GOSSEN METRAWATT
GMC-INSTRUMENTS GROUP

OPERATING INSTRUCTIONS

1/8.24
3-447-226-03

METRALINE MF

INSTALLATION TESTER FOR TESTING THE EFFECTIVENESS OF PROTECTIVE MEASUREMENTS IN ELECTRICAL INSTALLATIONS IN ACCORDANCE WITH IEC 60364-6, EN 61557 AND EN 50110-1 (DIN VDE 0100-600, DIN VDE 0105-100, VDE 0413)

TABLE OF CONTENTS

1 SAFETY INSTRUCTIONS

Read and follow these instructions carefully and completely in order to ensure safe and proper use.

The instructions must be made available to all persons who use the instrument.

Keep for future reference.

General

- The device may only be used in the commercial field by qualified electricians.
- Observe the five safety rules in accordance with EN 50110-1 (DIN VDE 0105-100), Operation of electrical installations–Part 100: General requirements.
  (1: Shut down entirely. 2: Secure against restart. 3: Assure absence of voltage at all poles. 4: Ground and short circuit. 5: Cover neighboring live components, or make them inaccessible.
- Observe and comply with all safety regulations which are applicable for your work environment.
- Wear suitable and appropriate personal protective equipment (PPE) whenever working with the instrument.
- The functioning of active medical devices (for example pacemakers, defibrillators) and passive medical devices may be affected by voltages, currents and electromagnetic fields generated by the tester and the health of their users may be impaired. Implement corresponding protective measures in consultation with the manufacturer of the medical device and your physician. If any potential risk cannot be ruled out, do not use the instrument.

Accessories

- Use only the specified accessories (included in the scope of delivery or listed as options) with the instrument.
- Carefully and completely read and adhere to the product documentation for optional accessories. Retain these documents for future reference.

Handling

- Use the instrument in undamaged condition only.
  Inspect the instrument before use. Pay particular attention to damage, interrupted insulation or kinked cables. Damaged components must be replaced immediately.
- Use the accessories and all cables in undamaged condition only.
  Inspect accessories and all cables before use. Pay particular attention to damage, interrupted insulation or kinked cables.
- If the instrument or its accessories don't function flawlessly, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If the instrument or accessories are damaged during use, for example if they're dropped, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If there are any signs of interior damage to the instrument or accessories (e.g. Loose parts in the housing), permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- The instrument and the accessories may only be used for the tests/measurements described in the documentation for the instrument.
- The integrated voltage measuring function and mains check of the test/measuring instrument may not be used to test systems or system components for the absence of voltage.
  Testing for the absence of voltage is only permissible with a suitable (2-pole) voltage tester / voltage measuring system which fulfills the requirements specified in DIN EN 61243.
- Route cables in an orderly fashion, e.g. the mains power cable and accessories cable. Loose, disorderly cables result in unnecessary danger of tripping and falling.

Operating Conditions

- Do not use the instrument and its accessories after long periods of storage under unfavorable conditions (e.g. humidity, dust or extreme temperature).
- Do not use the instrument and its accessories after extraordinary stressing due to transport.
- Do not expose the instrument to direct sunlight.
- Only use the instrument and its accessories within the limits of the specified technical data and conditions (ambient conditions, IP protection code, measuring category etc.).
- Do not use the instrument in potentially explosive atmospheres. Danger of explosion!
- Do not use the instrument in atmospheres subject to fire hazard. Danger of fire

- Implement adequate measures for protection against electrostatic discharge (ESD).

Rechargeable or Regular Batteries

- Use batteries in undamaged condition only. Risk of explosion and fire in the case of damaged batteries!
  Inspect the batteries before use. Pay particular attention to leaky and damaged batteries.
- If you use batteries or rechargeable batteries, you may use the respective test and measuring instrument only with the battery compartment cover properly inserted and closed. Otherwise, dangerous voltages may occur at the (rechargeable) battery terminals under certain circumstances.
- Do not use the device while the internal batteries are being charged.
- Recharge batteries in undamaged condition only. Risk of explosion and fire in the case of damaged rechargeable batteries!
  Inspect the batteries before use. Pay particular attention to leaky and damaged batteries.

Fuses

- The instrument may only be used as long as the fuses are in flawless condition. Defective fuses must be replaced. Fuses may only be replaced by our repair service department.
- Never bridge the fuses. Never put the fuses out of operation.

Measurement Cables and Establishing Contact

- Plugging in the measurement cables must not necessitate any undue force.
- Never touch conductive ends (for example of test probes).
- Fully unroll all measurement cables before starting a test/measurement. Never perform a test/measurement with the measurement cable rolled up.
- Avoid short circuits due to incorrectly connected measurement cables.
- Ensure that alligator clips, test probes or Kelvin probes make good contact.
- Do not move or remove as far as possible plugs, test probes, alligator clips or Kelvin probes until testing/measurement has been completed.
  Unwanted sparking may otherwise occur due to test current.
- Only use measurement cables and external cabling with a maximum length of 1 m.

Adjustment / Calibration

- Comply with national recalibration regulations and laws.
- Comply with national calibration regulations and laws.

Emissions

- Switch off nearby cell phones while performing tests/measurements with the instrument. Cell phone signals may impair the correct functioning of the device due to interference.

Data Security

- Always create a backup copy of your measurement/test data.
- The device is equipped with a data memory to which personal and/or sensitive data can be stored. Observe and comply with the applicable national data protection regulations. Use the corresponding functions provided by the test instrument (such as access protection), as well as other appropriate measures to prevent unauthorized access to the data.
- Protect the device against unauthorized tampering. Use the functions provided by the instrument (e.g. key lock/sealing/lock function) as well as other appropriate measures (e.g. restricting physical access to the instrument).

2 APPLICATIONS

Please read this important information!

2.1 INTENDED USE / USE FOR INTENDED PURPOSE

METRALINE MF is a professional, multifunctional, hand-held test instrument intended to perform all the measurements required for verification of electrical safety of installations in buildings. It is designed to perform the following measurement types:

- Loop resistance L-PE with short-circuit current calculation
- Loop resistance L-N
- Low resistance
- Continuity
- Insulation
- Testing of RCD for types A, AC, B, B+, F as well as 6 mA DC (RDC-DD)for E-charging stations
- Voltage (TRMS)
- Rotating field and frequency
- Earth resistance
- EVSE measurements

Safety of the user, as well as that of the instrument, is only assured when it's used for its intended purpose.

2.2 USE FOR OTHER THAN INTENDED PURPOSE

Using the instrument for any purposes other than those described in the condensed operating instructions or these instrument operating instructions is contrary to use for intended purpose. Use for Other than Intended Purpose may lead to unpredictable damage!

2.3 LIABILITY AND GUARANTEE

Liability and guarantee granted by Gossen Metrawatt GmbH complies with the applicable contractual and mandatory legal regulations.

3 DOCUMENTATION

3.1 INFORMATION CONCERNING THESE INSTRUCTIONS

Read these instructions attentively and carefully. They contain all necessary information for safe use of the instrument. Comply with them in order to protect yourself and others from injury, and to avoid damaging the instrument.

The latest version of these instructions is available on our website:

https://www.gmc-instruments.de/en/services/download-center/

Errors and Suggestions for Improvement

These instructions have been prepared with utmost care in order to ensure correctness and completeness. Unfortunately, errors can never be entirely avoided. Continuous improvement is part of our quality goal, so we always appreciate your comments and suggestions.

Gender Equality

For better readability, only the masculine form is used in these instructions in a grammatically impartial sense. The feminine and diverse forms are of course always implied as well.

Trademark Law

Product designations used in this document may be subject to brand law and patent law. They are of the property of their respective owner.

Copyright

3.2 IDENTIFICATION OF WARNINGS

Instructions for your safety and for the protection of the instrument and its environment are provided as warnings and notes at certain points within these instructions.

They're laid out as shown below and are graded in terms of the severity of the respective hazard. They also describe the nature and cause of the hazard, the consequences of non-observance and what must be done to avoid it.

DANGER

Death or serious injury is almost certain.

WARNING

Death or serious injury is possible.

CAUTION

Minor or moderate injury is possible.

ATTENTION

Damage to the product or the environment is possible.

Note

Important information.

Tip

Useful additional information or application tip.

3.3 IDENTIFIERS

The following identifiers are used in this documentation:

Identifier	Meaning
Control Element	Keys, buttons, menus and other controls
✓ Prerequisite	A condition etc. which must be fulfilled before a given action can be taken
▶ **Procedure**	Beginning of a procedural instruction
1. Procedural step	Steps of a procedure which must be completed in the specified order
↳ Result	Result of a procedural step
■ Enumeration ■ Enumeration	Bullet lists
Abb. 1: Caption	Description of the content of a figure
Tab. 1: Table 1	Description of the content of a table
Footnote	Comment

Tab. 2: Identifiers in this document

3.4 SYMBOLS IN THE DOCUMENTATION

The following icons are used in this documentation:

Icon	Meaning
	Read and adhere to the product documentation.
	General warning symbol.
	Warning regarding electrical voltage.

Tab. 3: Icons used in this document

4 GETTING STARTED

This chapter gives you an overview of the initial steps with the instrument.

1. Read and adhere to the product documentation. In particular, observe all safety information in the documentation, on the tester and on the packaging.
   - Safety Instructions ➪🗎4
   - Applications ➪🗎6
   - Documentation ➪🗎7
2. Familiarize yourself with the tester.
   - The Tester ➪🗎10
3. Familiarize yourself with the display and instrument operation.
   - Menu and Functions ➪🗎15
4. Install the tester.
   - Installation➪🗎21
5. Configuration and operation.
6. Operation➪🗎22

Further topics of interest: Maintenance ➪🗎58

5 THE TESTER

5.1 SCOPE OF DELIVERY

Please check the scope of delivery for completeness and intactness.

1	METRALINE MF (M520F)
1	Carrying case
3	Test lead 1 m
1	Test cable with safety plug
3	Test probes
3	Crocodile clips
1	USB cable type A to type B
6	Rechargeable batteries 1.5 V
1	Power supply
1	Test lead with test button to trigger a measurement
1	Condensed operating instructions
1	Software METRAreport (Download) https://www.gossenmetrawatt.de/en/services/mygmc/

5.2 OPTIONAL ACCESSORIES

Accessories	Article number
Remote Probe	Z520A
Probe Set	Z520B
Charger	Z520C
Accu Set	Z520D
Schuko Adapter	Z520E

Accessories	Article number
UK Adapter	Z520F
CH Adapter	Z520G
Professional Bag	Z520T
E-Set	Z590R

5.3 DEVICE OVERVIEW

5.3.1 FRONT

Fig. 2: Front Panel

1 TFT color display

5.3.2 BACK

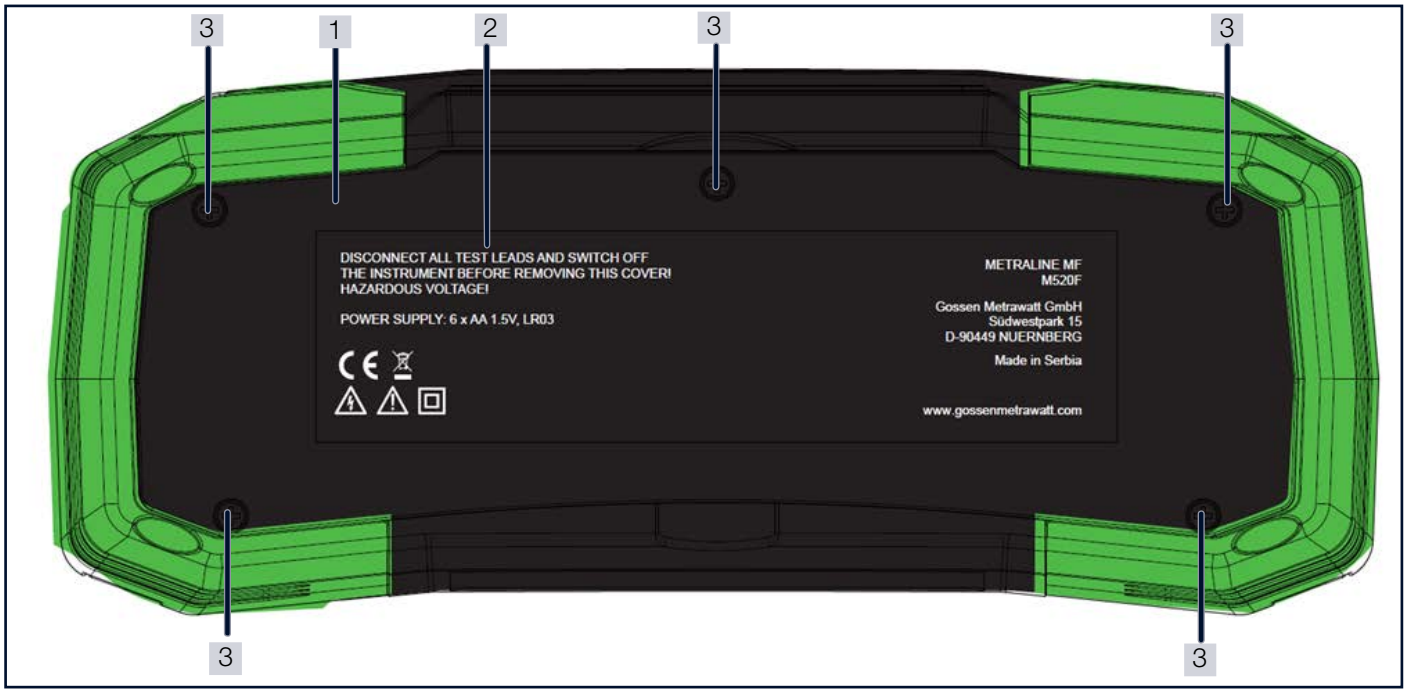


Fig. 3: Back of Instrument

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

5.3.3 BATTERY COMPARTMENT

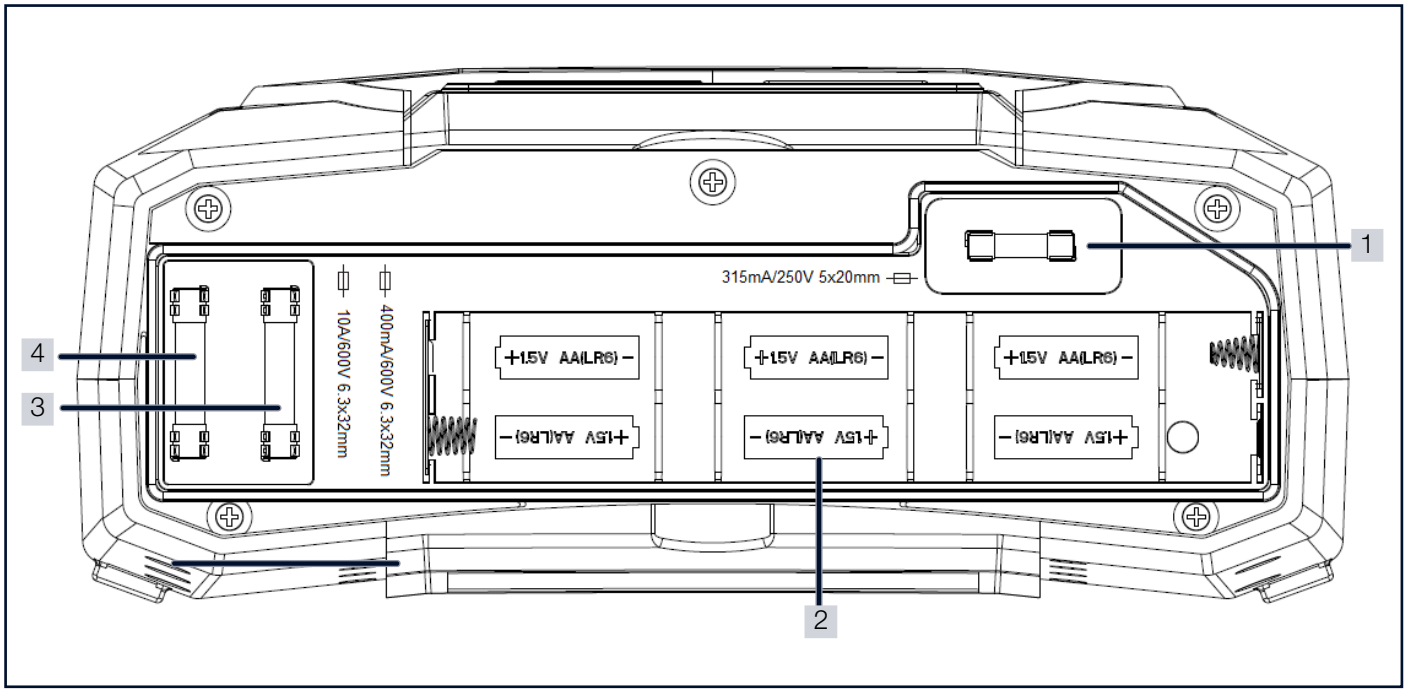


Fig. 4: Battery Compartment

1 Fuse F3
2 Battery cells
3 Fuse F2
4 Fuse F3

5.3.4 TOP

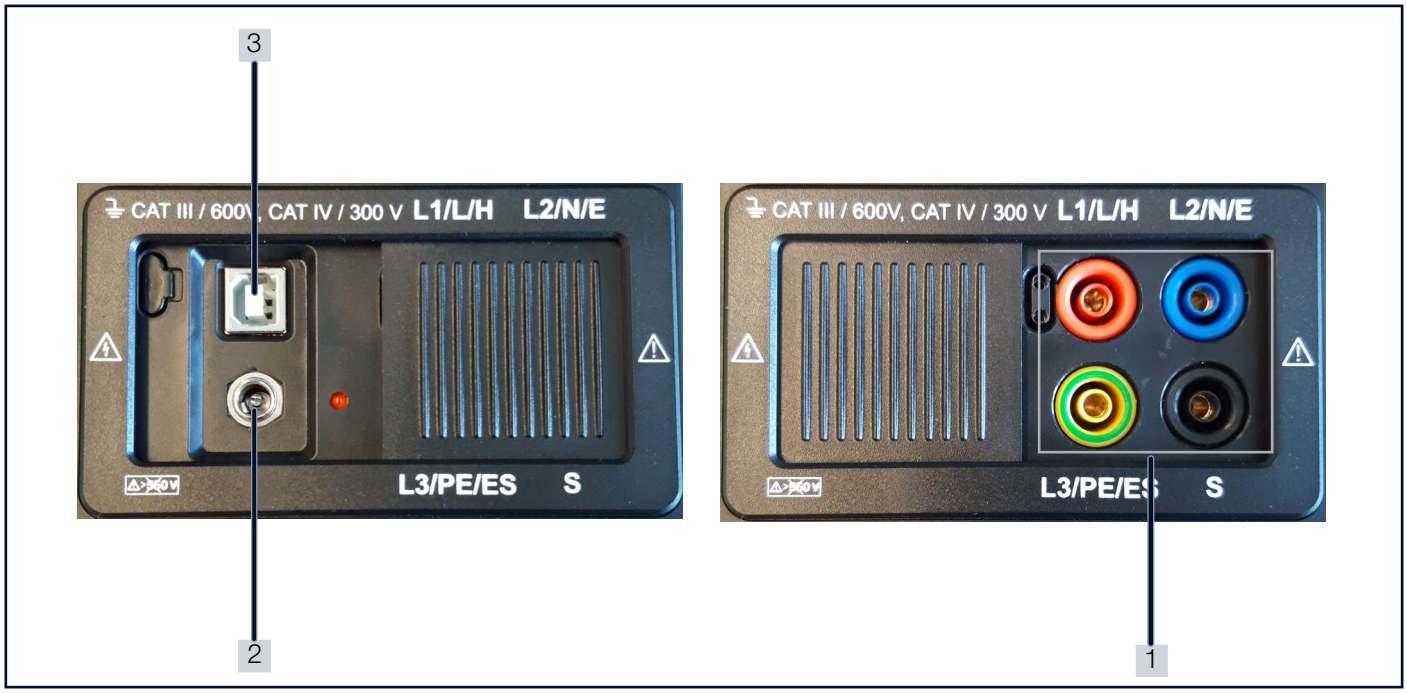


Fig. 5: Top of Instrument

1 Test lead sockets
2 Mains socket
3 USB port

5.3.5 Symbols on the Tester and the Included Accessories

Symbol	Meaning
	Warning concerning a point of danger (attention, observe documentation!)
	Warning regarding electrical voltage
	Double insulation (protection category II)
CE	European conformity marking
	The tester may not be disposed of with household trash ⇨ "Disposal and Environmental Protection" 🗎63.
	Power supply socket polarity

Tab. 4: Symbols on the Tester and the Included Accessories

5.4 RELEVANT STANDARDS

The instrument has been manufactured and tested in accordance with the following safety regulations:

DIN EN 60529 IEC 60529	Test instruments and test procedures Degrees of protection provided by enclosures (IP code)
DIN EN 61010-1 IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
DIN EN 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement
DIN EN IEC 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
DIN EN IEC 61557-1	Electrical safety in low voltage distribution systems up to 1000 V_{AC} and 1500 V_{DC} – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements
IEC 62955	Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles

5.5 TECHNICAL DATA

Power Supply		9 V_{DC} (6 × 1.5 V Ni-MH batteries, size AA)
Ambient Conditions	Operating temperatures:	0 … +40 °C
	Storage temperature:	–10 … +70 °C
	Relative atmospheric humidity:	Max. 95%, no condensation allowed
	Elevation:	Max. 2000 m
Electrical Safety	Pollution degree:	2
	Protection category:	II
	Surge protection	600 V CAT III
		300 V CAT IV
Electromagnetic Compatibility (EMC)	Interference emission:	EN 61326-1 class B
	Interference immunity:	DIN EN 61326-1 / IEC 61326-1 DIN EN 61326-2-33 / IEC 61326-2-33 EN 55011:2016 + A1:2017
Mechanical Design	Protection:	Housing: IP42 per DIN EN 60529 / IEC 60529 (protection against ingress of solid foreign objects: ≥ 1.0 mm dia.,Ø; protection against ingress of water: protected against dripping water when the housing is tilted up to 15°)
	Housing (W × H × D):	Approx. 25 × 10.7 × 13.5 cm
	Weight:	Approx. 1.30 kg (without batteries)
	Display:	480 × 320 TFT LCD
Data Interfaces	COM-port:	USB
Internal memory		1000 measurements

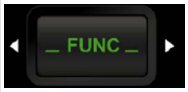
5.6 CHARACTERISTIC VALUES

Function	Measured variable	Display range
Continuity	Test current max. 7 mA	0.0 Ω … 1999 Ω
	Test current min. 200 mA	0.00 Ω … 1999 Ω
Insulation resistance (R_{ISO})	Nominal voltages 50/100/250 V	0.000 MΩ … 199.9 MΩ
	Nominal voltages 500/1000 V	0.000 MΩ … 999 MΩ
RCD testing	Contact Voltage [U_C]	0.0 V … 99.9 V
	Time [t]	0.0 ms … 500.0 ms
	Current [I]	0.2 × $I_{\Delta N}$ … 1.1 × $I_{\Delta N}$ (AC)
		0.2 × $I_{\Delta N}$ … 1.5 × $I_{\Delta N}$ (A).. ($I_{\Delta N}$ ≥30 mA)
		0.2 × $I_{\Delta N}$ … 2.2 × $I_{\Delta N}$ (A). ($I_{\Delta N}$ <30 mA)
		0.2 × $I_{\Delta N}$ … 2.2 × $I_{\Delta N}$ (B)
Impedance	Z_{line} L-L, L-N	0.0 Ω … 9999 Ω
	Z_{loop} L-PE	0.0 Ω … 9999 Ω
	Z_{loop} L-PE, non trip	0.0 Ω … 9999 Ω
Voltage and frequency (V)	TRMS	0 V … 550 V
	Frequency	10.0 Hz … 499.9 Hz
Phase rotation	TRMS	50 V AC … 550 V AC
		45 Hz … 400 Hz
Earth resistance (R_E)	3-wire, 4-wire	0.00 Ω … 9999 Ω
	Specific earth resistance	0.0 Ω … 9999 Ω

6 MENU AND FUNCTIONS

The instrument is operated via function keys on the front panel.
The settings and values are displayed on the display.

6.1 FUNCTION KEYS

Key	Description	Function
	**save**	Saves a measurement or a setting
	**zero**	Compensates the test lead resistance in low-value resistance measurements
	**help**	Access the help menu
	**light**	Configurate or turn off the display backlight
	**set**	Opens the setup menu
	**esc**	Exit a menu and return to the previous level
	**on/off**	Short keystroke: Instrument on Long keystroke: Instrument off The instrument will automatically switch off (APO) after the last key press if no voltage is applied
	**up**	Scroll upwards in a list
	**down**	Scroll downwards in a list
	**left**	Decrease a value Switch to the previous option
	**right**	Increase a value Switch to the next option
	**FUNC**	Switch beween different measurement modes
	**START/enter**	Start a test Enter a submenu Confirm an action

Tab. 5: Function Keys

6.2 USER INTERFACE

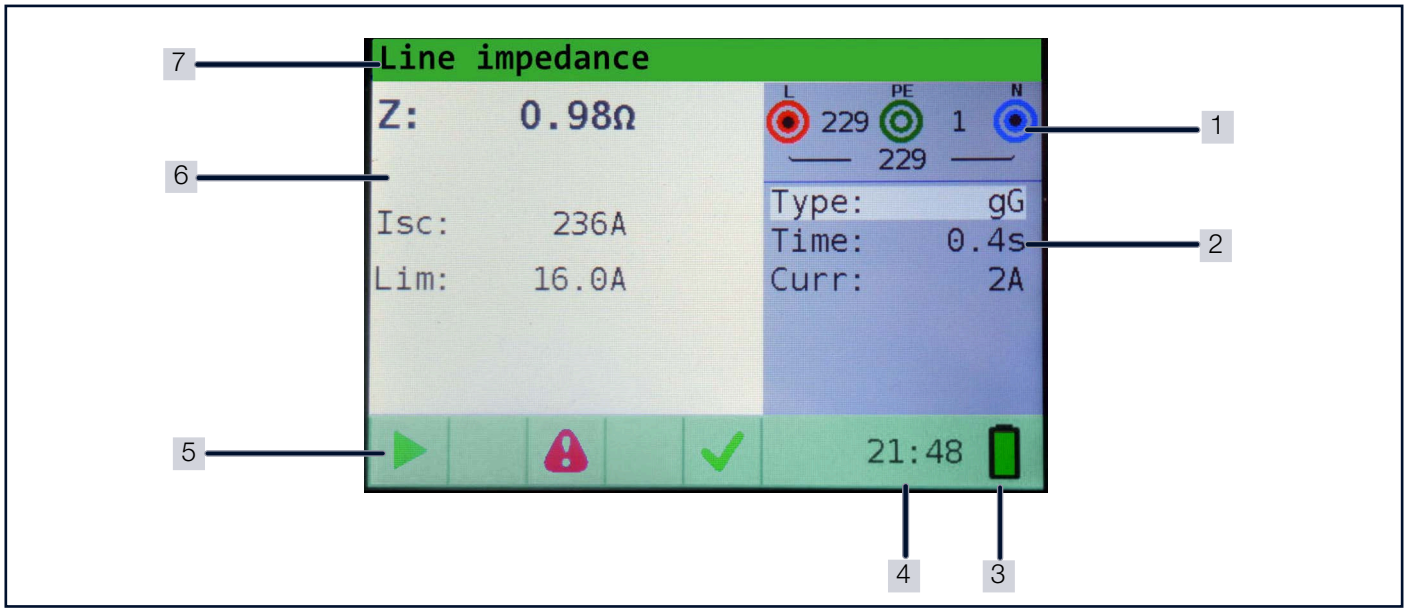


Fig. 6: Display

1 Online voltage and output monitor
2 Options field
3 Message field - battery status indicator
4 Current time
5 Status field
6 Result field
7 Function line

6.2.1 VOLTAGE AND OUTPUT TERMINAL MONITOR

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

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

6.2.2 BATTERY STATUS INDICATION

Indicator	Description
	Battery power indication Here: Battery partially charged
	Battery low or empty Battery pack is too weak to guarantee correct result. Replace the batteries.

Tab. 6: Battery Status Indication

The recharge process is indicated by a LED near the power supply socket.

6.2.3 STATUS FIELD

Icon	Description
	Dangerous voltage
COMP	Test leads are compensated
	Not ready for measurement
	Dangerous voltage on PE
	Result ok
	Result not ok
	RCD open or tripped
	RCD closed
	Ready for measurement
	Temperature too high
	Swap test leads
	Wait
	Noise on signal
	Check fuses
REF	Reference measurement (optional)
SF	Single fault in IT system (optional)

Tab. 7: Status Field Icons

6.2.4 ACOUSTIC WARNINGS

Sound	Description
Short high sound	Button is pressed
Continuous sound	During continuity test: The result is < 35 Ω
Increasing alarm	Dangerous voltage is applied
Short sound	Power off, end of measurement
Decreasing alarm	Warnings: ■ Temperature ■ Voltage and input ■ Start not possible
Periodic alarm	Warning! Phase voltage on the PE terminal! Stop all the measurements immediately and eliminate the fault before proceeding with any activity!

Tab. 8: Acoustic Warnings

6.3 MEASUREMENT FUNCTIONS

The following measurements can be selected by pressing **FUNC**:

- Voltage/rotation/frequency measurement
- Earth resistance (Ro, Re)
- Continuity (Continuity, R Low)
- R Insulation
- Line impedance (Line, voltage drop)
- Loop impedance (Loop, Rs, RCD)
- RCD (Auto, UC, Time, Current)
- EVSE measurement

6.4 MEASUREMENT SETTINGS

Parameters	Description
Mode	Sets the measurement mode
Limit	Sets the limit value
Distance	Earth resistance Ro: Sets the distance "a" between test rods
Type	Selects the RCD type
Time	Time
Curr	Current
F Isc	Scaling factor
IΔn	Sets the nominal current
Factor	Sets the nominal differential trip-out current multiplier
Pol.	Sets the test current starting polarity
Volt.	Sets the nominal test voltage
Freq	Frequency
Rotation	Rotation

Tab. 9: Measurement Settings

6.5 SETUP MENU

Submenu		Description
Date/time	**Year** **Month** **Day** **Hour** **Minute**	Sets date and time
Isc factor		Sets prospective short/fault current scaling factor
Start function	**Last function** **Earth resistance Re** **Continuity** **R insulation** **Line impedance** **Loop impedance** **RCD** **Voltage**	Sets the start function
RCD standard	**EN 61008/EN 61009** **EN 60364-4-41 TN/IT** **BS 7671** **AZ NZS 3017**	Select national standard for RCD testing
ELV	**50 V AC / 120V DC** **25V AC / 60V DC**	Select voltage for ELV warning
Power off time	**no power off** **30s** **1min** **5min** **10min** **30min** **1h**	Sets the time after which the device automatically turns off
Continuity timeout	**no timeout** **30s** **1min** **5min** **10min** **30min** **1h**	Select time-out when measurement should stop automatically
R insulation timeout	**no timeout** **30s** **1min** **5min** **10min** **30min** **1h**	Select time-out when measurement should stop automatically
Supply system	**TN (TT)** **IT** **Reduced low voltage (2 x 55 V)**	Select supply network/system

Submenu		Description
Device info		Displays information about the device: SN, Firmware, next calibration
Language	**English** **German** **Dutch** **French** **Spanish** **Italian**	Changes the language of the user interface
Buzzer	**Alarm and errors** **Alarm only** **All sounds**	Sets the options, when the buzzer should be active

Tab. 10: Setup Menu

- Press the key **set** to enter the setup menu.
- Press **up / down** to select the submenu.
- Press **START/enter** to enter the submenu.
- Press **left / right** to increase or decrease the value.

6.6 HELP SCREEN

The help screens contain diagrams that show the correct use of the device for every kind of measurement.

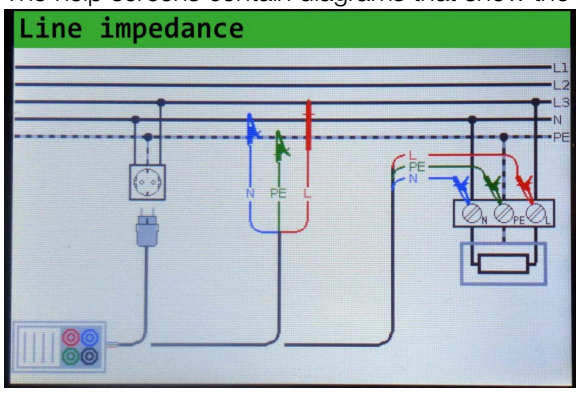


Fig. 7: Help Screen

- Press the key **help** to enter the help screen.
- Press **left** to switch to the previous help screen.
- Press **right** to switch to the next help screen.
- Press **help** or **esc** to close the help screen.

7 INSTALLATION

7.1 UNPACKING THE INSTRUMENT

1. Carefully remove instrument and accessories from the packaging.
2. Check delivery for completeness and possible damage.
3. In case of detected damages, hidden defects and short deliveries, document type and scope and contact the manufacturer or supplier immediately.
4. Keep packing material for further transport.

7.2 ESTABLISHING POWER SUPPLY

1. Remove the screws of the battery compartment cover on the back side of the instrument.
2. Remove the battery/fuse compartment cover.
3. Insert 6 1.5 V AA batteries into the battery tray. Ensure the correct polarity.
4. Place the battery compartment cover onto the battery tray.
5. Fix the screws of the battery compartment cover.

7.3 SWITCHING ON/OFF

7.3.1 SWITCHING ON THE INSTRUMENT

1. Briefly press the key **on/off**.
2. The firmware version is displayed on the screen for a few seconds. Afterwards, the last set mode is displayed on the screen. The instrument is ready for operation.

7.3.2 SWITCHING OFF THE INSTRUMENT

1. Press the key **on/off** for a few seconds.
2. The instrument is switched off.

8 OPERATION

8.1 SELECTING A FUNCTION OR SUBFUNCTION

1. Press **up** or **down** to select the the parameter or limit value you want to edit.
2. Press **left** or **right** to set the value for the selected parameter.

↳ The settings are retained until new changes are made.

8.2 PERFORMING A MEASUREMENT

Note

The indicator **Not ready for measurement** means that the selected measurement cannot be performed because of irregular conditions on input terminals.

Insulation resistance, continuity functions and earth resistance measurements can only be performed on de-energized objects.

PASS / FAIL indication is enabled when limit is set. Apply appropriate limit value for evaluation of measurement results.

In the case that only two of the three wires are connected to the electrical installation under test, only voltage indication between these two wires is valid.

1. Select the measurement function.
2. According to the measurement function, select the measurement mode.
3. According to the measurement function, select the limit values and/or parameters.
4. Connect the test leads to the instrument as described in the measurement function's **help** diagram.
5. Connect the test cables to the DUT as described in the measurement function's **help** diagram.
6. Check the status field for warnings.

✓ The symbol **Ready for measurement** is displayed in the status field.

7. Press **START/enter**.

↳ The test is performed.
The result value is displayed.
The result is marked with the symbol for the test status:
Result ok = Test passed
Result not ok = Test not passed.

8.3 INSULATION RESISTANCE MEASUREMENT

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

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

Measuring Range (MΩ)	Resolution (MΩ)	Accuracy
Insulation resistance: Nominal voltages 50 V_{DC} Measurement range according to 61557: 50 kΩ **…** 80 MΩ		
0.1 … 80.0	(0.100 … 1.999) 0.001 (2.00 … 80.00) 0.01	±(5% of reading + 3 digits)
Insulation resistance: Nominal voltages 100 V_{DC} and 250 V_{DC} Measurement range according to 61557 from 100 kΩ … 199.9 MΩ		
0.1 ÷ 199.9	(0.100 … 1.999) 0.001 (2.00 … 99.99) 0.01 (100.0 … 199.9) 0.1	±(2% of reading + 3 digits)

Measuring Range (MΩ)	Resolution (MΩ)	Accuracy
Insulation resistance: Nominal voltages 500 V_{DC} and 1000 V_{DC} Measurement range according to 61557 from 500 kΩ … 199.9 MΩ		
0.1 … 199.9	(0.100 … 1.999) 0.001 (2.00 … 99.99) 0.01 (100.0 … 199.9) 0.1	±(2% of reading + 3 digits)
200 … 999	(200.0 … 999) 1	±(10% of reading)

Measuring Range (V)	Resolution (V)	Accuracy
Voltage		
0 … 1200	1	±(3% of reading + 3 digits)

Nominal voltages	50V_{DC}, 100 V_{DC}, 250 V_{DC}, 500 V_{DC}, 1000 V_{DC}
Open circuit voltage	-0 % / +20 % of nominal voltage
Measuring current	min. 1 mA at R_N=U_N 1 kΩ/V
Short circuit current	max. 15 mA
Number of possible tests with a new set of batteries	up to 1000 (with 2300 mAh battery cells)
Auto discharge after test	

▶ Performing an Insulation Resistance Measurement

WARNING

Risk of electric shock!

- Do not touch the test object during the measurement or before it is fully discharged.
- Perform insulation resistance measurements only on de-energized objects.
- Disconnect all loads and close all switches before measuring the insulation resistance between installation conductors.

ATTENTION

Damaged instrument due to unsuitable voltage

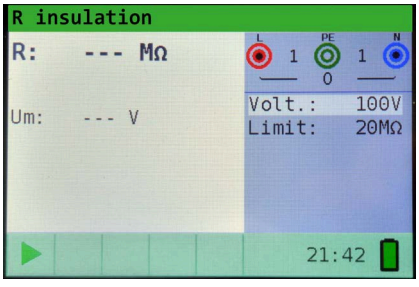
Unsuitable voltage results in damage to the instrument and the accessories.

- Do not connect test terminals to external voltage higher than 550 V (AC or DC).

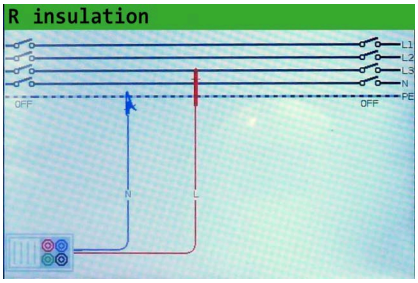
Note

In case the instrument gets moistened the results could be impaired. In such case it is recommended to dry the instrument and accessories for at least 24 hours.

1. Press **FUNC** and select **R Insulation**.
2. Select **Volt** to set the value for the nominal test value.
3. Select **Limit** to set the low limit resistance value.

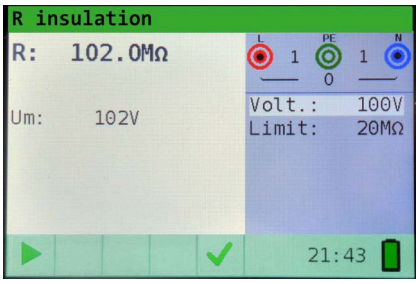


4. Make sure no voltages are present on the DUT.
5. Connect the test leads to the instrument.
6. Connect the test cables to the DUT.



7. Check the status field for warnings.
8. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
R	Insulation resistance
Um	Actual voltage applied to DUT

8.4 CONTINUITY MEASUREMENT

Two continuity sub-functions are available:

- R Low (ca. 240 mA) continuity test with automatic polarity reversal
- Low current (ca. 4 mA) continuous continuity test (optional), useful when testing inductive systems

8.4.1 R LOW TEST

This function is used to test the resistance between two different points of the installation to ensure that a conductive path exists between them. The test ensures that all protective conductors, earth conductors or bonding conductors are correctly connected, terminated and have the correct resistive value.

The measurement of the R Low resistance is performed with a test current of more than 200 mA. An automatic pole reversal of the test voltage and the test current is performed during the test. This test checks for any components (e.g. diodes, transistors, SCRs) that may have a rectifying effect on the circuit which could cause problems when a voltage is applied.

This measurement completely complies with EN 61557-4 regulations.

Measuring Range (Ω)	Resolution (Ω)	Accuracy
Measurement range according to 61557: 0.1 Ω … 1999 Ω		
0.1 … 20.0	(0.10 … 19.99) 0.01 (2.00 … 80.00) 0.01	±(3% of reading + 3 digits)
20 … 1999	(20.0 … 99.9) 0.1 (100 … 1999) 1	±(5% of reading)

Open circuit voltage	5 V_{DC}
Measuring current	min. 200 mA into load resistance of 2 Ω
Test lead compensation	up to 5 Ω
Number of possible tests with a new set of batteries	up to 1400 (with 2300 mAh battery cells)
Automatic polarity reversal of the test voltage	

Performing an R Low Test

WARNING

Risk of electric shock!

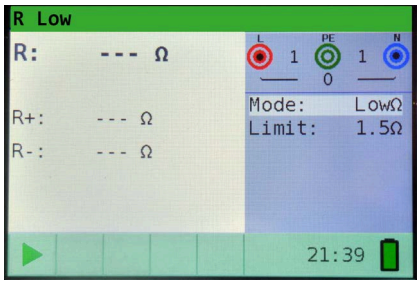
- Perform the measurements only on de-energized objects.
- Parallel impedances or transient currents may influence test results.

Note

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

.

1. Press **FUNC** and select **Continuity** or **R Low**.
2. Select **Mode** to set the test mode **LowΩ**.
3. Select **Limit** to set the limit resistance value.



4. Connect the test leads to the instrument.
5. Short test leads.

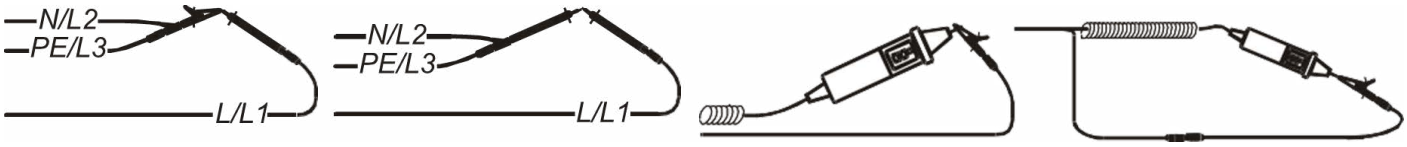
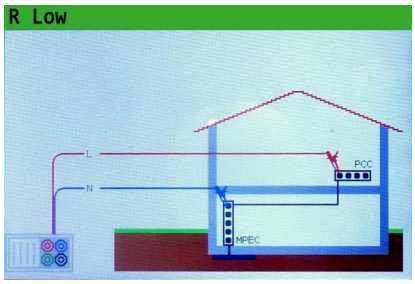
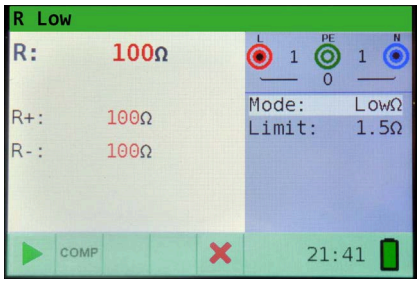


Fig. 8: Shorting of test Leads

6. Press **zero** to start compensation of test lead resistance.
   ↳ After successful compensation, the indicator **zero** is displayed in the status field.
7. Press **zero** again to remove the compensation of test lead resistance.
   ↳ After having removed compensation, the indicator **zero** disappears from the status field.
8. Make sure no voltages are present on the DUT.
9. Connect the test cables to the DUT.



10. Check the status field for warnings.
11. If the icon **Ready for measurement** is displayed, press **START/enter**.
    ↳ The test is performed.
    The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
R	Main LowΩ resistance result (average of R+ and R- results)
R+	LowΩ resistance sub-result with positive voltage at L terminal
R-	LowΩ resistance sub-result with positive voltage at N terminal

8.4.2 CONTINUITY TEST

Continuous low-value resistance measurements can be performed without pole reversal of the test voltages and a lower test current (a few mA). In general, the function serves as an ordinary Ω-meter with low-test current. The function can also be used to test inductive components such as motors and coiled cables.

Measuring Range (Ω)	Resolution (Ω)	Accuracy
0.1 … 1999	(0.1 … 99.9) 0.1 (100 … 1999) 1	±(5% of reading + 3 digits)

Open circuit voltage	5 V_{DC}
Short circuit current	max. 7 mA
Test lead compensation	up to 5 Ω

▶ **Performing a Continuity Test**

WARNING

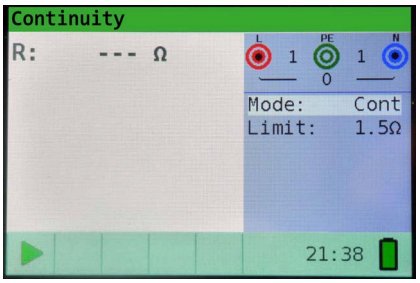
Risk of electric shock!

- Perform the measurements only on de-energized objects.

Note

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

1. Press **FUNC** and select **Continuity** or **R Low**.
2. Select **Mode** to set the test mode **Cont**.
3. Select **Limit** to set the limit resistance value.



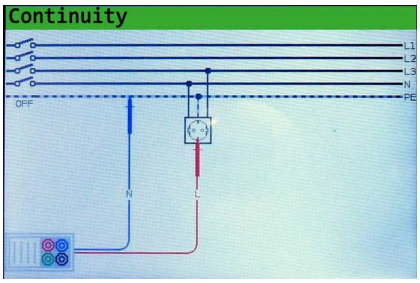
4. Connect the test leads to the instrument.
5. Press **zero** to start compensation of test lead resistance.

↳ After successful compensation, the indicator **zero** is displayed in the status field.

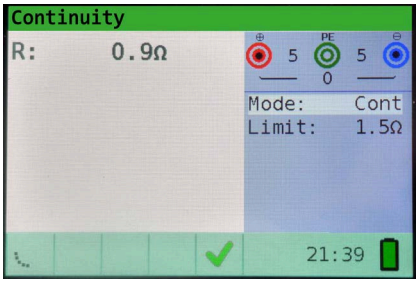
6. Press **zero** again to remove the compensation of test lead resistance.

↳ After having removed compensation, the indicator **zero** disappears from the status field.

7. Make sure no voltages are present on the DUT.
8. Connect the test cables to the DUT.



9. Check the status field for warnings.
10. If the icon **Ready for measurement** is displayed, press **START/enter**.
↳ The continuous test is performed until the function is stopped manually.
11. Press **START/enter**.
↳ The measurement is stopped.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
R	Low current continuity resistance result
I	Current used in the measurement

8.5 TESTING RCD

Sub-functions for RCD testing:

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

Nominal residual current	6 mA, 10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA
Nominal residual current accuracy	-0 / +0.1 I_Δ; $I_\Delta = I_{\Delta N}$, 2 $I_{\Delta N}$, 5 $I_{\Delta N}$
	-0.1 I_Δ / +0; I_Δ = ½ $I_{\Delta N}$
Test current shape	Sine-wave (AC), DC (B), pulsed (A)
RCD type	general (G, non-delayed), selective (S, time-delayed), EVSE
Test current starting polarity	0°, 180°
Voltage range	93 V … 134 V; 185 V … 266 V; 45 Hz … 65 Hz

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

	½ × $I_{\Delta N}$			1 × $I_{\Delta N}$			2 × $I_{\Delta N}$			5 × $I_{\Delta N}$			RCD I_Δ		
$I_{\Delta N}$ (mA)	AC	A	B	AC	A	B	AC	A	B	AC	A	B	AC	A	B
6	3	2.1	3	6	12	12	12	24	24	30	60	60	✓	✓	✓
10	5	3.5	5	10	20	20	20	40	40	50	100	100	✓	✓	✓
30	15	10.5	15	30	42	60	60	84	120	150	212	300	✓	✓	✓
100	50	35	50	100	141	200	200	282	400	500	707	1000	✓	✓	✓
300	150	105	150	300	424	600	600	848	n.a.	1500	n.a.	n.a.	✓	✓	✓
500	250	175	250	500	707	1000	1000	1410	n.a.	2500	n.a.	n.a.	✓	✓	✓
650	325	228	325	650	919	1300	1300	n.a.	n.a.	n.a.	n.a.	n.a.	✓	✓	✓
1000	500	350	500	1000	1410	n.a.	2000	n.a.	n.a.	n.a.	n.a.	n.a.	✓	✓	✓

Tab. 11: RCD test current selection according to IEC 61009

8.5.1 PARAMETERS AND LIMITS FOR RCD TESTING

Limit Contact Voltage

Limit contact voltage can be set in contact voltage U_C function only.

50 V_{AC}	Limited safety contact voltage for standard domestic area
25 V_{AC}	Contact voltage for special environments (hospitals, wet places, etc.)

Nominal Differential Trip-out Current

Nominal differential current is the rated trip-out current of an RCD.

The following RCD current ratings can be set:

6 mA
10 mA
30 mA
100 mA
300 mA
500 mA
650 mA
1000 mA

Multiplier of Nominal Residual Current

Selected nominal differential current can be multiplied as follows:

- ½
- 1
- 2
- 5

RCD Type and Test Current Starting Polarity

The instrument enables testing of general (non-delayed) and selective (time-delayed) RCDs.

The types of RCD the instrument is suitable for testing include:

Test current shape

AC	Alternating residual current
A	Pulsating DC residual current
B	Pure or nearly pure DC residual current (depends on model)

RCD type

G	General, non-delayed
S	Selective, time-delayed
EVSE	(depends on model)

Test current starting polarity

0° Positive start polarity

180° Negative start polarity

Testing Selective (Time-delayed) RCDs

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

8.5.2 CONTACT VOLTAGE

Leakage current flowing to the PE terminal causes a voltage drop across earth resistance, which is called contact voltage (U_C). This voltage is present on all accessible parts connected to the PE terminal and should be lower than the safety limit voltage.

The parameter contact voltage is measured without tripping-out the RCD. RL is a fault loop resistance and is calculated as follows:

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

Displayed contact voltage relates to the rated nominal differential current of the RCD and is multiplied by a safety factor.

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

Measuring Range (V)	Resolution (V)	Accuracy
Measuring range according to EN61557-6 is 3.0 V … 49.0 V f. limit contact voltage 25 V. Measuring range according to EN61557-6 is 3.0 V … 99.0 V for limit contact voltage 50 V		
3.0 … 9.9	0.1	(-0 %/+10 % of reading + 5 digits)
10.0 … 99.9	0.1	(-0 %/+10 % of reading + 5 digits)

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

▶ Performing a Contact Voltage Measurement

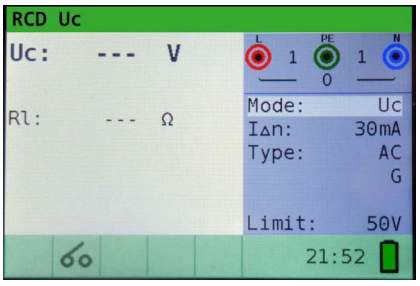
Note

Parameters set in one function are also kept for other RCD functions!

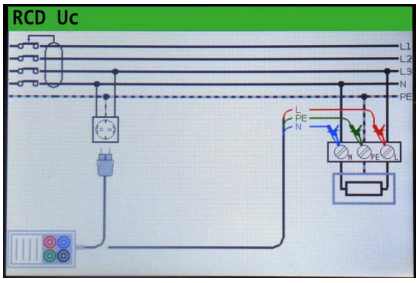
The measurement of contact voltage does not normally trip an RCD. However, the trip limit of the RCD may be exceeded because of leakage current flowing to the PE protective conductor or a capacitive connection between L and PE conductors.

The RCD trip-lock sub-function (function selector switch in **LOOP RCD** option) takes longer to complete but offers much better accuracy of fault loop resistance (in comparison to the RL sub-result in **Contact voltage** function).

1. Press **FUNC** and select **RCD**.
2. Select **Mode** and set the **Uc** mode.
3. Select $I_{\Delta N}$ to set the value for the nominal residual current.
4. Select **Type** to set the RCD type.
5. Select **Limit** to set the limit contact value.

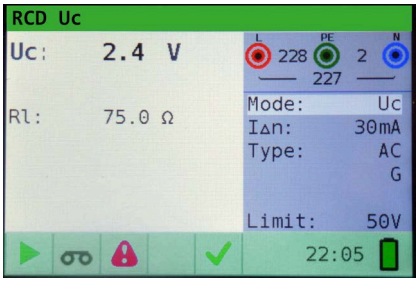


6. Connect the test leads to the instrument.
7. Connect the test cables to the DUT.



8. Check the status field for warnings.
9. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
U_C	Contact voltage
Rl	Fault loop resistance
Limit	Limit earth fault loop resistance value

8.5.3 TRIP-OUT TIME

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

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

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

Trip-out times according to BS 7671:

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

*)Test current of ½ $I_{\Delta N}$ cannot cause trip-out of the RCDs

Trip-out times according to IEC 62955:

	$I_{\Delta N}$dc	10 × $I_{\Delta N}$dc	33 × $I_{\Delta N}$dc	
6 mA_{DC} RCDs	t_Δ > 10000 ms	t_Δ < 300 ms	t_Δ < 100 ms	

	$I_{\Delta N}$	2 × $I_{\Delta N}$	5 × $I_{\Delta N}$	167 × $I_{\Delta N}$
30 mA_{AC} RCDs	no trip	t_Δ < 300 ms	t_Δ < 80 ms	t_Δ < 80 ms

Measuring Range (ms)	Resolution (ms)	Accuracy
Complete measurement range corresponds to EN 61557-6 requirements. Specified accuracies are valid for complete operating range.		
0.0 … 500.0	0.1	(±3 ms)

Test current	½ × $I_{\Delta N}$, $I_{\Delta N}$, 2 × $I_{\Delta N}$, 5 × $I_{\Delta N}$
Limit contact voltage	25 V, 50 V

No multipliers available

▶ **Performing a Trip-out Time Measurement**

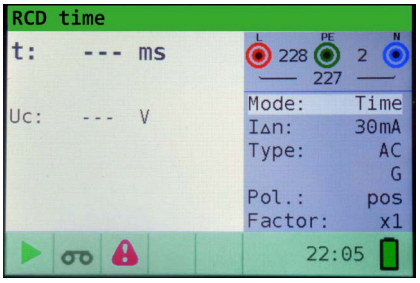
Note

Parameters set in one function are also kept for other RCD functions!

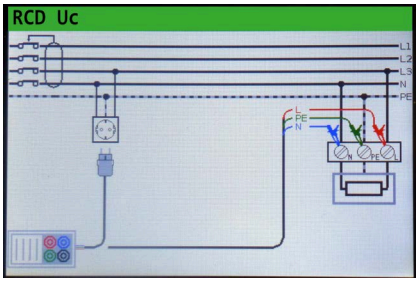
RCD trip-out time measurement will be performed only if the contact voltage at nominal differential current is lower than the limit set in the contact voltage setting.

The measurement of contact voltage does not normally trip an RCD. However, the trip limit of the RCD may be exceeded because of leakage current flowing to the PE protective conductor or a capacitive connection between L and PE conductors.

1. Press **FUNC** and select **RCD**.
2. Select **Mode** and set the **Time** mode.
3. Select $I_{\Delta N}$ to set the value for the nominal differential trip-out current.
4. Select Factor to set the nominal differential trip-out current multiplier.
5. Select **Type** to set the RCD type.
6. Select **Pol.** to set the test current starting polarity.

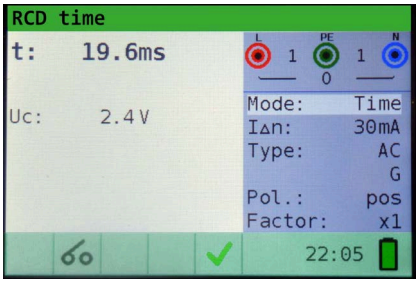


7. Connect the test leads to the instrument.
8. Connect the test cables to the DUT.



9. Check the status field for warnings.
10. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✔	Result ok
✘	Result not ok
t	Trip-out time
U_C	Contact voltage

8.5.4 TRIP-OUT CURRENT

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

Measuring Range (Δ)	Resolution (Δ)	Accuracy
Measurement range corresponds to EN61557-6 for $I_{\Delta N}$ ≥10 mA. Specified accuracies are valid for complete operating range.		
0.2 × $I_{\Delta N}$ … 1.1 × $I_{\Delta N}$ (AC type)	0.05 × $I_{\Delta N}$	±0.1 × $I_{\Delta N}$
0.2 × $I_{\Delta N}$ … 1.5 × $I_{\Delta N}$ (A type, $I_{\Delta N}$ ≥30 mA)	0.05 × $I_{\Delta N}$	±0.1 × $I_{\Delta N}$
0.2 × $I_{\Delta N}$ … 2.2 × $I_{\Delta N}$ (A type, $I_{\Delta N}$ =10 mA)	0.05 × $I_{\Delta N}$	±0.1 × $I_{\Delta N}$
0.2 × $I_{\Delta N}$ … 2.2 × $I_{\Delta N}$ (B type)	0.05 × $I_{\Delta N}$	±0.1 × $I_{\Delta N}$

Measuring Range (ms)	Resolution (ms)	Accuracy
Trip-out time		
0.0 … 300.0	1	(±3 ms)

Measuring Range (V)	Resolution (V)	Accuracy
Contact voltage		
3.0 … 9.9	0.1	(-0 %/+10 % of reading + 5 digits)
10.0 … 99.9	0.1	(-0 %/+10 % of reading + 5 digits)

Performing a Trip-out Current Measurement

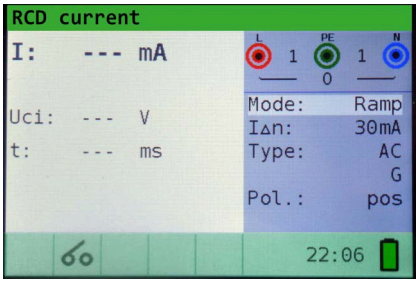
Note

Parameters set in one function are also kept for other RCD functions!

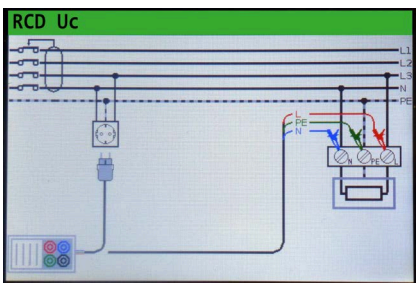
RCD trip-out time measurement will be performed only if the contact voltage at nominal differential current is lower than the limit set in the contact voltage setting.

The measurement of contact voltage does not normally trip an RCD. However, the trip limit of the RCD may be exceeded because of leakage current flowing to the PE protective conductor or a capacitive connection between L and PE conductors.

1. Press **FUNC** and select **RCD**.
2. Select **Mode** and set the **Ramp** mode.
3. Select **$I_{\Delta N}$** to set the value for the nominal residual current.
4. Select **Type** to set the RCD type.
5. Select **Pol.** to set the test current starting polarity.

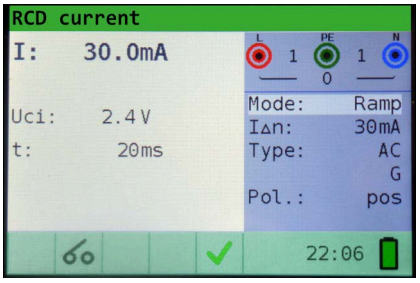


6. Connect the test leads to the instrument.
7. Connect the test cables to the DUT.



8. Check the status field for warnings.
9. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
I	Trip-out current
U_{Ci}	Contact voltage
t	Trip-out time

8.5.5 RCD AUTOTEST

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

▶ **Performing an RCD Autotest**

WARNING

Risk of electric shock!

- Leakage currents in the circuit following the residual current device (RCD) may influence the measurements.
- Special conditions in residual current devices (RCD) of a particular design, for example of type S (selective and resistant to impulse currents) shall be taken into consideration.
- Equipment in the circuit following the residual current device (RCD) may cause a considerable extension of the operating time. Examples of such equipment might be connected capacitors or running motors.

Note

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

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

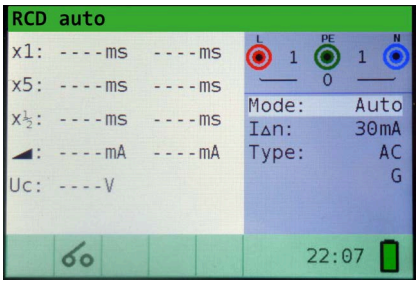
The **x1** Auto tests will be automatically skipped for RCD type B with rated residual currents of $I_{\Delta N}$ = 1000 mA.

The **x5** Auto tests will be automatically skipped in the following cases:

RCD type AC with rated residual currents of $I_{\Delta N}$ = 1000 mA
RCD type A and B with rated residual currents of $I_{\Delta N} \geq$ 300 mA

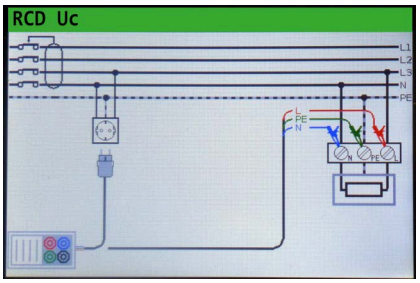
In these cases, the auto test result passes if the t1 to t4 results pass, and on the display are omitted t5 and t6.

1. Press **FUNC** and select **RCD**.
2. Select **Mode** and set the **Auto** mode.
3. Select $I_{\Delta N}$ to set the value for the nominal differential trip-out current.
4. Select **Type** to set the RCD type.



5. Connect the test leads to the instrument.
6. Connect the test cables to the DUT.
7. Check the status field for warnings.
8. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The autotest sequence starts.



Autotest Sequence

Step 1

Trip-out time measurement with the following measurement parameters:

- Test current of $I_{\Delta N}$
- Test current started with the positive half-wave at 0°

Measurement normally trips an RCD within allowed time period.

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

Step 2

Trip-out time measurement with the following measurement parameters:

- Test current of $I_{\Delta N}$
- Test current started with the negative half-wave at 180°

Measurement normally trips an RCD within allowed time period.

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

Step 3

Trip-out time measurement with the following measurement parameters:

- Test current of 5 × $I_{\Delta N}$
- Test current started with the positive half-wave at 0°

Measurement normally trips an RCD within allowed time period.

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

Step 4

Trip-out time measurement with the following measurement parameters:

- Test current of 5 × $I_{\Delta N}$
- Test current started with the negative half-wave at 180°

Measurement normally trips an RCD within allowed time period.

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

Step 5

Trip-out time measurement with the following measurement parameters:

- Test current of ½ × $I_{\Delta N}$
- Test current started with the positive half-wave at 0°

Measurement normally trips an RCD within allowed time period.

↳ After performing the measurement, the autotest sequence automatically proceeds with step 6.

Step 6

Trip-out time measurement with the following measurement parameters:

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

Measurement normally trips an RCD within allowed time period.

↳ After performing the measurement, the autotest sequence automatically proceeds with step 7.

Step 7

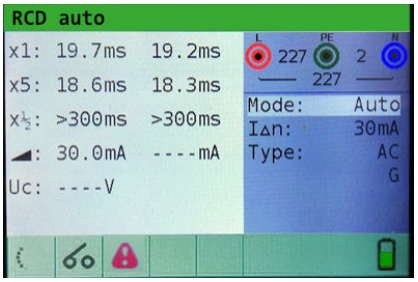
Ramp test measurement with the following measurement parameters:

- Test current started with the positive half-wave at 0°

This measurement determines the minimum current required to trip the RCD.

After the measurement has been started, the test current generated by the instrument is continuously increased, until the RCD trips.

↳ After performing the measurement, the autotest sequence automatically proceeds with step 8.



Step 8

Ramp test measurement with the following measurement parameters:

- Test current started with the negative half-wave at 180°

This measurement determines the minimum current required to trip the RCD.

After the measurement has been started, the test current generated by the instrument is continuously increased, until the RCD trips.

↳ The test results are displayed.

Result	Description
✓	Result ok
✗	Result not ok
x 1 (left)	Step 1 trip-out time result, t3 ($I_{\Delta N}$, 0°)
x 1 (right)	Step 2 trip-out time result, t4 ($I_{\Delta N}$, 180°)
x 5 (left)	Step 3 trip-out time result, t5 (5 × $I_{\Delta N}$, 0°)
x 5 (right)	Step 4 trip-out time result, t6 (5 × $I_{\Delta N}$, 180°)
x ½ (left)	Step 5 trip-out time result, t1 (½ × $I_{\Delta N}$, 0°)
x ½ (right)	Step 6 trip-out time result, t2 (½ × $I_{\Delta N}$, 180°)
I_{Δ} (+)	Step 7 trip-out current (+), positive polarity
I_{Δ} (–)	Step 8 trip-out current (–), negative polarity
U_C	Contact voltage for rated $I_{\Delta N}$

8.6 FAULT LOOP IMPEDANCE AND PROSPECTIVE FAULT CURRENT MEASUREMENT

The loop impedance function has three sub-functions:

- LOOP IMPEDANCE sub-function
  performs a fast fault loop impedance measurement on supply systems which do not contain RCD protection.
- LOOP IMPEDANCE RCD trip-lock sub-function
  performs fault loop impedance measurement on supply systems which are protected by RCDs
- LOOP IMPEDANCE Rs sub-function with configurable RCD-value
  performs fault loop impedance measurement on supply systems which are protected by RCDs

Zloop L-PE, I_{pfc} subfunction

Measuring Range (Ω)	Resolution (Ω)	Accuracy
Measuring range according to EN61557-3 is 0.25 Ω …1999 Ω		
0.2 … 9999	(0.20 … 19.99) 0.01 (20 … 99.9) 0.1 (100 … 9999) 1	±(5 % of reading + 5 digits)

Measuring Range (A)	Resolution (A)	Accuracy
Prospective fault current (calculated value)		
0.00 … 19.99	0.0)	Consider accuracy of fault loop resistance measurement
20.00 … 99.9	0.1	
100 … 999	1	
1.00k … 9.99k	10	
10.0 … 100.0k	100	

Test current (at 230 V)	3.4 A, 50 Hz Sine wave (10 ms ≤ t_{LOAD} 15 ms)
Nominal voltage range	93 V **…** 134 V; 185 V **…** 266 V (45 Hz **…** 65 Hz)

Zloop L-PE RCD and Rs, I_{pfc} non-trip subfunction

Measuring Range (Ω)	Resolution (Ω)	Accuracy (may be impaired in case of heavy noise on mains voltage)
Measuring range according to EN61557-3 is 0.75 Ω …1999 Ω		
0.4 … 19.99	(0.40 … 19.99) 0.01	±(5 % of reading + 10 digits)
20.0 … 9999	(20 … 99.9) 0.1 (100 … 9999) 1	±10 % of reading

Measuring Range (A)	Resolution (A)	Accuracy
Prospective short-circuit current (calculated value)		
0.00 … 19.99	0.0)	Consider accuracy of fault loop resistance measurement
20.00 … 99.9	0.1	
100 … 999	1	
1.00k … 9.99k	10	
10.0 … 100.0k	100	

Nominal voltage range	93 V **…** 134 V; 185 V **…** 266 V (45 Hz **…** 65 Hz)

8.6.1 FAULT LOOP IMPEDANCE

The fault loop impedance measures the impedance of the fault loop in the event that a short-circuit to an exposed conductive part occurs (i.e. a conductive connection occurs between the phase conductor and protective earth conductor). To measure loop impedance, the instrument uses a high-test current.

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

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

Nominal input voltage U_N	Voltage range
115 V	93 V ≤ $U_{L\text{-}PE}$ < 134 V
230 V	185 V ≤ $U_{L\text{-}PE}$ ≤ 266 V

▶ Performing a Fault Loop Impedance Measurement

Note

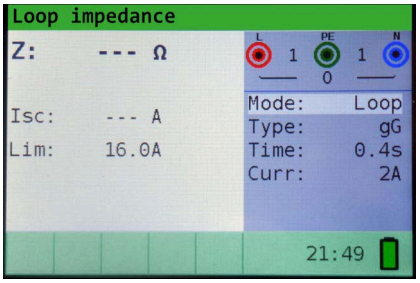
The specified accuracy of test parameters is valid only if mains voltage is stable during the measurement.

Fault loop impedance measurement trips RCD protected circuits.

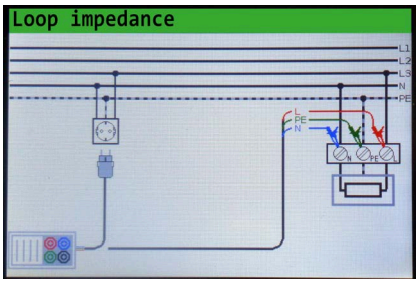
Isc depends on Z, Un and scaling factor

The current limit depends on fuse type, fuse current rating, fuse trip-out time

1. Press **FUNC** and select **Loop Impedance**.
2. Select **Mode** and set the **Loop** mode.
3. Select **Time** to set the time.
4. Select **Type** to set the desired type.
5. Select **Curr** to set the test current.

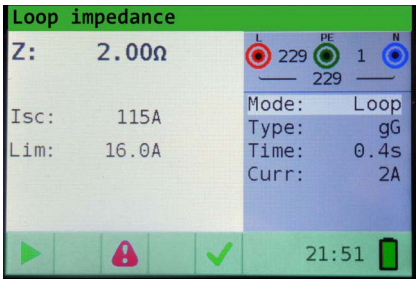


6. Connect the test leads to the instrument.
7. Connect the test cables to the DUT.



8. Check the status field for warnings.
9. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok

Result	Description
✖	Result not ok
Z	Fault loop impedance
I_{SC}	Prospective fault current (displayed in amps)

8.6.2 FAULT LOOP IMPEDANCE TEST RCD (FOR RCD PROTECTED CIRCUITS)

The fault loop impedance is measured with a low test current to avoid tripping the RCD. This function can also be used for fault loop impedance measurement in system equipped with RCDs which have a rated trip-out current of 30 mA and above.

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

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

Nominal input voltage U_N	Voltage range
115 V	93 V ≤ $U_{L\text{-}PE}$ < 134 V
230 V	185 V ≤ $U_{L\text{-}PE}$ ≤ 266 V

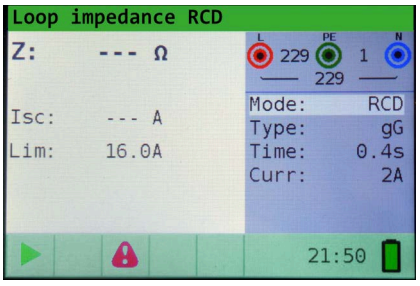
▶ Performing an RCD Trip-lock Measurement

Note

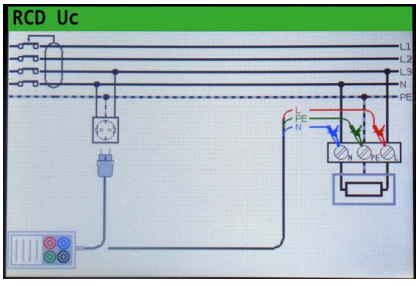
The measurement of fault loop impedance using trip-lock function does not normally trip an RCD. However, if the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

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

1. Press **FUNC** and select **Loop Impedance**.
2. Select **Mode** and set the **RCD** mode.
3. Select **Time** to set the time.
4. Select **Type** to set the desired type.
5. Select **Curr** to set the test current.

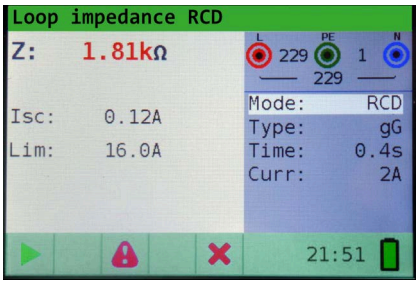


6. Connect the test leads to the instrument.
7. Connect the test cables to the DUT.



8. Check the status field for warnings.
9. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
Z	Fault loop impedance
I_{SC}	Prospective fault current (displayed in amps)

8.6.3 FAULT LOOP IMPEDANCE TEST RS (FOR ADJUSTABLE CURRENT)

The fault loop impedance is measured with a low test current to avoid tripping the RCD. It is possible to adjust the value of the RCD, while the test current depends on the chosen value. By this function it is possible to test each RCD-type with the maximum possible current without tripping the RCD.

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

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

Nominal input voltage U_N	Voltage range
115 V	93 V ≤ $U_{L\text{-}PE}$ < 134 V
230 V	185 V ≤ $U_{L\text{-}PE}$ ≤ 266 V

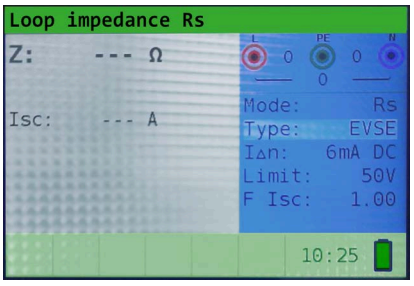
▶ Performing an Rs Trip-lock Measurement

Note

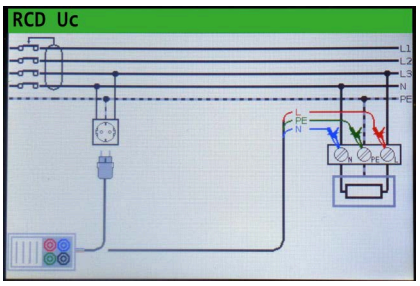
The measurement of fault loop impedance using trip-lock function does not normally trip an RCD. However, if the trip limit may be exceeded as a result of leakage current flowing through the PE protective conductor or a capacitive connection between L and PE conductors.

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

1. Press **FUNC** and select **Loop Impedance**.
2. Select **Mode** and set the **Rs** mode.
3. Select **Type** to set the desired type.
4. $I_{\Delta N}$ to select the current.
5. Select **Limit** to set the limit value.
6. Select **F** I_{SC} to set the scaling factor.

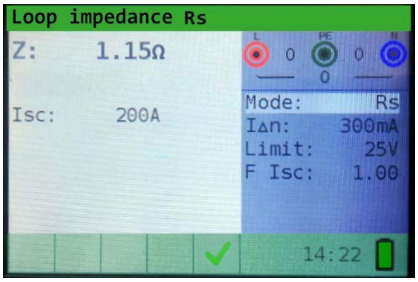


7. Connect the test leads to the instrument.
8. Connect the test cables to the DUT.



9. Check the status field for warnings.
10. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
Z	Fault loop impedance
I_{SC}	Prospective fault current (displayed in amps)

8.7 LINE IMPEDANCE AND PROSPECTIVE SHORT-CIRCUIT CURRENT MEASUREMENT

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

Prospective short circuit current is calculated as follows:

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

Nominal input voltage U_N	Voltage range
115 V	93 V ≤ $U_{L\text{-}PE}$ < 134 V
230 V	185 V ≤ $U_{L\text{-}PE}$ ≤ 266 V
400 V	321 V ≤ $U_{L\text{-}PE}$ ≤ 485 V

Zline L-L, L-N, I_{pfc} subfunction

Measuring Range (Ω)	Resolution (Ω)	Accuracy
Measuring range according to EN61557-3 is 0.25 Ω …1999 Ω		
0.2 … 9999	(0.20 … 19.99) 0.01 (20 … 99.9) 0.1 (100 … 9999) 1	±(5 % of reading + 5 digits)

Measuring Range (A)	Resolution (A)	Accuracy
Prospective short-circuit current (calculated value)		
0.00 … 19.99	0.0)	Consider accuracy of line resistance measurement
20.00 … 99.9	0.1	
100 … 999	1	
1.00k … 9.99k	10	
10.0 … 100.0k	100	

Test current (at 230 V)	3.4 A, 50 Hz Sine wave (10 ms ≤ t_{LOAD} 15 ms)
Nominal voltage range	93 V **…** 134 V; 185 V **…** 266 V (45 Hz **…** 65 Hz)

Measuring Range (%)	Resolution (%)	Accuracy
Voltage drop		
0.0 … 9.9	0.1	Consider accuracy of the line measurement (only calculated value)

8.7.1 LINE IMPEDANCE MEASUREMENT

Performing a Line Impedance Measurement

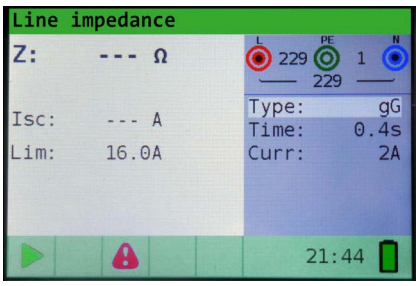
Note

The specified accuracy of tested parameters is valid only if the mains voltage is stable during the measurement.

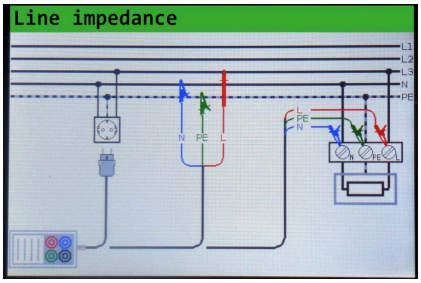
Isc depends on Z, Un and scaling factor.

The current limit depends on fuse type, fuse current rating, fuse trip-out time.

1. Press **FUNC** and select **Line impedance**.
2. Select **Mode** and set the **Line** mode.
3. Select **Type** to select the desired type.
4. Select **Time** to set the time.
5. Select **Curr** to set the test current.

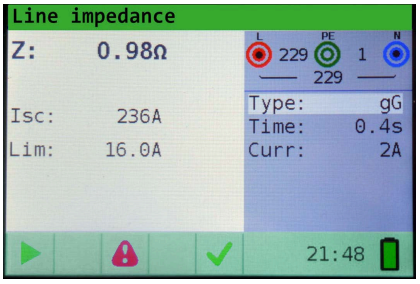


6. Connect the test leads to the instrument, in order to perform phase-neutral or phase- phase line impedance measurement.
7. Connect the test cables to the DUT.



8. Check the status field for warnings.
9. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
Z	Line impedance
I_{SC}	Prospective short-circuit current

8.7.2 VOLTAGE DROP MEASUREMENT

The voltage drop function is a measurement of the line impedance and result is compared to a reference result which has been taken before on some other point of the installation (usually the entry point since this point has the lowest impedance). The voltage drop in %, the impedance and the prospective short circuit current are shown.

The voltage drop in % is calculated as follows:

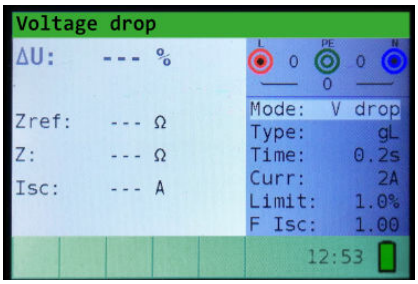
$$\Delta U = \frac{(Z - Z_{REF}) \times I_N}{U_N}$$

Performing a Voltage Drop Measurement

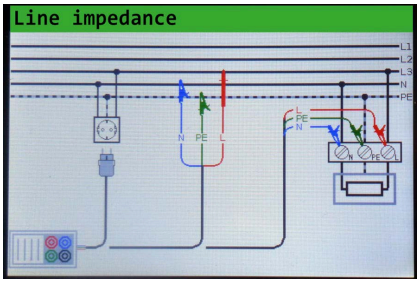
Note

The specified accuracy of tested parameters is valid only if the mains voltage is stable during the measurement.

1. Press **FUNC** and select **Line impedance**.
2. Select **Mode** and set the **V drop** mode.
3. Select **Type** to select the desired type.
4. Select **Time** to set the time.
5. Select **Curr** to set the test current.
6. Select **Limit** to set the limit value.
7. Select **F I_{SC}** to set the scaling factor.



8. Connect the appropriate test leads from the reference point to the instrument to perform phase-neutral or phase-phase line impedance measurement.

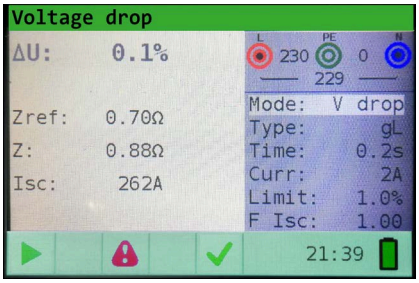


9. Press the key **zero**.

↳ **REF** is displayed.
The instrument is ready to take the measurement of the reference position in the installation.

10. Check the status field for warnings.
11. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
$_{\Delta}U$	Voltage drop of the test point compared to the reference point
Zref	Line impedance of the reference point
Z	Line impedance
I_{SC}	Prospective short-circuit current

8.8 PHASE SEQUENCE TESTING

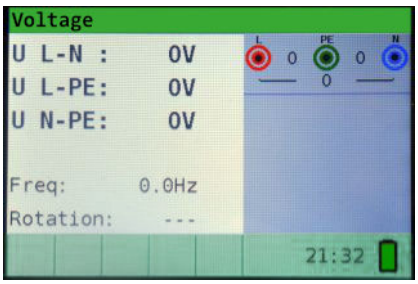
In practice, we often deal with the connection of three-phase loads (motors and other electro-mechanical machines) to three-phase mains installation. Some loads (ventilators, conveyors, motors, electro-mechanical machines, etc.) require a specific phase rotation and some may even be damaged if the rotation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

Measuring according to EN61557-7

Nominal mains voltage range	50 V_{AC} … 550 V_{AC}
Nominal frequency range	45 Hz ... 400 Hz
Result displayed	Right: 1-2-3, Left:3-2-1

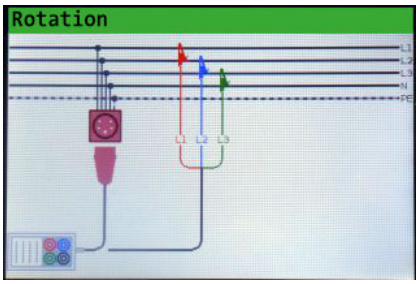
▶ Performing a Phase Sequence Test

1. Press **FUNC** and select **Voltage**.



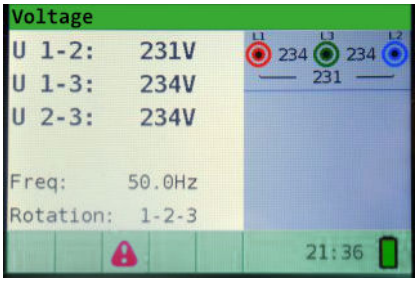
2. Connect the test leads to the instrument.

↳ The results are displayed as soon as the full test lead connection to the DUT has been set up.



↳ All three-phase voltages are displayed in order of their sequence represented by the numbers 1, 2 and 3.

3. Check the status field for warnings.



Result	Description
Freq	Frequency
Rotation	Phase sequence
-.-.-	Irregular rotation value

8.9 VOLTAGE AND FREQUENCY MEASUREMENT

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

Measuring Range (V)	Resolution (V)	Accuracy
0 … 550	1	±(2 % of reading + 2 digits)
Frequency range	0 Hz, 45 Hz … 400 Hz	

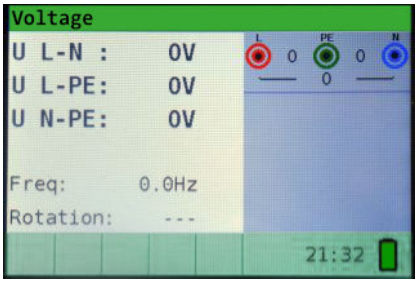
Measuring Range (Hz)	Resolution (Hz)	Accuracy
10 … 499	0.1	±(0.2 % of reading + 1 digit)
Nominal voltage range	10 V … 550 V	

Performing a Voltage and Frequency Measurement

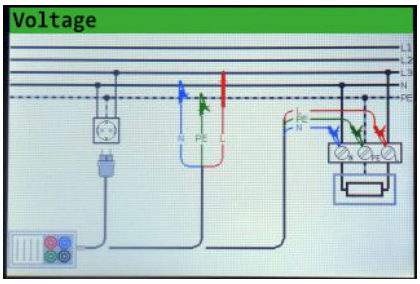
Note

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

1. Press **FUNC** and select **Voltage**.

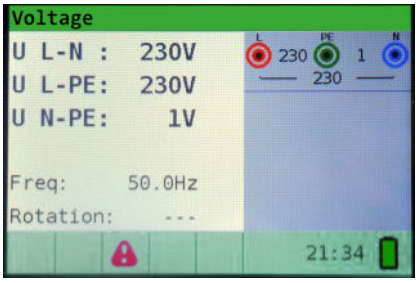


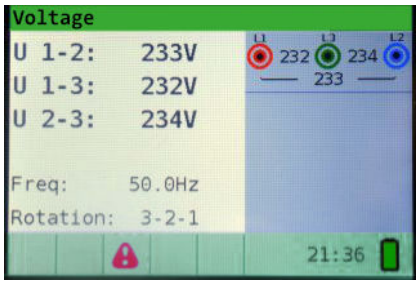
2. Connect the test leads to the instrument.
3. Connect the test cables to the DUT.



4. Check the status field for warnings.

↳ The test is performed.
The test result is displayed during measurement, showing fluctuations as they occur.





Result	Description
U L-N	Voltage between phase and neutral conductors
U L-PE	Voltage between phase and protective conductors
U N-PE	Voltage between neutral and protective conductors
Three-phase system test:	
U 1-2	Voltage between phases L1 and L2
U 1-3	Voltage between phases L1 and L3
U 2-3	Voltage between phases L2 and L3

8.10 EARTH RESISTANCE MEASUREMENT

8.10.1 EARTH RESISTANCE MEASUREMENT (RE), 3-WIRE, 4-WIRE

Measuring Range (Ω)	Resolution (Ω)	Accuracy
Measuring range according to EN61557-5 is 100 Ω … 1999 Ω		
1.0 … 9999	(1.00 … 19.99) 0.01 (20 … 199.9) 0.1 (200 … 9999) 1	±(5 % of reading + 5 digits)

Max. auxiliary earth electrode resistance Rh	100 RE or 50 kΩ (whichever is lower)
Max. probe resistance Rs	100 RE or 50 kΩ (whichever is lower)
Rh and Rs values are indicative	
Additional probe resistance error at Rh_{max} or Rs_{max}	±(10 % of reading + 10 digits)
Additional error at 3 V voltage noise (50 Hz)	±(5 % of reading + 10 digits)
Open circuit voltage	<30 V_{AC}
Short circuit current	<30 mA
Test voltage frequency	126.9 Hz
Test voltage shape	Sine wave

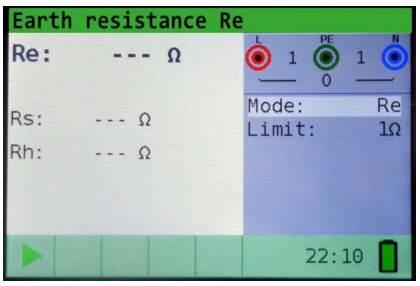
Automatic measurement of auxiliary electrode resistance and probe resistance

▶ **Performing Earth Resistance Measurement**

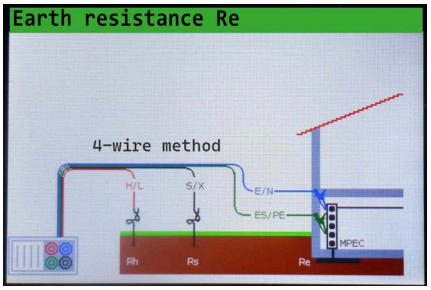
Note

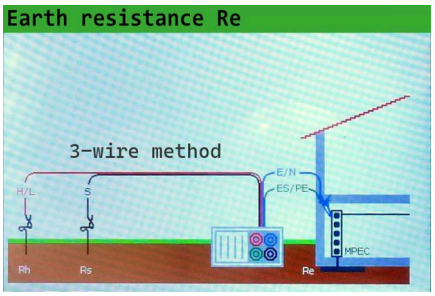
If a voltage of higher than 10 V exists between test terminals, the earth resistance measurement will not be performed.

1. Press **FUNC** and select **Earth resistance**.
2. Select **Mode** and set the **Re** mode.
3. Select **Limit** to set the limit resistance value.



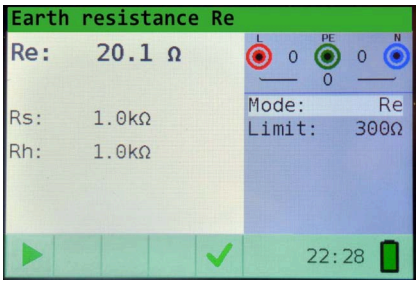
4. Connect the test leads to the instrument.
5. Connect the test cables to the DUT.





6. Check the status field for warnings.
7. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
Re	Resistance to earth
Rs	Resistance of S (potential) probe
Rh	Resistance of H (current) probe

8.10.2 SPECIFIC EARTH RESISTANCE MEASUREMENT (RO)

It is advisable to measure Earth Resistivity, when defining parameters of earthing system (required length and surface of earth electrodes, most appropriate depth of installing earthing system etc.) to reach more accurate calculations.

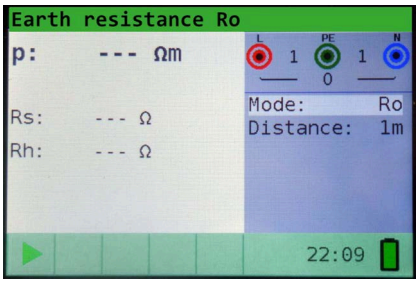
Measuring Range (Ω)	Resolution (Ω)	Accuracy
Rh and Rs values are indicative		
6.0 Ωm … 99.9 Ωm	0.1 Ωm	±(5 % of reading + 5 digits)
100 Ωm … 999 Ωm	1 Ωm	±(5 % of reading + 5 digits)
1.0 kΩm … 9.99 kΩm	0.01 kΩm	±(10 % of reading for Re 2 kΩ … 19.99 kΩ)
10.0 kΩm … 99.9 kΩm	0.1 kΩm	±(10 % of reading for Re 2 kΩ … 19.99 kΩ)
100 kΩm … 9999 kΩm	1 kΩm	±(20 % of reading for Re >20 kΩ)
Principle: ρ = 2· π ·d·Re, where Re is a measured resistance in 4-wire method and d is distance between the probes.		

▶ **Performing Specific Earth Resistance Measurement (Ro)**

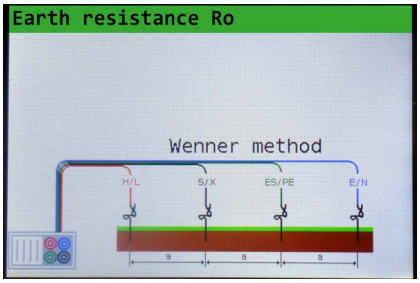
Note

If a voltage of higher than 10 V exists between test terminals, the earth resistance measurement will not be performed.

1. Press **FUNC** and select **Earth resistance**.
2. Select **Mode** and set the **Ro** mode.
3. Select **Distance** to set the distance "a" between test rods.

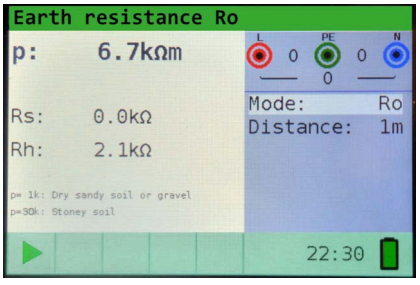


4. Connect the test leads to the instrument.
5. Connect the test cables to the DUT.



6. Check the status field for warnings.
7. If the icon **Ready for measurement** is displayed, press **START/enter**.

↳ The test is performed.
The test result is displayed.



Result	Description
✓	Result ok
✗	Result not ok
Re	Resistance to earth

Result	Description
Rs	Resistance of S (potential) probe
Rh	Resistance of H (current) probe

8.11 STORING MEASUREMENTS

After the measurement is completed, results can be stored in internal memory of the instrument together with the sub-results and function parameters.

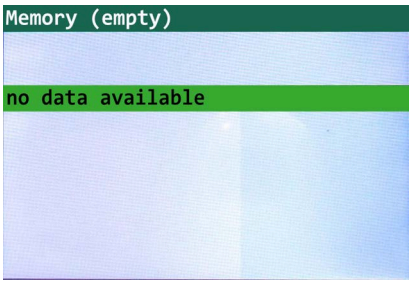
- The instrument can store up to 1000 measurements
- The list of records can be stepped through
- A single record or all records can be deleted
- The IDs for customer, location and object can be edited

8.11.1 OVERVIEW

✓ No actual measurement is made.
✓ No records are stored.

1. Press the key **save**.

↳ An empty memory screen is displayed.



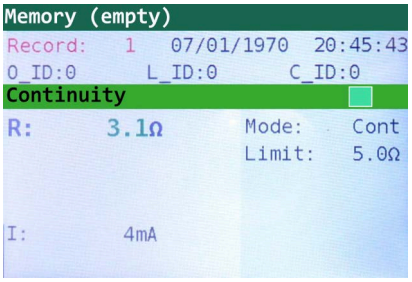
8.11.2 SAVING RESULTS

✓ A measurement has been performed.
✓ The results are displayed.

1. Press **save**.

↳ The following saved results are displayed:

- Next record number (in red letters)
- Current date (day/month/year)
- Time (hour:minutes:seconds)
- Object ID
- Location ID
- Customer ID
- Measurement function
- Measurement Results
- Measurement Mode
- Measurement Limit



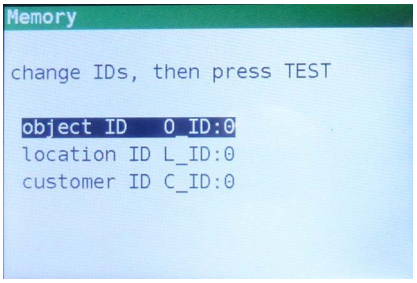
Change Customer ID, Location ID or Object ID

1. Press **left**.

↳ The ID editor is displayed.

2. Use **up / down** to select the ID type you want to change.
3. Use **left** / **right** to increase or decrease the value of the ID.
4. Press **esc** to return to the record screen without changing the IDs.
5. Press **START/enter** to save the IDs in the actual record.

↳ The new IDs will be used for the following new records.



Store the Result of a Measurement

1. Press **START/enter**.

↳ The result is saved in the internal memory with the next record number.
The record number changes from red to black letters.

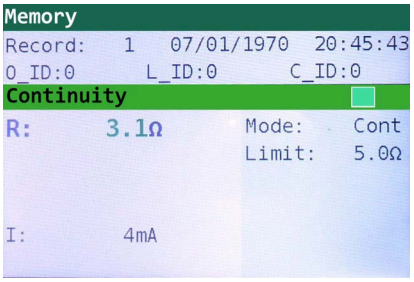
↳ Each result is displayed in colored letters:

- Green: measured and passed
- Red: measured but failed
- Black: measured but not judged

↳ The green function bar contains a colored field that indicates the overall result of the measurement:

- Green: measured and passed
- Red: measured but failed
- Brown: measured but not judged

2. To abort the saving, press **esc**.



8.11.3 RECALLING RESULTS

1. Press **save**.

↳ The last record is displayed.

2. Use **up / down** to scroll through the records.

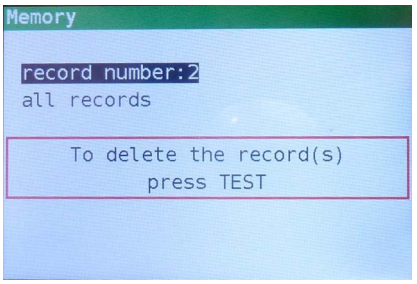
8.11.4 DELETING RESULTS

Delete a Single Record

1. Press **save**.

↳ The last record is displayed.

2. Use **up / down** to select the record you want to delete.
3. Press **right**.
4. The delete screen is displayed.
5. Press **START/enter**.
6. The selected record is deleted.

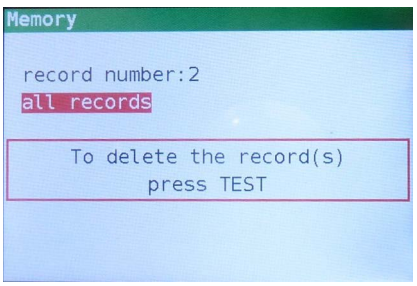


Delete All Records

1. Press **save**.

↳ The last record is displayed.

2. Press **right**.
3. The delete screen is displayed.
4. Use **down** to select **all records**.
5. Press **START/enter**.
6. All records are deleted.



Note

When a single record is deleted, the record number of the deleted record is not used for new records.
When all records are deleted, all IDs and numbers are reset.

8.11.5 SAVING MEASUREMENT RESULTS TO PC

Installing the METRAreport software

1. Go to the website https://www.gmc-instruments.de/services/mygmc.
2. Log in with your credentials.
3. Download the **METRAreport** installation package.
4. Unpack the **METRAreport** installation package on the PC.
5. Follow the installing instructions on the PC.

Connecting the Instrument to a PC

✓ All test objects and test leads have been removed from the instrument.

1. Insert in the USB-B plug into the USB port of the instrument.
2. Insert the USB-A Plug into the USB port of the PC.

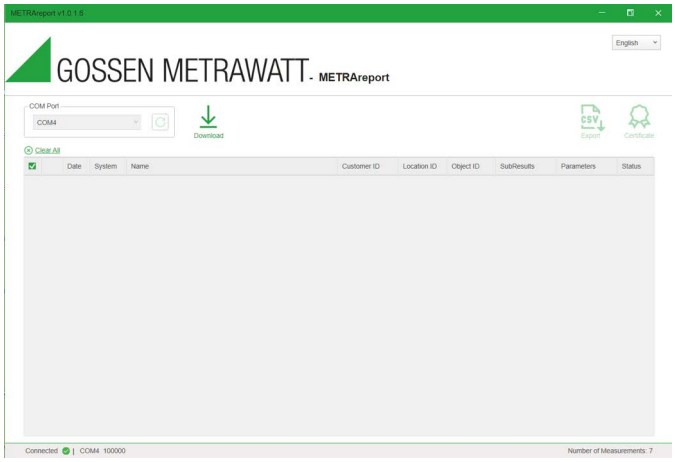
↳ The USB driver is installed automatically on a free COM port on the PC.

Copy Measurement Results to a PC

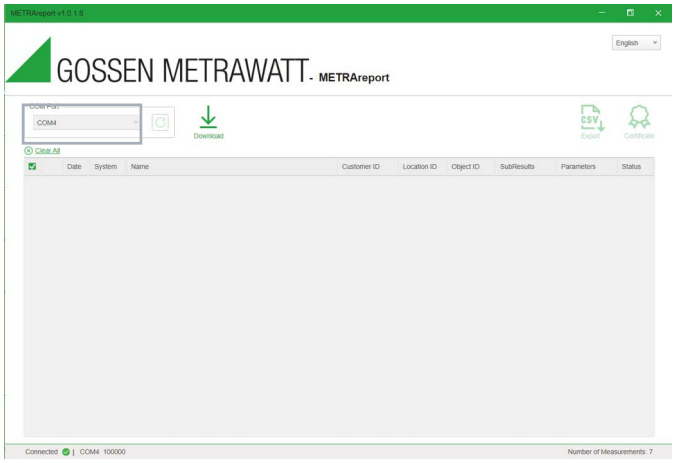
✓ The instrument is connected to the PC.

1. Start the **METRAreport** software on the PC.

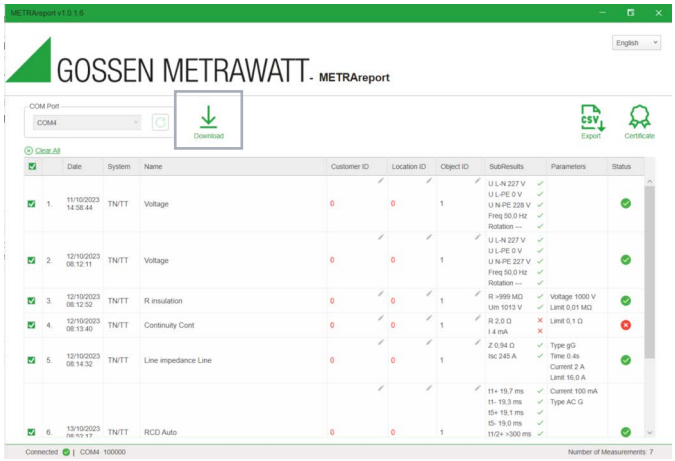
↳ The **METRAreport** home screen is displayed.



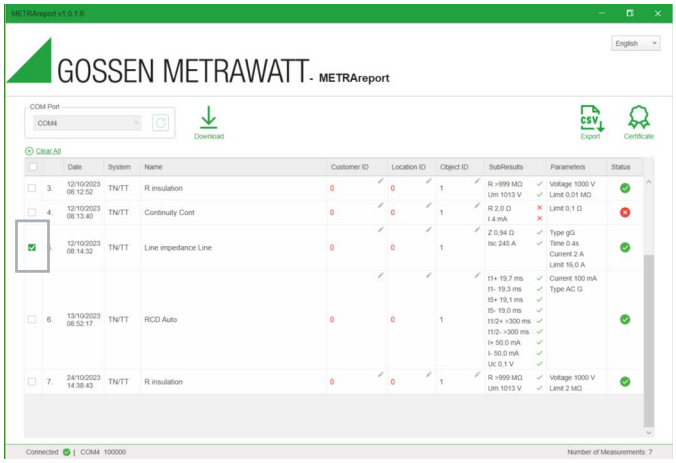
2. Click on the button **Refresh** .
3. In the dropdown menu **COM Port**, select the COM port the USB plug has been assigned to.



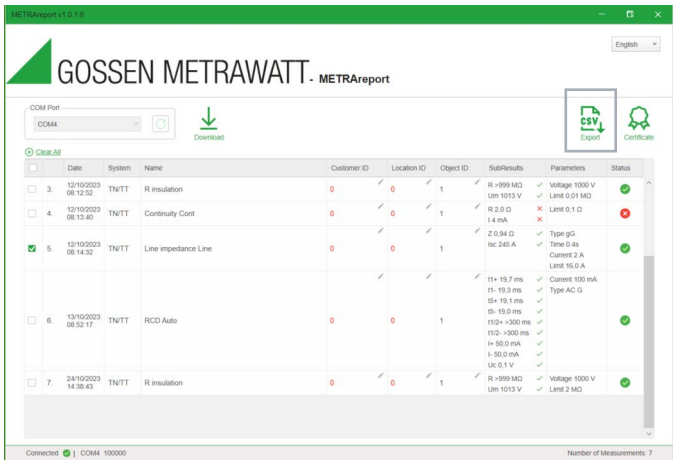
4. Click on the button **Download**.
↳ The records saved in the instrument's internal memory is displayed.



5. Select the checkboxes of the measurements you want to download.

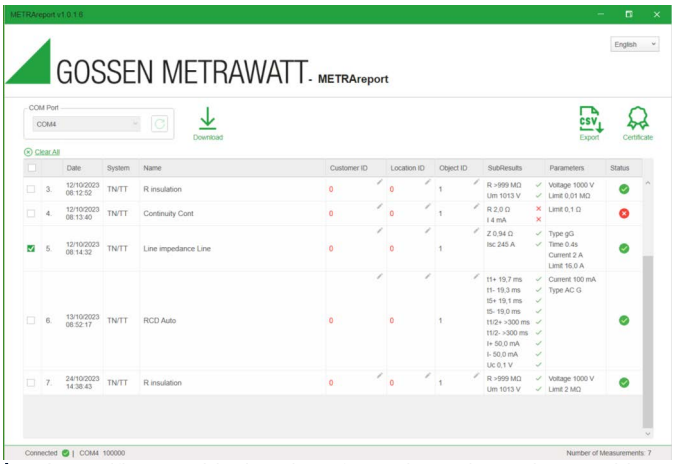


6. Click on the button **CSV Export**.
↳ The selected records are transferred to the PC as*.csv file.



Create a Certificate

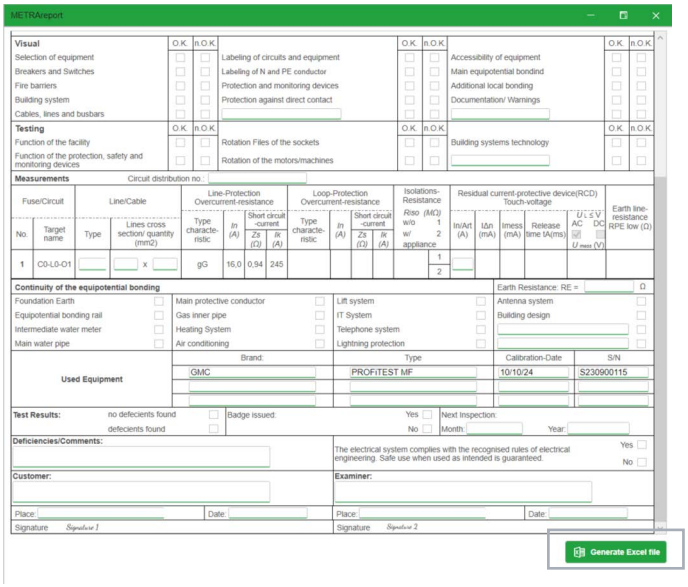
7. Select one single record from the displayed measurements.
8. Click on the button **Certificate**.



↳ A certificate with the data from the selected record is generated.

9. Click on the button **Generate Excel file**.

↳ The selected record is transferred to the PC as*.xlsx file.



9 STORAGE AND TRANSPORT

ATTENTION

Improper Storage

Damage to the product and measuring error due to environmental influences

- Store the instrument in a protected location and only within the limits of permissible ambient conditions. The respective ambient conditions (temperature, humidity etc.) can be found under ⇨ "Technical Data" 🗎13.

ATTENTION

Improper Transport

Damage to the product and measuring error

- Transport the instrument only within the limits of permissible ambient conditions (temperature, humidity etc.) ⇨ "Technical Data" 🗎13.
- Only use the included carrying case to transport the instrument.

10 MAINTENANCE

10.1 CLEANING

DANGER

Life endangering due to electric shock!

The instrument and its accessories are operated with electric power. Therefore there is a general risk of electric shock which can be fatal or cause severe injury.

- The instrument, the accessories and all connected conductors must be voltage-free before and during cleaning. Switch the test instrument off and disconnect it from the mains power supply.
- Never immerse the instrument/accessories in water or other fluids.
- Never touch the instrument/accessories with wet or moist hands.
- Allow the instrument to dry completely before use.

ATTENTION

Unsuitable cleaning agents

Unsuitable cleaning agents such as aggressive or abrasive cleansers result in damage to the instrument/ accessories.

- Use a cloth which has been slightly dampened with water or alcohol for cleaning.
- Avoid the use of cleansers, abrasives, solvents or liquids based on petrol or hydrocarbon.

Keep the outside surfaces of the instrument and any accessories clean.

10.2 CALIBRATION

Use of your instrument and resultant stressing influence the instrument and lead to deviation from warranted accuracy values.

In the case of strict measuring accuracy requirements, as well as in the event of severe stressing (e.g. severe climatic or mechanical stress), we recommend a calibration interval of 3 years.

Please contact GMC-I Service GmbH for calibration services⇨ "Contact, Support and Service" 🗎61.

Note

Date on Calibration Certificate / Calibration Interval Begins Upon Receipt

Your instrument is furnished with a calibration certificate on which a date appears. This date may be further in the past if your instrument has been stored for some time prior to sale.

The instruments are stored in accordance with the specified conditions. Drift is thus negligible for a duration of 1 year and longer storage periods are highly unusual.

Consequently, the instrument's characteristic values lie within the specifications and the first calibration interval can be determined as of the date of receipt.

10.3 REPLACING A FUSE

WARNING

Risk of injury due to incorrect fuse!

If a fuse of the wrong type is used, the instrument can be overloaded and cause fire or failure of protective devices.

- Replace any blown fuses with exactly the same type of fuse.

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

✓ The instrument has been turned off.
✓ Any measuring accessory has been removed from the instrument.
1. Unfasten the screws and take off the battery cover on the rear of the instrument.
2. Replace the fuse with exactly the same type of fuse.
3. Close the battery cover and fasten the screws.

10.4 BATTERY MAINTENANCE

10.4.1 CHANGING THE BATTERIES

WARNING

Risk of injury due to hazardous voltage!

When connected to an installation, the instruments battery compartment can contain hazardous voltage inside.

- Before opening the battery compartment cover, disconnect any measuring accessory connected to the instrument and turn off the instrument.

✓ The instrument has been turned off.
✓ Any measuring accessory has been removed from the instrument.
1. Unfasten the screws and take off the battery cover on the rear of the instrument.
2. Replace the batteries. Use rechargeable Ni-MH batteries (size AA) with a capacity of ≥2300 mAh.
3. Close the battery cover and fasten the screws.

10.4.2 CHARGING THE BATTERIES

WARNING

Risk of injury due to hazardous voltage or fire!

If a power supply adapter with the wrong polarity is used, the instrument can cause fire or electric shock.

- Use only the original power supply adapter.
- Ensure the correct polarity displayed on the power supply adapter.

Note

The charger in the instrument is a pack cell charger. The cells are connected in series during the charging process. To achieve full charging performance all batteries must have similar charging status, type and age.

✓ Rechargeable Ni-MH batteries (size AA) with a capacity of ≥2300 mAh are inserted in the battery compartment.
1. Connect the power supply adapter to the instrument.

↳ The batteries are being charged.

10.4.3 IMPROVEMENT OF BATTERY SERVICE LIFE

Prevent memory effect

Discharge and recharge the nickel-metal hydride batteries full once in a while. This helps to keep the battery healthy by avoiding crystal development in discharged areas.

Exercise the battery

Use the batteries regularly to extend their service life.

If the instrument is not to be used for a long period of time, remove all batteries from the battery compartment. Apply a new battery break-in procedure to a dormant battery to regain its ability to work properly.

New battery break-in

New batteries must be fully charged before use. It is essential to charge and discharge the battery completely so that it can regain its maximum rated capacity.

11 CONTACT, SUPPORT AND SERVICE

Gossen Metrawatt GmbH can be reached directly and simply – we have a single number for everything! Whether you require support or training, or have an individual inquiry, we can answer all of your questions here:

+49-911-8602-0	Monday to Thursday:	8 a.m. to 4 p.m.
	Friday:	8 a.m. to 2 p.m.
Or contact us by e-mail at:	info@gossenmetrawatt.com	

Do you prefer support by e-mail?

Measuring and Test Technology:	support@gossenmetrawatt.com
Industrial Measuring Technology:	support.industrie@gossenmetrawatt.com

Please contact GMC-I Service GmbH for repairs, replacement parts and calibration[1]:

+49-911-817718-0
service@gossenmetrawatt.com
www.gmci-service.com/en

Beuthener Str. 41
90471 Nürnberg
Germany

1. DAkkS calibration laboratory per DIN EN ISO/IEC 17025
accredited by the Deutsche Akkreditierungsstelle GmbH under reference number D-K-15080-01-01.

12 CERTIFICATIONS

12.1 CE DECLARATION

The instrument fulfills all requirements of applicable EU directives and national regulations. We confirm this with the CE mark.
You can find the CE declaration on our website:

https://www.gmc-instruments.de/en/services/download-center/

12.2 CALIBRATION CERTIFICATE

A calibration certificate is available on demand ⇨ "Contact, Support and Service" 🗎61.

12.3 TEST REPORT

A test report is available at:

https://www.gossenmetrawatt.de/en/services/mygmc/

13 DISPOSAL AND ENVIRONMENTAL PROTECTION

Proper disposal makes an important contribution to the protection of our environment and the conservation of natural resources.

ATTENTION

Environmental Damage

Improper disposal results in environmental damage.

- Follow the instructions concerning return and disposal included in this section.

The following comments refer specifically to the legal situation in the Federal Republic of Germany. Owners or end users who are subject to other regulations must comply with the respective local requirements and implement them correctly on site. Further information can be obtained, for example, from the responsible authorities or the local distributor.

Waste Electrical Equipment, Electrical or Electronic Accessories and Waste Batteries (including rechargeable batteries)

Electrical equipment and batteries (including rechargeable batteries) contain valuable raw materials that can be recycled, as well as hazardous substances which can cause serious harm to human health and the environment, and they must be recycled and disposed of correctly.

The symbol at the left depicting a crossed-out garbage can on wheels refers to the legal obligation of the owner or end user (German electrical and electronic equipment act ElektroG and German battery act BattG) not to dispose of used electrical equipment and batteries with unsorted municipal waste (“household trash”). Waste batteries must be removed from the old device (where possible) without destroying them and the old device and the waste batteries must be disposed of separately. The battery type and its chemical composition are indicated on the battery’s labelling. If the abbreviations “Pb” for lead, “Cd” for cadmium or “Hg” for mercury are included, the battery exceeds the limit value for the respective metal.

Please observe the owner’s or end user’s responsibility with regard to deleting personal data, as well as any other sensitive data, from old devices before disposal.

Old devices, electrical or electronic accessories and waste batteries (including rechargeable batteries) used in Germany can be returned free of charge to Gossen Metrawatt GmbH or the service provider responsible for their disposal in compliance with applicable regulations, in particular laws concerning packaging and hazardous goods. Waste batteries must be handed over in discharged state and/or with appropriate precautionary measures against short-circuiting. Further information regarding returns can be found on our website.

Packaging Materials

We recommend retaining the respective packaging materials for the case that you might require servicing or calibration in the future.

WARNING

Danger of Asphyxiation Resulting from Foils and Other Packaging Materials

Children and other vulnerable persons may suffocate if they wrap themselves in packaging materials, or their components or foils, or if they pull them over their heads or swallow them.

- Keep packaging materials, as well as their components and foils, out of the reach of babies, children and other vulnerable persons.

In accordance with German packaging law (VerpackG), the user is obligated to correctly dispose of packaging and its components separately, and not together with unsorted municipal waste (“household trash”).

Private end consumers can dispose of packaging free of charge at the responsible collection point. Packaging which is not subject to so-called system participation is returned to the appointed service provider. Further information regarding returns can be found on our website.

GOSSEN METRAWATT
GMC-INSTRUMENTS GROUP

YOUR CONTACT

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