

Uln	Voltage between phases L1 and L2
ΔU	Voltage drop
Isc1	First fault leakage current at single fault between L1/PE
Isc2	First fault leakage current at single fault between L2/PE
R1	Threshold insulation resistance between L1-PE
R2	Threshold insulation resistance between L2-PE
I1	Calculated first fault leakage current for R1
I2	Calculated first fault leakage current for R2
Z (LN)	Line impedance
Zref	Reference Line impedance
Ipsc (LN)	Prospective short-circuit current

4.32 Z auto - Auto test for fast line and loop testing

Tests / measurements implemented in Z auto test sequence

Voltage
Z line
Voltage Drop
Zs rcd
Uc

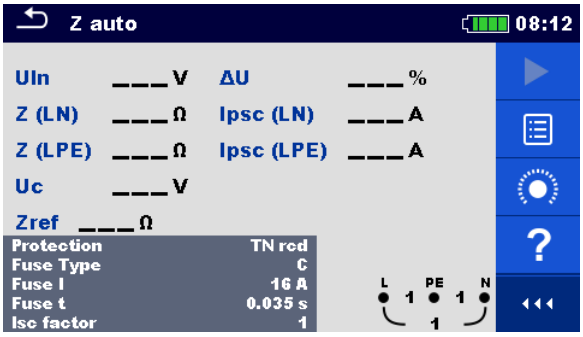


Figure 4.105: Z auto menu

Measurement parameters / limits

Protection	**Protection type** [TN, TNrcd, TTrcd]
Fuse type	**Selection of fuse type** [Off, Custom, gG, NV, B, C, D, K]
Fuse I	**Rated current of selected fuse**
Fuse t	**Maximum breaking time of selected fuse**
I (ΔU) [1)]	**Rated current for ΔU measurement (custom value)**
Isc factor	**Isc factor** [Custom, 0.20 ... 3.00]
I test	**Test current** [Standard, Low]
Type	**RCD type** [AC, A, F, B*, B+*,F]
I ΔN	**Rated RCD residual current sensitivity** [10 mA, 15 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA]
Selectivity	**Characteristic** [G, S]
Phase [2)]	**Selection of test** [-, L1, L2, L3]
I test	**Test current** [Standard, Low]
Limit(ΔU)	**Maximum voltage drop** [Off, Custom, 3.0 % ... 9.0 %]
Ia(Ipsc (LN), Ipsc (LPE)) [3)]	**Minimum short circuit current for selected fuse or custom value**
Limit Uc	**Conventional touch voltage limit** [Custom, 12 V, 25 V, 50 V]

1) Applicable if Fuse type is set to Off or Custom.
2) With Plug test cable or Plug commander Z auto test is measured in the same way regardless of the setting. The parameter is meant for documentation.
3) Ipsc (LPE) is considered if Protection is set to TN or TNrcd. Ipsc(LN) is always considered.

* Model MI 3152 only

Refer to ***Fuse tables guide*** for detailed information on fuse data.

Connection diagram

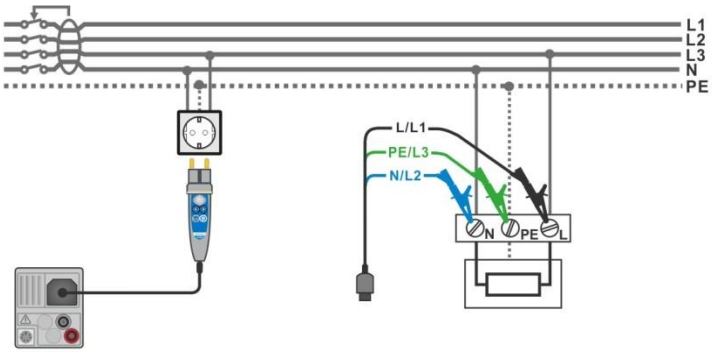


Figure 4.106: Z auto measurement

Measurement procedure

- Enter the **Z auto** function.
- Set test parameters / limits.
- Measure the impedance Zref at origin (optional), see chapter ***4.15 Voltage Drop.***
- Connect test cable to the instrument.
- Connect test leads or Plug commander to the object under test, see ***Figure 4.97***.
- Start the test.
- Save results (optional).

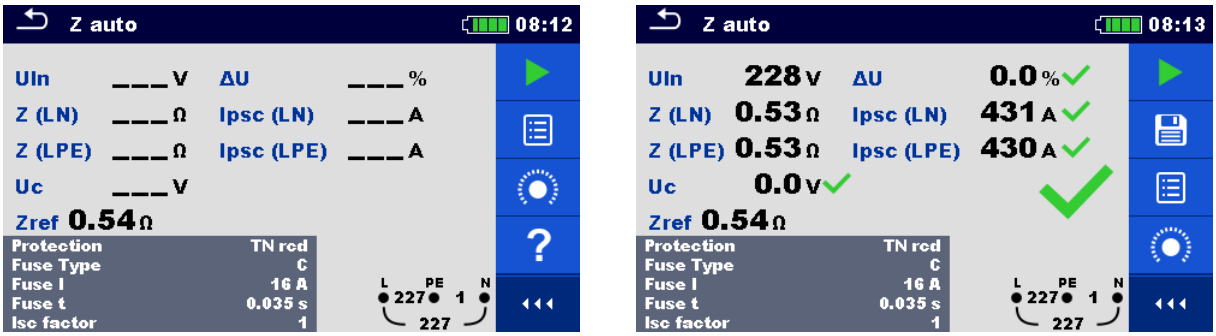


Figure 4.107: Example of Z auto measurement results

Measurement results / sub-results

Uln	Voltage between phase and neutral conductors
ΔU	Voltage drop
Z (LN)	Line impedance
Z (LPE)	Loop impedance
Zref	Reference Line impedance
Ipsc (LN)	Prospective short-circuit current
Ipsc (LPE)	Prospective fault current
Uc	Contact voltage

4.33 R line mΩ – DC resistance measurement (MI 3144)

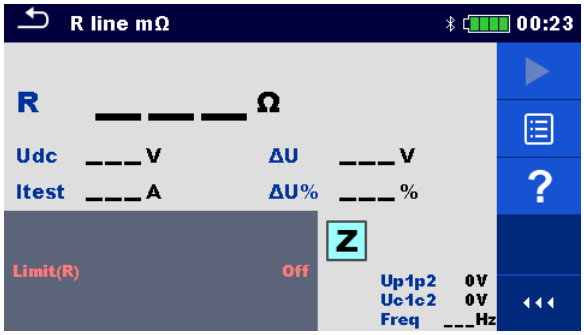


Figure 4.108: R line mΩ menu

Measurement parameters / limits

Limit (R)	**Limit** [Off, Custom, 0.01 Ω … 19 Ω]

Connection diagram

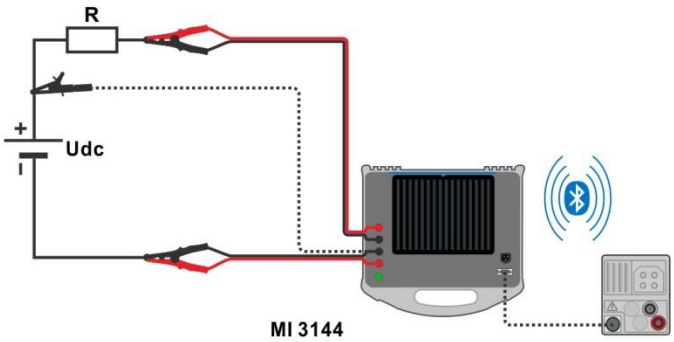


Figure 4.109: R line mΩ measurement connection

Refer to ***MI 3144 – Euro Z 800 V Instruction manual*** for detailed information.

Measurement procedure

- Connect MI 3152(H) instrument with MI 3144 Euro Z 800 V instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **R line mΩ** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3144 Euro Z 800 V instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads to MI 3144 Euro Z 800 V instrument.
- Connect test leads to the object under test.
  Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.
- Start the measurement using  or  button.
- Save results (optional).

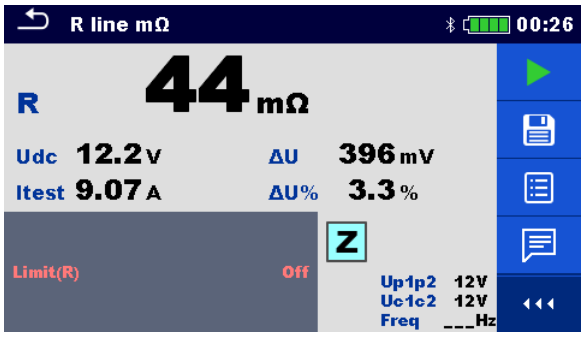


Figure 4.110: Example of R line mΩ measurement result

Measurement results / sub-results

R	Line resistance
Itest	Test current
Udc	Voltage
ΔU	Voltage drop
ΔU%	Voltage drop in percentage

Voltage monitor:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

4.34 ELR Current Injection Test (MI 3144)

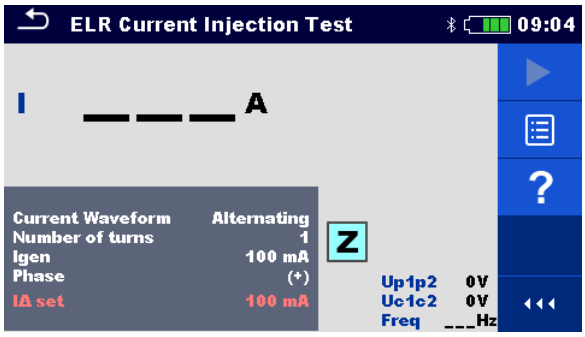


Figure 4.111: ELR Current Injection Test menu

Measurement parameters / limits

Current Waveform	**Current waveform** [Alternating, Pulsating, DC]
Number of turns	**Number of turns** [1 … 10]
I gen	**Current** [3 mA, 5 mA, 6 mA, 10 mA, 15 mA, 30 mA, 50 mA, 100 mA, 150 mA, 250 mA, 300 mA, 500 mA]
Phase	**Phase** [(+), (-)]
IΔ set	**Current limit for selected generated current and number of turns.**

Connection diagram

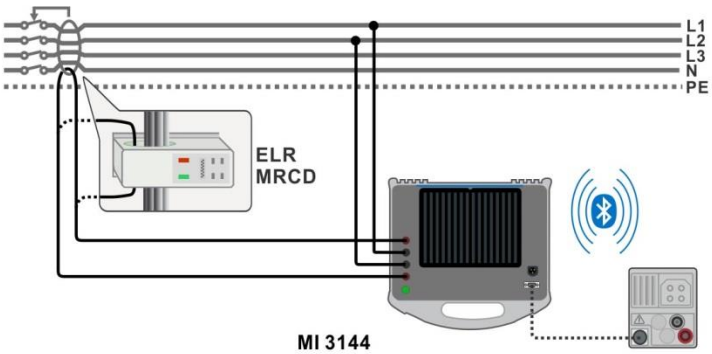


Figure 4.112: ELR Current Injection Test / Combination Time Test connection

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

Measurement procedure

- Connect MI 3152(H) instrument with MI 3144 Euro Z 800 V instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **ELR Current Injection Test** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3144 Euro Z 800 V instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads to MI 3144 Euro Z 800 V instrument.
- Connect test leads to the object under test. See ***Figure 4.112***.
  Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

- Start the measurement using ▶ or button.
- Use ✓✗ to select PASS / FAIL / NO STATUS indication.
- Press ▶▶ or the key to confirm selection and complete the measurement.
- Save results (optional).

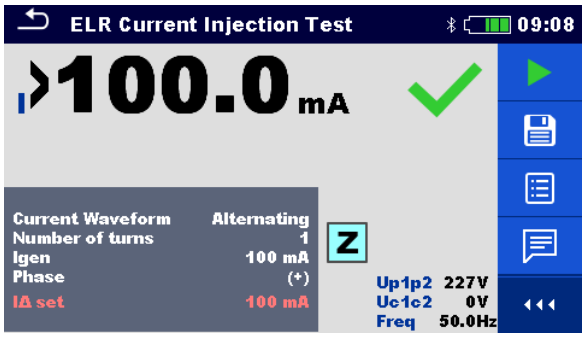


Figure 4.113: Example of ELR Current Injection Test measurement result

Measurement results / sub-results

I	Current

Voltage monitor:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

4.35 ELR Combination Time Test (MI 3144)

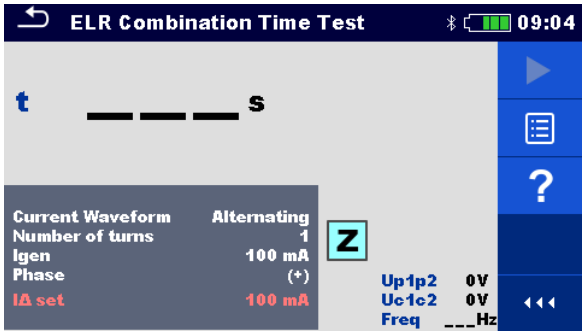


Figure 4.114: ELR Combination Time Test menu

Measurement parameters / limits

Current Waveform	**Current waveform** [Alternating, Pulsating, DC]
Number of turns	**Number of turns** [1 … 10]
I gen	**Current** [3 mA, 5 mA, 6 mA, 10 mA, 15 mA, 30 mA, 50 mA, 100 mA, 150 mA, 250 mA, 300 mA, 500 mA]
Phase	**Phase** [(+), (-)]
Test duration	**Duration** [0.3 s, 0.5 s, 1 s, 2 s, 5 s, 10 s, 20 s]
IΔ set	**Current limit for selected generated current and number of turns.**

Connection diagram

See ***Figure 4.112***.
Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

Measurement procedure

- Connect MI 3152(H) instrument with MI 3144 Euro Z 800 V instrument via serial RS232 or pair them using Bluetooth communication.
- Enter the **ELR Combination Time Test** function.
- Set test parameters / limits.
- Check Bluetooth communication active sign if MI 3144 Euro Z 800 V instrument is connected to MI 3152(H) instrument via Bluetooth communication.
- Connect test leads to MI 3144 Euro Z 800 V instrument.
- Connect test leads to the object under test. See ***Figure 4.112***.
  Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.
- Start the measurement using or button.
- Use to select PASS / FAIL / NO STATUS indication.
- Press or the key to confirm selection and complete the measurement.
- Save results (optional).

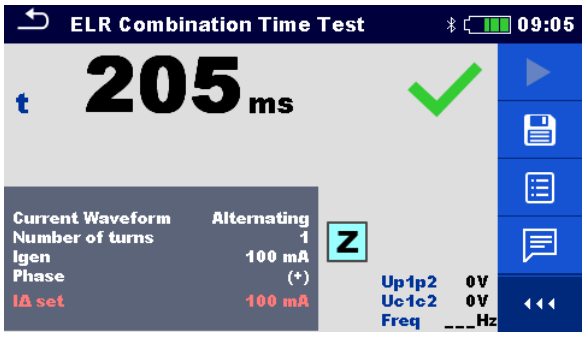


Figure 4.115: Example of ELR Combination Time Test result

Measurement result

t	Time

Voltage monitor:

Up1p2	Voltage P1-P2
Uc1c2	Voltage C1-C2
Freq	Frequency

Refer to ***MI 3144 Euro Z 800 V Instruction manual*** for detailed information.

4.36 EVSE Diagnostic Test (A 1632)

EVSE Diagnostic Test should be performed with A 1632 eMobility Analyser connected with MI 3152(H) instrument via Bluetooth communication.

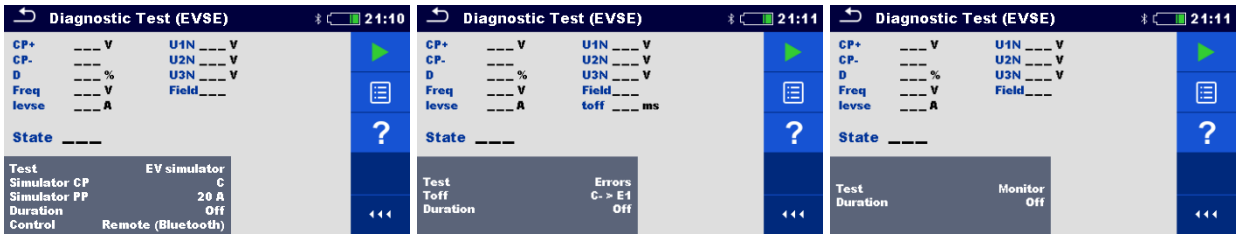


Figure 4.116: Diagnostic Test (EVSE) start screens – EV simulator, Errors and Monitor

Measurement parameters / limits

With selection of the Test parameter on the start screen, three diagnostic sub-tests can be set.

Test	**Test [EV simulator, Monitor, Errors]**	
	EV simulator	- Simulation of Electrical Vehicle
	Monitor	- Monitoring of EVSE – EV interconnection and signalling
	Errors	- Simulation of CP Errors
Toff	**Simulated CP errors** [C->E1, C->E2, C->E3, D->E1, D->E2, D->E3]	
Simulator CP	**CP (control pilot) state setting** [nc, A, B, C, D]	
Simulator PP	**PP (proximity pilot) state setting** [nc, 13 A, 20 A, 32 A, 63 A, 80 A]	
Duration	**Test duration** [Off, 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 90 s, 120 s, 180 s]	
Control	**Analyser control** [Remote (Bluetooth), Manual (A 1632)]	

Connection diagrams

Refer to ***A 1632 – eMobility Analyser Instruction manual*** for detailed information.

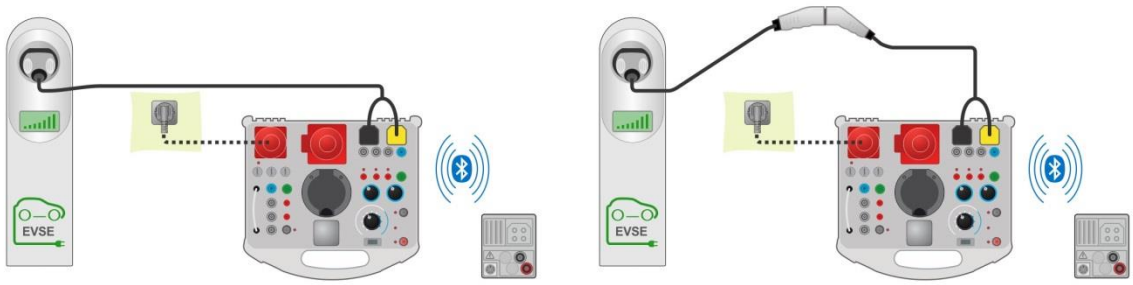


Figure 4.117: Diagnostic Test, EV simulator and Errors sub-tests - connection to EVSE

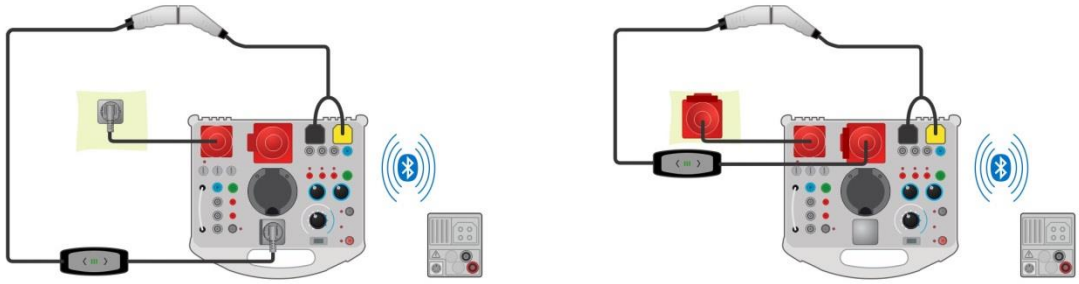


Figure 4.118: Diagnostic Test, EV simulator and Errors sub-tests - connection to Mode 2 charging cable powered from Analyser

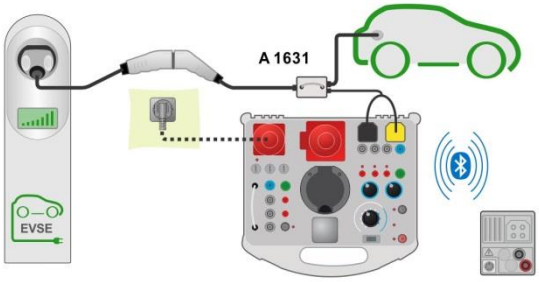


Figure 4.119: Diagnostic Test (EVSE) - Monitor sub-test - connection to EVSE or charging cable

Diagnostic test procedure

‣ Pair and connect MI 3152(H) with A 1632 eMobility Analyser instrument via Bluetooth communication.
‣ Enter the **Diagnostic Test (EVSE)** function.
‣ Set test parameters / limits.
‣ Check Bluetooth communication active sign if A 1632 eMobility Analyser is connected to MI 3152(H) instrument via Bluetooth communication.
‣ Connect the charging cable / station to A 1632 eMobility Analyser adapter. See ***Figure 4.117***, ***Figure 4.118*** and ***Figure 4.119***. Refer to ***A 1632 eMobility Analyser Instruction manual*** for detailed information.
‣ Start the measurement using ▶ or button.
‣ Manually apply status (optional).
‣ Stop the measurement using ■ or button.
‣ Save results (optional).

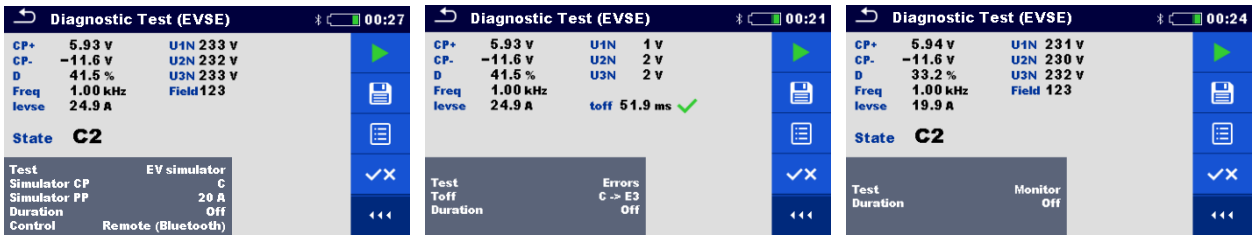


Figure 4.120: Examples of Diagnostic Test (EVSE) measurement results – EV simulator, Errors and Monitor

Measurement results / sub-results

CP+	Maximal value of CP (control pilot) signal
CP-	Minimal value of CP (control pilot) signal
D	Duty cycle of CP (control pilot) signal
Freq	Frequency of CP (control pilot) signal
Ievse	Charging current available by charging cable / EVSE
U1N	Voltage UL1-N on the output of charging cable / EVSE
U2N	Voltage UL2-N on the output of charging cable / EVSE
U3N	Voltage UL3-N on the output of charging cable / EVSE

Field	1.2.3 – correct connection – CW rotation sequence 3.2.1 – invalid connection – CCW rotation sequence
toff	Disconnection time of charging cable / EVSE
State	System state

Refer to ***A 1632 eMobility Analyser Instruction manual*** for detailed information.

4.37 Locator

This function is intended for tracing mains installation, like:

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

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

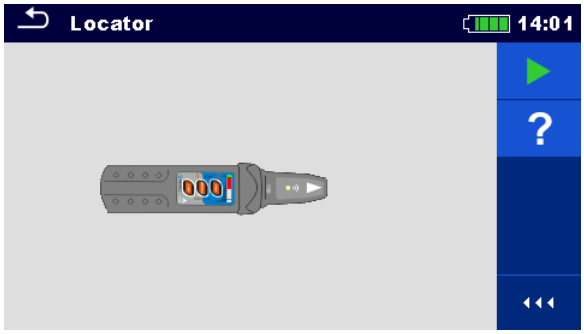


Figure 4.121: Locator main screen

Typical applications for tracing electrical installation

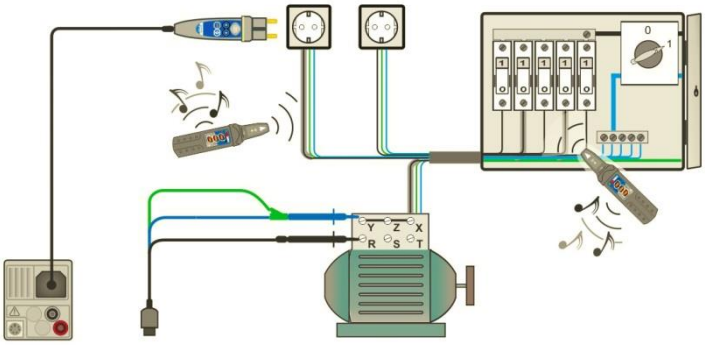


Figure 4.122: Tracing wires under walls and in cabinets

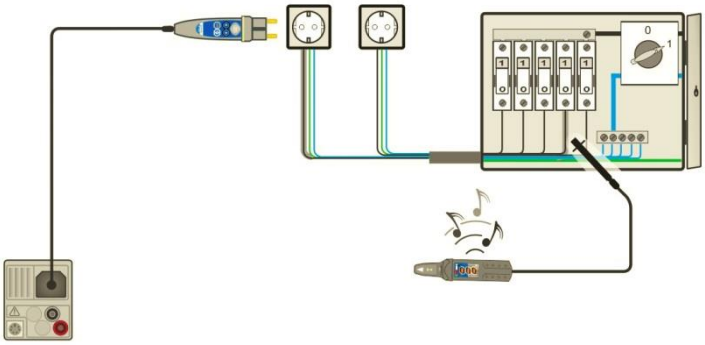


Figure 4.123: Locating individual fuses

Line tracing procedure

- Select ***Locator*** function in ***Other*** menu.
- Connect test cable to the instrument.
- Connect test leads to the tested object (see ***Figure 4.122*** and ***Figure 4.123***).
- Start the test.
- Trace lines with receiver (in IND mode) or receiver plus its optional accessory.
- Stop the test.

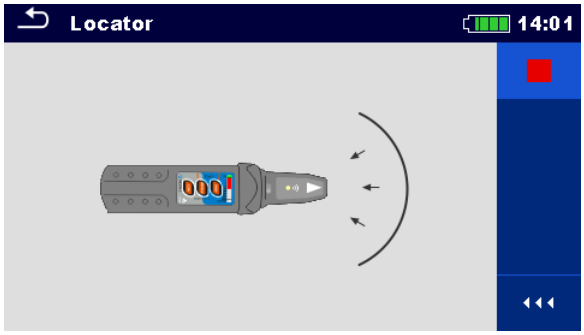


Figure 4.124: Locator active

4.38 Functional inspections

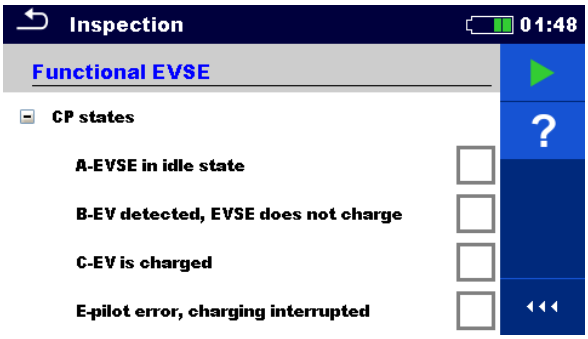


Figure 4.125: Example of Functional inspection menu

Inspection

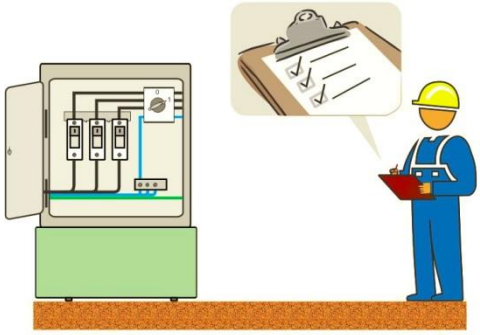


Figure 4.126: Functional inspection test circuit

Functional inspection procedure

- Select the appropriate Functional Inspection test from **Function** menu.
- Start the inspection.
- Perform the inspection of the item under test.
- Apply appropriate ticker(s) to items of inspection.
- End inspection.
- Save results (optional).

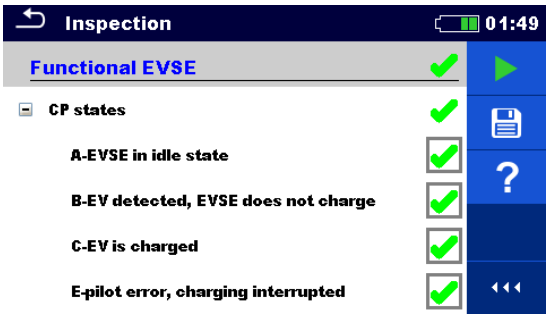


Figure 4.127: Example of Functional inspection results

4.39 Measurements using adapter MD 9273

Clamp MD 9273 can be used as an adapter connected via Bluetooth® communication with EurotestXC in manner to expand it Power quality Test range. Supported test measurements and signal recordings are:

- P- Power
- U – Voltage
- I – Current
- Imax – Inrush current
- h_n Harmonics U – Voltage harmonics
- h_n Harmonics I – Current harmonics

Required test is selected from the CLAMP section of the Single Tests menu, see *Figure 4.128* below. Menu is available only when Adapter MD 9273 is set.

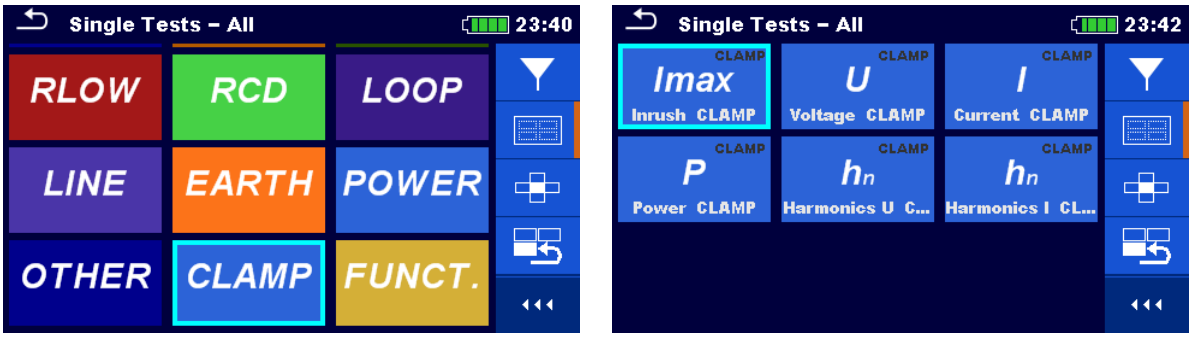


Figure 4.128: CLAMP single test selection menu

Selected test is configured from EurotestXC. Adapter MD 9273 acquires test signals, process measurements and send results to the EurotestXC. Results are presented on the instrument screen and can be saved to the Workspace memory for later use.

4.39.1 Power CLAMP

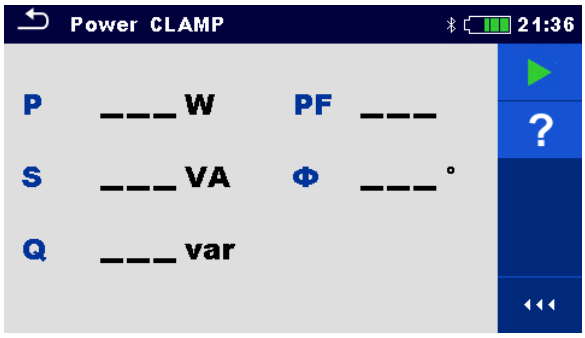


Figure 4.129: Power CLAMP menu

Measurement parameters

There are no parameters to be set.

Connection diagram

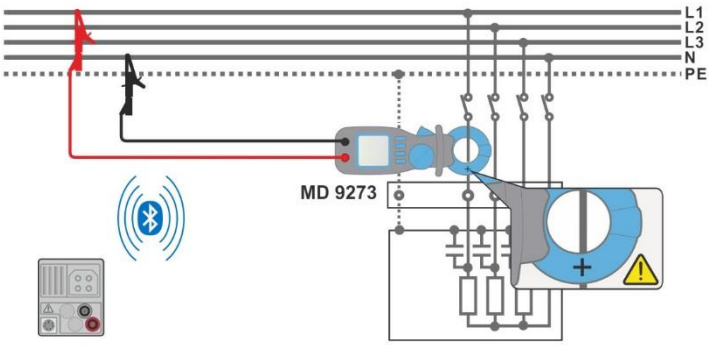


Figure 4.130: Power CLAMP connection

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Power CLAMP** function and wait for active Bluetooth® communication sign.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

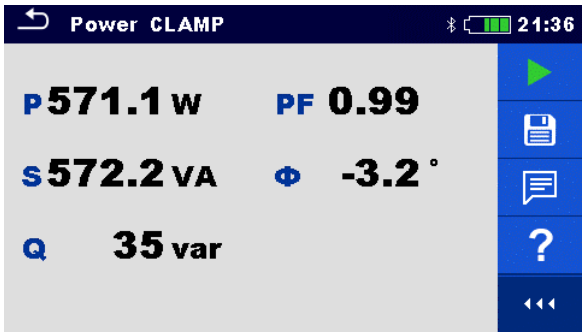


Figure 4.131: Power CLAMP results

Measurement results / sub-results

P	Active power
S	Apparent power
Q	Reactive power (capacitive or inductive)
PF	Power factor (capacitive or inductive)
Φ	Phase displacement between voltage and current in degrees

Note:

- Voltage test terminals connection and current flow toward load should be taken into account; the red voltage terminal should be connected to the Line terminal and the jaw should be correctly oriented, to obtain positive sign of Power test result. If Power test result has negative sign, connection of voltage terminal or jaw orientation are opposite and the result of phase displacement angle has opposite sign too. Consequently, load character determination (capacitive or inductive) is mismatched.

4.39.2 Voltage CLAMP

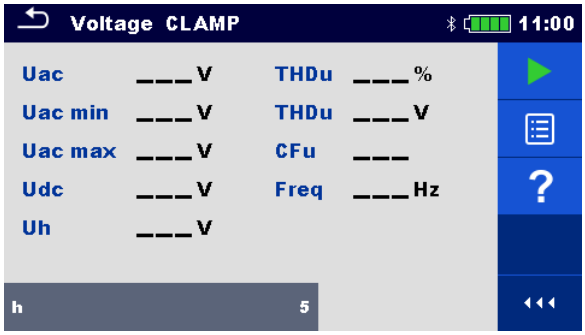


Figure 4.132: Voltage CLAMP menu

Measurement parameters

h	Harmonic setup [1 to 19, 1st is fundamental frequency]

Connection diagram

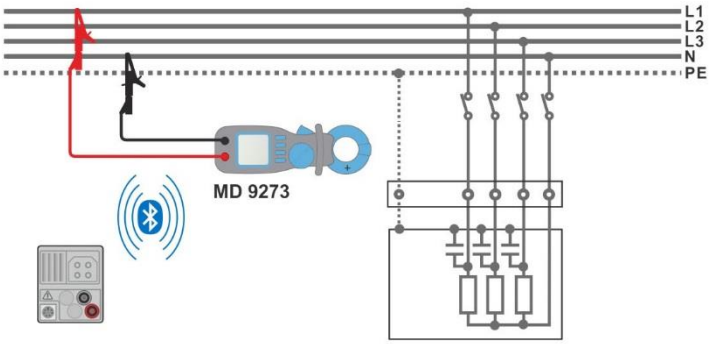


Figure 4.133: Voltage CLAMP connection

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Voltage CLAMP** function and wait for active Bluetooth® communication sign.
- Set test parameter.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

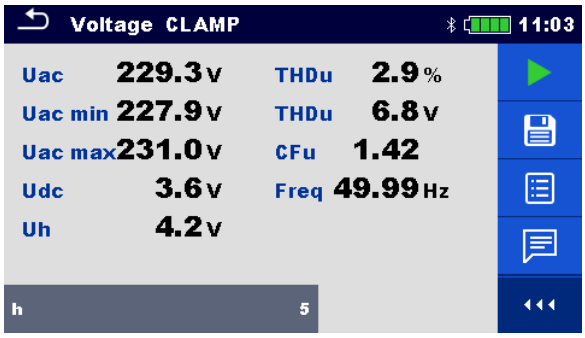


Figure 4.134: Voltage CLAMP results

Measurement results / sub-results	
Uac	Effective ac voltage value – last obtained result
Uac min	Minimum effective ac voltage value during measurement time duration
Uac max	Maximum effective ac voltage value during measurement time duration
Udc	DC voltage value
THDu [V]	Effective voltage value of all harmonics (without voltage value at fundamental frequency)
THDu [%]	Total harmonic distortion
Uh	Effective voltage value of set harmonic
CFu	Voltage Crest factor – peak voltage to effective ac voltage ratio
Freq	Fundamental frequency

4.39.3 Current CLAMP

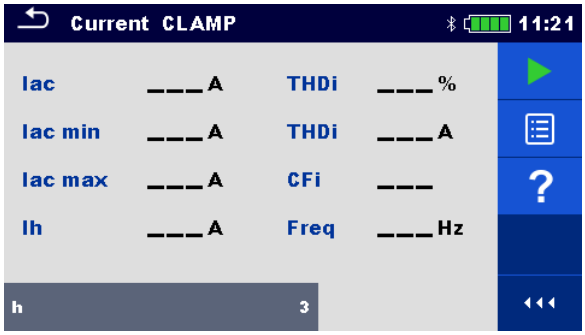


Figure 4.135: Current CLAMP menu

Measurement parameters	
h	Harmonic setup [1 to 19, 1st is fundamental frequency]

Connection diagram

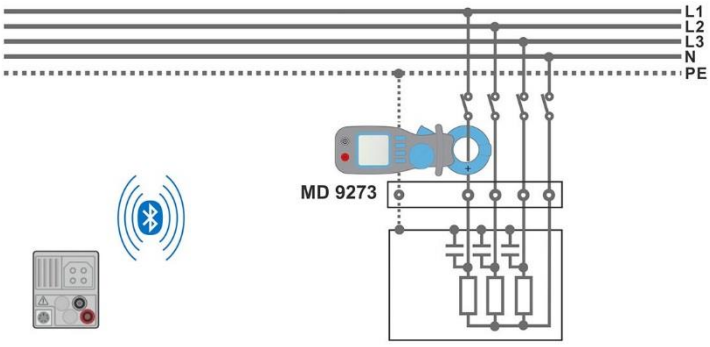


Figure 4.136: Current CLAMP connection

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Current CLAMP** function and wait for active Bluetooth® communication sign.
- Set test parameter.
- Start the continuous measurement.

- Stop the measurement.
- Save results (optional).

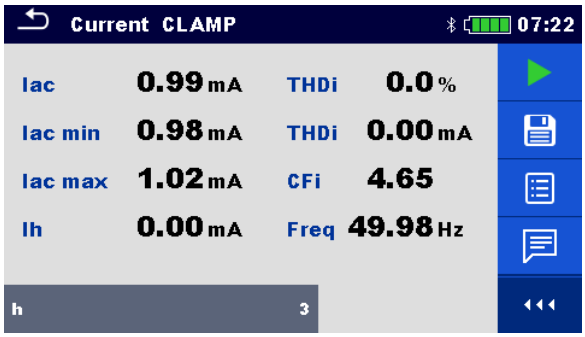


Figure 4.137: Current CLAMP results

Measurement results / sub-results	
Iac	Effective ac current value – last obtained result
Iac min	Minimum effective ac current value during measurement time duration
Iac max	Maximum effective ac current value during measurement time duration
THDi [A]	Effective current value of all harmonics (without current value at fundamental frequency)
THDi [%]	Total harmonic distortion
Ih	Effective current value of set harmonic
CFi	Current Crest factor – peak current to effective current ratio
Freq	Fundamental frequency

4.39.4 Inrush CLAMP

Inrush CLAMP function records current and voltage transients that occur when load is turned on. Recorded values are presented on the screen of the instrument in separate charts. Two event triggers can be set, Voltage dip or Inrush current. Only one trigger can be active at the same time; when one is set, the other is switched off automatically. Voltage dip trigger is effective only if MD 9273 Voltage input is connected to supply circuit. Minimum effective circuit voltage is calculated during recorded transient and compared with set voltage threshold. Inrush current trigger is effective only if the wire with flowing current is embraced with MD 9273 jaws. Maximum effective ac circuit current is calculated during recorded transient and compared with set Inrush threshold.
After Inrush Test is started, MD 9273 starts to record signals and waits for trigger event to occur, which is symbolised with sign on the bottom right of the screen. Displayed chart is divided in Pre-trigger area, presenting first second of total set chart duration time and transient event area – rest of the chart duration time.
Trigger event occur automatically, when one of the recorder signals achieve set threshold level or can be initiated manually by tapping on the icon within command menu on the right of the screen, see right screen picture of the figure below.

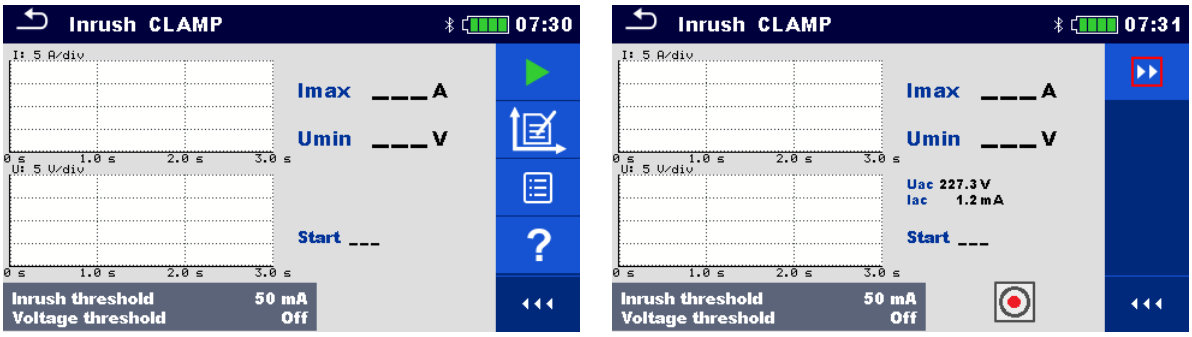


Figure 4.138: Inrush CLAMP menu – setup on the left, waiting for trigger on the right

Test parameters	
Inrush threshold	Inrush current threshold setting [Off, 5 mA … 90 A]
Voltage threshold	Voltage dip threshold setting [Off, 50 V … 500 V]
Duration	Recording duration [3 s, 10 s]

Connection diagram

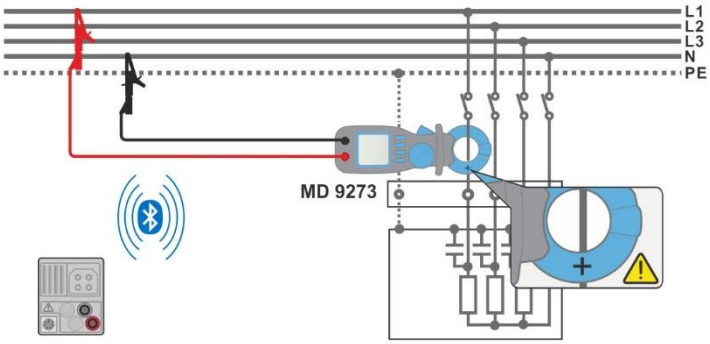


Figure 4.139: Inrush CLAMP connection

Test procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Inrush CLAMP** function and wait for active Bluetooth® communication sign.
- Set test parameters.
- Set charts Y value range[1)] within expected values (optional; could be set later, after the test).
- Start the test.
- Initiate set threshold event or manually trigger test recording.
- Save results (optional) after test is finished and results and recorded charts are presented on the screen.

1) Chart range selection:
  - Voltage range [100 mV/div … 100 V/div]
  - Current range [10 mA/div … 200 A/div]

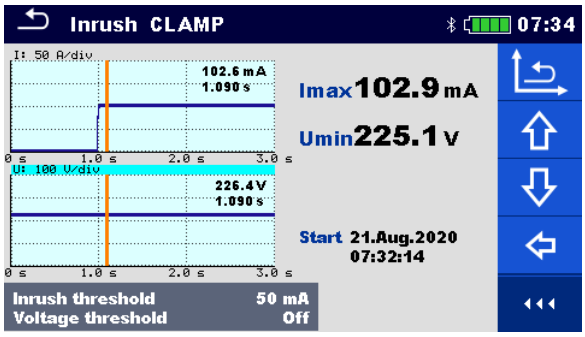


Figure 4.140: Inrush CLAMP results

Test results / sub-results	
I:	Inrush current chart [2] range
	Recorded effective ac current value at cursor position
	Relative time of recorded data at cursor position
U:	Circuit voltage chart [2] range
	Recorded effective ac voltage value at cursor position
	Relative time of recorded data at cursor position
Imax	Inrush current maximum value of recorded data
Umin	Circuit voltage dip minimum value of recorded data
Uac	Effective ac voltage (within the measurement)
Iac	Effective ac current (within the measurement)
Start	Inrush test start recording time (from Master Instrument)

[2] Tap on chart area or drag graph line cursor to present chart value at chosen time. Use left / right arrow keys for smooth setting.

4.39.5 Harmonics U CLAMP

Harmonics (1 through to 19) are measured and displayed in the chart as an absolute magnitude of the signal or as a percentage of the signal value at the fundamental frequency (the 1st harmonic h1). Absolute magnitude or percent value display is chosen by Type parameter setting.

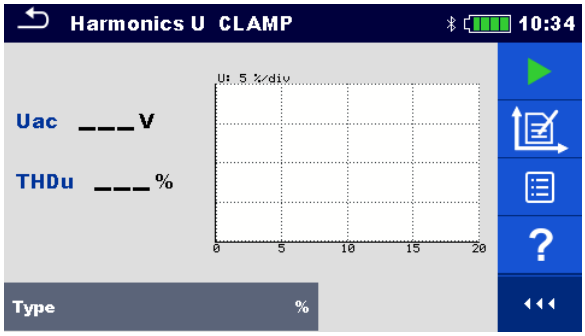


Figure 4.141: Harmonics U CLAMP menu

Measurement parameters	
Type	[%, V] % – harmonics and distortion are displayed as relative value V – harmonics and distortion are displayed as absolute value

Connection diagram

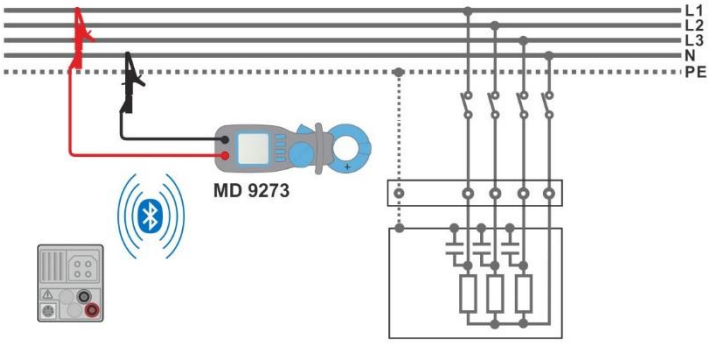


Figure 4.142: Harmonics U CLAMP connection

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Harmonics U CLAMP** function and wait for active Bluetooth® communication.
- Set Type parameter.
- Set charts Y value range[3)] within expected values (optional; could be set later, after the test).
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

[3)] Chart Voltage range selection: [100 mV/div … 100 V/div]

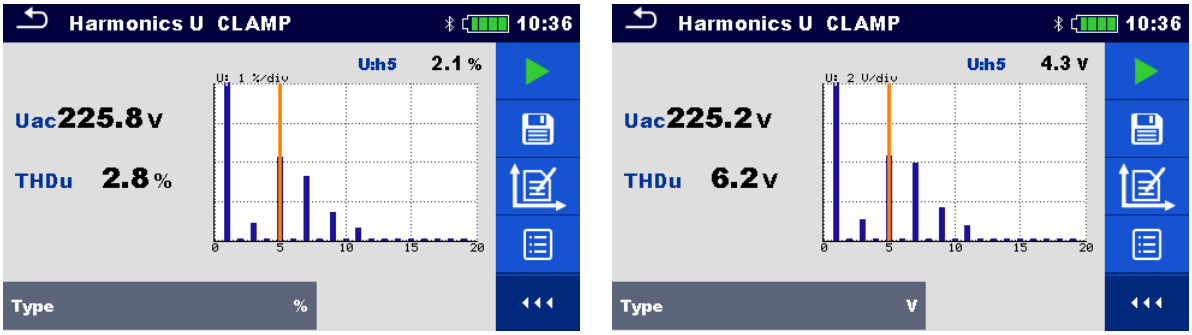


Figure 4.143: Harmonics U CLAMP results

Measurement results / sub-results

U:	Harmonics chart range
Uac	Effective ac voltage value
THDu [%]	Total harmonic distortion
THDu [V]	Effective voltage value of all harmonics (without voltage value at fundamental frequency)
U:h5 [%]	Relative value of 5th harmonic [4)]
U:h5 [V]	Absolute voltage of 5th harmonic [4)]

[4)] Tap on chart area at chosen harmonic to present its value.

4.39.6 Harmonics I CLAMP

Harmonics (1 through to 19) are measured and displayed in the chart as an absolute magnitude of the signal or as a percentage of the signal value at the fundamental frequency (the 1st harmonic h1). Absolute magnitude or percent value display is chosen by Type parameter setting.

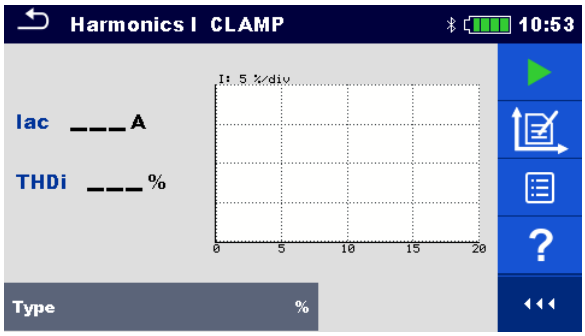


Figure 4.144: Harmonics I CLAMP menu

Measurement parameters

Type	[%, A] % – harmonics and distortion are displayed as relative value A – harmonics and distortion are displayed as absolute value

Connection diagram

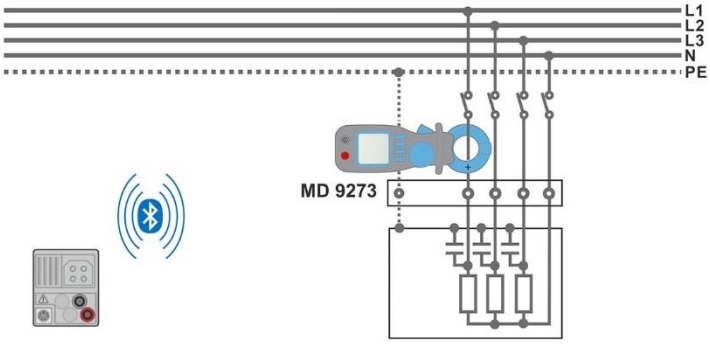


Figure 4.145: Harmonics I CLAMP connection

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Harmonics I CLAMP** function and wait for active Bluetooth® communication.
- Set Type parameter.
- Set charts Y value range within expected values (optional; could be set later, after the test).
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

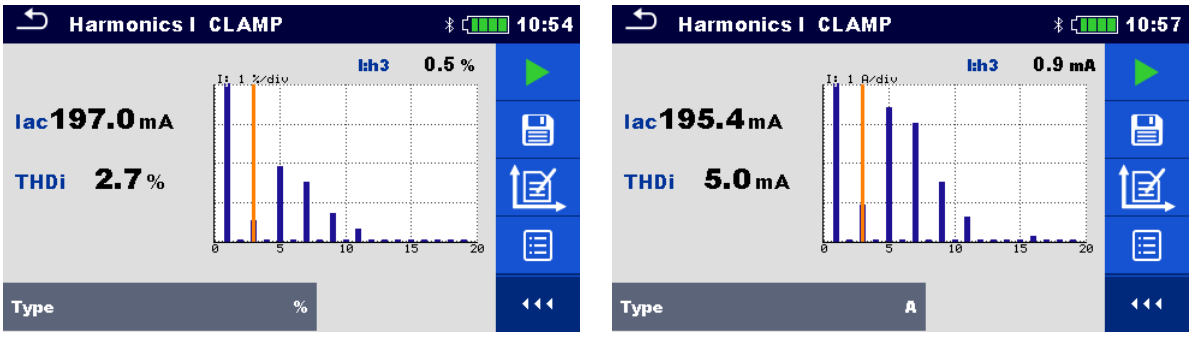


Figure 4.146: Harmonics I CLAMP results

Measurement results / sub-results	
I	Harmonics chart
Iac	Effective ac current value
THDi [%]	Total harmonic distortion
THDi [A]	Effective current value of all harmonics (without current value at fundamental frequency)
I:h3 [%]	Relative value of 3rd harmonic [5)]
I:h3 [A]	Absolute current value of 3rd harmonic [5)]

[5)] Tap on chart area at chosen harmonic to present its value.

5 Upgrading the instrument

The instrument can be upgraded from a PC via the RS232 or USB communication port. This enables to keep the instrument up to date even if the standards or regulations change. The firmware upgrade requires internet access and can be carried out from the ***Metrel ES Manager*** software with a help of special upgrading software – ***FlashMe*** which will guide you through the upgrading procedure. For more information refer to Metrel ES Manager Help file.

6 Maintenance

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

6.1 Fuse replacement

There are three fuses under back cover of the EurotestXC 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.
F2, F3	F 4 A / 500 V, 32×6.3 mm (breaking capacity: 50 kA) General input protection fuses of test terminals L/L1 and N/L2.

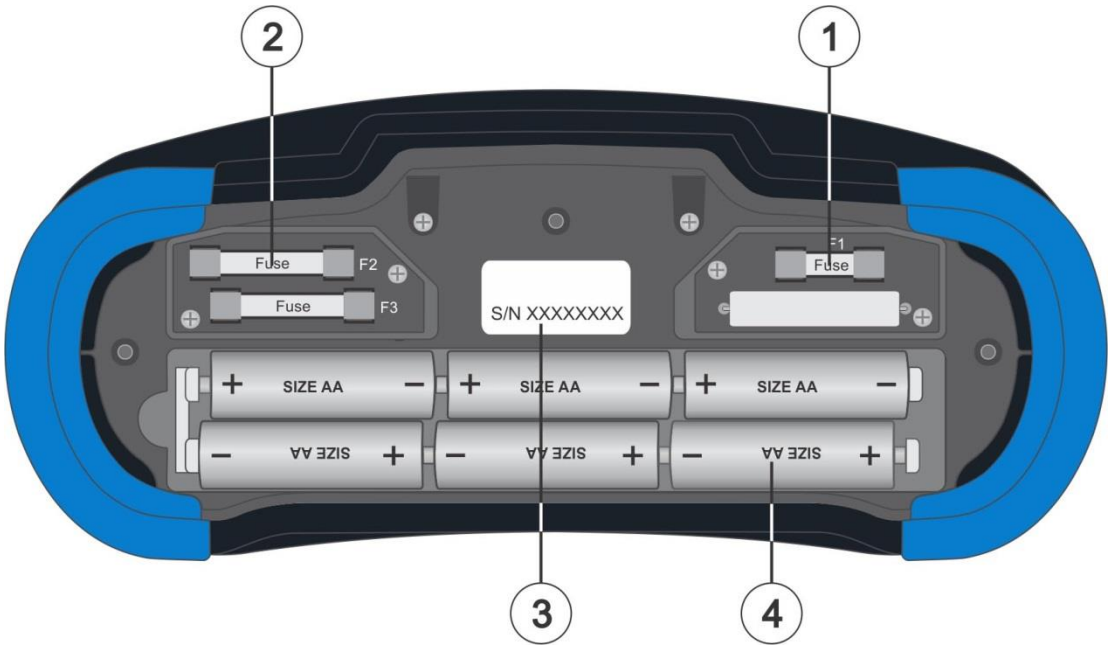


Figure 6.1: Fuses

Warnings!

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

6.2 Warranty & Repairs

Any potentially defective items should be returned to Metrel accompanied by information regarding the faults that was incurred. It is recommended that any defective equipment is sent back to Metrel via the Partner Distributor from which the product was purchased.

All defective products will be replaced or repaired within policy period. For these items, a full refund will only be issued if a sufficient replacement is not available. Any shipping / return shipping costs are not refundable.
Metrel shall not be held liable for any loss or damage resulting from the use or performance of the products. In no event shall Metrel be liable to the customer or its customers for any special, indirect, incidental, exemplary or punitive damages resulting from loss of use, interruption of business or loss of profits, even if Metrel has been advised of the possibility of such damages.
If the customer's unit is out of warranty but needs repairs, a quote for repair will be provided via the Partner Distributor through which the instrument was sent in.

Notes

- Any unauthorized repair or calibration of the instrument will infringe the product's warranty.
- All sales are subject to Metrel Standard Terms and Conditions. Metrel reserves the right to change the conditions at any time. Any typographical, clerical or other error or omission in any sales literature, quotation, price list, acceptance of offer, invoice or other documentation or information issued by Metrel shall be subject to correction without any liability on the part of the customer.
- Specifications and designs of goods are subject to change by Metrel at any time without notice to the customer. Metrel reserves the right to make any changes in the specification of goods which are required to conform with any applicable statutory or EC requirements or, where goods are to be supplied to Metrel specification, which do not materially affect their quality or performance.
- If a condition was found to be invalid or void it would not affect the overall validity of the remainder of the conditions;
- Metrel are excluded from liability for any delays or failure to comply, where the reason is beyond Metrel control;

No order which has been accepted by Metrel may be cancelled by the customer except with the agreement in writing of Metrel and on terms that the customer shall indemnify Metrel in full against all loss (including loss of profit), costs (including the cost of all labour and materials used), damages, charges and expenses incurred by Metrel as a result of cancellation. The minimum charge for such cancellation will be 25 % of the total value of the goods ordered.

Appendix A – Commanders (A 1314, A 1401)

A.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 competent authorized personnel!

A.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 AAA) 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.

A.3 Description of commanders

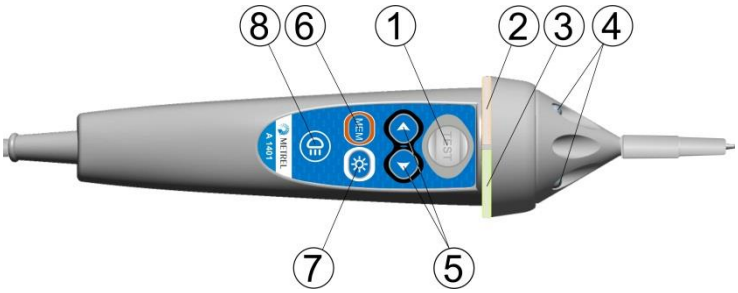


Figure A.1: Front side Tip commander (A 1401)

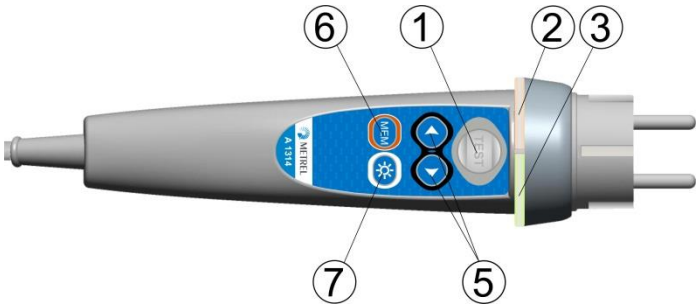


Figure A.2: Front side Plug commander (A 1314)

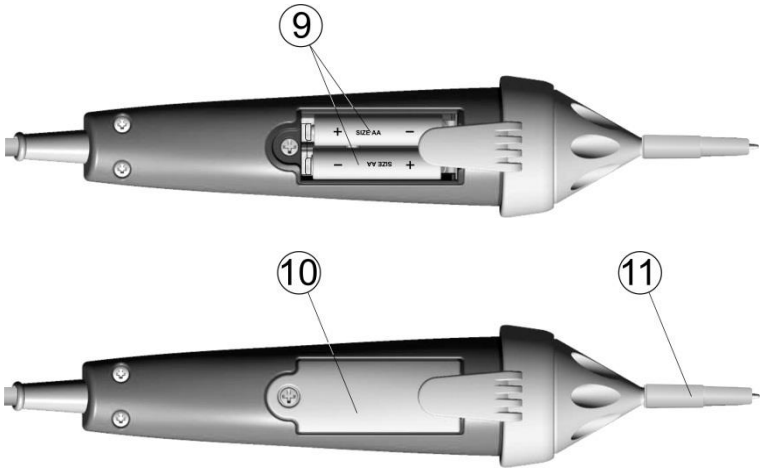


Figure A.3: Back side

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 Ni-MH	
10	Battery cover	Battery compartment cover	
11	Cap	Removable CAT IV cap (Tip commander)	

A.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

Appendix B – Locator receiver R10K

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

Detectors	**Operation**
In built inductive sensor (**IND**)	Tracing hidden wires.
Current clamp (optional)	Connected through the rear connector. Locating wires.
Selective probe	Connected through the rear connector. Locating fuses in fuse cabinets.

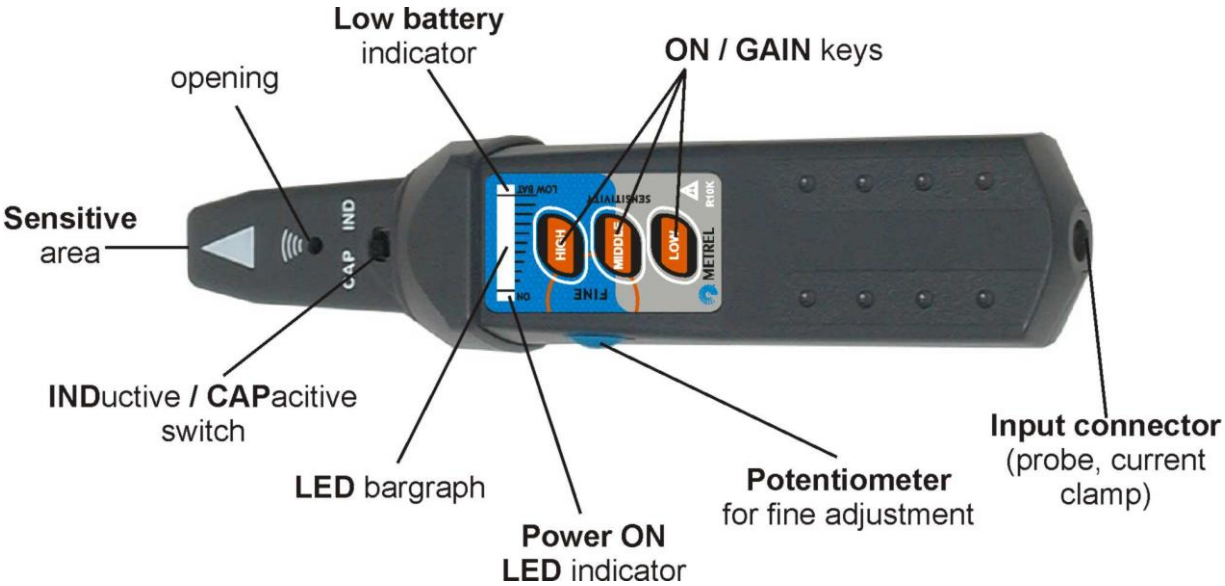


Figure B.1: Receiver R10K

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

Note

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

Appendix C – Tests and Measurements with adapters

		 A 1507 3-phase active switch	 A 1143 Euro Z 290 A	 MI 3143 Euro Z 440 V	 MI 3144 Euro Z 800 V	 A 1632 eMobility Analyser	 MD 9273 Leakage Clamp meter with Bluetooth®
Voltage	1-phase	-	-	-	-	-	-
	3-phase	•	-	-	-	-	-
Socket test basic(live)		-	-	-	-	-	-
Riso	50 V – 1000 V	•	-	-	-	-	-
	2500 V	-	-	-	-	-	-
Diagnostic test	50 V – 1000 V	-	-	-	-	-	-
	2500 V	-	-	-	-	-	-
Varistor		-	-	-	-	-	-
R low		•	-	-	-	-	-
Continuity		-	-	-	-	-	-
Ring Continuity		-	-	-	-	-	-
Socket		-	-	-	-	-	-
Rpe		•	-	-	-	-	-
RCD Auto		•	-	-	-	-	-
RCD Uc		•	-	-	-	-	-
RCD t		•	-	-	-	-	-
RCD I		•	-	-	-	-	-
Zs rcd		•	-	-	-	-	-
Z loop		•	-	-	-	-	-
Z auto		•	-	-	-	-	-
Z line		•	-	-	-	-	-
Voltage Drop		•	-	-	-	-	-
Z loop mOhm		-	•	•	•	-	-
Z line mOhm		-	•	•	•	-	-
High Current		-	-	•	•	-	-
Current clamp Meter		-	-	-	•	-	-
Rline mOhm		-	-	-	•	-	-
ELR Current Injection Test		-	-	-	•	-	-
ELR Combination Time Test		-	-	-	•	-	-
Utouch		-	-	•	•	-	-
Earth 3W		-	-	-	-	-	-

	 **A 1507 3-phase active switch**	 **A 1143 Euro Z 290 A**	 **MI 3143 Euro Z 440 V**	 **MI 3144 Euro Z 800 V**	 **A 1632 eMobility Analyser**	 **MD 9273 Leakage Clamp meter with Bluetooth®**
Earth 2 clamps	-	-	-	-	-	-
Ro	-	-	-	-	-	-
Power	-	-	-	-	-	-
Harmonics	-	-	-	-	-	-
Currents	-	-	-	-	-	-
IMD	-	-	-	-	-	-
ISFL	-	-	-	-	-	-
Locator	-	-	-	-	-	-
Illumination	-	-	-	-	-	-
Auto TT	-	-	-	-	-	-
Auto TN	-	-	-	-	-	-
Auto TN(rcd)	-	-	-	-	-	-
Auto IT	-	-	-	-	-	-
Diagnostic Test (EVSE)	-	-	-	-	•	-
Power CLAMP	-	-	-	-	-	•
Voltage CLAMP	-	-	-	-	-	•
Current CLAMP	-	-	-	-	-	•
Inrush CLAMP	-	-	-	-	-	•
Harmonics U CLAMP	-	-	-	-	-	•
Harmonics I CLAMP	-	-	-	-	-	•