



MI 6601 MediTest
Instruction manual
Ver.1.2.2, code no. 20753214

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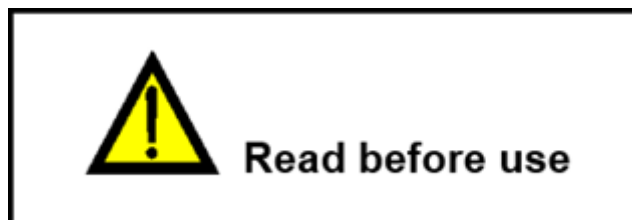
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1 General description

1.1 Warnings and notes



1.1.1 Safety warnings

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

- Read this instruction manual carefully, otherwise use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!
- Consider warning markings on the instrument!
- If the test equipment is used in manner not specified in this instruction manual the protection provided by the equipment may be impaired!
- Do not use the instrument and accessories if any damage is noticed!
- Regularly check the instrument and accessories for correct functioning to avoid hazard that could occur from misleading results.
- Use only *Metrel* standard or optional test accessories!
- Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!
- Instrument servicing and calibration is allowed to be carried out only by a competent authorized person!
- *Metrel* Auto Sequences® are designed as guidance to tests in order to significantly reduce testing time, improve work scope and increase traceability of the tests performed. *Metrel* assumes no responsibility for any Auto Sequence by any **means. It is the user's responsibility, to check adequacy for the purpose of use of** the selected Auto Sequence. This includes type and number of tests, sequence flow, test parameters and limits.
- Do not connect external voltage to CLAMP inputs. It is intended only for connection of Clamps approved by *Metrel*.
- Use only earthed mains outlets to supply the instrument!
- In case a fuse has blown refer to the chapter [Maintenance](#).

1.1.2 Warnings related to safety of measurement functions

Leakage current tests (with mains voltage), power test	Load currents higher than 10 A can result in high temperatures of fuse holders! It is advisable not to run tested devices with load currents above 10 A for more than 15 minutes. Recovery period for cooling is required before proceeding with tests! Maximum intermittent duty cycle for measurements with load currents higher than 10 A is 50 %.
Leakage current tests (measurement parameters U_{nom} , $U_{max(calc)}$)	Leakage current tests acc. to the IEC 60601 and IEC 62353 include parameters that enable scaling of measured results up and down. Wrong setting of this parameters can result in too low leakage current result(s). User must be skilled to correctly set these parameters and interprets the results.
Leakage current tests with internal generator (subleakage, leakage-alternative method, leakages with use of Vext)	The voltage and current of the internal voltage source generator is safe but relatively close to the safety limits ($> 3.5 \text{ mA@} > 50 \text{ V}$). Touching conductive parts with voltage of internal source applied could potentially be harmful. Therefore, consider generally known precautions against risk of electric shock!
Insulation resistance tests	Do not touch the test object during the measurement or before it is fully discharged! Risk of electric shock!

1.1.3 Note related to measurement procedure

- In general, the procedure for measurement consists of the following steps in exact order.
 1. Select measurement function
 2. Connect test leads / accessories to the test instrument and to the device under test
 3. Start and stop the measurement
 4. Disconnect device under test from the test instrument

1.1.4 General notes

- LCD screenshots in this document are informative only. Screens on the instrument may be slightly different.
- *Metrel* reserve the right to make technical modifications without notice as part of the further development of the product.

1.1.5 Markings on the instrument

	Read the Instruction manual with special care to safety operation«. The symbol requires an action!
	Mark on your equipment certifies that it meets requirements of all subjected EU regulations.
	Mark on your equipment certifies that it meets requirements of all subjected UK regulations.
	This equipment should be recycled as electronic waste.

1.2 Standards applied

The instrument is manufactured and tested according to the following regulations, listed below.

Electromagnetic compatibility (EMC)

EN 61326-1	Electrical equipment for measurement, control and laboratory use - EMC requirements – Part 1: General requirements
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Safety (LVD)

EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements
EN 61010-2-030	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits
EN 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test
EN 61010-2-032	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement
EN 61557	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures Instrument complies with all relevant parts of EN 61557 standards.

Functionality

EN 60601	Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
EN 62353, (VDE-0751-1)	Medical electrical equipment - Recurrent test and test after repair of medical electrical equipment
AS/NZS 3551	Management programs for medical devices
VDE 0701-702	In-service safety inspection and testing of electrical equipment Inspection after repair, modification of electrical appliances – Periodic inspection on electrical appliances General requirements for electrical safety
AS/NZS 3760	In-service safety inspection and testing of electrical equipment

2 Instrument set and accessories

2.1 **Standard set of the instrument**

- Instrument MI 6601 MediTest
- Test lead 1.5 mm², 1 m, 5 pcs, (black, brown, green, yellow, purple)
- Test tip, 3 pcs, (black, brown, green)
- Alligator clip, 5 pcs, (2 x black, brown, green, yellow)
- Mains cable, 3 x 1.5 mm², 2 m
- USB cable
- MicroSD card 8 GB
- Bag for accessories
- Calibration Certificate
- Short form instruction manual
- PC SW Metrel Medical ES Manager and Instruction manual download link

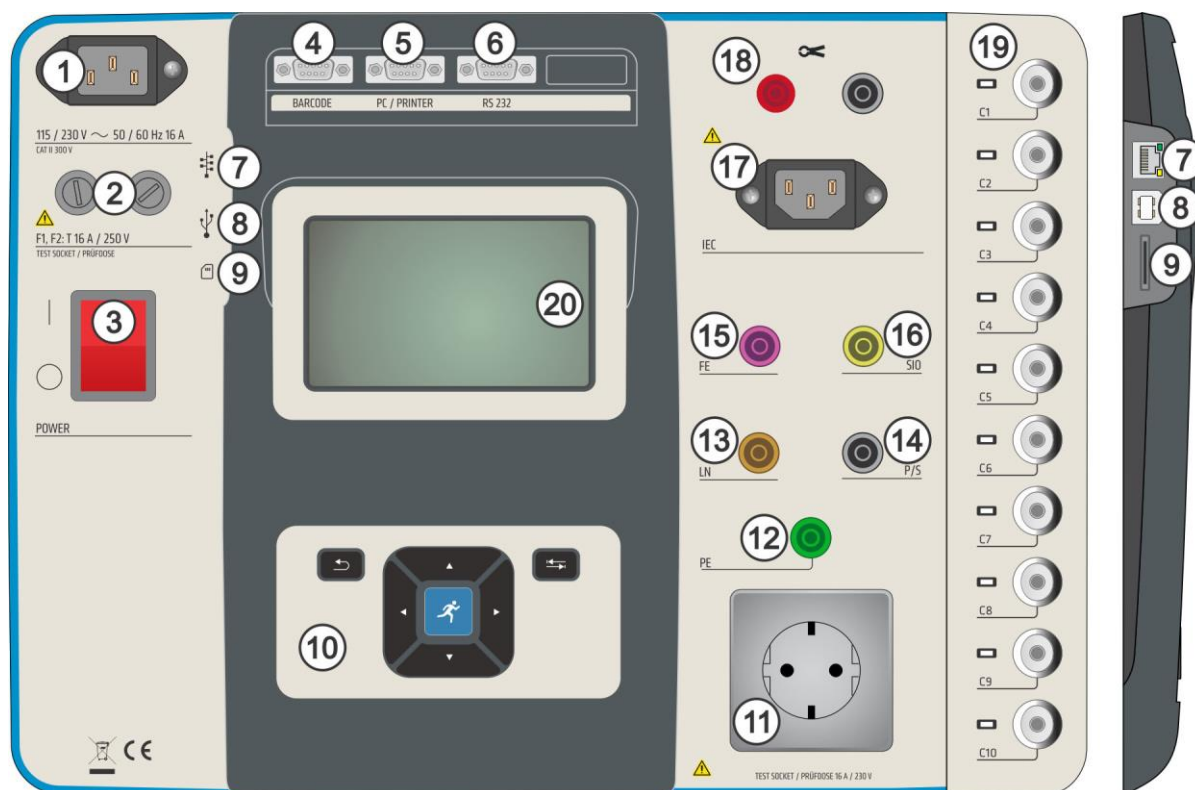
See the attached sheet "Included in the Set".

2.2 **Optional accessories**

For a list of optional accessories, approved with this test instrument, visit www.metrel.si.

3 Instrument description

3.1 Front panel



1	Mains supply connector
2	F1, F2 fuses (see Fuses)
3	Power On/Off switch
4	Barcode scanner and RFID / NFC reader / writer device serial port
5	PC / Printer serial port
6	Serial port (not in use)
7	Ethernet communication port
8	USB communication port
9	MicroSD card slot
10	Keypad
11	Mains test socket
12	PE connector
13	LN connector
14	P/S (probe) connector
15	FE (functional earth) connector

16	SIO (signal I/O) connector
17	IEC test connector
18	Current clamp inputs
19	Connections: configurable AP, NEP, EP connections with LED indicators
20	Colour TFT display with touch screen

4 Instrument operation

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

4.1 General meaning of keys

	Cursor keys are used to: • Select appropriate option. • Left, right, up, down. • In some functions: page up, page down.
	RUN key is used to: • Confirm selected option. • Start and stop measurements.
	Escape key is used to: • Return to previous menu without changes. • Abort measurements. • Reset instrument (long press >5 s).
	Option key is used to: • Expand column in control panel. • Show detailed view of options.

4.2 General meaning of touch gestures

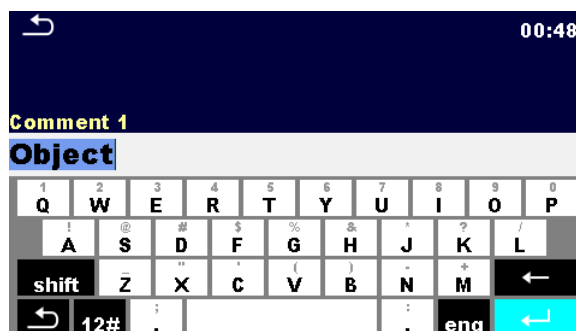
	Tap (briefly touch surface with fingertip) is used to: • Select appropriate option. • Confirm selected option. • Start and stop measurements.
	Swipe (press, move, lift) up/ down is used to: • Scroll content in same level. • Navigate between views in same level.
 long	Long press (touch surface with fingertip for at least 1 s) is used to: • Select additional keys (virtual keyboard).



Tap Escape icon is used to:

- Return to previous menu without changes.
- Abort / stop measurements.

4.3 Virtual keyboard



Note

- If Backspace is held for 2 s, all characters will be selected.
- Set English, Greek, Russian, Hebrew character set: eng, GR, RU, HEB.

Hint

Long press on some keys opens additional keys.

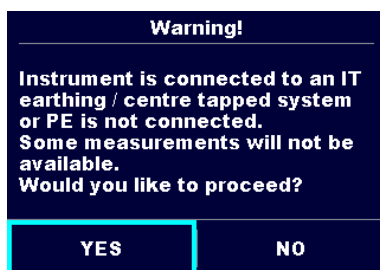
4.4 Safety checks, symbols, messages

At start up and during operation the instrument performs various safety checks to ensure safety and to prevent any damage. If a safety check fails, an appropriate warning message will be displayed and safety measures will be taken.

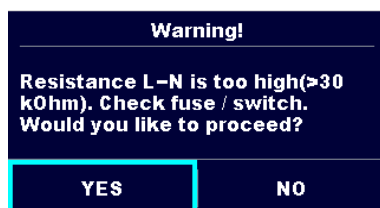
Supply voltage warning

- No earth connection.
- Instrument is connected to an IT earthing system.

YES: continue normally, NO: continue in a limited mode (measurements are disabled).

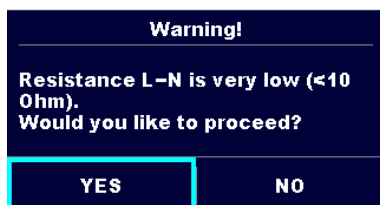
**WARNING**

The instrument must be earthed properly to work safely.

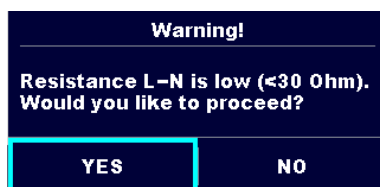
**Resistance L-N > 30 kΩ**

In pre-test a high input resistance was measured.

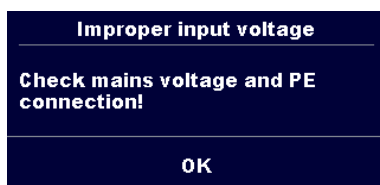
- Device under test is not connected or switched on.
- Input fuse of device under test is blown.

**Resistance L-N < 10 Ω**

In pre-test a very low resistance of the device under test supply input was measured. This can result in a high current after applying power to the device under test. If the too high current is only of short duration (caused by a short inrush current) the test can be performed otherwise not.

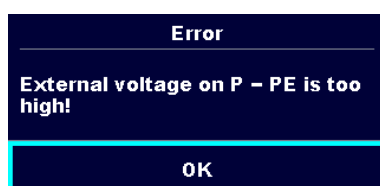
**Resistance L-N < 30 Ω**

In pre-test a low input resistance of the device under test was measured. This can result in a high current after applying power to the device. If the high current is only of short duration (caused by a short inrush current) the test can be performed, otherwise not.



Warning for improper supply voltage condition.

OK: Continue in limited mode (measurements are disabled)



In pre-test a too high external voltage was detected between P and PE terminals. The measurement was cancelled.

Warning! External voltage on FE too high! OK	In pre-test a too high external voltage was detected between FE and PE terminals. The measurement was cancelled.
Warning! External voltage on SIO too high! OK	In pre-test a too high external voltage was detected between SIO and PE terminals. The measurement was cancelled.
Error External voltage on socket PE is too high! OK	In pre-test a too high external voltage was detected between LN and PE terminals. The measurement was cancelled.
Warning! Leakage is high(>3.5 mA). Would you like to proceed? YES NO	In pre-test a possible high leakage current was detected. It is likely that a dangerous leakage current (higher than 3.5 mA) will flow after applying power to the device under test.
Error Measurment stopped because of too high leakage current. OK	The measured leakage current was higher than 20 mA. Measurement was aborted. In pre-test a high overall leakage current was detected. The measurement results could be compromised due to heavy loading of the Vext generator.
Error I load is too high (>16 A)! OK	The load current higher than 16 A is detected. Measurement is aborted.
Error I load is too high (>10 A)! OK	The average load current higher than 10 A over the last 5 min test interval is detected. Measurement is stopped. Recovery period for cooling is required before proceeding with tests!

	The instrument is overheated. The measurement can't be carried out until the icon disappears.
	The device under test should be switched on (to ensure that the complete circuit is tested).
	In case of simultaneously measuring of Riso, Riso-S or Isub, Isub-S: if the voltage has dropped because of one measurement the other measurement is also compromised.
	Measurement result Isub, Isub-S is scaled to 110 V.
	Red dot indicates output with higher leakage measured. Applicable only if phase reversal is enabled during the measurement.
	WARNING A high voltage is / will be present on the instrument output! (high test voltage, or mains voltage).
	Test leads resistance in Continuity / Protective Earth measurement is not compensated.
	Test leads resistance in Continuity / Protective Earth measurement is compensated.
	Test passed. Result is inside predefined limits.
	Test failed. Result is out of predefined limits.
	Conditions on the input terminals allow starting the measurement; consider other displayed warnings and messages.



Conditions on the input terminals do not allow starting the measurement, consider displayed warnings and messages.



Stop the measurement.



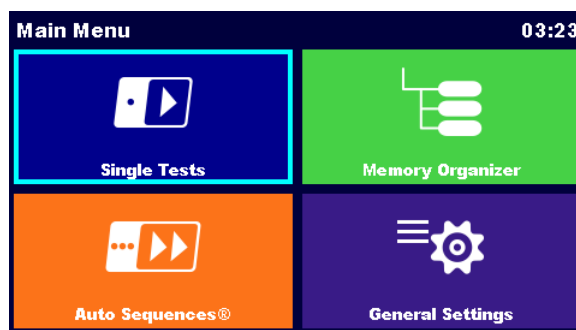
Bluetooth communication active / inactive.

Hint

For some icons more information is displayed if  on icon.

4.5 Instrument main menu

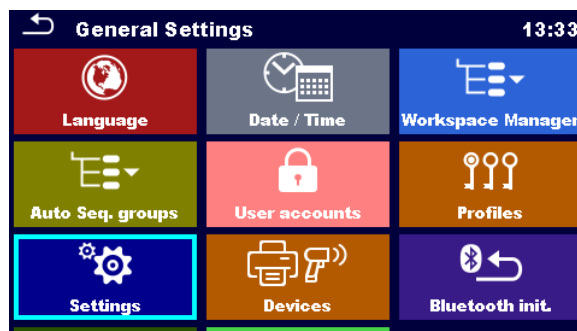
From the instrument Main Menu four main operation menus can be selected.



Single Test	Menu for selecting single tests
Auto Sequences®	Menu for selecting Auto sequences
Memory Organizer	Menu for working with structured test objects and measurements
General Settings	Menu for setup of the instrument

4.6 General settings menu

In the General Settings menu general parameters and settings of the instrument can be viewed or set.



Language	Language selection
Date / Time	Setting date and time
Workspace Manager	Managing project files
Auto Sequence® groups	Managing lists of Auto Sequences®
User accounts	Managing user accounts
Profiles	Instrument profiles (This setting is visible only if more than one profile is available.)
Settings	Setting different system and measuring parameters
Devices	Setting external devices
Bluetooth init.	Bluetooth initialization
Initial Settings	Factory settings
About	Instrument data

4.6.1 Settings



Touch screen	Set Touch screen on / off.
--------------	----------------------------

Keys & touch sound	Set key touch sound on / off.
Equipment ID	Offered equipment ID in Memory Organizer: • Increment – offered ID will be incremented +1. • Replicate – offered ID will be the same as last used. • Blank – ID will not be offered.
Equipment name	Offered equipment Name in Memory Organizer: • Replicate – name will be the same as last used. • Blank – name will not be offered.
Retest period	Offered retest period in Memory Organizer: • Replicate – offered retest period will be the same as last used. • Blank – retest period will not be offered.
Ch_1 clamp type	Setting of current clamp type.
Unom	Nominal Line to earth voltage [100 V, 110 V, 120 V, 220 V, 230 V or 240 V] (for normalization of leakage current results if testing medical equipment according to IEC 62353).
Result	Setting of result of the measurement: • Worst – the worst result • Last – the last result
Test mode	• Standard – Visual and Functional inspection status fields should be set manually. • Expert – Visual and Functional inspection status fields are filled automatically with PASS status.
Auto seq. flow	• Ends if fail – Auto Sequence will end if a measurement / inspection failed. Proceeding tests will be skipped. • Proceeds if fail – Auto Sequence will proceed if fail status of measurement / inspection is detected.
Ext. Keyboard	• Set external BT keyboard on / off. See A 1578 BT keyboard manual.

Note

Rules regarding Result setting and instrument operation:

- In general, the worst result(s) of the main result is considered. Sub-result(s) taken at the same time as the worst case of the main result are displayed.
- In the function Leak's & Power the worst case of Idiff and I touch are considered. The Power result measured at the time of worst Idiff is displayed.
- In the function Riso, Riso-S the worst case of Riso and Riso-S are considered. The Um result measured at the time of worst Riso is displayed.
- For the Power measurement the last result is considered regardless of the Result setting.

Ethernet setting options

Obtain an IP	- Automatically – The instrument is automatically assigned an IP address from the local network using the DHCP protocol. - Manual – The user must provide the correct network settings.
IP address	[XXX.XXX.XXX.XXX] – Displays the instrument's IP address. In manual mode, the user should enter the correct value.
Port	[0 ... 65535] – Selects the port number on which the instrument listens for incoming connections. The instrument communicates using UDP/IP protocol. Max. UDP packet length is 1024 bytes.
Subnet mask	[XXX.XXX.XXX.XXX] – In manual mode, the user should enter the correct value.
Default gateway	[XXX.XXX.XXX.XXX] – In manual mode, depending on the network topology, the use can enter the correct value or leave it as it is, if not needed.
Preferred DNS server	[XXX.XXX.XXX.XXX] – In manual mode, depending on the network topology, the use can enter the correct value or leave it as it is, if not needed.
Alternate DNS server	[XXX.XXX.XXX.XXX] – In manual mode, depending on the network topology, the use can enter the correct value or leave it as it is, if not needed.
Host name	[MI6601_XXXXXXXX] – Displays the instrument's unique name on the local network. The host name consists of the instrument's name and its serial number.
MAC address	[XX:XX:XX:XX:XX:XX] – Displays the instrument's MAC address. User can change the address in case of another device on the network using the same value.

Note

- Instrument will reset to apply new Ethernet settings (if modified).

4.6.2Bluetooth initialization

In this menu the Bluetooth module is reset.

4.6.3Initial Settings

In this menu internal Bluetooth module will be initialized and the instrument settings, measurement parameters and limits will be set to initial (factory) values.

WARNING

Following customized settings will be lost when setting the instruments to initial settings:

- Measurement limits and parameters.
- Global parameters, System settings and Devices in General settings menu.
- Opened Workspace and Auto Sequence® group will be deselected.
- User will be signed out.

Note

Following customized settings will stay:

- Profile settings
- Data in memory (Data in Memory organizer, Workspaces, Auto Sequence® groups and Auto Sequences®)
- User accounts

4.6.4 About

In this menu instrument data (name, serial number, FW (firmware) and HW (hardware) version, profile code, HD (hardware documentation) version, and date of calibration) can be viewed.

About 13:47	
Name	MI 6601 MediTest
S/N	21321254
FW version	1.2.7.a2086ef1
FW Profile	CAAB
HW version	1
HD version	1

Note

- Info of some test adapters is also displayed if they are connected.

4.6.5 User Accounts

The instrument has a User Accounts system. Following actions can be managed:

- Setting if signing in to work with the instrument is required or not.
- Adding and deleting new users, setting their user names and passwords.

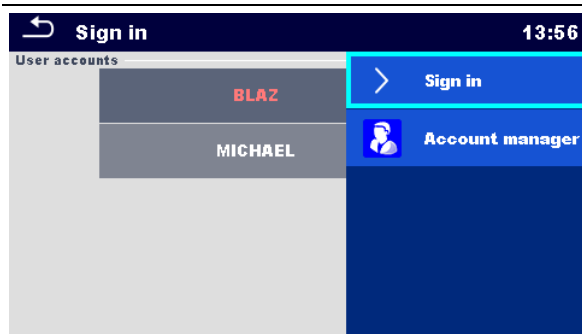
- Setting the password for allowing Black Box operation. See Black Box protocol for more information.

Default passwords

'ADMIN'	The default account manager password
Second account manager password	This password is delivered with the instrument and always unlocks the Account manager
Empty (disabled)	Default password for Black Box operation

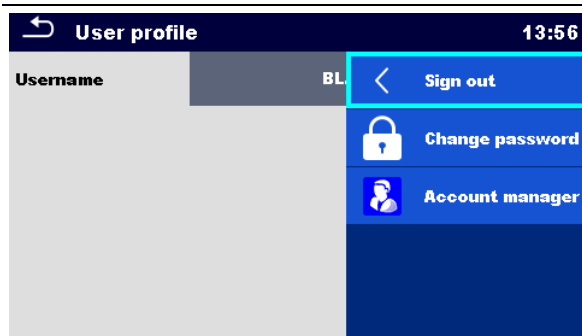
Note

- If a user account is set and the user is signed in the user's name will be stored for each measurement.



Sign in as user: Select User, Sign in, change user Password.

Sign in as administrator: Select Account manager, set account manager Password.



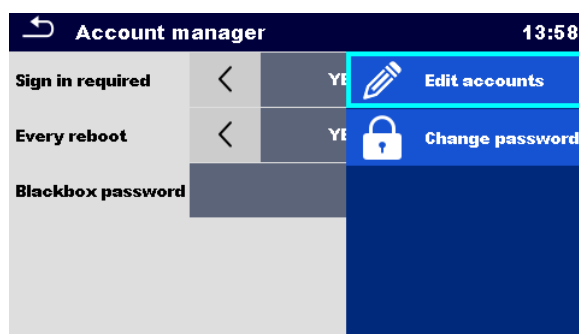
User sign out: select Sign out

Change user password (individual users can change their password): Select Change password, set new password.

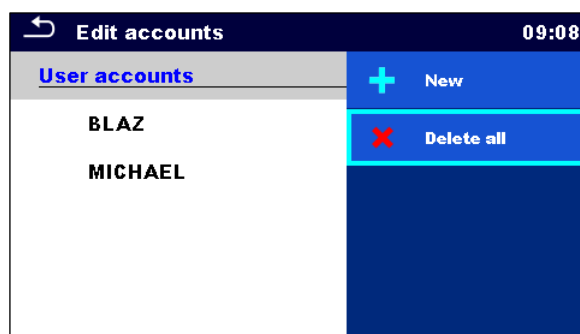
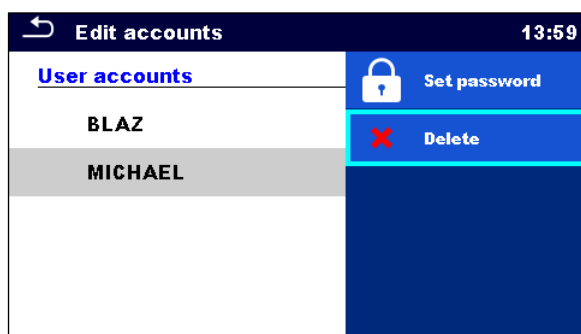
Account manager sign out: is automatic by exiting the Account manager menu.

4.6.6 Managing accounts

User Accounts can be managed by the Account manager.



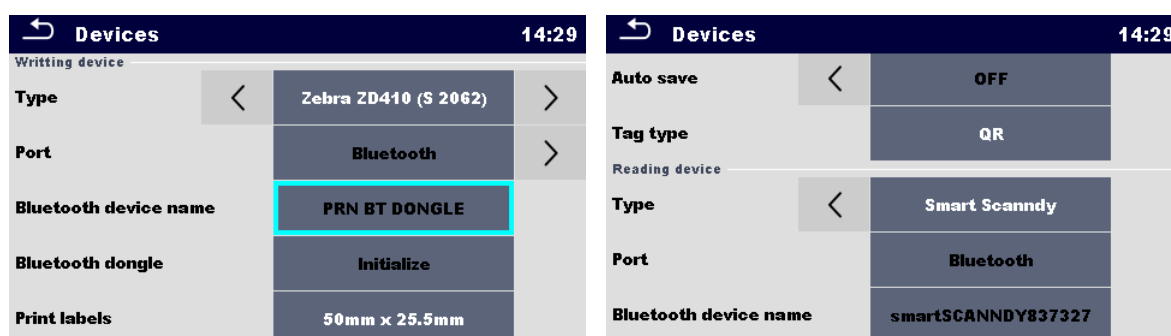
Sign in required	Require signing in
Every reboot	Sign in is required once, or at each reboot of the instrument
Change password	Change account manager password. Password is case sensitive.
Blackbox password	Set Black Box password (same password is valid for all users)



Add new user	Header line (User accounts), New, add name and password
Delete all users	Header line (User accounts), Delete all
Delete user	Select user, Delete
Change user's password	Select user, Set password

4.6.7 Devices

In this menu operation with external devices (printers, scanners) is configured.



Writing devices

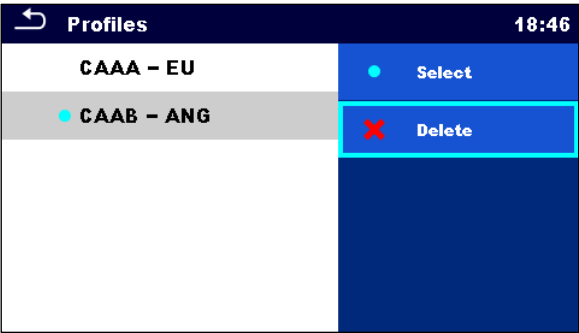
Type	Set appropriate writing device [Serial printer, Bluetooth printer, RFID writer].
Port	Set communication port of selected writing device.
Bluetooth device name	Go to menu for pairing with selected Bluetooth device.
Bluetooth dongle	Initialize Bluetooth Dongle.
Print labels	Select label form size. See Printing labels / writing RFID/ NFC tags .
Printed date	Select date printed on label: [Test date, Retest date].
Auto save	Set simultaneous saving of finished Auto Sequence when label is printed or RFID / NFC tag is written: [On print, On write, OFF] See Auto Sequence result screen .
Tag format, Tag type	Set tag / label format and type. See Printing labels / writing RFID/ NFC tags .

Reading devices

Type	Set appropriate reading device (QR or barcode scanner, RFID reader, Android phone...).
Port	Set communication port of selected reading device.
Bluetooth device name	Go to menu for pairing with selected Bluetooth device.

4.7 Instrument profiles

The instrument uses specific system and measuring settings in regard to the scope of work or country it is used. These specific settings are stored in instrument profiles. By default, each instrument has at least one profile activated. Proper licence keys must be obtained to add more profiles to the instrument. See [Appendix E - Profile](#) Notes for more information about functions specified by profiles.



Select	Select profile
Delete	Delete profile

Note

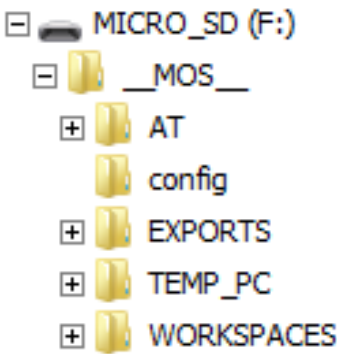
- This menu is visible only if more than one profile is available.

4.8 Workspace Manager

The Workspace Manager is intended to manage with different Workspaces and Exports stored on the microSD card.

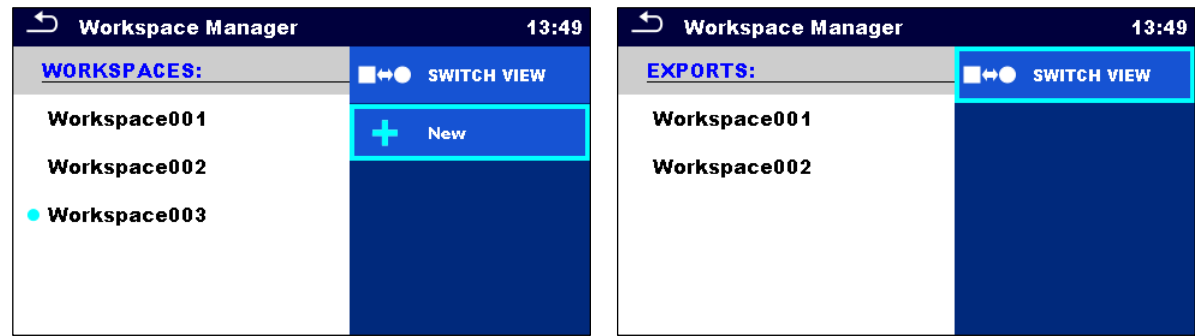
4.8.1 Workspaces and Export

The works can be organized with help of Workspaces and Exports. Both Exports and Workspaces contain all relevant data (measurements, parameters, limits, structure objects) of an individual work.



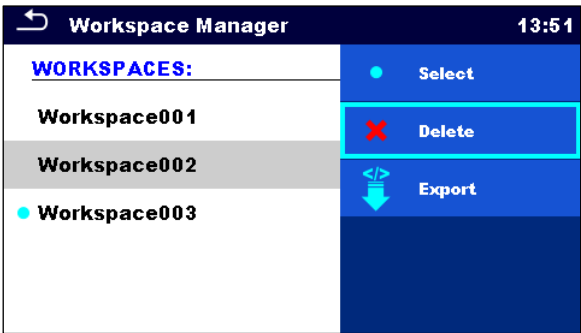
Workspaces are stored on microSD card on directory WORKSPACES, while Exports are stored on directory EXPORTS. Export files can be read by Metrel applications that run on other devices. Exports are suitable for making backups of important works or can be used for

storage of works if the removable microSD card is used as a mass storage device. To work on the instrument an Export should be imported first from the list of Exports and converted to a Workspace. To be stored as Export data a Workspace should be exported first from the list of Workspaces and converted to an Export. In the Workspace manager menu Workspaces and Exports are displayed in two separated lists.



Header line (Workspaces, Exports), Switch View	Switch between Exports and Workspaces
---	---------------------------------------

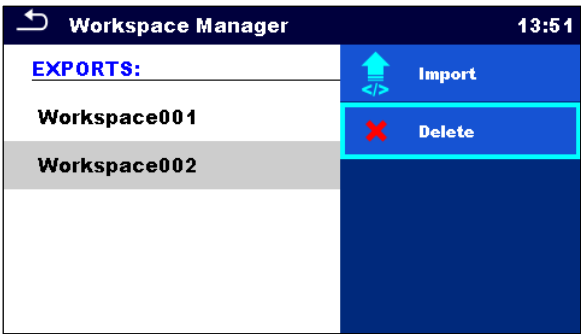
Header line (Workspaces), New	Add new Workspace
-------------------------------	-------------------



Select	Open selected Workspace in Memory Organizer
--------	---

Delete	Delete selected Workspace
--------	---------------------------

Export	Export selected Workspace into an Export
--------	--

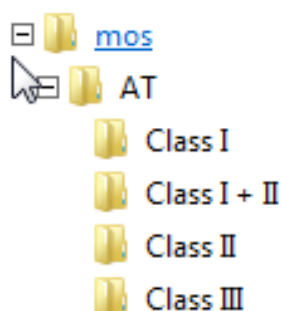


Import	Import selected Export to a Workspace
--------	---------------------------------------

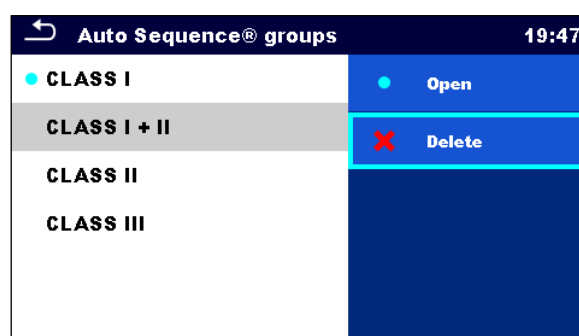
Delete	Delete selected Export
--------	------------------------

4.9 Auto Sequence® groups

The Auto Sequences in the instrument can be organized by using lists. In a list a group of similar Auto Sequences is stored. The Auto Sequence® groups menu is intended to manage with different lists. Folders with lists of Auto Sequences are stored in *Root__MOS__\AT* on the microSD card.



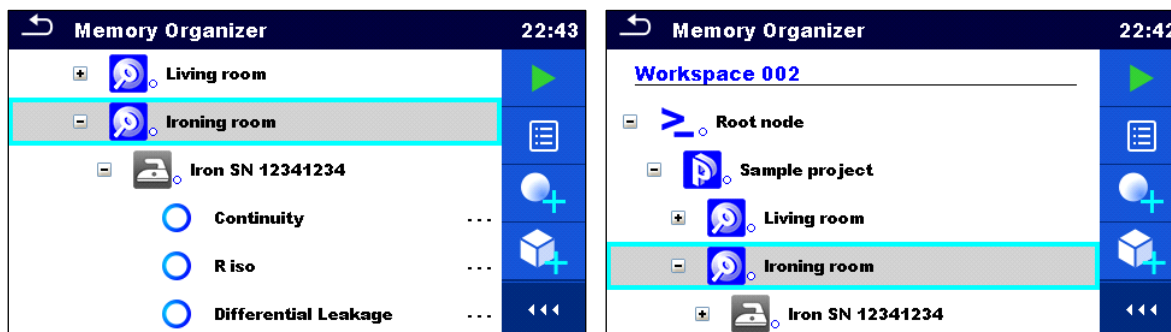
In Auto Sequence® groups menu lists of Auto Sequences® are displayed.



Open	Open the selected Auto Sequence group in the Auto Sequences® main menu.
Delete	Delete the selected Auto Sequence group.

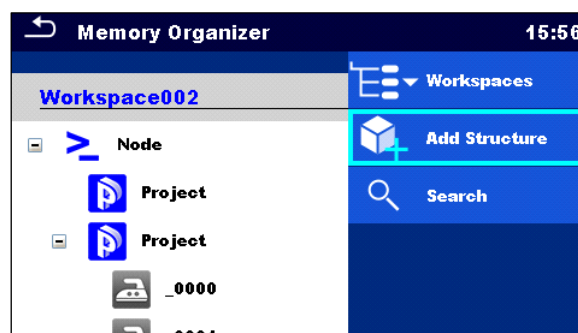
5 Memory Organizer

Memory Organizer is an environment for storing and working with test data. The data is organized in a multilevel tree structure with Structure objects and Measurements. For a list of available structure objects see [Appendix D - Structure](#) objects.



5.1 Operations in Memory Organizer

5.1.1 Operations on Workspace



Header line (Workspace), Workspaces	Go to Workspace Manager from Memory Organizer
-------------------------------------	---

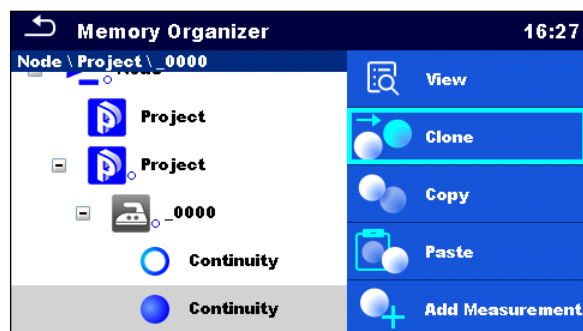
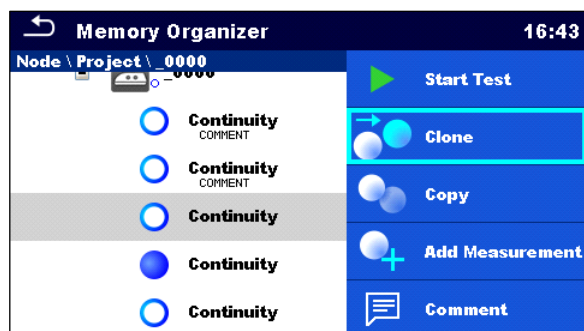
Header line (Workspace), Search	Search for structure elements
---------------------------------	-------------------------------

Node:

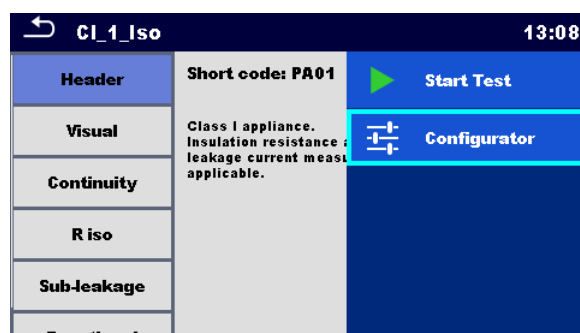
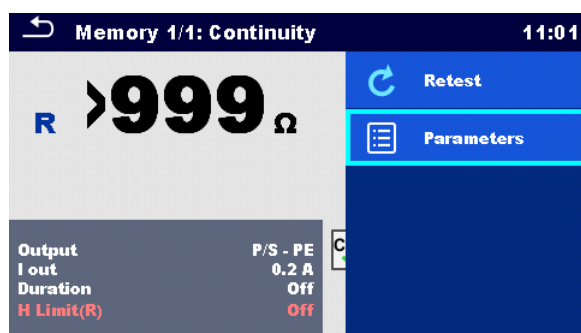
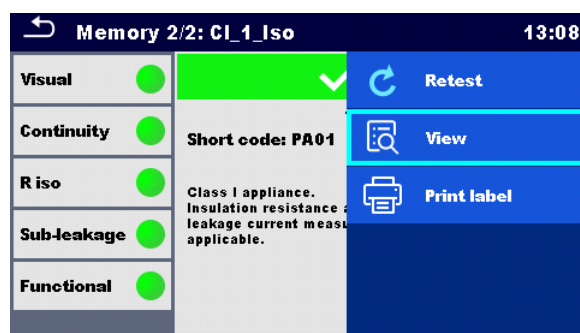
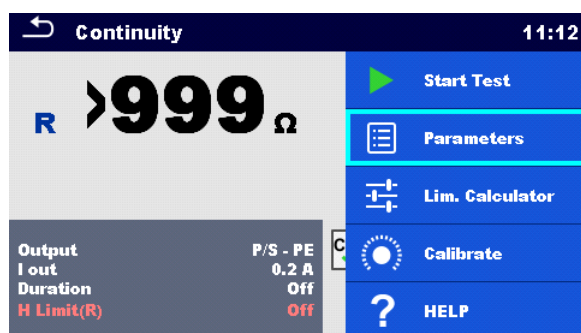
Node is the highest-level structure element. One Node is a must; others are optional and can be created or deleted freely.

Add a new node	Header line (Workspace), Add structure
----------------	--

5.1.2 Operations on measurements



Start Test	Start a new measurement
Clone	Copy selected measurement as an empty measurement under the same Structure object
Copy, Paste	Copy a selected measurement as an empty measurement to any location in structure tree
Add	Add an empty measurement
Comment	View / add a comment to the measurement
Delete	Delete a measurement
Retest, Start Test	Run a new measurement or Auto Sequence with same settings as selected measurement



Parameters	View / edit parameters
View	Enter menu for viewing details of Single test or Auto Sequence
Configurator	See Auto Sequence® Configurator

5.1.3 Measurement statuses

Measurement statuses indicate the status of a measurement or a group of measurements in the Memory Organizer.

Statuses of Single tests

	Passed finished single test with test results
	Failed finished single test with test results
	Finished single test with test results and no status
	Empty single test without test results

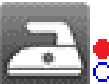
Overall statuses of Auto Sequence

 or 	At least one single test in the Auto Sequence passed and no single test failed
 or 	At least one single test in the Auto Sequence failed
 or 	At least one single test in the Auto Sequence was carried out and there were no other passed or failed single tests
 or 	Empty Auto Sequence with empty single tests

Overall status of measurements under structure elements

Overall status of measurements under each structure element gives a fast information on tests without expanding tree menu.

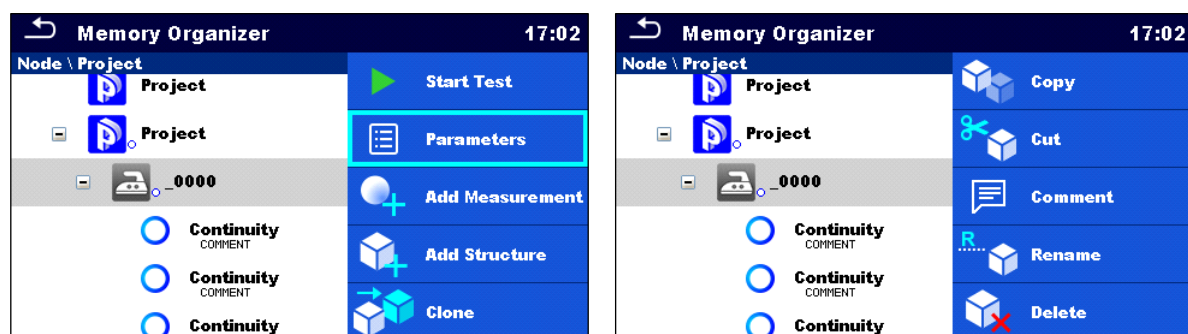
Options

	There are no measurement result(s) under selected structure object. Measurements should be made.
	One or more measurement result(s) under selected structure object has failed. Not all measurements under selected structure object have been made yet.
	All measurements under selected structure object are completed but one or more measurement result(s) has failed.



No status indication if all measurement results under each structure element / sub-element have passed or are without measurements.

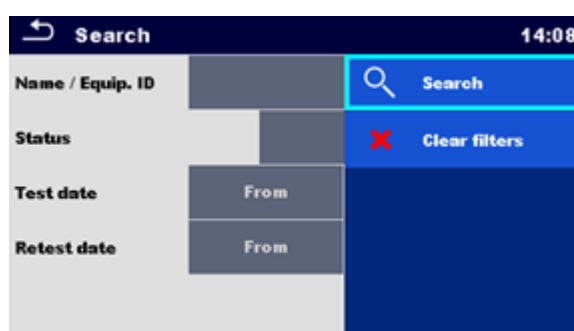
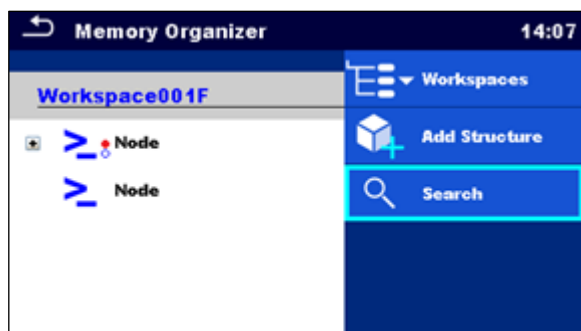
5.1.4 Operations on Structure objects



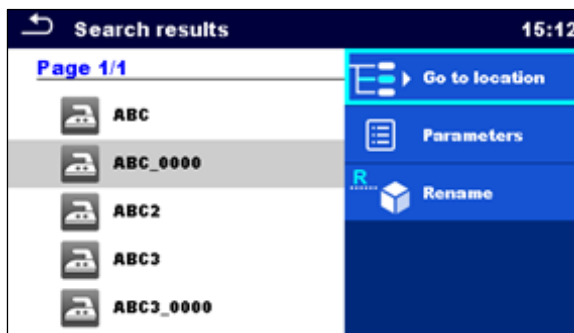
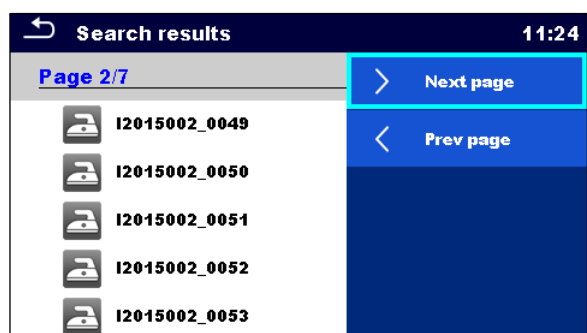
Start Test	Start a new measurement (proceeds to menus for selection of measurement)
Parameters	View / edit parameters
Clone	Copy selected element as to same level in the structure tree
Copy, Paste	Copy selected element to any allowed location in structure tree
Cut, Paste	Move selected Structure with child items (sub-structures and measurements) to any allowed location in structure tree
Print label, Write RFID	Print / write RFID (if printing / writing device is set) For details, see Printing labels / writing RFID/NFC tags .
Add	Add a new empty measurement. Menu for adding new measurement will open
Attachment	View link of attachment
Comment	View/edit/add a comment to the structure element
Rename	Rename the structure element
Delete	Delete the structure element

5.1.5 Searching in Memory Organizer

In Memory organizer it is possible to search for different structure objects and their parameters.



Header line (Workspace), Search	Enter Search menu
Search	Search according to parameter, status...
Clear filters	Clear set filters in Search menu



Operations on found structure objects

Header line (Page x/y), Next Page, Previous Page	Go Page Up / Down
Go to location	Jump to selected location in Memory organizer
Parameters	View/edit parameters
Rename	Rename the found object

Note

Equipment ID, Test date, Retest date refer only to the following structure objects:

- Appliance
- Appliance FD
- Medical equipment
- Medical equipment FD

6 Single tests

Different modes for selecting single tests are available.

6.1 Selection modes

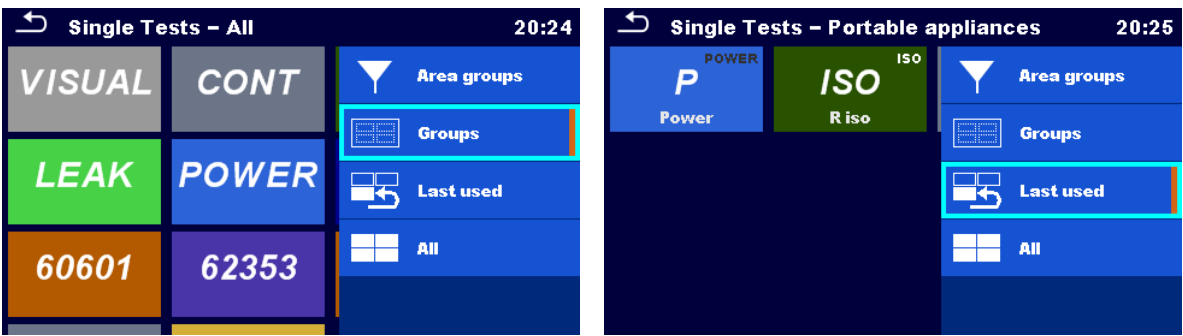
6.1.1 Area groups

With help of area groups, it is possible to limit the number of offered single tests, according to the field of use.



Select Area Group	Select appropriate Area group or All single tests
-------------------	---

Groups of single tests, Last used single tests	In selected area group, two views are available.
--	--



Groups	View groups of available measurements
Last used	View last made measurements
All	View all measurements combined
Area groups	Change area group

For the selected group a submenu with all single tests that belongs to the selected group and Area group is displayed.



6.2 Single test screens

In the Single test screens main measuring results, sub-results, limits and parameters of the measurement are displayed. In addition, on-line statuses, warnings and other information are displayed.



1	Name of function
2	Options
3	Statuses, infos, warnings
4	Parameters (white) and limits (red)
5	Sub-result
6	Main result
7	Test metadata

Test metadata

2m 12s 1m 35s	Estimated test duration, estimated remained time (h – hours, m – minutes, s – seconds)
-------------------------------------	---

Σ 72

Number of all tests within a single test

● 68

Number of finished and not failed test results

● 4

Number of failed test results

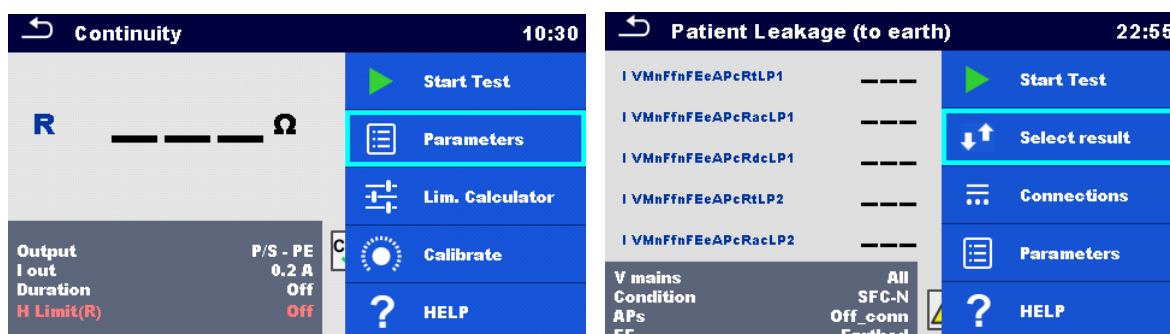
○ 0

Empty single test without test results

Note

- Test metadata are shown in medical tests only.

6.2.1 Single test start screen

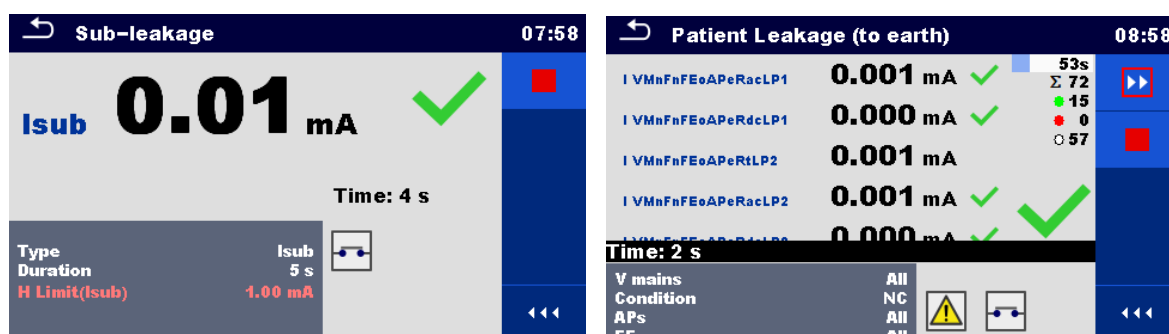


Start test	Start single test
Parameters, or tap on Parameters field	Set parameters/ limits of single test
Help	View help screens
Select result	View parameters of individual results in single test

Connections, Lim.calculator, Calibrate: other options are available, depending on the test. See [Single test measurements](#) for more information.

Add comments before the test (applicable on some single tests): In the Parameters menu comments can be stored as a part of the single test Parameters, Comment 1, Comment 2.

6.2.2 Single test screen during test



End single test



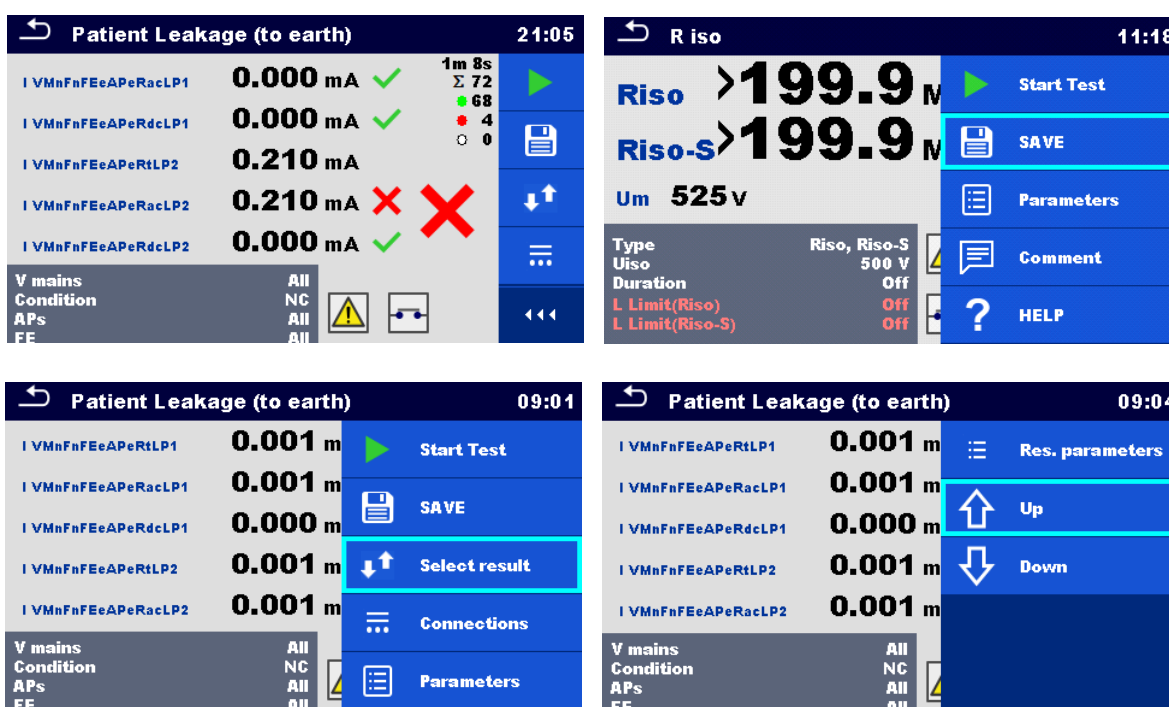
Proceed to next step into single test

Testing procedure (during the test)

Observe the displayed results and statuses

Check for eventual messages, warnings

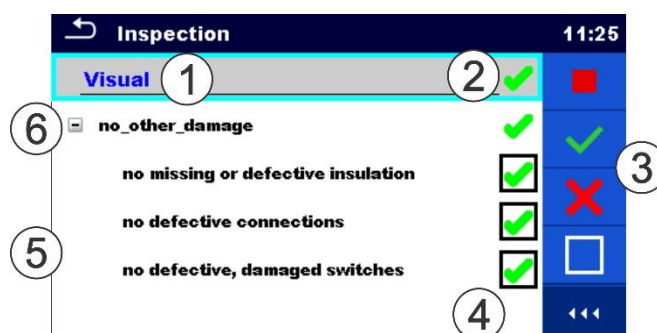
6.2.3 Single test result screen



Start test	Start a new single test
Select result, Up /Down, Res. Parameters	Select a result in single test and view its parameters
Connections	View configuration of connections
Save	Save the result
A new measurement was started from a Structure object in the structure tree	The measurement will be saved under the selected Structure object
A new measurement was started from the Single test main menu	Saving under the last selected Structure object will be offered by default. The user can select another Structure object or create a new Structure object. By pressing the Save key in Memory organizer menu the measurement is saved under selected location.
An empty measurement was selected in Memory Organizer and started	The result(s) will be added to the measurement. The measurement will change its status from 'empty' to 'finished'.
An already carried out measurement was selected in Memory Organizer, viewed and then restarted	A new measurement will be saved under the selected Structure object.
Comment	Add comment to the measurement

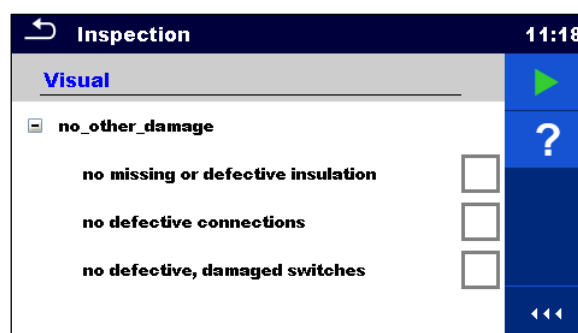
6.3 Single test (inspection) screens

Visual and Functional inspections are a special type of single tests. Items to be visually or functionally checked are displayed. Appropriate statuses can be applied.



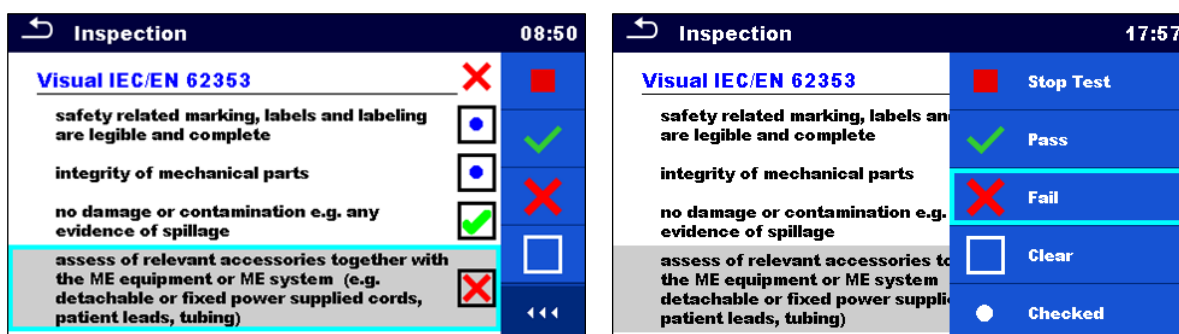
1	Selected inspection
2	Overall status
3	Options
4	Status fields
5	Child items
6	Item

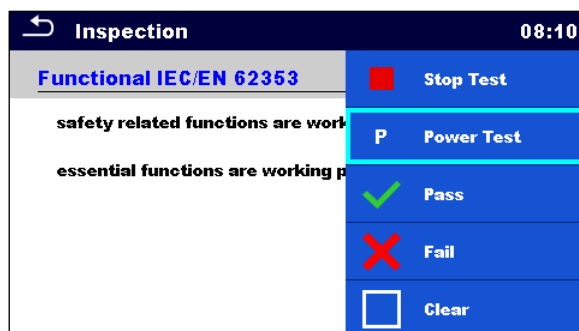
6.3.1 Single test (inspection) start screen



Start test	Start the inspection
Help	View help screens

6.3.2 Single test (Inspection) screen during test





Header line (name of inspection), apply Pass or Fail or Checked or Clear	Apply or clear the overall status to complete inspection
Select group of items, apply Pass or Fail or Checked or Clear	Apply or clear the status of group of items
Select items, apply Pass or Fail or Checked or Clear	Apply or clear the status of an individual item
Power Test	Power is applied to the mains test socket to power up the tested equipment during a functional inspection.

Hint

Tap on  or use  key to set status.

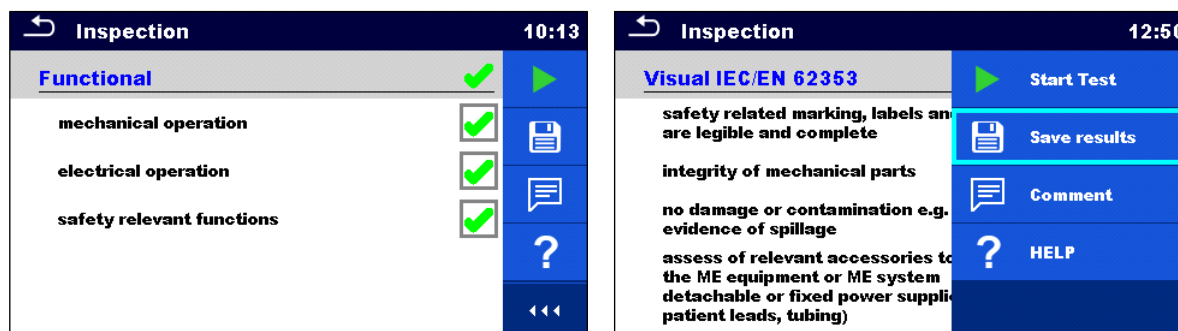
Rules for automatic applying of statuses

The parent items will automatically get a status on base of statuses in child items	- A fail status has highest priority. A fail status for any item will result in a fail status in all parent items and an overall fail result. - If there is no fail status in child items the parent item will get a status only if all child items have a status. - Pass status has priority over checked status.
The child items will automatically get a status on base of status in the parent item	All child items will get the same status as applied to the parent item.

Note

- Inspections and even inspection items inside one inspection can have different status types. For example, some inspections don't have the 'checked' status.
- Only inspections with an overall status can be saved.

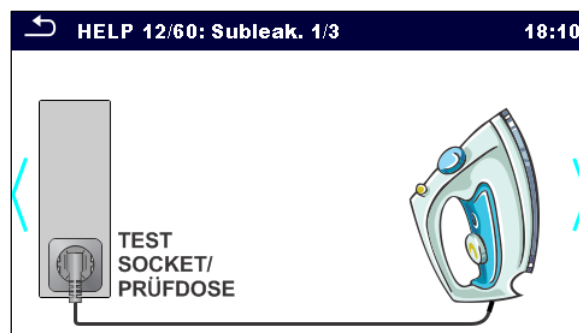
6.3.3 Single test (Inspection) result screen



Start test	Start a new inspection
Save results	Save the result
Comment	Add comment to the inspection
Help	View help screens
A new inspection was started from a Structure object in the structure tree	The inspection will be saved under the selected Structure object.
A new inspection was started from the Single test main menu	Saving under the last selected Structure object will be offered by default. The user can select another Structure object or create a new Structure object. By pressing the Save key in Memory organizer menu the inspection is saved under selected location.
An empty inspection was selected in Memory Organizer and started	The result(s) will be added to the inspection. The inspection will change its status from 'empty' to 'finished'.
An already carried out inspection was selected from Memory Organizer, viewed and then restarted	A new inspection will be saved under the selected Structure object.

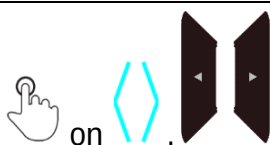
6.3.4 Help screens

Help screens contain diagrams for proper connection of the instrument.



Help

Open help screen



Go to other help screens

6.4 Configuring the instrument connections and parameters for the tests on medical equipment

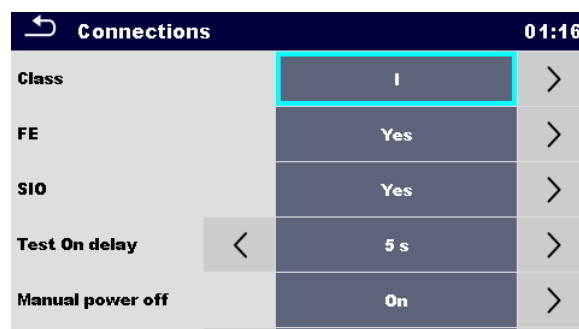
The instrument's test connections must be adjusted to the medical device under test. The configuration of test connections can be adjusted in the Connections menu.

On base of the settings in the Connections menu: the test parameters, limits and results are automatically configured for the selected test.

Note

- The number of different tests in a single test can be high. If a complete test according to the standard and with all variations included is not needed, the number of tests inside the Single test can be limited by changing the settings in the Single test parameter field.

6.4.1 Connections main menu



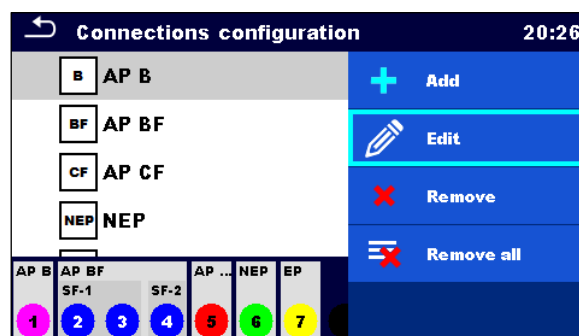
Class	Protection class I, II or IP (Internal <u>P</u> ower) of tested device
FE	FE connection is included / not included in test
SIO	SIO connection is included / not included in test.
Test On delay	Delay after each power ON of device in order to start measurement after DUT (<u>D</u> evice <u>U</u> nder <u>T</u> est) is stabilized (for example ME based on Windows OS is ready to use)
Manual power off	On: the DUT will not be powered off automatically after the test is finished. This enables a save and controlled switch off of the tested device. Off: the DUT will be powered off automatically.
Power Off delay	Delay after each power Off in order to assure safe and complete power off of DUT (before it is switched on again).
Connections configuration	Go to sub-menus for setting APs, NEPs and EP.

Note

- Medical insulation resistance measurements, alternative leakage measurements (Class I or Class II), and all measurements (if Class IP is set), ignore setting regarding Test On delay and Power Off delay parameters.
- Power Off delay setting is not taken into account, if “Manual power off” parameter is set to “On”.

6.4.2Connections configuration

In this menu the instrument's connections C1 to C10 can be configured as APs, NEPs or EP. In the lower part of the screen the momentary configuration of the P/S and C1 to C10 test ports is indicated.



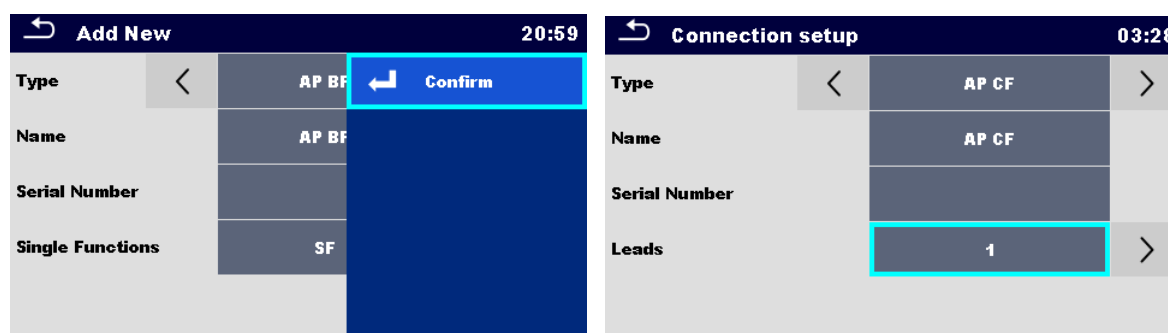
Add	Add a new connection (Enter Connection setup)
Edit	Setup / Edit) / view selected connection (Enter Connection setup)
Remove	Remove selected connection
Remove all	Remove all connections

Note

- For the first NEP the P/S connection is selected by default. For further NEPs C connections will be used.

6.4.3 Connection setup

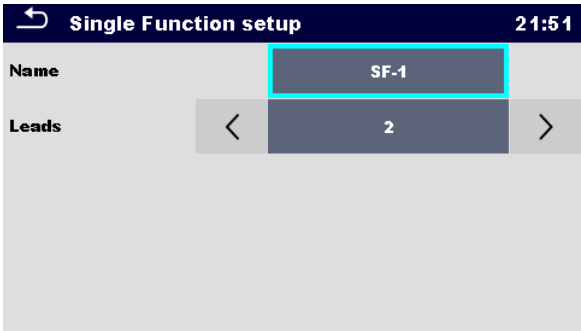
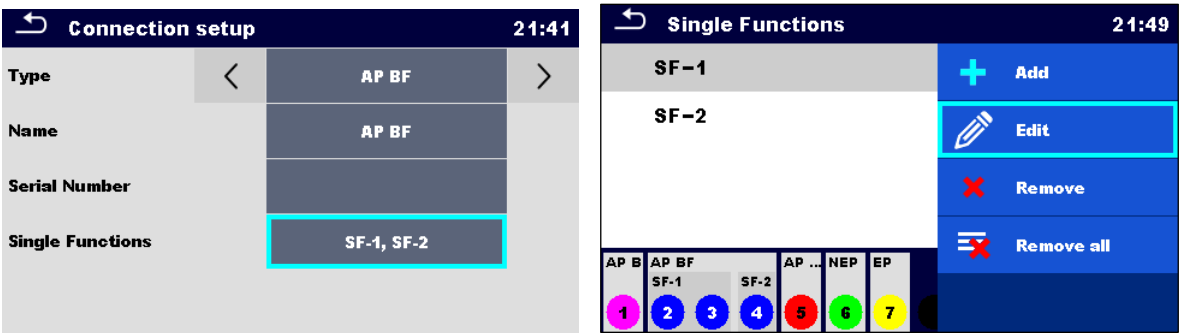
In this menu the parameters of APs, NEPs and EP can be set / modified.



AP B	Name, Serial number, Number of leads
AP BF	Name, Serial number, Single functions (Name, Leads)
AP CF	Name, Serial number, Number of leads
NEP	Name
EP	Name
Confirm	Add a new connection

6.4.4 Single functions (AP BF only)

APs of type BF can be further divided in parts with different single functions: Connection setup, Type AP BF, Single Functions. In the lower part of the screen the momentary configuration of the P/S and C1 to C10 test ports is indicated.

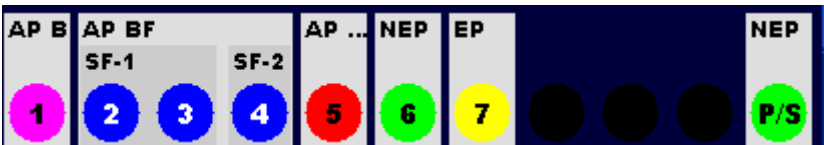


Add	Define a new single function connection
Edit	Edit / view selected single function connection
Remove	Remove selected single function connections
Remove all	Remove all single function connections

Single Function setup	
Name, Leads	Set name and number of leads of type AP BF single function connections

6.4.5Colour coding of connections

The connections are colour coded. The coding is the same on the LEDs on front panel and on the display.



Purple	AP B
Blue	AP BF
Red	AP CF
Green	NEP

Yellow	EP
Off / Black	Connection not used

Note

- Dark grey area in the lower part of the screen indicates type AP BF single functions and common functional connections.

6.5 Single test measurements

6.5.1 Visual inspection

Test results / sub-results

Pass, Fail, Checked

Test circuit



6.5.2 Continuity // Protective earth resistance

Test results / sub-results

R Resistance

Test parameters

Output (Continuity)	Output: [P/S – PE, MS_PE – IEC_PE]
Output (Protective earth resistance)	Output: [P/S – PE]
Test current	I out: [0.2 A, 25 A]
Duration	Duration: [Off, 2 s ... 180 s]

Test limits

Limit (R) (Continuity)	H Limit(R): [Off, Custom, 0.01 Ω ... 9 Ω]
------------------------	--

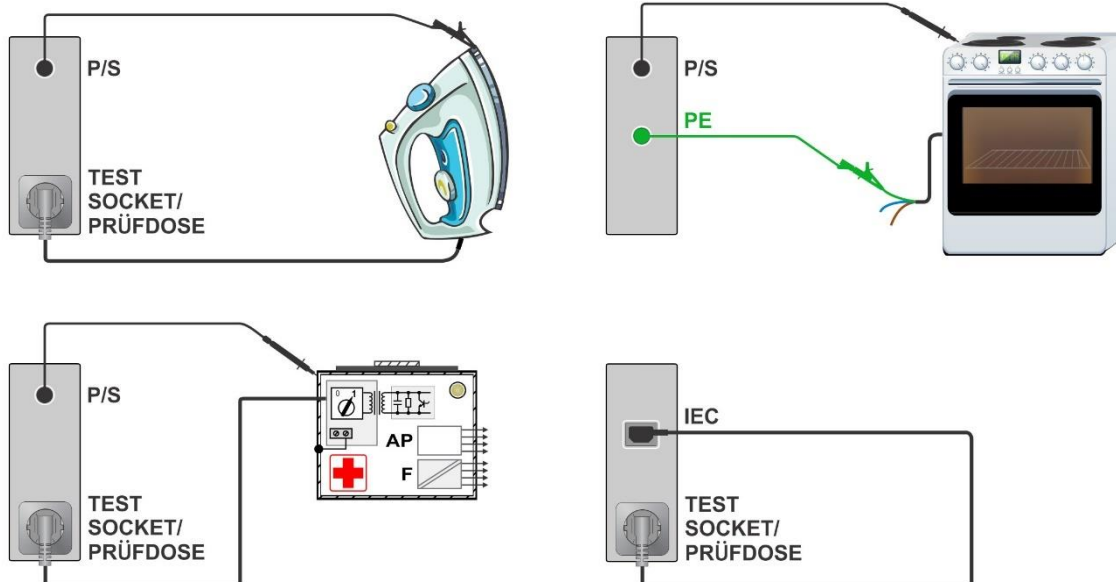
Limit (R) (Protective earth resistance)	Limit(R): [Off, Custom, 0.1 Ω ... 0.5 Ω]
---	---

Additional options	
Calibrate	Calibrate – see Compensation of test lead / IEC test cable resistance .
Limit Calculator	Lim. Calculator see Limit calculator .

Note

- For the test between P/S and PE banana sockets only test current 200 mA is available.

Test circuits

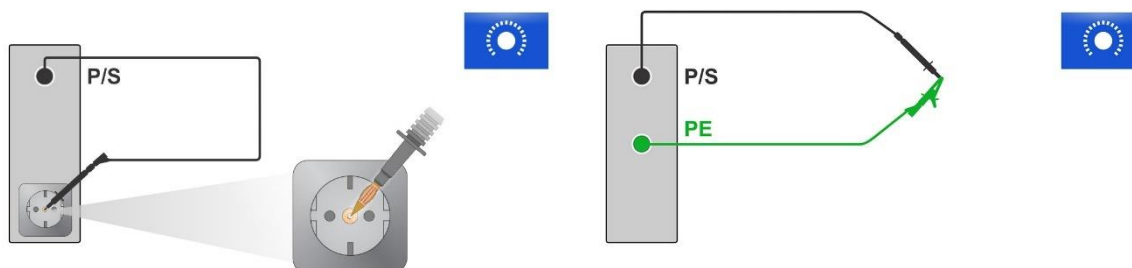


6.5.3 Compensation of test lead(s) / IEC test cable resistance

Resistance of test lead(s) and cables can be compensated. Compensation is possible in following functions:

- Continuity (Output = P/S – PE, MS_PE – IEC_PE)
- Protective Earth Resistance (Output = P/S – PE)

Connection for compensating the resistance of test lead(s) / IEC test cable





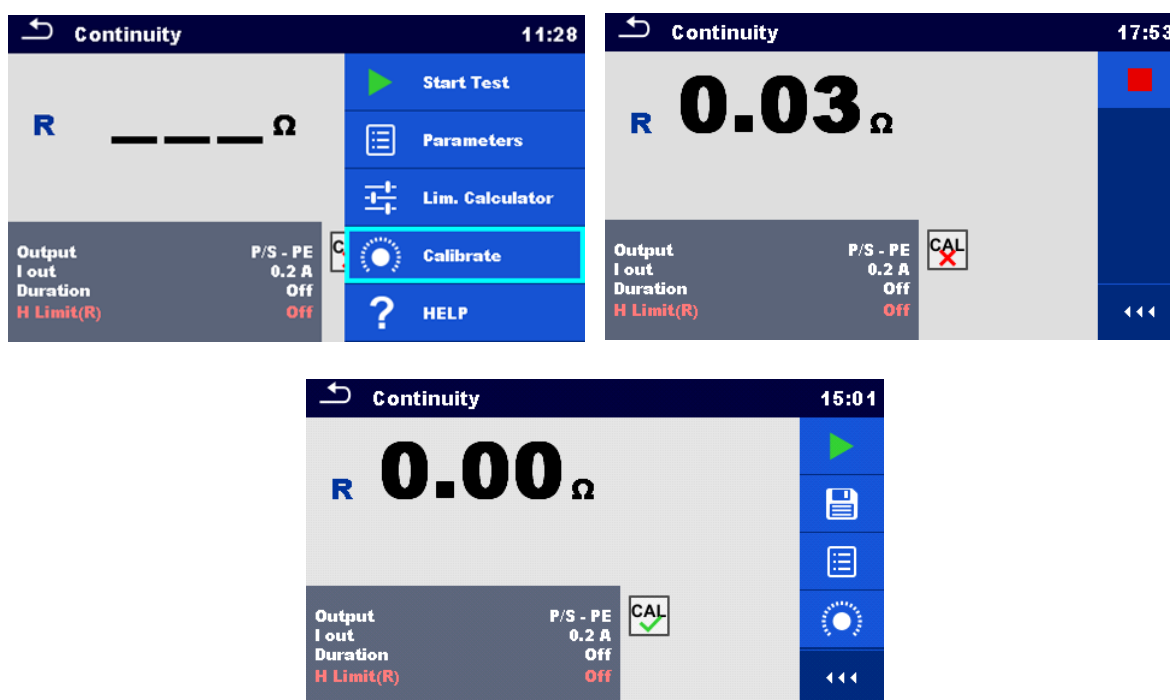
Compensation of test lead(s) / IEC test cable resistance procedure

Select single test and its parameters.

Connect test lead to the instrument between P/S terminal and PE terminal on test socket or short-circuit test leads connected to P/S and PE banana sockets, or connect IEC test cable between IEC connector and test socket.

Calibrate: Compensate test lead(s) / IEC test cable resistance

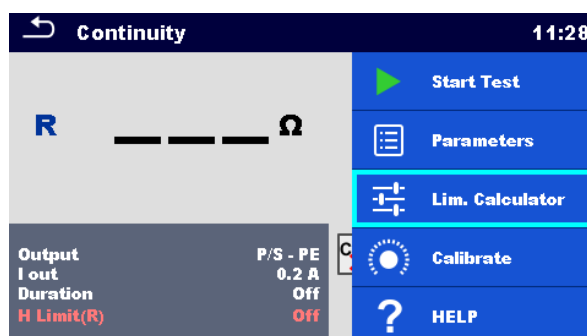
Symbol  is displayed if the compensation was carried out successfully.



Note

- The compensation value is correct only for the output (P/S terminal – PE terminal on test socket or P/S terminal – PE terminal) at which the calibration was carried out.
- It is recommended to compensate leads resistance with the same test current as the measurement will be made.

6.5.4 Limit calculator



Limit calculator is a tool for determining the resistance high limit.

Open Limit calculator	Lim. Calculator
Define the limit value	Set Limit rule: Length, Cross-section, Custom

Limit rules:

A: $EN / CSA \leq 1.5 \text{ mm}^2$

Resistance limit is set in accordance with the EN 50678 and EN 50699 standards, for wires with cross-section areas up to 1.5 mm^2 .

L wire length	R Limit [Ω]
$L \leq 5 \text{ m}$	0.3
$5 \text{ m} < L \leq 12.5 \text{ m}$	0.4
$12.5 \text{ m} < L \leq 20 \text{ m}$	0.5
$20 \text{ m} < L \leq 27.5 \text{ m}$	0.6
$27.5 \text{ m} < L \leq 35 \text{ m}$	0.7
$35 \text{ m} < L \leq 42.5 \text{ m}$	0.8
$42.5 \text{ m} < L \leq 50 \text{ m}$	0.9
$50 \text{ m} < L \leq 57.5 \text{ m}$	1.0

B: Calculator

Resistance limit is calculated by the formula:

$$R = \rho \frac{L}{A} + 0.1 \Omega$$

ρ	Specific resistance of copper $1.68 \times 10^{-8} \Omega \text{m}$
L	Wire length selected from a list (1 m, 2 m, 3 m, ... ,100 m) or custom numeric entry
A	Wire cross section selected from a list (0.50 mm ² , 0.75 mm ² , 1.00 mm ² , 1.50 mm ² , 2.5 mm ² , 4.0 mm ² , 10.0 mm ²) or custom numeric entry

C: NEN 3140

Resistance limit is derived from table on wire length and wire cross-section basis. Table is based on NEN 3140 standard.

	Wire cross-section [mm ²]			
	1.5	2.5	4	6
L wire length	R Limit [Ω]			
L ≤ 2 m	0.22	0.21	0.21	0.21
2 m < L ≤ 5 m	0.26	0.24	0.22	0.21
5 m < L ≤ 10 m	0.32	0.27	0.24	0.23
10 m < L ≤ 15 m	0.38	0.31	0.27	0.24
15 m < L ≤ 20 m	0.43	0.34	0.29	0.26
20 m < L ≤ 25 m	0.49	0.38	0.31	0.27
25 m < L ≤ 30 m	0.55	0.41	0.33	0.29
30 m < L ≤ 35 m	0.61	0.45	0.35	0.30
35 m < L ≤ 40 m	0.67	0.48	0.38	0.32
40 m < L ≤ 45 m	0.73	0.52	0.40	0.33
45 m < L ≤ 50 m	0.78	0.55	0.42	0.35

	Wire cross-section [mm ²]		
	10	16	25
L wire length	R Limit [Ω]		
L ≤ 2 m	0.20	0.20	0.20
2 m < L ≤ 5 m	0.21	0.21	0.20
5 m < L ≤ 10 m	0.22	0.21	0.21
10 m < L ≤ 15 m	0.23	0.22	0.21
15 m < L ≤ 20 m	0.24	0.22	0.21
20 m < L ≤ 25 m	0.24	0.23	0.22
25 m < L ≤ 30 m	0.25	0.23	0.22
30 m < L ≤ 35 m	0.26	0.24	0.22
35 m < L ≤ 40 m	0.27	0.24	0.23
40 m < L ≤ 45 m	0.28	0.25	0.23
45 m < L ≤ 50 m	0.29	0.25	0.24

D: Custom

Resistance limit is directly selected from a list (Off, 0.01 Ω ... 0.09 Ω , 0.1 Ω ... 0.9 Ω , 1 Ω ... 9 Ω) or set via keypad (Custom).

6.5.5 Insulation resistance (Riso, Riso-S)

Test results / sub-results

Riso	Insulation resistance
Riso-S	Insulation resistance-S
Um	Test voltage

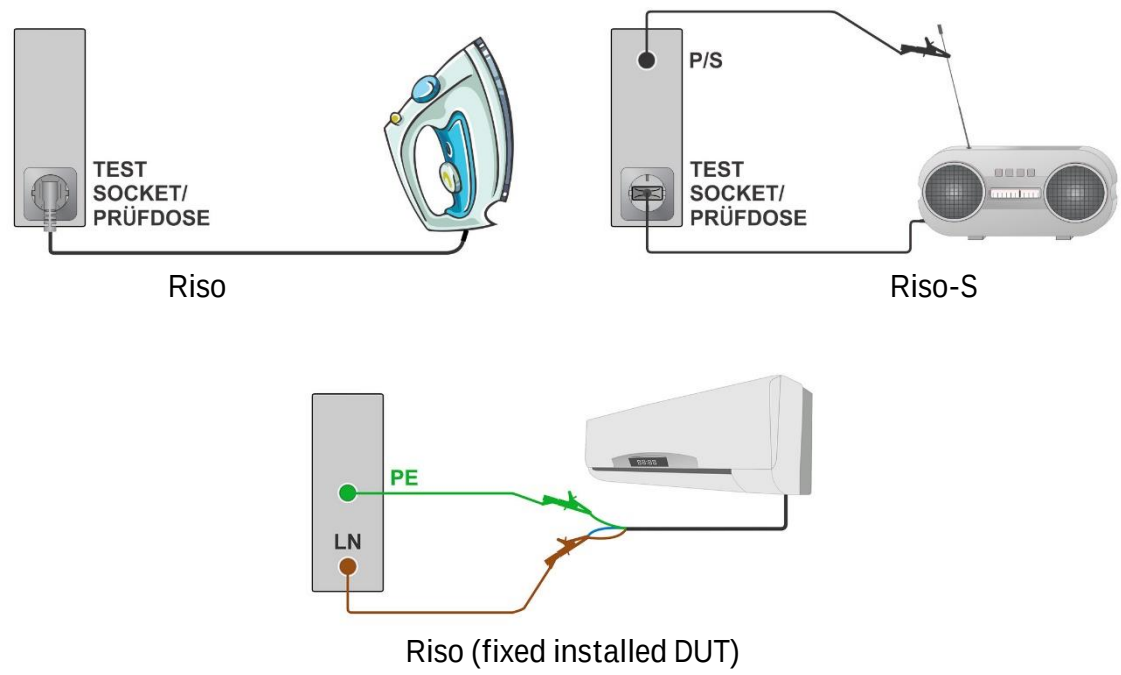
Test parameters

Type of test	Type [Riso, Riso-S, (Riso, Riso-S)]
Nominal test voltage	Uiso [250 V, 500 V]
Duration	Duration [Off, 2 s ... 180 s]

Test limits

Limit (Riso)	L Limit (Riso) [Off, Custom, 0.01 M Ω ... 10.0 M Ω]
Limit (Riso-S)	L Limit (Riso-S) [Off, Custom, 0.1 M Ω ... 10.0 M Ω]

Test circuits



Note

- The current through the P/S probe is also considered in the Riso result.

6.5.6Sub-leakage (Isub, Isub-S)

Test results / sub-results

Isub	Sub-leakage current
Isub-S	Sub-leakage current-S

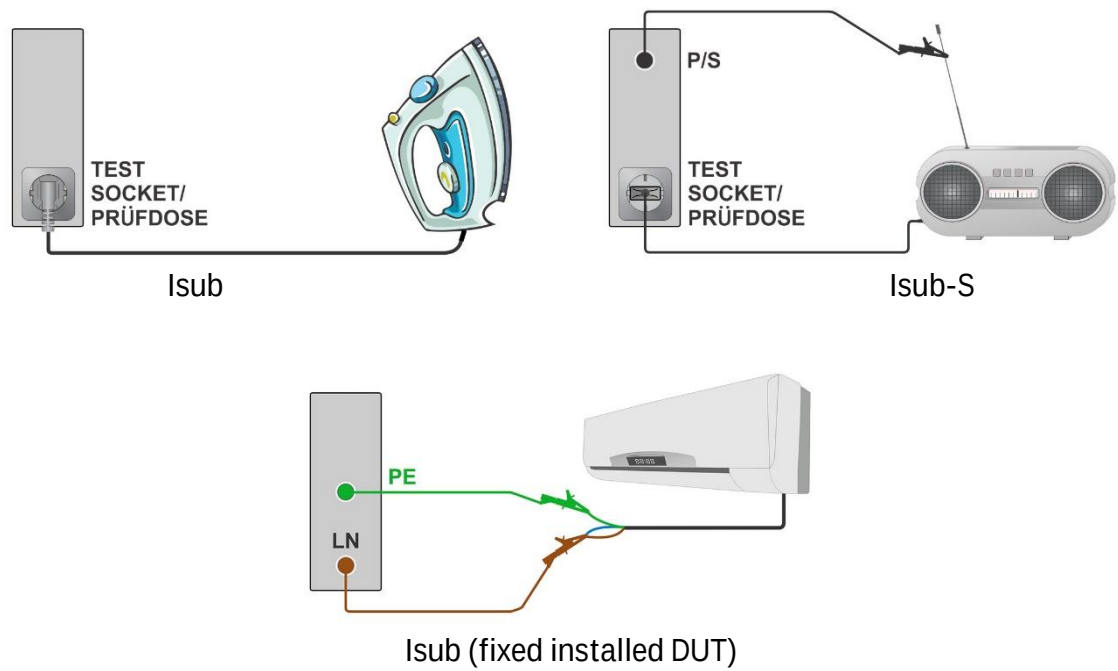
Test parameters

Type of test	Type [Isub, Isub-S]
Duration	Duration [Off, 2 s ... 180 s]

Test limits

Limit (Isub)	H Limit (Isub) [Off, Custom, 0.25 mA ... 15.0 mA]
Limit (Isub-S)	H Limit (Isub-S) [Off, Custom, 0.25 mA ... 15.0 mA]

Test circuits



Note

- When P/S probe is connected during the Sub-leakage measurement, then the current through it is also considered.

6.5.7 Differential Leakage

Test results / sub-results

Idiff	Differential Leakage current
P	Power

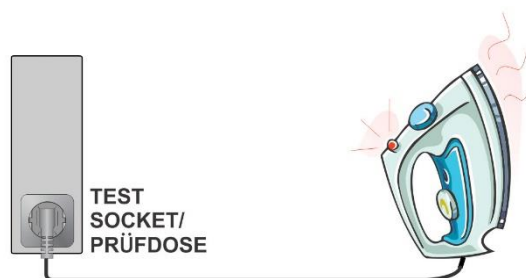
Test parameters

Duration	Duration [Off, 2 s ... 180 s]
Change	YES: The test is performed in two steps, with phase voltage applied on right and left outputs of the mains test socket. NO: The test is performed with phase voltage applied only on the right output of the mains test socket.
Delay	Delay between the two steps, if Change = YES, [0.2 s ... 5 s]

Test limits

Limit (Idiff)	H limit (Idiff) [Off, Custom, 0.25 mA ... 15.0 mA]
---------------	--

Test circuit



6.5.8 Ipe Leakage

Test results / sub-results

I _{pe}	PE current
P	Power

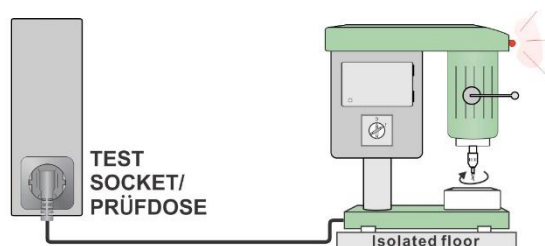
Test parameters

Duration	Duration [Off, 2 s ... 180 s]
Change	YES: The test is performed in two steps, with phase voltage applied to right and left outputs of the mains test socket. NO: The test is performed with phase voltage applied only on the right output of the mains test socket.
Delay	Delay between the two steps, if Change = YES [0.2 s ... 5 s]

Test limits

Limit (I _{pe})	H Limit (I _{pe}) [Off, Custom, 0.25 mA ... 15.0 mA]
--------------------------	---

Test circuit



6.5.9 Touch Leakage

Test results / sub-results

Itou	Touch Leakage current
P	Power

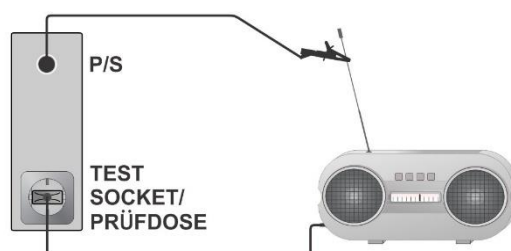
Test parameters

Duration	Duration [Off, 2 s ... 180 s]
Change	YES: The test is performed in two steps, with phase voltage applied on right and left outputs of the mains test socket. NO: The test is performed with phase voltage applied only on the right output of the mains test socket.
Delay	Delay between the two steps, if Change = YES [0.2 s ... 5 s]

Test limits

Limit (Itou)	H limit (Itou) [Off, Custom, 0.25 mA ... 15.0 mA]
--------------	---

Test circuit



6.5.10 Power

Test results / sub-results

P	Active power
S	Apparent power
Q	Reactive power
PF	Power factor
THDu	Total harmonic distortion – voltage
THDi	Total harmonic distortion – current
Cos Φ	Cosine Φ

I	Load current
U	Voltage

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
----------	-------------------------------

Test limits

High Limit (P)	H limit(P) [Off, Custom, 10 W ... 3.50 kW]
Low Limit (P)	L limit(P) [Off, Custom, 10 W ... 3.50 kW]

Test circuit



6.5.11 Leak's & Power

Test results / sub-results

P	Active power
Itou	Touch Leakage current
Idiff	Differential Leakage current
S	Apparent power
Q	Reactive power
PF	Power factor
THDu	Total harmonic distortion – voltage
THDi	Total harmonic distortion – current
Cos Φ	Cosine Φ
I	Load current
U	Voltage

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
----------	-------------------------------

Change	YES: The test is performed in two steps, with phase voltage applied to right and left outputs of the mains test socket. NO: The test is performed with phase voltage applied only on the right output of the mains test socket.
Delay time	Delay between the two steps, if Change = YES [0.2 s ... 5 s]
Test limits	
High Limit (P)	H Limit(P) [Off, Custom, 10 W ... 3.50 kW]
Low Limit (P)	L Limit(P) [Off, Custom, 10 W ... 3.50 kW]
High Limit (Idiff)	H Limit(Idiff) [Off, Custom, 0.25 mA ... 15.0 mA]
High Limit (Itou)	H Limit(Itou) [Off, Custom, 0.25 mA ... 15.0 mA]

Test circuit



6.5.12 Polarity

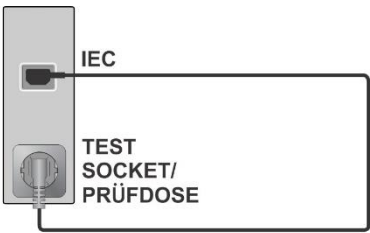
Test results / sub-results

Result	Indication of the test [Pass, <i>Description of the fault</i>]
--------	---

Test parameters / limits

Test mode	Mode [normal]
Test status	Status [On, Off]
L and N cross	Cross of phase and neutral wire [not allowed, allowed]

Test circuit



6.5.13 Clamp current

Test results / sub-results

I	Current
---	---------

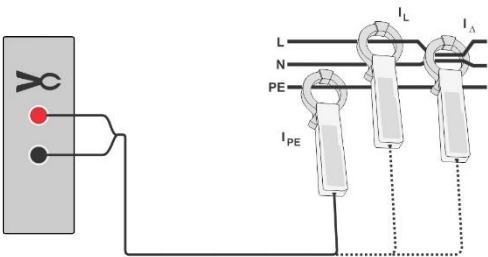
Test parameters

Indication of the type of current measured	Test [Differential leakage, PE leakage, Current]
Duration	Duration [Off, 2 s ...180 s]
Current clamp model	Ch1 clamp type [A1579]

Test limits

High Limit (I, Idiff, Ipe)	Limit(I,Idiff,Ipe) [Off, Custom, 0.25 mA ... 15.0 mA]
----------------------------	---

Test circuit



Note

- The frequency range of this measurement is limited. This measurement function cannot be used for measuring leakage currents of appliances that are able to generate leakage currents with frequencies above 10 kHz or above the specified frequency range of the clamp.

6.5.14 Riso (LN-PE, LN-NEP, LN-AP, AP-PE, AP-NEP)

Test results / sub-results

According to set Parameters and Connections.

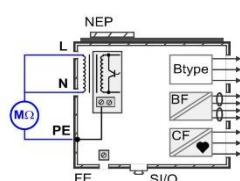
Test parameters

Duration	Duration [Off, 2 s ... 180 s]
Test (LN=>AP only)	[All, B type, F type] B type: B type AP parts are tested F type: F-type AP parts are tested All: all tests will be carried out Options depend on set configuration.
Connections	Set configuration is considered.
Uiso	Test voltage (LN-PE) [250 V, 500 V] Test voltage (others) [500 V]

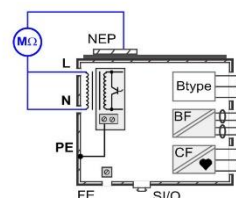
Test limits

Limit	Class I: [2 M Ω], Class II: [7 M Ω], AP of F-type: [70 M Ω]
Limit (B, CI I)	
Limit (B, CI II)	
Limit (BF, CF)	

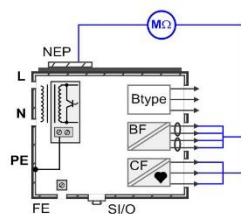
Test circuits



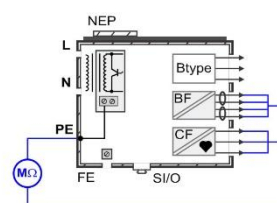
LN-PE



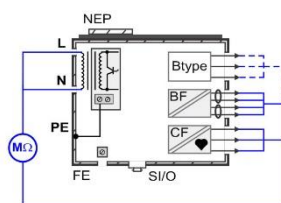
LN-NEP



AP-NEP



AP-PE



LN-AP

Note

- Multiple NEPs in Riso LN-NEP and Riso AP-NEP test functions are connected together.

6.5.15 Equipment Leakage (alternative, direct, differential)

Test results / sub-results

According to set Parameters and Connections.

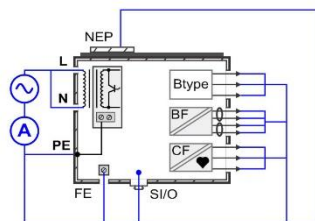
Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket. All: tests in normal and reversed position
Unom	The leakage current is calculated to Unom [100 V ... 240 V].
Connections	Set configuration is considered.

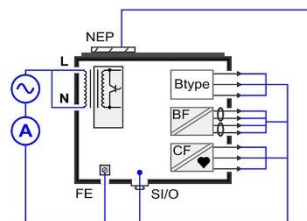
Test limits

Limit (CI I) (alternative)	Class I: [1000 μ A], Class II: [500 μ A]
Limit (CI II) (alternative)	
Limit (CI I) (direct, differential)	Class I: [500 μ A], Class II: [100 μ A]
Limit (CI II) (direct, differential)	

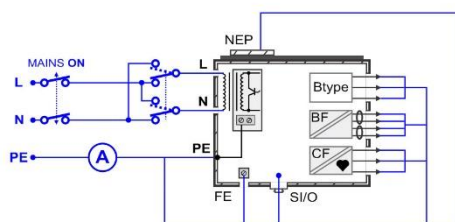
Test circuits



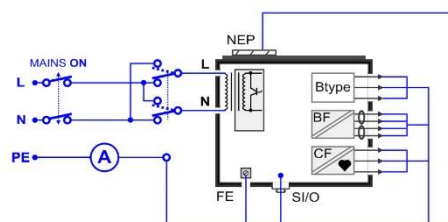
Alternative Class I



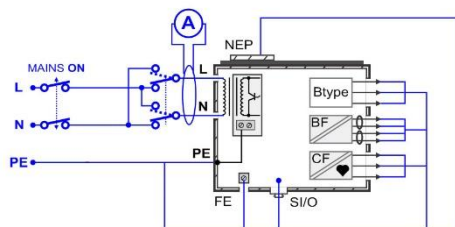
Alternative Class II



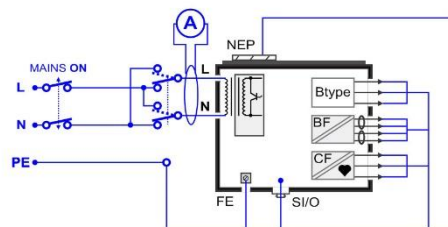
Direct Class I



Direct Class II



Differential Class I



Differential Class II

6.5.16 Applied Part Leakage (alternative, direct)

Test results / sub-results

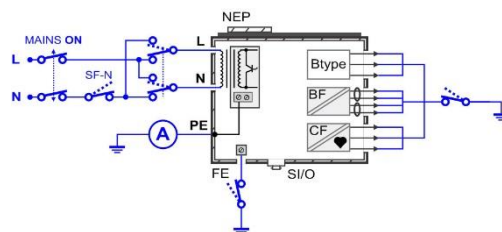
According to set Parameters and Connections.

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket. All: tests in normal and reversed position
Unom	The leakage current is calculated to Unom [100 V ... 240 V].
Test (AP => Vext)	[All, 1 ... 10]: AP or SF group included in the test. Number indicates first connection of set AP or SF. All: all tests will be carried out.

Condition	[All, NC, SFC-N] NC: normal condition SFC-N: single fault, N open All: all tests will be carried out.
APs	[All, Earthed, Off_conn] Earthed: APs will be earthed Off_conn: APs will be connected and left floating All: all tests will be carried out.
FE	[All, Earthed, Off] Earthed: FE will be earthed Off: FE will be open All: all tests will be carried out.
Umax (calc)	[Mains, Custom] Mains: result at actual mains voltage Custom: result is scaled to set Umax(calc)
Connections	Set configuration is considered.
Test limits	
Limit (NC)	[5 mA]
Limit (SFC)	[10 mA]

Test circuit



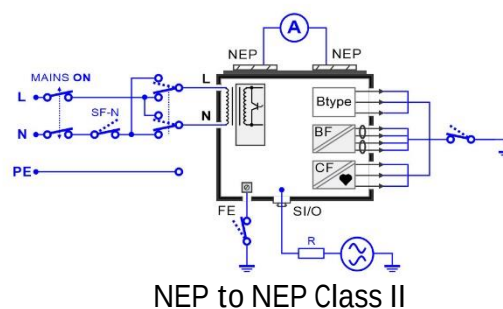
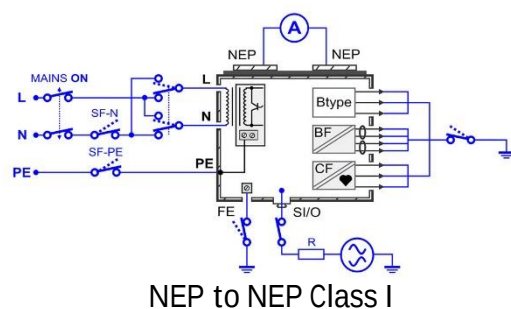
6.5.18 Touch Current, Touch Current (NEP to NEP)

Test results / sub-results

According to set Parameters and Connections.

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket.



Note

- According to IEC/EN 60601 in the SFC-PE condition the enclosure that is normally earthed become a NEP, and the touch current between enclosure and PE should be tested. This measurement will be carried out automatically if there is an EP connection defined and the ME enclosure is connected to the EP connection.

6.5.19 Patient Leakage (to earth), Total Patient Leakage (to earth)

Test results / sub-results

According to set Parameters and Connections.

Test parameters

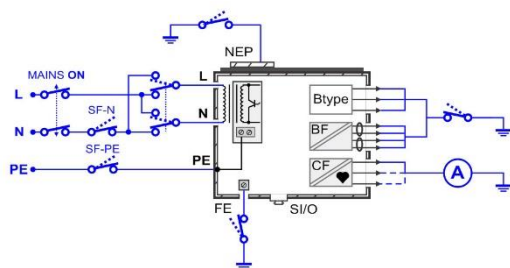
Duration	Duration: [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket All: all tests will be carried out.
Condition	[All, NC, SFC-N, SFC-PE] NC: normal condition SFC-N: single fault, N open SFC-PE: single fault, PE open All: all tests will be carried out.
APs	[All, Earthed, Off_conn] Earthed: APs will be earthed Off_conn: APs will be connected and left floating All: all tests will be carried out.
NEPs	[All, Earthed, Off] Earthed: NEPs will be earthed Off: NEPs will be open All: all tests will be carried out.

FE	[All, Earthed, Off] Earthed: FE will be earthed Off: FE will be open All: all tests will be carried out.
Result	[All, AC, DC, TRMS] AC: ac portion of the leakage current DC: dc portion of the leakage current TRMS: trms value of the leakage current All: all results will be shown.
Umax (calc)	[Mains, Custom] Mains: result is as measured Custom: result is scaled to set Umax(calc)
Test (AP =>PE)	[All, 1 ... 10]: AP or SF group included in the test. Number indicates first connection of set AP or SF. All: all tests will be carried out.
Connections	Set configuration is considered.

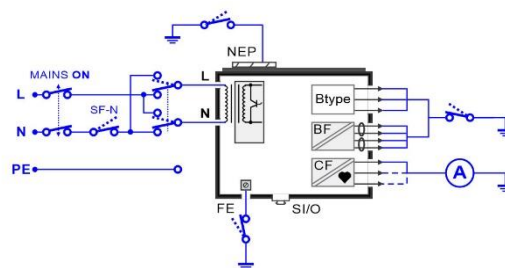
Test limits

			Total
Limit (NC)	B, ac	100 μ A	500 μ A
	B, dc	10 μ A	50 μ A
	BF, ac	100 μ A	500 μ A
	BF, dc	10 μ A	50 μ A
	CF, ac	10 μ A	50 μ A
	CF, dc	10 μ A	50 μ A
Limit (SFC)	B, ac	500 μ A	1000 μ A
	B, dc	50 μ A	100 μ A
	BF, ac	500 μ A	1000 μ A
	BF, dc	50 μ A	100 μ A
	CF, ac	50 μ A	100 μ A
	CF, dc	50 μ A	100 μ A

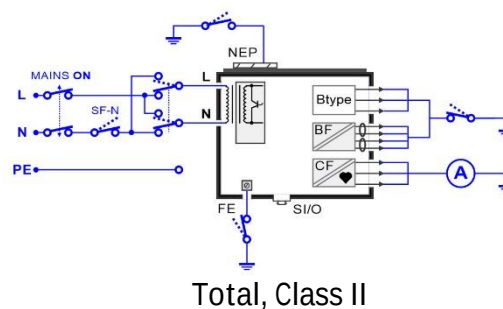
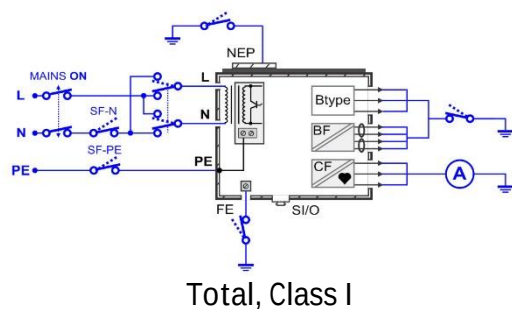
Test circuit



Class I



Class II



6.5.20 Patient Leakage (Vext on AP), Total Patient Leakage (Vext on AP)

Test results / sub-results

According to set Parameters and Connections.

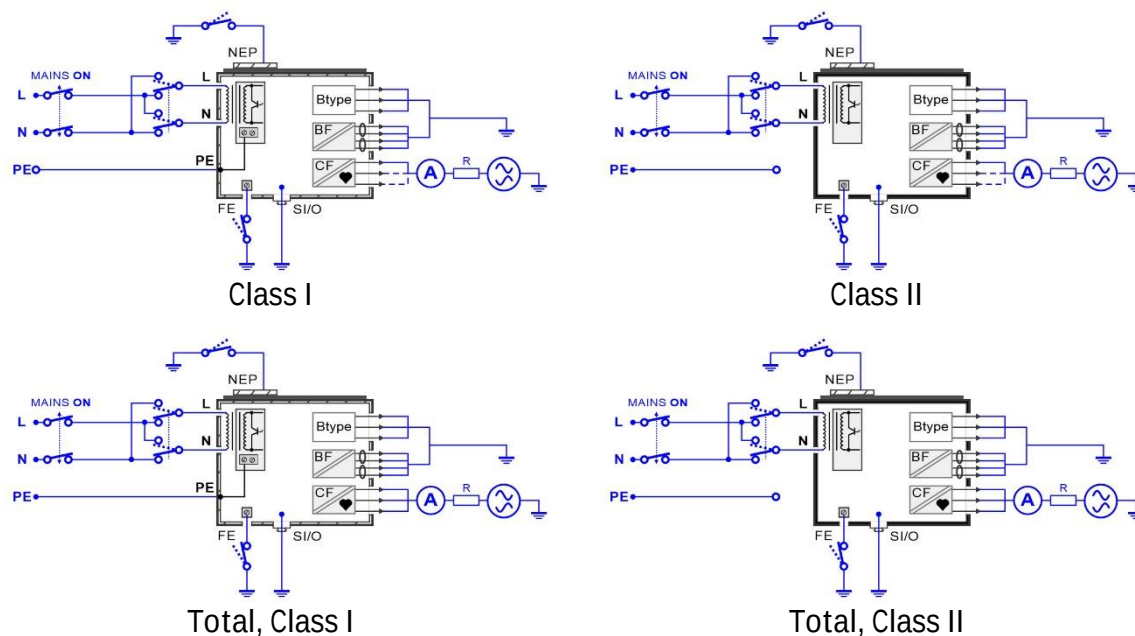
Test parameters

Duration	Duration: [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket All: all tests will be carried out.
Vext AP	[All, Normal, Reversed] Normal: Vext has same phase as mains voltage Reversed: Vext has opposite phase as mains voltage All: all tests will be carried out.
NEPs	[All, Earthed, Off] Earthed: NEPs will be earthed Off: NEPs will be open All: all tests will be carried out.
FE	[All, Earthed, Off] Earthed: FE will be earthed Off: FE will be open All: all tests will be carried out.
Umax (calc)	[Mains, Custom] Mains: result is as measured Custom: result is scaled to set Umax(calc)
Test (Vext =>AP)	[All, 1 ... 10]: AP or SF group included in the test. Number indicates first connection of set AP or SF. All: all tests will be carried out.
Connections	Set configuration is considered.

Test limits

		Total
Limit (BF)	5000 μ A	5000 μ A
Limit (CF)	50 μ A	100 μ A

Test circuit



6.5.21 Patient Leakage (Vext on SIO), Total Patient Leakage (Vext on SIO)

Test results / sub-results

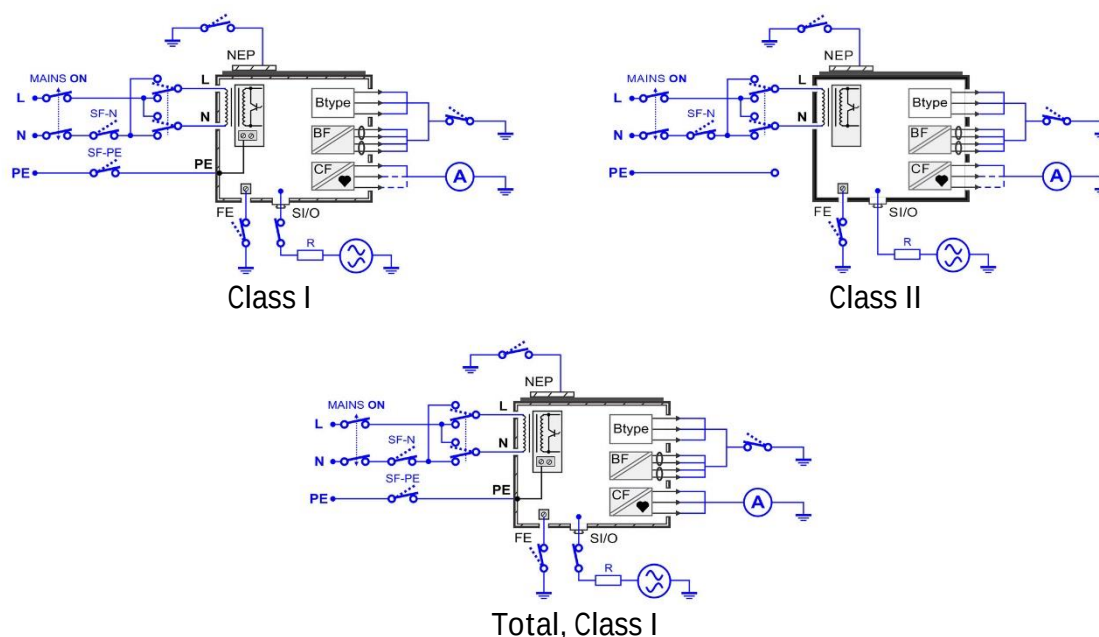
According to set Parameters and Connections.

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket. Reversed: phase voltage is applied to the left output of the mains test socket. All: all tests will be carried out.
Condition	[All, NC, SFC-N, SFC-PE] NC: normal condition SFC-N: single fault, N open SFC-PE: single fault, PE open All: all tests will be carried out.
Vext SIO	[All, Normal, Reversed]

	Normal: Vext has same phase as mains voltage. Reversed: Vext has opposite phase as mains voltage. All: all tests will be carried out.		
APs	[All, Earthed, Off_conn] Earthed: APs will be earthed. Off_conn: APs will be connected and left floating. All: all tests will be carried out.		
NEPs	[All, Earthed, Off] Earthed: NEPs will be earthed. Off: NEPs will be open. All: all tests will be carried out.		
FE	[All, Earthed, Off] Earthed: FE will be earthed. Off: FE will be open. All: all tests will be carried out.		
Umax (calc)	[Mains, Custom] Mains: result at actual mains voltage. Custom: result is scaled to set Umax(calc).		
Result	[All, AC, DC, TRMS] AC: ac portion of the leakage current. DC: dc portion of the leakage current. TRMS: trms value of the leakage current. All: all results will be shown.		
Test (AP=>PE)	[All,1 ... 10]: AP or SF group included in the test. Number indicates first connection of set AP or SF. All: all tests will be carried out.		
Connections	Set configuration is considered.		
Test limits			
			Total
Limit (NC)	B, ac	100 µA	500 µA
	B, dc	10 µA	50 µA
	BF, ac	100 µA	500 µA
	BF, dc	10 µA	50 µA
	CF, ac	10 µA	50 µA
	CF, dc	10 µA	50 µA
Limit (SFC)	B, ac	500 µA	1000 µA
	B, dc	50 µA	100 µA
	BF, ac	500 µA	1000 µA
	BF, dc	50 µA	100 µA
	CF, ac	50 µA	100 µA
	CF, dc	50 µA	100 µA

Test circuit



6.5.22 Patient Leakage (Vext on NEP), Total Patient Leakage (Vext on NEP)

Test results / sub-results

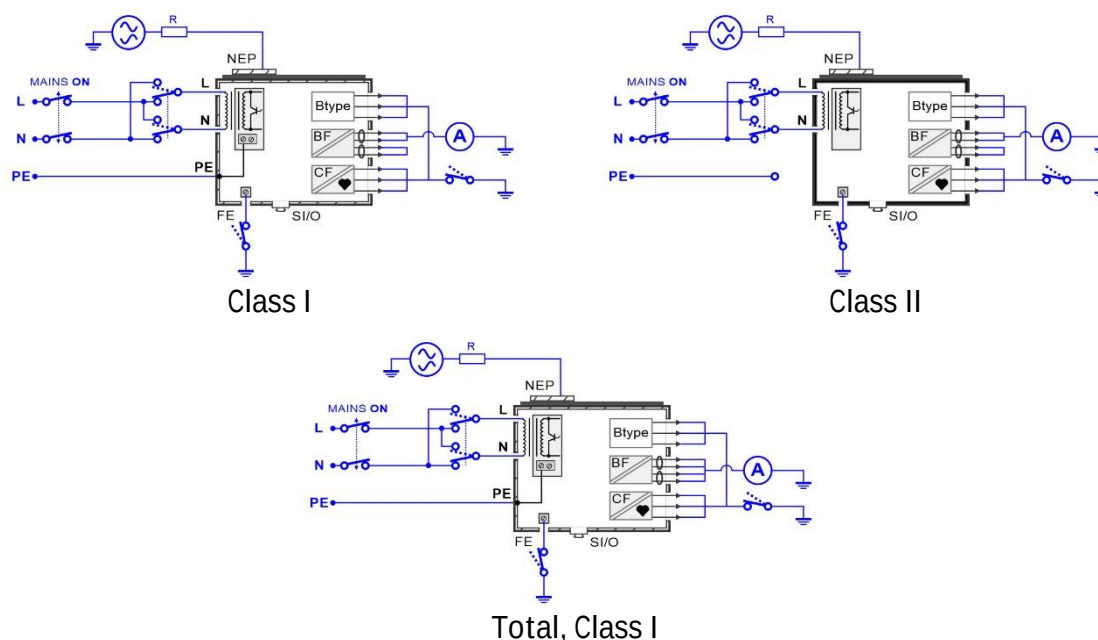
According to set Parameters and Connections.

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket All: all tests will be carried out.
Vext NEP	[All, Normal, Reversed] Normal: Vext has same phase as mains voltage Reversed: Vext has opposite phase as mains voltage All: all tests will be carried out.
APs	[All, Earthed, Off_conn] Earthed: APs will be earthed Off_conn: APs will be connected and left floating All: all tests will be carried out.
FE	[All, Earthed, Off] Earthed: FE will be earthed Off: FE will be open All: all tests will be carried out.

Umax (calc)	[Mains, Custom] Mains: result at actual mains voltage Custom: result is scaled to set Umax(calc)
Test (AP=>PE)	[All,1 ... 10]: AP or SF group included in the test. Number indicates first connection of set AP or SF. All: all tests will be carried out
Connections	Set configuration is considered.
Test limits	
	Total
Limit (B)	500 μ A 1000 μ A
Limit (BF)	500 μ A 1000 μ A

Test circuit



6.5.23 Patient Auxiliary Current

Test results / sub-results

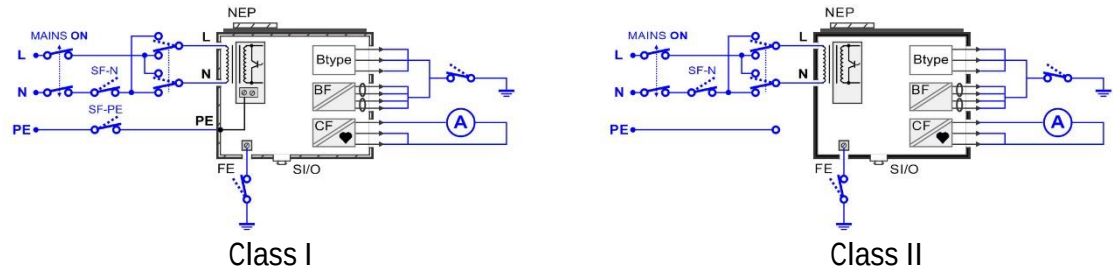
According to set Parameters and Connections.

Test parameters

Duration	Duration [Off, 2 s ... 180 s]
V mains	[All, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket

Reversed: phase voltage is applied to the left output of the mains test socket All: all tests will be carried out.		
Condition	[All, NC, SFC-N, SFC-PE] NC: normal condition SFC-N: single fault, N open SFC-PE: single fault, PE open All: all tests will be carried out.	
FE	[All, Earthed, Off] Earthed: FE will be earthed Off: FE will be open All: all tests will be carried out.	
Umax (calc)	[Mains, Custom] Mains: result at actual mains voltage Custom: result is scaled to set Umax(calc)	
Test (1=>other)	[All, 1 ... 10]: NEP included in the test. Number: test selected lead to all other leads of applied part All: all tests will be carried out.	
Connections	Set configuration is considered.	
Test limits		
Limit (NC)	B, ac	100 μA
	B, dc	10 μA
	BF, ac	100 μA
	BF, dc	10 μA
	CF, ac	10 μA
	CF, dc	10 μA
Limit (SFC)	B, ac	500 μA
	B, dc	50 μA
	BF, ac	500 μA
	BF, dc	50 μA
	CF, ac	50 μA
	CF, dc	50 μA

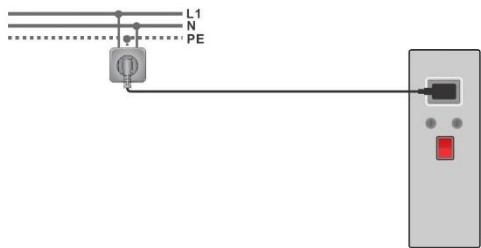
Test circuit



6.5.24 Mains Voltage

Test results / sub-results	
Uln	Mains voltage
Freq	Mains frequency
Test parameters	
Duration	Duration [Off, 2 s ... 180 s]

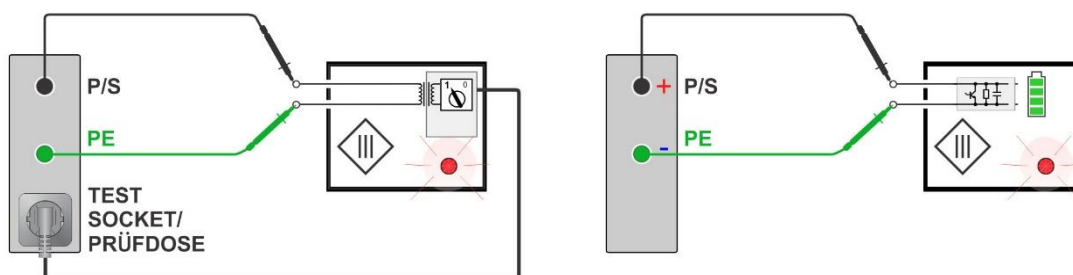
Test circuit



6.5.25 Voltage P-P

Test results / sub-results	
U trms	TRMS voltage
Uac	a.c. voltage
Udc	d.c. voltage
Freq	Mains frequency
Test parameters	
V mains	[Off, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket

	Reversed: phase voltage is applied to the left output of the mains test socket. Off: no voltage on mains test socket
Condition	[NC, SFC-N, SFC-PE] NC: normal condition SFC-N: single fault, N open SFC-PE: single fault, PE open
Duration	Duration [Off, 2 s ... 180 s]



Note

- Voltmeter is floating against PE.

6.5.26 Touch Voltage

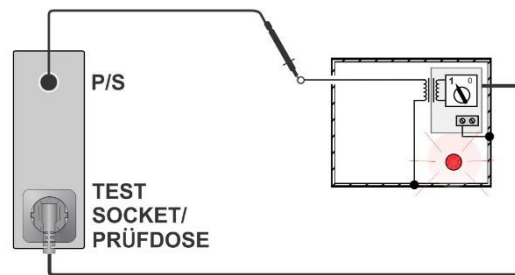
Test results / sub-results

U trms	TRMS voltage
Uac	a.c. voltage
Udc	d.c.voltage
Freq	Mains frequency

Test parameters

V mains	[Off, Normal, Reversed] Normal: phase voltage is applied to the right output of the mains test socket Reversed: phase voltage is applied to the left output of the mains test socket. Off: no voltage on mains test socket
Condition	[NC, SFC-N, SFC-PE] NC: normal condition SFC-N: single fault, N open SFC-PE: single fault, PE open
Duration	Duration [Off, 2 s ... 180 s]

Test circuit



Note

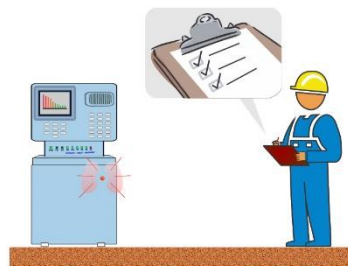
- Voltmeter is earthed in all Condition states.

6.5.27 Functional test

Test results / sub-results

Pass, Fail, Checked

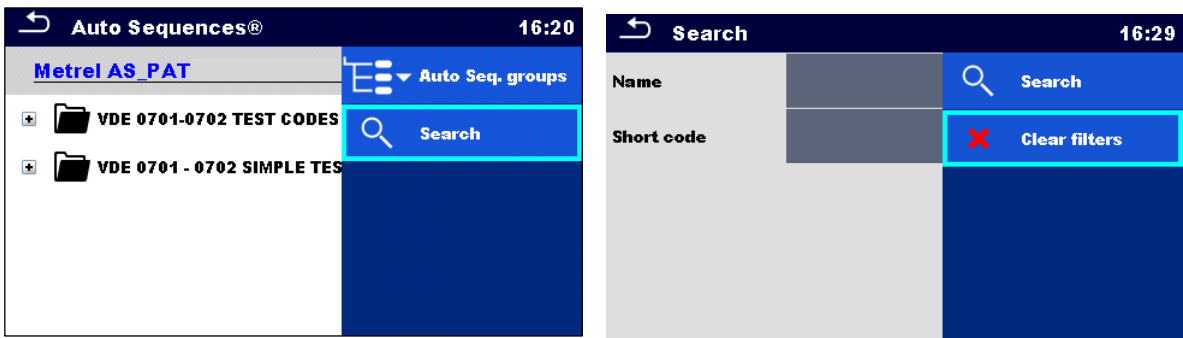
Test circuit



7 Auto Sequences®

Auto Sequences® are pre-programmed sequences of measurements. The Auto Sequences can be pre-programmed on PC with the Metrel Medical ES Manager software and uploaded to the instrument. On the instrument parameters and limits of individual single test in the Auto Sequence can be changed / set.

7.1 Selection and searching of Auto Sequences

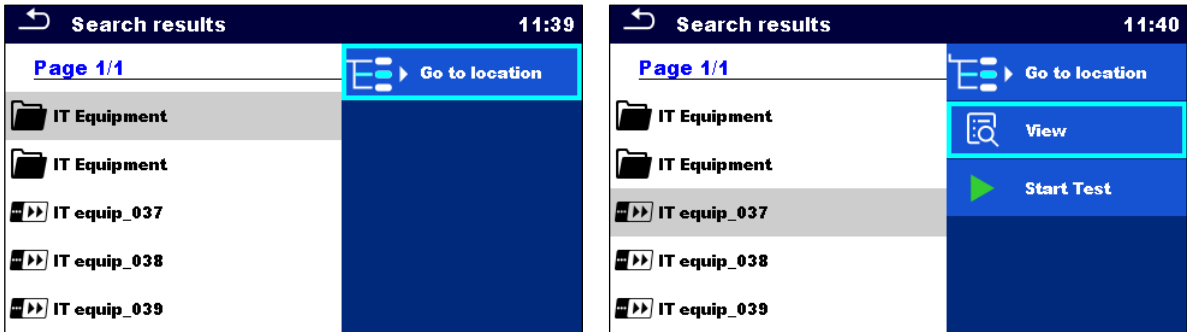


Selecting an Auto Sequence list in Auto Sequence groups menu

Go to Auto Sequence® groups menu	Header line (Auto Sequence list), Auto Seq. groups
----------------------------------	--

Searching of Auto Sequences

Search for Auto Sequence	Header line (Auto Sequence list), Search, set filters (Name or Short code)
Clear filters	Clear filters



Operations on found Auto Sequences

Page x/y, Next Page, Previous Page	To jump Page Up/Down
Go to location	Go to location in Auto Sequences® menu

Start Test	Start Auto Sequence
View	View Auto Sequence

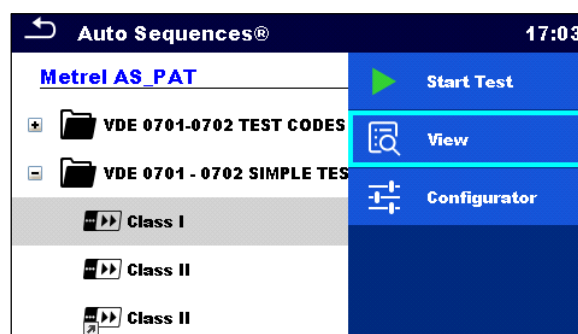
7.1.1 Organization of Auto Sequences® in Auto Sequences® menu

The Auto Sequence® menu can be organized in a structural manner with folders, sub-folders and Auto Sequences. Auto Sequence in the structure can be the original Auto Sequence or a shortcut to the original Auto Sequence.

Originals and shortcuts

Auto Sequences marked as shortcuts and the original Auto Sequences are coupled. Changing of parameters or limits in any of the coupled Auto Sequences will influence on the original Auto Sequence and all its shortcuts.

 Class II	The original Auto Sequence®.
 Class II	A shortcut to the original Auto Sequence®.



Start Test	Start of Auto Sequence
View	Detailed view of Auto Sequence
Configurator	Enter Auto Sequence Configurator, see Auto Sequence® Configurator

7.2 Auto Sequence

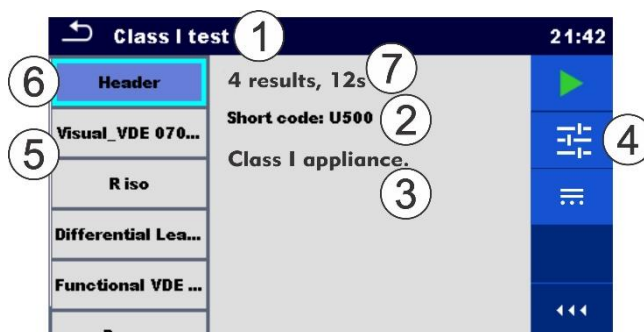
Carrying out Auto Sequences step by step

Before starting, the Auto Sequence view menu is shown, (unless it was started directly from the Main Auto Sequences® menu). Before the test, parameters and limits of individual measurements can be edited.

During the execution phase of an Auto Sequence, pre-programmed single tests are carried out. The sequence of single tests is controlled by pre-programmed flow commands.

After the test sequence is finished the Auto Sequence result menu is shown. Details of individual tests can be viewed and the results can be saved to Memory organizer.

7.2.1 Auto Sequence® view menu



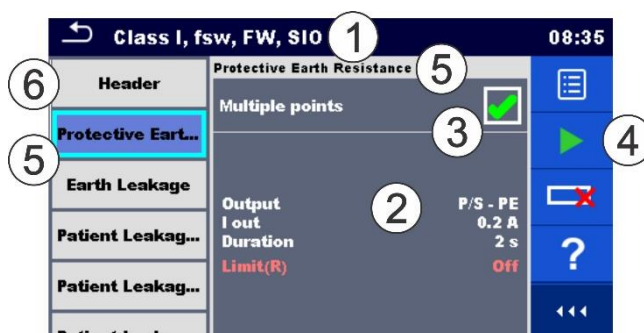
Header is selected

1	Auto Sequence name
2	Short code
3	Description
4	Options
5	Single tests
6	Header
7	Estimated test results, estimated test duration

Start Test Start of Auto Sequence

Configurator Enter Auto Sequence configurator, see [Auto Sequence® Configurator](#).

Connections Enter Connections main menu, see [Configuring the instrument connections and parameters for the test](#).



Single test is selected

1	Auto Sequence name
2	Parameters / limits of selected single test
3	Multiple points selected
4	Options
5	Single tests
6	Header
Parameters	View/edit parameters
Start Test	Start of Auto Sequence®
Exclude / Include step	Exclude / Include individual single test from the Auto Sequence, see Including/ excluding single tests.
Help	View help screens

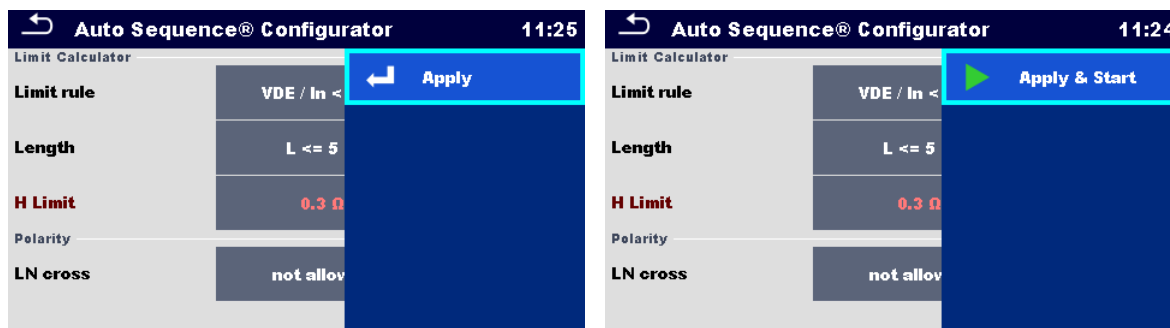
Enable multiple points testing: set Multiple points, see [Managing multiple points.](#)

7.2.2 Auto Sequence® Configurator

The Configurator options is offered only when single tests within selected Auto Sequence have configurable limits / parameters that are likely to be changed. For example, if testing prolongation cables the length need to be set for each individual cable.

The settings can be changed before the Auto Sequence is executed. New settings will be considered for the actual Auto Sequence only.

See [Single test measurements](#) for details of parameters and limits.



Apply & Start

Start Auto Sequence from Configurator menu

Apply	Confirm limits and parameters settings and return to view menu
-------	--

7.2.3 Including/ excluding single tests

The Auto Sequence can contain too many or inadequate tests. It is possible to exclude individual single tests from the Autosequence.

	Exclude selected single test from the Auto Sequence
	Include excluded single test back in the Auto Sequence
	Excluded single tests are marked.

The set exclusions are valid only for the actual test.

Note

- Flow commands within excluded steps will not be executed.

7.2.4 Indication of Loops

R iso x3

The attached 'x3' at the end of single test name indicates that a loop of single tests is programmed. This means that the marked single test will be carried out as many times as the number behind the 'x' indicates. It is possible to exit the loop before, at the end of each individual measurement.

7.2.5 Managing multiple points

Multiple points



If the device under test has more than one test point for an individual single test and the selected Auto Sequence predicts only one test point (one single test) it is possible to change the Auto Sequence appropriately. Single tests with enabled Multiple points ticker will be

executed in a continuous loop. It is possible to exit the loop anytime at the end of each individual measurement.

The Multiple points setting is valid only for the actual Auto Sequence. If the user often tests appliances with more than one test points it is recommended to program a special Auto Sequence with pre-programmed loops.

Hint

Enable multiple points is typically used:

- if testing earthing connections and the DUT has more than one earthed conductive parts.
- if testing touch leakage and the DUT has more than one non-earthed conductive parts.

The multiple points feature is not available in medical leakage tests. In medical leakage tests, all relevant test points are already covered inside one the single test.

7.2.6 Step by step execution of Auto Sequences

While the Auto Sequence is running, it is controlled by pre-programmed flow commands.

Examples of actions controlled by flow commands

Pauses during the Auto Sequence (texts, warnings, pictures)

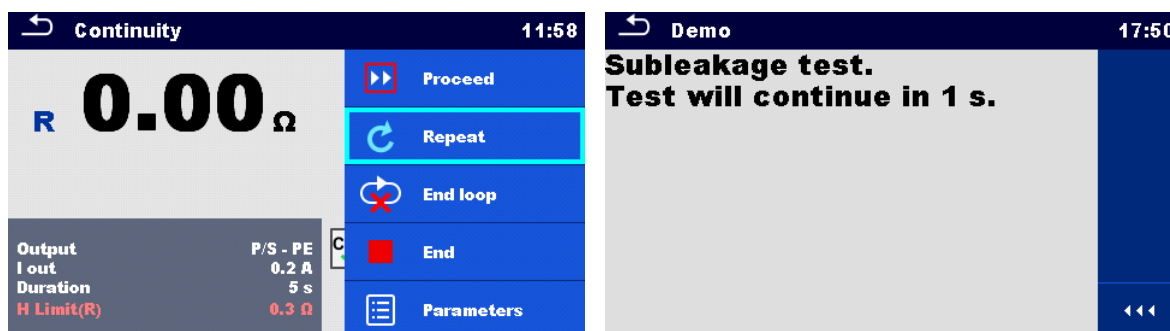
Buzzer Pass / Fail sound after the tests

Pre-set data off appliances

Expert mode for Inspections

Skip non-safety notifications

For the actual list and description of flow commands see [Metrel Medical ES Manager software help file](#).



The offered options in the control panel depend on the selected single test, its result and the programmed test flow.

Proceed	Proceeds to the next step in the test sequence.
Repeat	Repeat the measurement.
End loop	Exit the loop of single tests and proceeds to the next step.
End	End the Auto Sequence® and go to result screen.
Parameters	View parameters/limits of single test.
Comment	Add comment

Auto Sequence test metadata

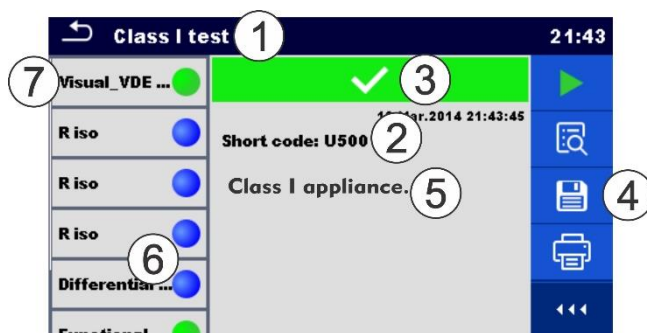
 	Estimated test duration, estimated remained time (h – hours, m – minutes, s – seconds)
 72	Number of all test results, as set in the current single test
 68	Number of finished and not failed test results
 4	Number of failed test results
 0	Number of empty test results (test results of single tests waiting to be conducted or if they were skipped)

Note

- Test metadata are shown in medical tests only.

7.2.7 Auto Sequence result screen

After the Auto Sequence is finished the result screen is displayed. At the left side of the display the single tests and their statuses in the Auto Sequence are shown. In the middle of the display the header of the Auto Sequence with Short code and description of the Auto Sequence is displayed. At the top the overall Auto Sequence result status is displayed. For more information see [Measurement statuses](#).



1	Auto Sequence name
2	Short code
3	Overall status
4	Options
5	Description
6	Status of single test
7	Single tests



Start Test	Start a new Auto Sequence
View	View results of individual measurements.
Connections	Enter Connections main menu to view connection settings
Comment	Add comment to Auto Sequence
Print label Print & Save Write RFID Write & Save	Print / write RFID (if printing / writing device is set) For details, see Printing labels / writing RFID/NFC tags
Tap on Single test	Viewing details of individual single tests, add comment on individual single test
Save results	Save the Auto Sequence results
A new Auto Sequence was selected and started from a	The Auto Sequence result will be saved under the selected Structure object

Structure object in the structure tree	
A new Auto Sequence was started from the Auto Sequence main menu	Saving under the last selected Structure object will be offered by default. The user can select another Structure object or create a new Structure object. By pressing Save in Memory organizer menu the Auto Sequence result is saved under selected location.
An empty measurement was selected in structure tree and started	The result(s) will be added to the Auto Sequence. The Auto Sequence will change its overall status from 'empty' to 'finished'.
An already carried out Auto Sequence was selected in structure tree, viewed and then restarted	A new Auto Sequence result will be saved under the selected Structure object.

7.2.8 Printing labels / writing RFID/NFC tags

Note

- Offered options depend on Devices settings menu. If no writing device is set, then 'Print label' and 'Write RFID' options are hidden.

	Print label.
	Print label and Save Auto Sequence results simultaneously. Option is available if Devices parameter Auto save is set to On print, see Devices .
	Write RFID / NFC tag. All data including Auto Sequence results are written to the RFID/NFC writing device. For information about supported tag types refer to Appendix B - Print labels and write / read RFID / NFC tags .
	Write RFID / NFC tag and Save Auto Sequence results simultaneously. Option is available if Devices parameter Auto save is set to On write, see Devices .

8 Maintenance

8.1 Periodic calibration

It is essential that all measuring instruments are regularly calibrated in order for the technical specification listed in this manual to be guaranteed. We recommend an annual calibration.

8.2 Fuses

There are two fuses on the left side panel: F1, F2: T 16 A / 250 V / (32 × 6.3) mm / 1500 A: intended for instrument protection. For position of fuses see [Front panel](#).

WARNING

- Switch off the instrument and disconnect all test accessories and mains cord before replacing the fuses.
- Replace blown fuses with the same type as defined in this document.

8.3 Service

For repairs under or out of warranty please contact your distributor for further information. Unauthorized person is not allowed to open the instrument. There are no user replaceable parts inside the instrument.

8.4 Cleaning

Use a soft, slightly moistened cloth with soap water or alcohol to clean the surface of the instrument. Leave the instrument to dry totally before using it.

WARNING

- Do not use liquids based on petrol or hydrocarbons!
- Do not spill cleaning liquid over the instrument!

9 Communications

The instrument can communicate with the Metrel Medical ES Manager PC software. There are four communication interfaces available on the instrument: RS-232, USB, Ethernet and Bluetooth. Instrument can also communicate to various external devices (Android devices, scanners, printers, ...).

9.1 USB and RS232 communication with PC

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

How to establish an USB or RS-232 link:

- RS-232 communication: connect a PC COM port to the instrument PC / PRINTER connector using the RS232 serial communication cable.
- USB communication: connect a PC USB port to the instrument USB connector using the USB interface cable.
- Switch on the PC and the instrument.
- Run the Metrel Medical ES Manager software.
- Select communication port (COM port for USB communication is identified as "Measurement Instrument USB VCom Port").
- The instrument is prepared to communicate with the PC.

9.2 Bluetooth communication with printers and scanners

The instrument can communicate with supported Bluetooth printers and scanners. Contact Metrel or your distributor which external devices and functionalities are supported. See [Devices](#) for details how to set the external Bluetooth device.

9.3 Ethernet communication

The instrument is also capable of communicating through an Ethernet port. The Ethernet communication must be fully configured in the setting menu before first use. See [Settings](#) for details. Metrel Medical ES Manager is currently not supporting Ethernet communication. Contact Metrel or your distributor regarding options for using the Ethernet communication.

9.4 RS-232 communication with other external devices

It is possible to communicate with serial scanners and RFID / NFC reader / writer device via the BARCODE serial port and with serial printers via the PC / PRINTER serial port. Contact Metrel or your distributor which external devices and functionalities are supported. See [Devices](#) for details how to set the external device.

10 Technical specifications

10.1 Continuity // Protective earth resistance

Continuity

	Range	Resolution	Accuracy
R	0.00 Ω ... 19.99 Ω	0.01 Ω	$\pm(2\% \text{ of reading} + 2 \text{ D})$
	20.0 Ω ... 99.9 Ω	0.1 Ω	$\pm 3\% \text{ of reading}$
	100.0 Ω ... 199.9 Ω	0.1 Ω	$\pm 5\% \text{ of reading}$
	200 Ω ... 999 Ω	1 Ω	indicative

Operating range (acc. to EN 61557-4)..... 0.08 Ω ... 199.9 Ω

Test currents 0.2 A, 25 A

Current source (at nominal mains voltage,

use of standard accessories) > 0.2 A at $R < 2 \Omega$

> 25 A into short circuit at 230 V

Open circuit voltage..... < 6 V a.c.

10.2 Insulation Resistance (Riso, Riso-S)

Insulation resistance, Insulation resistance -S (250 V, 500 V)

	Range	Resolution	Accuracy
Riso Riso-S	0.00 M Ω ... 19.99 M Ω	0.01 M Ω	$\pm(3\% \text{ of reading} + 2 \text{ D})$
	20.0 M Ω ... 99.9 M Ω	0.1 M Ω	$\pm 5\% \text{ of reading}$
	100.0 M Ω ... 199.9 M Ω	0.1 M Ω	$\pm 10\% \text{ of reading}$

Output voltage

	Range	Resolution	Accuracy
Um	0 V ... 600 V	1 V	$\pm(3\% \text{ of reading} + 2 \text{ D})$

Operating range (acc. to EN 61557-2)..... 0.08 M Ω ... 199.9 M Ω

Nominal voltages Un 250 V, 500 V (- 0 %, + 10 %)

Short circuit current..... max. 2.0 mA

10.3 Sub-Leakage Current, Substitute Leakage Current - S

Substitute leakage current, Substitute leakage current - S

	Range	Resolution	Accuracy
I _{sub}	0.00 mA ... 1.99 mA	0.01 mA	±(3 % of reading + 3 D)
I _{sub-S}	2.00 mA ... 19.99 mA	0.01 mA	±5 % of reading

Operating range (acc. to EN 61557-16) 0.02 mA ... 19.99 mA

Open circuit voltage..... 230 V a.c., 110 V a.c.

Current calculated to mains supply voltage (110 V or 230 V) is displayed.

10.4 Differential Leakage current

Differential leakage current

	Range	Resolution	Accuracy
I _{diff}	0.000 mA ... 1.999 mA	1 µA	±(3 % of reading + 3 D)
	2.00 mA ... 19.99 mA	0.01 mA	±5 % of reading

Power (active)

	Range	Resolution	Accuracy
P	0.00 W ... 19.99 W	0.01 W	±(5 % of reading + 5 D)
	20.0 W ... 199.9 W	0.1 W	±5 % of reading
	200 W ... 1999 W	1 W	
	2.00 kW ... 3.70 kW	10 W	

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

Influence of load current < 0.02 mA/A

10.5 PE leakage current

PE leakage current

	Range	Resolution	Accuracy
I _{pe}	0.000 mA ... 1.999 mA	1 µA	±(3 % of reading + 3 D)
	2.00 mA ... 19.99 mA	0.01 mA	±5 % of reading

Power (active)

	Range	Resolution	Accuracy
P	0.00 W ... 19.99 W	0.01 W	$\pm(5 \% \text{ of reading} + 5 \text{ D})$
	20.0 W ... 199.9 W	0.1 W	$\pm 5 \% \text{ of reading}$
	200 W ... 1999 W	1 W	
	2.00 kW ... 3.70 kW	10 W	

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.6 Touch leakage current

Touch leakage current

	Range	Resolution	Accuracy
Itou	0.000 mA ... 1.999 mA	1 μA	$\pm(3 \% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5 \% \text{ of reading}$

Power (active)

	Range	Resolution	Accuracy
P	0.00 W ... 19.99 W	0.01 W	$\pm(5 \% \text{ of reading} + 5 \text{ D})$
	20.0 W ... 199.9 W	0.1 W	$\pm 5 \% \text{ of reading}$
	200 W ... 1999 W	1 W	
	2.00 kW ... 3.70 kW	10 W	

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.7 Power

Power (active)

	Range	Resolution	Accuracy
P	0.00 W ... 19.99 W	0.01 W	$\pm(5 \% \text{ of reading} + 5 \text{ D})$
	20.0 W ... 199.9 W	0.1 W	$\pm 5 \% \text{ of reading}$
	200 W ... 1999 W	1 W	
	2.00 kW ... 3.70 kW	10 W	

Power (apparent)

	Range	Resolution	Accuracy
S	0.00 VA ... 19.99 VA	0.01 VA	±(5 % of reading + 5 D)
	20.0 VA ... 199.9 VA	0.1 VA	±5 % of reading
	200 VA ... 1999 VA	1 VA	
	2.00 kVA ... 3.70 kVA	10 VA	

Power (reactive)

	Range	Resolution	Accuracy
Q	±(0.00 var ... 19.99 var)	0.01 var	±(5 % of reading + 5 D)
	±(20.0 var ... 199.9 var)	0.1 var	±5 % of reading
	±(200 var ... 1999 var)	1 var	
	±(2.00 kvar ... 3.70 kvar)	10 var	

Power factor

	Range	Resolution	Accuracy
PF	0.00i ... 1.00i 0.00c ... 1.00c	0.01	±(5 % of reading + 5 D)

Total Harmonic Distortion (voltage)

	Range	Resolution	Accuracy
THDU	0.0 % ... 99.9 %	0.1 %	±(5 % of reading + 5 D)

Total Harmonic Distortion (current)

	Range	Resolution	Accuracy
THDI	0 mA ... 999 mA	1 mA	±(5 % of reading + 5 D)
	1.00 A ... 16.00 A	10 mA	±5 % of reading

Cosine Φ

	Range	Resolution	Accuracy
Cos Φ	0.00i ... 1.00i 0.00c ... 1.00c	0.01	±(5 % of reading + 5 D)

Current

	Range	Resolution	Accuracy
I	0 mA ... 999 mA	1 mA	±(3 % of reading + 5 D)
	1.00 A ... 16.00 A	10 mA	±3 % of reading

Voltage

	Range	Resolution	Accuracy
U	0.0 V ... 199.9 V	0.1 V	±(3 % of reading + 10 D)
	200 V ... 264 V	1 V	±3 % of reading

Accuracy is valid within $0.5c \leq PF \leq 0.8i$

10.8 Leak's & Power

Power (active)

	Range	Resolution	Accuracy
P	0.00 W ... 19.99 W	0.01 W	±(5 % of reading + 5 D)
	20.0 W ... 199.9 W	0.1 W	±5 % of reading
	200 W ... 1999 W	1 W	
	2.00 kW ... 3.70 kW	10 W	

Touch leakage current

	Range	Resolution	Accuracy
Itou	0.000 mA ... 1.999 mA	1 µA	±(3 % of reading + 3 D)
	2.00 mA ... 19.99 mA	0.01 mA	±5 % of reading

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

Differential leakage current

	Range	Resolution	Accuracy
Idiff	0.000 mA ... 1.999 mA	1 µA	±(3 % of reading + 3 D)
	2.00 mA ... 19.99 mA	0.01 mA	±5 % of reading

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

Influence of load current < 0.02 mA/A

Power (apparent)

	Range	Resolution	Accuracy
S	0.00 VA ... 19.99 VA	0.01 VA	±(5 % of reading + 5 D)
	20.0 VA ... 199.9 VA	0.1 VA	±5 % of reading
	200 VA ... 1999 VA	1 VA	
	2.00 kVA ... 3.70 kVA	10 VA	

Power (reactive)

	Range	Resolution	Accuracy
Q	±(0.00 var ... 19.99 var)	0.01 var	±(5 % of reading + 5 D)
	±(20.0 var ... 199.9 var)	0.1 var	±5 % of reading
	±(200 var ... 1999 var)	1 var	
	±(2.00 kvar ... 3.70 kvar)	10 var	

Power factor

	Range	Resolution	Accuracy
PF	0.00i ... 1.00i 0.00c ... 1.00c	0.01	±(5 % of reading + 5 D)

Total Harmonic Distortion (voltage)

	Range	Resolution	Accuracy
THDU	0.0 % ... 99.9 %	0.1 %	±(5 % of reading + 5 D)

Total Harmonic Distortion (current)

	Range	Resolution	Accuracy
THDI	0 mA ... 999 mA	1 mA	±(5 % of reading + 5 D)
	1.00 A ... 16.00 A	10 mA	±5 % of reading

Cosine Φ

	Range	Resolution	Accuracy
Cos Φ	0.00i ... 1.00i 0.00c ... 1.00c	0.01	±(5 % of reading + 5 D)

Current

	Range	Resolution	Accuracy
I	0 mA ... 999 mA	1 mA	±(3 % of reading + 5 D)
	1.00 A ... 16.00 A	10 mA	±3 % of reading

Voltage

	Range	Resolution	Accuracy
U	0.0 V ... 199.9 V	0.1 V	±(3 % of reading + 10 D)
	200 V ... 264 V	1 V	±3 % of reading

10.9 Polarity

Test voltage (normal) 50 V
 Results Pass, PE open, L open, N open, LN cross,
 LN short, LPE short, NPE short,
 LPE FAULT, NPE FAULT, Multiple fault

10.10 Clamp current

True RMS current (using 1000:1 current clamp)

	Range	Resolution	Accuracy
I Idiff Ipe	0.10 mA ... 9.99 mA	0.01 mA	±(5 % of reading + 10 D)
	10.0 mA ... 99.9 mA	0.1 mA	±(5 % of reading + 5 D)
	100 mA ... 999 mA	1 mA	±(5 % of reading + 5 D)
	1.00 A ... 9.99 A	0.01 A	±(5 % of reading + 5 D)
	10.0 A ... 24.9 A	0.1 A	±(5 % of reading + 5 D)

Accuracy of current transformer is not considered.
 Frequency range of current clamp is not considered.

10.11 Insulation Resistance Riso LN-PE, LN-NEP, LN-AP, AP-PE, AP-NEP

Riso

	Range	Resolution	Accuracy
R	0.00 MΩ ... 19.99 MΩ	0.01 MΩ	±(3 % of reading + 2 D)
	20.0 MΩ ... 199.9 MΩ	0.1 MΩ	±5 % of reading

Output voltage

	Range	Resolution	Accuracy
Um	0 V ... 600 V	1 V	±(3 % of reading + 2 D)

Operating range (acc. to EN 61557-2) 0.08 MΩ ... 199.9 MΩ
 Nominal voltage Un 250 V (Riso LN-PE), 500 V (all)
 Tolerance of nominal voltage Un (- 0 %, + 10 %)
 Short circuit current max. 2.0 mA

10.12 Equipment leakage (alternative, direct, differential)

Equipment leakage current (direct, differential, alternative)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range direct and differential method

(acc. to EN 61557-16) 0.010 mA ... 19.99 mA

Operating range alternative method

(acc. to EN 61557-16) 0.020 mA ... 19.99 mA

Influence of load current (differential method) < 0.02 mA/A

10.13 Applied Part leakage (alternative, direct)

Applied Part leakage current (direct, alternative)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range direct method

(acc. to EN 61557-16) 0.010 mA ... 19.99 mA

Operating range alternative method

(acc. to EN 61557-16) 0.020 mA ... 19.99 mA

10.14 Touch current, Touch current (NEP to NEP)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.15 Patient leakage (Vext on SIO), Total patient leakage (Vext on SIO)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.16 Patient leakage (Vext on NEP), Total patient leakage (Vext on NEP)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.17 Patient leakage (Vext on AP), Total patient leakage (Vext on AP)

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.18 Patient leakage, Total patient leakage

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.19 Patient auxiliary current

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.20 Earth leakage

	Range	Resolution	Accuracy
I	0.000 mA ... 1.999 mA	1 μ A	$\pm(3\% \text{ of reading} + 3 \text{ D})$
	2.00 mA ... 19.99 mA	0.01 mA	$\pm 5\% \text{ of reading}$

Operating range (acc. to EN 61557-16) 0.010 mA ... 19.99 mA

10.21 Mains Voltage

Voltage

	Range	Resolution	Accuracy
UIn	96.9 V ... 123.6 V	0.1 V	$\pm(2\% \text{ of reading} + 2 \text{ D})$
	201 V ... 260 V	1 V	

Frequency

	Range	Resolution	Accuracy
Freq	45.0 Hz ... 65.0 Hz	0.1 Hz	$\pm(0.2\% \text{ of reading} + 1 \text{ D})$

10.22 Voltage P-P, Touch Voltage

Voltage (U trms, Uac)

	Range	Resolution	Accuracy
U trms Uac	0.0 V ... 199.9 V	0.1 V	$\pm(2\% \text{ of reading} + 10 \text{ D})$
	200 V ... 264 V	1 V	$\pm 2\% \text{ of reading}$

Voltage (Udc)

	Range	Resolution	Accuracy
Udc	$\pm(0.0 \text{ V} \dots 199.9 \text{ V})$	0.1 V	$\pm(2\% \text{ of reading} + 10 \text{ D})$
	$\pm(200 \text{ V} \dots 264 \text{ V})$	1 V	$\pm 2\% \text{ of reading}$

Frequency

	Range	Resolution	Accuracy
Freq	0 Hz (DC)		Indicative
	15.0 Hz ... 499.9 Hz	0.1 Hz	$\pm(0.2\% \text{ of reading} + 1 \text{ D})$

Result type.....	True r.m.s. (TRMS), AC, DC
Input resistance (Point to Point)	input P/S 200 k Ω to earth, input PE 200 k Ω to earth
Input resistance (Touch).....	input P/S 200 k Ω to earth
Nominal frequency range	0 Hz (DC), 15 Hz ... 500 Hz
Bandwidth.....	1 kHz

10.23 General data

Mains supply

Supply voltage, frequency	115 V / 230 V AC, 50 Hz / 60 Hz
Supply voltage tolerance	± 10 %
Max. power consumption	300 VA (without load on test socket)
Max. load.....	10 A continuous, 16 A short duration, 1.5 kW motor
Mains supply overvoltage category.....	CAT II / 300V
Altitude	≤ 2000 m

Measuring categories

Instrument:	Cat II / 300 V
Test socket:	Cat II / 300 V
Plug test cable:.....	Cat II / 300 V

Leakage current measurements

Measuring device (MD)	comply to EN 60601 and EN 61557-16 requirements
Sub-leakage, Vext voltage source current capability	ca 3 mA (< 3.5 mA) @ 50 V
Measurement type	AC, DC or True RMS, as per EN 60601 and EN 61557-16 requirements

Protection classifications

Power supply	Class I
Pollution degree	2
Degree of protection.....	IP 40 IP 20 (mains test socket)
Case	Shock proof plastic / portable

Display

Display	Colour TFT display, 4.3 inch, 480 x 272 pixels
Touch screen	Capacitive

Communication

Memory depends on microSD card size
RS232 interfaces 3
USB 2.0 Standard USB Type B
Bluetooth Class 2
Ethernet Dynamic IP (DHCP)

EMC

Emission Class B (Group 1)
Immunity Industrial environment

Reference conditions

Reference temperature range: 15 °C ... 35 °C
Reference humidity range: 35 % ... 65 % RH

Operation conditions

Operation Outdoor use
Working temperature range: 0 °C ... +40 °C
Maximum relative humidity: 85 % RH (0 °C ... 40 °C), non-condensing

Storage conditions

Temperature range: -10 °C ... +60 °C
Maximum relative humidity: 90 % RH (-10 °C ... +40 °C)
80 % RH (40 °C ... 60 °C)

Fuses

F1, F2 T 16 A / 250 V, 32 mm × 6.3 mm / 1500 A

General

Dimensions (w×h×d): 42 cm × 18 cm × 33 cm
Weight 8.1 kg

Accuracies apply for 1 year in reference conditions. Temperature coefficient outside these limits is 0.2 % of measured value per °C plus 1 digit, otherwise noted.

11 Appendix A - Abbreviations

11.1 Abbreviations for parts of medical equipment

AP	applied part
B.....	applied part of type B
BF.....	applied part of type BF
CF.....	applied part of type CF
EP.....	earthed conductive part
FE.....	functional earth
MD	leakage current measuring device
ME.....	medical equipment
NEP	non earthed conductive part
PE.....	protective earth
SIO	signal Input / Output

11.2 Abbreviated description of results in Single tests

In some single tests abbreviated description of parameters and their values is added to individual results.

Test parameter	Abbreviation parameter	Value of test parameter	Abbreviation value
Vmains	VM	All	a
		Normal	n
		Reversed	r
Fault_condition	F	All	a
		NC	n
		SFC-N	fn
		SFC-PE	fpe
Vext_AP	VA	All	a
		Normal	n
		Reversed	r
Vext_SIO	VS	All	a
		Normal	n
		Reversed	r
Vext_NEP	VN	All	a
		Normal	n
		Reversed	r
FE	FE	All	a
		Earthed	e
		Off	o
APs	AP	All	a
		Earthed	e
		Off_con	c

Test parameter	Abbreviation parameter	Value of test parameter	Abbreviation value
NEPs	N	All (earthed, off) Earthed Off	a e o
Result	R	All (AC, DC, TRMS) AC DC TRMS	a ac dc t
Test(AP=>PE)	LP	All 1..10	a 1..10
Test(Vext=>AP)	LV	All 1..10	a 1..10
Test(1=>other)	LA	All 1..10	a 1..10
Test(NEP,EP=>PE)	LT	All P/S,1..10	a p, 1,2,3,...
Test(NEP=>NEP)	LN	All P/S-1 P/S-2 P/S-3 8-10 9-10	a p1 p2 p3 810 910
Test(AP=>Vext)	LX	All 1..10	a 1..10
Test(LN=>AP)	LI	All B type F type	a b f

12 Appendix B - Print labels and write / read RFID / NFC tags

The instrument supports different label printers and RFID / NFC reader / writer devices. Please check with Metrel or distributor which printers, R/W devices and labels are supported in your instrument profile.

12.1 Tag formats

In the tables below, the content printed on the selected label/ tag is shown.

Generic format

<i>Size [W × H]</i>	<i>Field</i>	<i>Data</i>
50 mm × 25.5 mm	QR	Parent object name, Test code, Object ID, Test date, Retest period, Auto Sequence® status, Object status, User.

RFID / NFC

Type	Data
NTAG216	Parent object name, Test code, Object ID, Test date, Retest period, Auto Sequence® status, Object status, User.

Note

- If Auto Sequence® was modified, its test code will be marked with an asterisk (*).

13 Appendix C - Remote operation

Different possibilities of remote operation of the instrument are supported.

13.1 Metrel Medical ES Manager

The Metrel Medical ES Manager is Metrel's SW application for Windows. Among a plenty of features it enables also a complete control over the instrument.

For more information refer to [Metrel Medical ES Manager software help file](#).

13.2 Black Box protocol

The Black Box protocol is used for controlling the instrument with Terminal program / application. Communication via: Ethernet, USB and RS232 is possible. The Black Box protocol is a system of rules that allows a PC as a master to start communication by sending the request command to the instrument, which answers according to the protocol.

For more information contact Metrel or distributor.

13.3 SDK

SDK is a powerful interface for data communication with Metrel test instruments. The SDK itself is a set of subroutine definitions, protocols, and tools for building application software. It is intended for those who want to develop software using .NET platform and need to interface with Metrel instruments. The Metrel Instrument Communication SDK bundles client libraries for accessing Metrel instruments and provides a unified programming interface using C# programming language. The SDK includes a set of API calls which makes communication with Metrel instruments simple for the user.

For more information contact Metrel or distributor.

14Appendix D - Structure objects

Structure elements used in Memory Organizer may be instrument's Profile dependent.

Symbol	Default name	Description
	Node	Node
	Project	Project
	Location	Location
	Client	Client
	Appliance	Appliance (basic description)
	Appliance FD	Appliance (full description)
	Medical device	Medical device (basic description)
	Medical device FD	Medical device (full description)
	Element	Universal element

15 Appendix E - Profile Notes

So far there are no specific profile notes for this instrument.

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