MI 3211 TeraOhmHP 10 kV
MI 3215 TeraOhmHP 15 kV

Instruction manual

Ver. 1.1.1, code no. 20 753 388

METREL®

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Hereby, Metrel d.o.o. declares that the MI 3211 and MI 3215 are in compliance with Directive 2014/53/EU (RED) and all other subjected EU directive. The full text of the EU declaration of conformity is available at the following internet address https://www.metrel.si/DoC.

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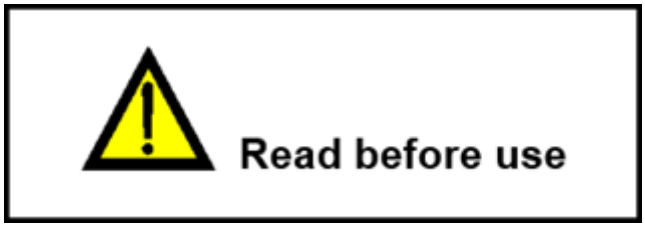
1 General description

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!
- Use only *Metrel* standard or optional test accessories!
- Only adequately trained and competent persons may operate the equipment.
- 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.
- Do not touch any conductive parts of equipment under test during the test, risk of electric shock!
- Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!
- Do not use the equipment in a wet environment, around explosive gas, vapour or dust.
- Instrument servicing and calibration is allowed to be carried out only by a competent authorized person!
- In rare cases (internal fault) the test equipment can behave in an uncontrolled manner (LCD blinking, freezing, not responding to keys, etc.). In this case consider the test equipment and the test object as hazardous live and perform all safety measures to turn off (reset) the test equipment and to discharge the test object manually!
- *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.

- **It is the user's responsibility to ensure that automated tests using Blackbox** commands, and custom-made Auto Sequences are safe and comply with all safety regulations.

1.1.2 Warnings related to batteries

- The instrument contains a Li-ion battery that is not user-replaceable and can only be replaced by authorized service personnel.
- When disposing of electronic devices containing Li-ion batteries, ensure proper recycling according to local regulations.

1.1.3 Warnings related to safety of measurement functions

WARNING

Capacitive objects may be charged to a high voltage during the measurement.

Risk of electric shock!
Always consider precautions against electric shock!

MI 3211
Voltage measurements may be performed on energized objects, up to 600 V CAT IV.

MI 3215
Voltage measurements may be performed on energized objects, up to 1000 V CAT IV.

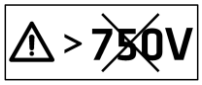
Working with the instrument – safety precautions for insulation tests	Make sure that the tested object is disconnected (mains voltage disconnected) and de-energized before connecting the test leads and starting the measurement Always connect accessories to the test equipment and to the test object before starting the test. Do not touch test leads or crocodile clips during measurement.
Handling with capacitive loads	Note that a charge above 45 µC (for example 1 kV on 40 nF, 10 kV on 4 nF, or 15 kV on 3 nF) are hazardous live!

	Never touch the measured object during the testing until it is totally discharged, automatically and manually! In case of a capacitive test object, automatic discharge of the object may not be done immediately after finishing the measurement. Because of dielectric absorption, capacitive test objects (capacitors, cables, transformers, etc.) must be shorted out after the measuring process is completed.
Insulation resistance	Conditions for starting the test in regard to external voltage on test terminals): U < 50V: test will start normally MI 3215: U = 50 V to 1000 V: test will start, noise icon will lit. Results may be impaired. U > 1000 V: test will not start, noise icon will lit. MI 3211: U = 50 V to 600 V: test will start, noise icon will lit. Results may be impaired. U > 600 V: test will not start, noise icon will lit.
Burn mode	Normal breakdown mode is disabled. The test will proceed even in case of insulation breakdown. Test may damage the insulation. This enables the location of a failure to be detected with various methods (visual, geophone, acoustic, etc.)

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!
	Hazardous voltage is present on test terminals
	Do not use the equipment on energized distribution system with voltages higher than 750 V.

	Instrument is protected by reinforced insulation.
	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 EU 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

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 61010-2-034	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength
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

2 Instrument set and accessories

2.1 Standard set of the instrument MI 3211

- Instrument MI 3211 TeraOhmHP 10 kV
- High voltage measuring leads with alligator clips (black, blue, red)
- Mains cable
- USB cable
- Bag for accessories
- Calibration Certificate
- Short form instruction manual
- PC SW Metrel ES Manager, Instruction manual: download from WebCD page (link included)

2.2 Standard set of the instrument MI 3215

- Instrument MI 3215 TeraOhmHP 15 kV
- High voltage measuring leads with alligator clips (black, blue, red)
- Mains cable
- USB cable
- Bag for accessories
- Calibration Certificate
- Short form instruction manual
- PC SW Metrel ES Manager, Instruction manual: download from WebCD page (link included)

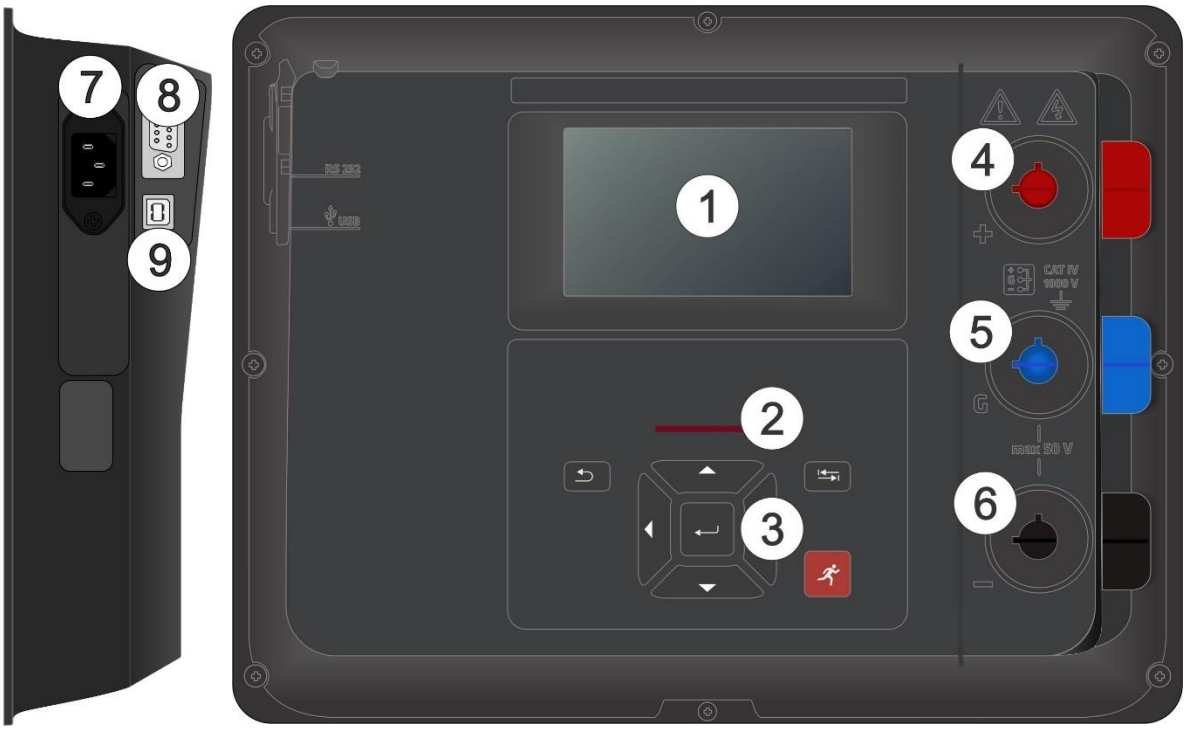
See the attached sheet "Included in the Set".

2.3 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	Colour TFT display with touch screen
2	LED hazard indicator (high voltage warning)
3	Keypad
4	(+) Rx test terminal
5	(G) Guard terminal
6	(-) Rx test terminal
7	Mains supply input
8	Serial port
9	USB communication port

4 Instrument operation

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

4.1 General meaning of keys

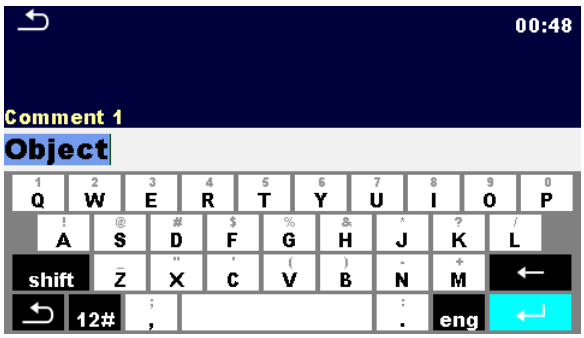
	Cursor keys are used to: • select appropriate option; • Left, right, up, down; • In some functions: page up, page down.
	Enter key is used to • confirm selected option;
	Run key is used to: • start measurement if pressed and held for 3 s; • stop measurement.
	Escape, On/Off key is used to: • return to previous menu without changes; • abort / stop measurements • switch On / Off the instrument; • hard switch off (by hardware) the instrument if pressed and held for 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**

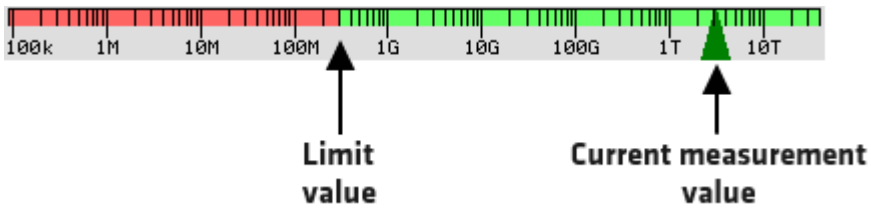
At start up and during operation the instrument performs various safety checks to ensure safety and to prevent any damage. If a safety check fails, an appropriate warning message will be displayed, and safety measures will be taken.

4.4.1 Terminal voltage monitor

The terminal voltage monitor displays true RMS voltage conditions on the test terminals for voltages >30 V. If terminal voltage >50 V is detected, noise icon is displayed, LED hazard indicator is blinking and warning sound is on (if enabled).

4.4.2 Bar graph

In some measurement functions, the current resistance measurement value is indicated in the logarithmic scale bar graph. When a measurement limit is selected, it splits the bar graph into red (fail) area (left of the limit value) and green (pass) area (right of the limit value).



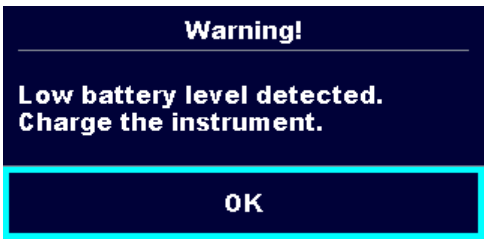
4.4.3 Battery

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

	Battery capacity indication.
	Low battery. Recharge the battery cells.
	Battery is full.
	Battery fault indication.
	Charging in progress.

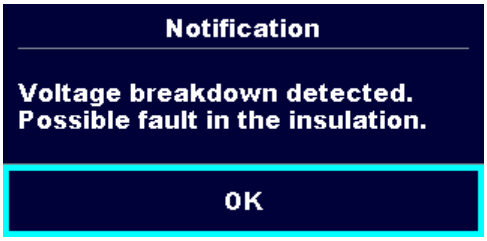
4.4.4 Messages

In the message field warnings and messages are displayed.



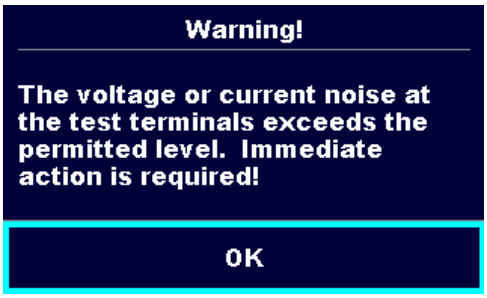
Low battery level is detected.

The measurement is aborted.



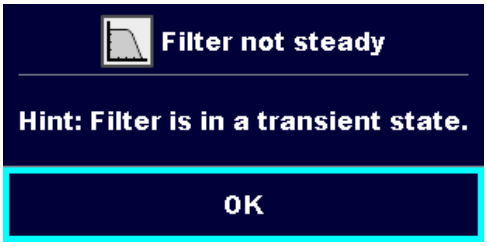
Voltage breakdown is detected.

The measurement immediately ends.

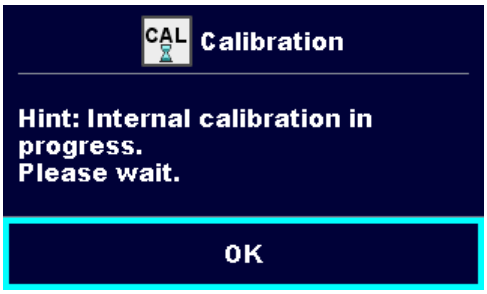


The voltage or current noise at the test terminals exceeds the permitted level. Immediate action is needed!

Check the reason and safely remove the test leads from the voltage source.

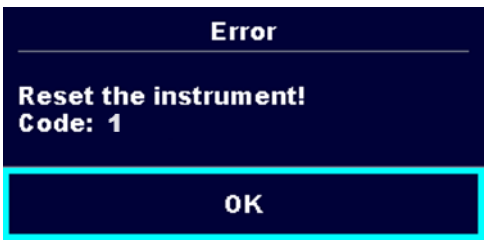


Filter (Average) is in transient state and needs additional samples.



Instrument is in self-calibration mode. This is performed automatically after the instrument is powered-on and lasts a few seconds.

Measurement is not allowed to start.



Self-calibration error is detected.

The measurement is aborted.

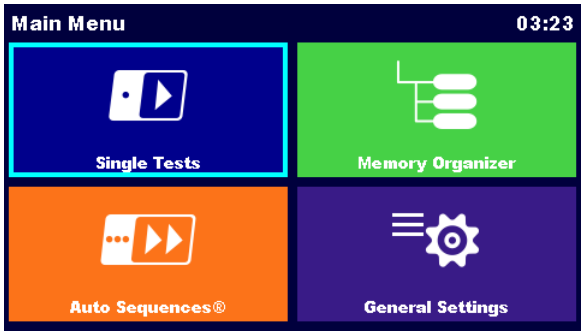
	Conditions on the input terminals allow starting the measurement; consider other displayed warnings and messages.
	Conditions on the input terminals do not allow starting the measurement, consider displayed warnings and messages.
	Stop the measurement.
	Warning! High voltage is applied to the test terminals. Limit [> 50 Vrms on test terminals].
	A high voltage is / will be present on the instrument output! (Withstanding test voltage, Insulation test voltage or mains voltage).
	High electrical noise was detected during measurement. Results may be impaired.
	Measurement is running, consider displayed warnings.
	Burn mode active.
	Filter (Average) is in transient state and needs additional samples.
	Instrument is in self-calibration mode.
	Test passed. Result is inside predefined limits.
	Test failed. Result is out of predefined limits.
	Bluetooth communication active.

Hint

For some icons more information is displayed if  on icon.

4.5 Instrument main menu

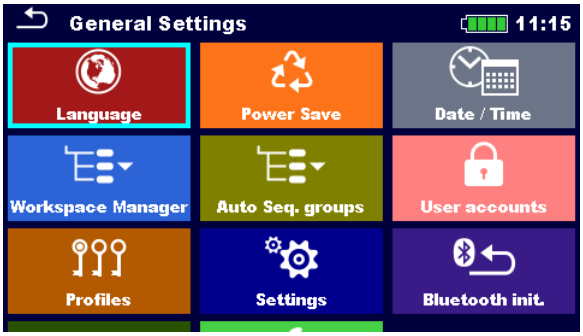
From the instrument Main Menu four main operation menus can be selected.

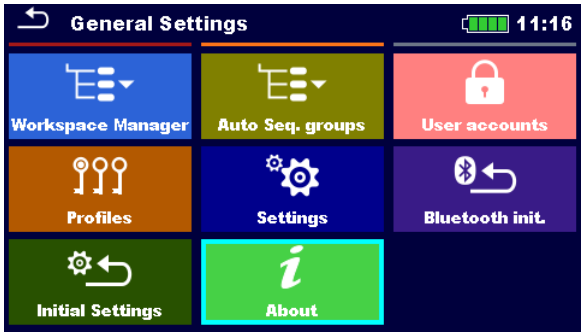


Single Test	Menu for selecting single tests
Auto Sequences®	Menu for selecting Auto sequence®
Memory Organizer	Menu for working with structured test objects and measurements
General Settings	Menu for setup of the instrument

4.6 General settings menu

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



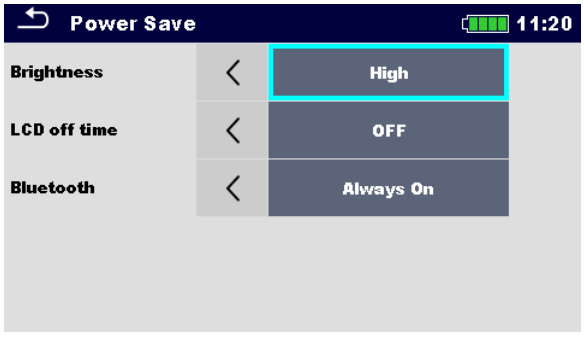


Language	Language selection
Power Save	Brightness of LCD, enabling/disabling Bluetooth communication
Date / Time	Setting date and time
Workspace Manager	Managing project files

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
Bluetooth initialization	Bluetooth module initialization
Initial Settings	Factory settings
About	Instrument data

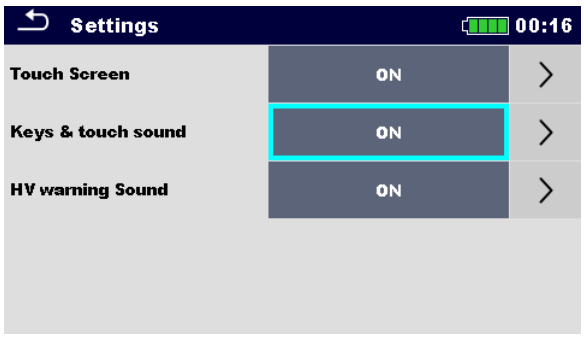
4.6.1 Power Save

In this menu different options for decreasing power consumption can be set.



Brightness	Setting of LCD brightness level.
LCD off time	Setting LCD off after set time interval. LCD is switched on after pressing any key or touching the LCD.
Bluetooth	Always On: Bluetooth module is ready to communicate. Save mode: Bluetooth module is set to sleep mode and is not functioning.

4.6.2Settings



Touch screen	Set Touch screen on / off.
Keys & touch sound	Set key touch sound on / off.
HV warning Sound	Set high voltage sound warning on / off.

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.

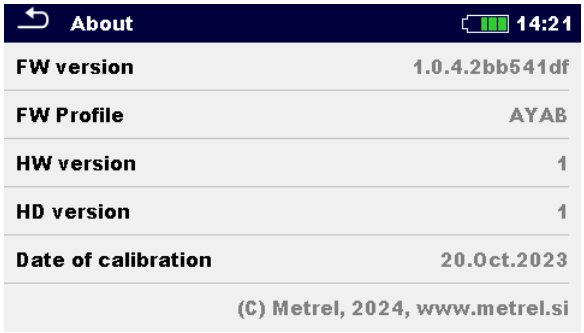
Note

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.



4.6.5User Accounts

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

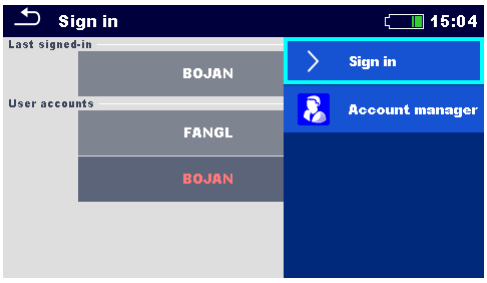
- Setting if signing in to work with the instrument is required or not.
- Adding and deleting new users, setting their user names and passwords.
- Setting the password for allowing Black Box operation.

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

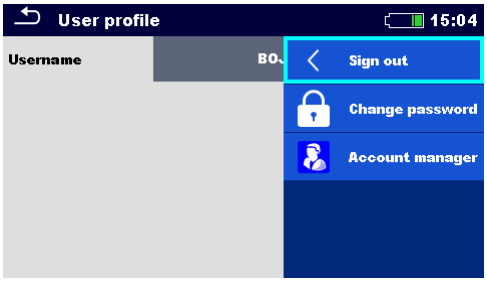
Note

- 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.



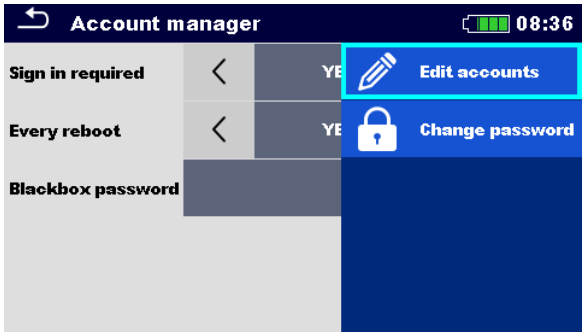
User sign out: select Sign out

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

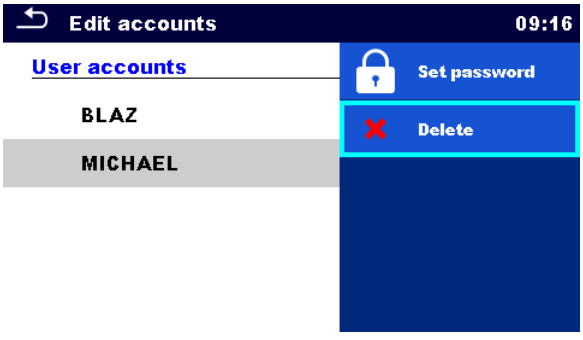
Account manager sign out: is automatic by exiting the Account manager menu.

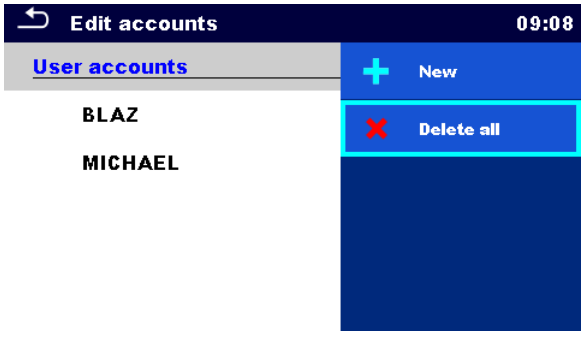
4.6.6 Managing accounts

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

4.7 Instrument profiles

In current implementation of this instrument Different FW profiles are not supported.

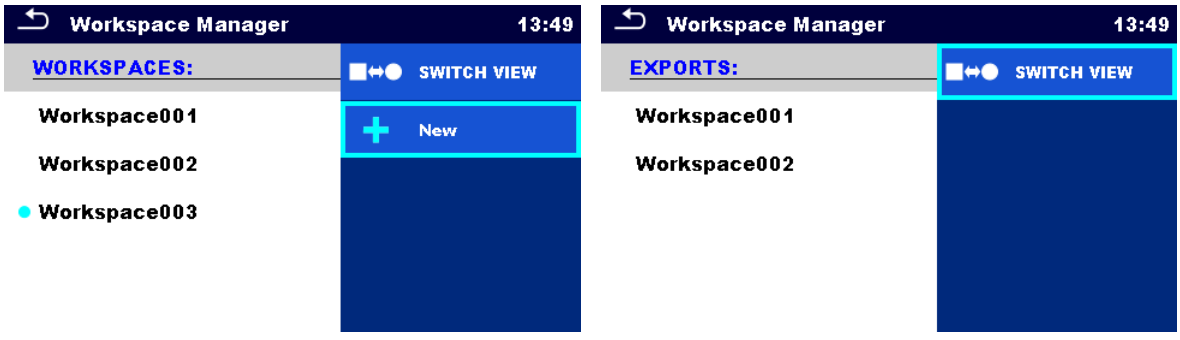
4.8 Workspace Manager

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

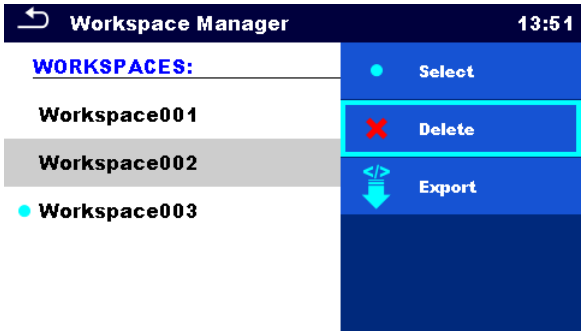
4.8.1 Workspaces and Export

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.

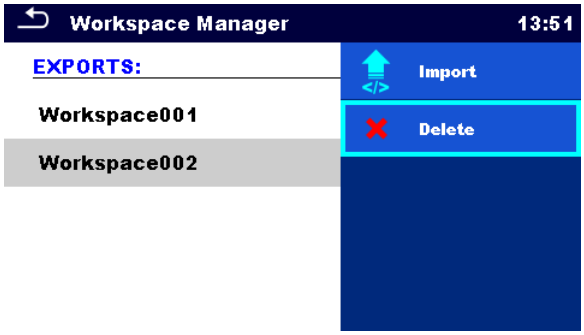
Export files can be read by Metrel applications that run on other devices. Exports are suitable for making backups of important works. To work on the instrument an Export should be imported first from the list of Exports and converted to a Workspace. To be stored as Export data a Workspace should be 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



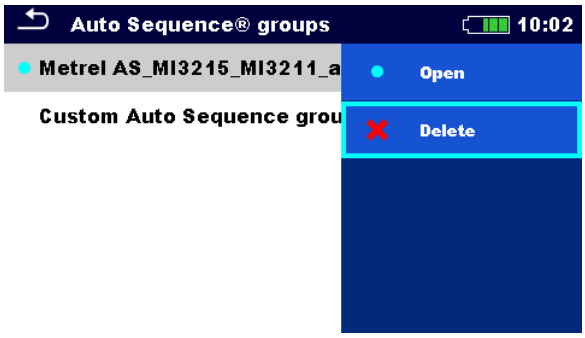
Select	Open selected Workspace in Memory Organizer
Delete	Delete selected Workspace
Export	Export selected Workspace into an Export



Import	Import selected Export to a Workspace
Delete	Delete selected Export

4.9 **Auto Sequence® groups**

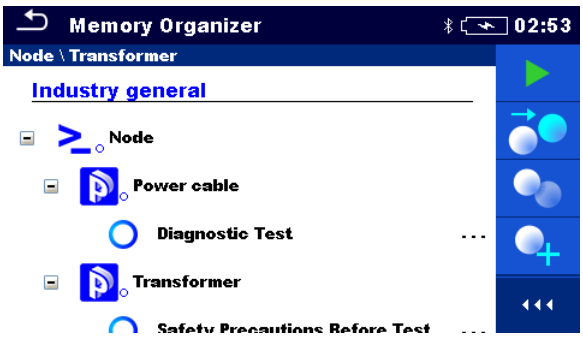
The Auto Sequences in the instrument can be organized by using lists. In a list a group of similar Auto Sequences is stored. The Auto Sequence® groups menu is intended to manage with different lists.
In Auto Sequence® groups menu lists of Auto Sequences® are displayed.

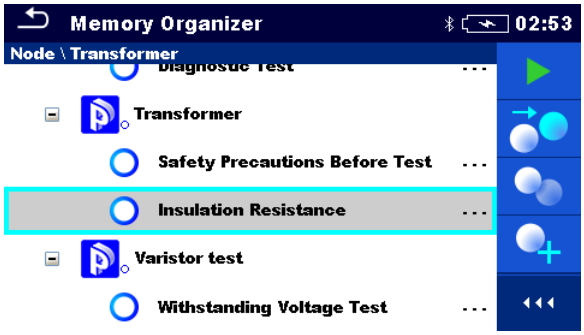


Open	Open the selected Auto Sequence® group in the Auto Sequences® main menu.
Delete	Delete the selected Auto Sequence® group.

5 Memory Organizer

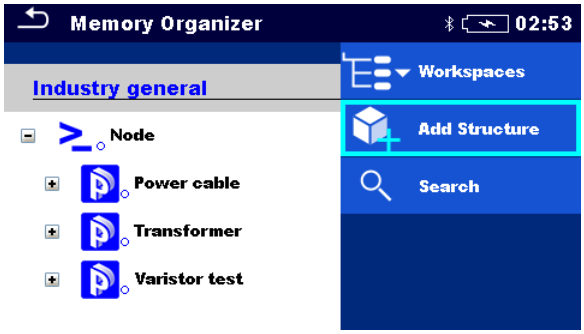
Memory Organizer is an environment for storing and working with test data. The data is organized in a multilevel tree structure with Structure objects and Measurements. For a list of available structure objects see *Appendix A - Structure objects*.





5.1 Operations in Memory Organizer

5.1.1 Operations on Workspace

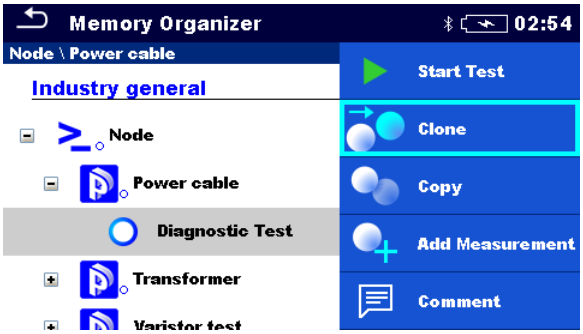


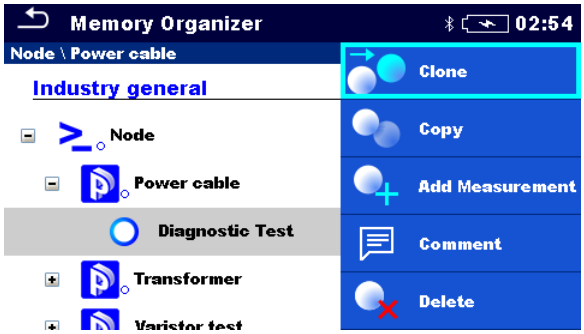
Header line (Workspace), Workspaces	Go to Workspace Manager from Memory Organizer
Header line (Workspace), Search	Search for structure elements

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

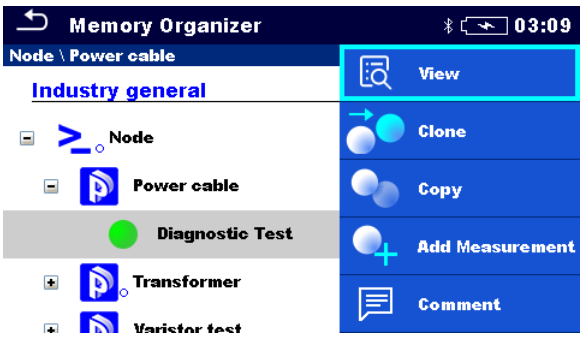
Add a new node	Header line (Workspace), Add structure

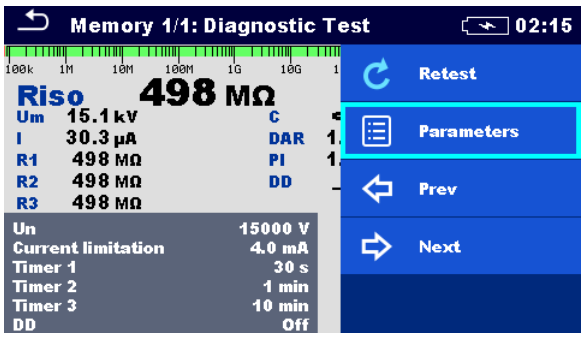
5.1.2 Operations on measurements





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 Measurement	Add an empty measurement
Comment	Add / view a comment to the measurement
Delete	Delete a measurement





View	Enter menu for viewing details of test
Parameters	View / edit parameters
Retest	Run a new measurement with same settings as selected measurement

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

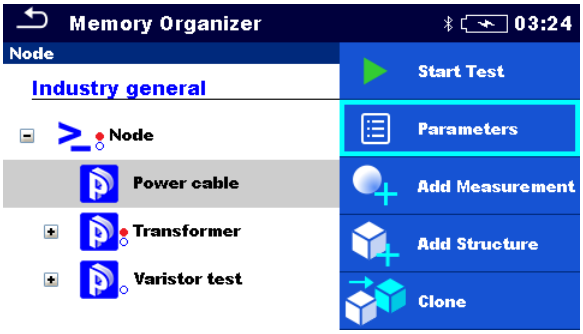
Overall statuses of Auto Sequence

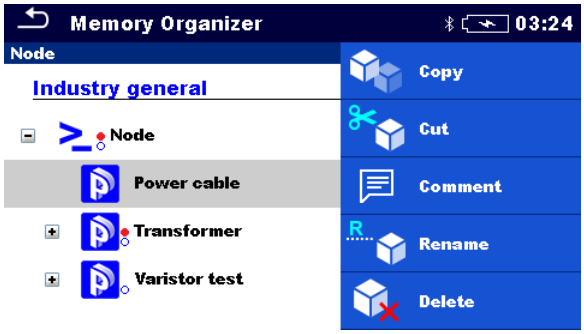
	At least one single test in the Auto Sequence passed and no single test failed
	At least one single test in the Auto Sequence failed
	At least one single test in the Auto Sequence was carried out and there were no other passed or failed single tests
	Empty Auto Sequence with empty single tests

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.

	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

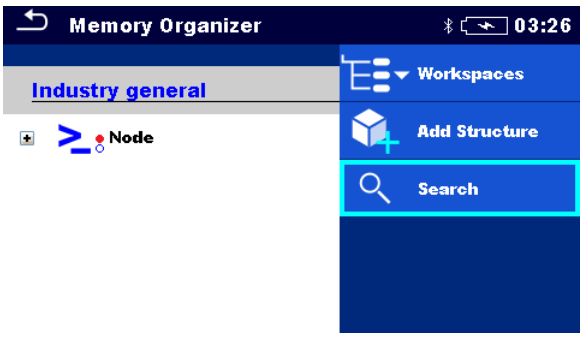


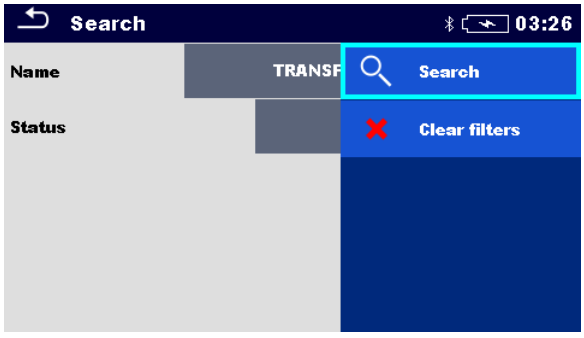


Start Test	Start a new measurement (proceeds to menus for selection of measurement).
Parameters	View / edit parameters.
Add Measurement	Add a new empty measurement. Menu for adding new measurement will open.
Add Structure	Add a new structure object. Menu for adding new structure object will open.
Clone	Copy selected element as to same level in the structure tree.
Copy, Paste	Copy selected element to any allowed location in structure tree. Menu for selecting inclusions (parameters, attachments, sub structures, sub measurements) of copy command is opened.
Cut, Paste	Move selected Structure with child items (sub-structures and measurements) to any allowed location in structure tree.
Comment	View/edit/add a comment to the structure element.
Rename	Rename the structure element.
Delete	Delete the structure element.

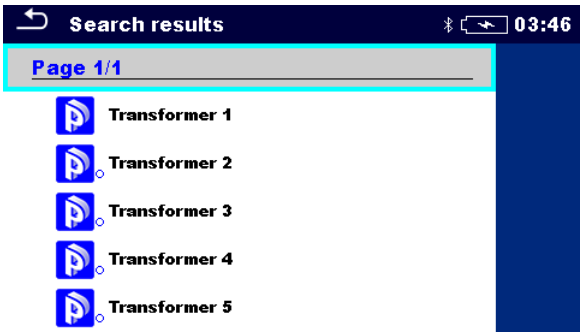
5.1.5 Searching in Memory Organizer

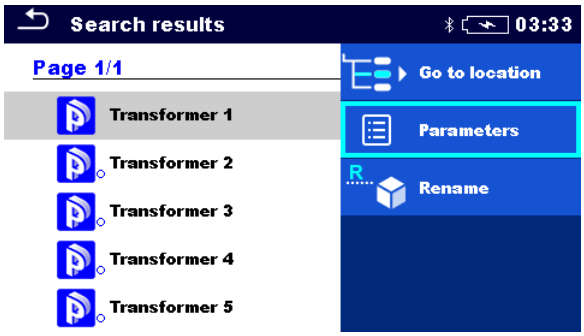
In Memory organizer it is possible to search for different structure objects and their parameters.





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

	Go Page Up / Down
Go to location	Jump to selected location in Memory organizer
Parameters	View/edit parameters
Rename	Rename the found object

6 Single tests

There are different modes for selecting single tests available.

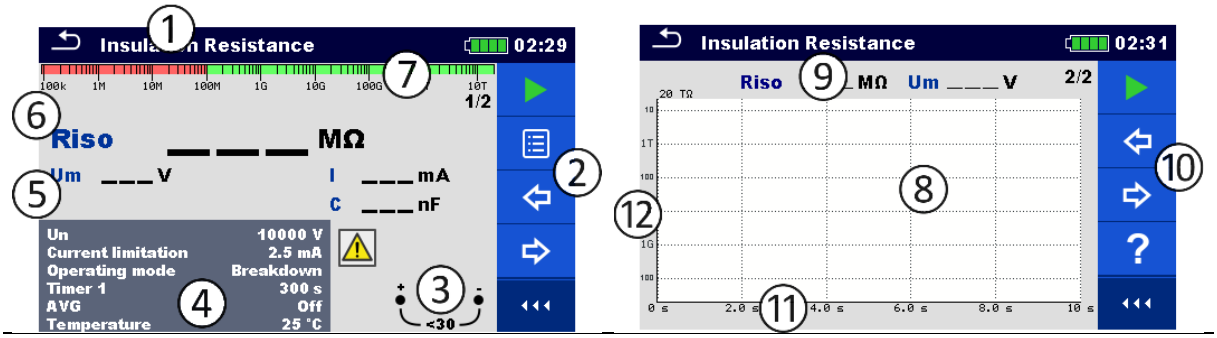
6.1 Selection modes

In Single tests main menu three modes for selecting single tests are available.

Groups	View groups of similar tests
Last used	View last made measurements
All	View all measurements

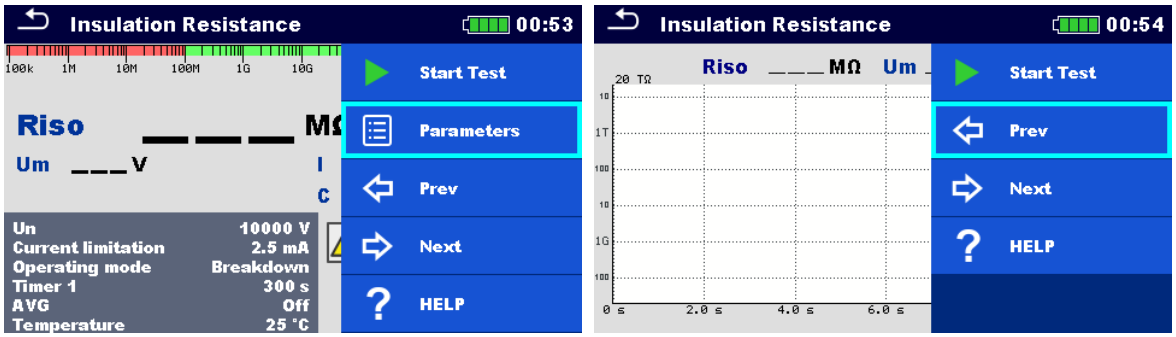
6.2 Single test screens

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. In the Graph screen the main measuring result vs. time is displayed online, during the measurement.



1	Name of function
2	Control panel (Options)
3	Statuses, info, warnings
4	Parameters (white) and limits (red)
5	Sub-result
6	Main result
7	Logarithmic scale bar graph
8	Graph
9	Results
10	Control panel (graph options)
11	Time axis
12	Result axis

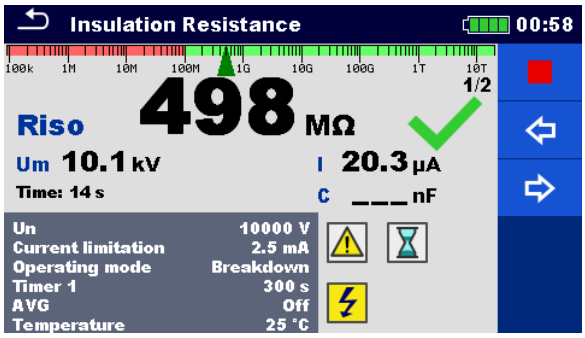
6.2.1 Single test start screens

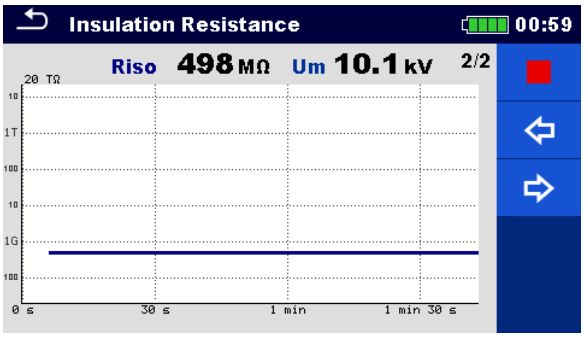


Start test	Start single test (can't start on graph screen)
Parameters, or tap on Parameters field	Set parameters/ limits of single test
Prev	Go to previous screen
Next	Go to next screen

Help	View help screens

6.2.2 Single test screens during test



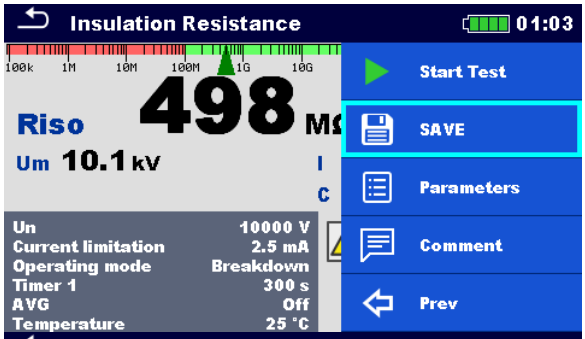


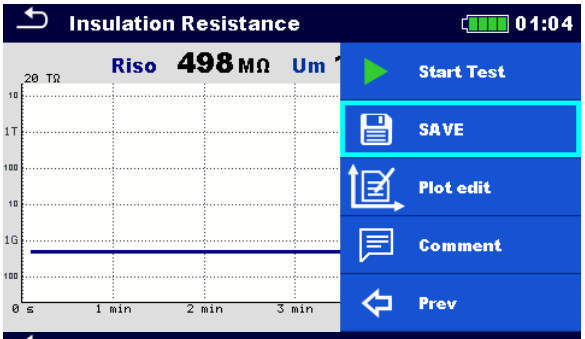
	End single test
Prev	Go to previous screen
Next	Go to next screen

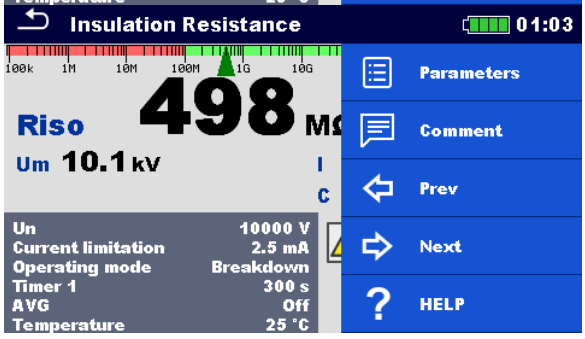
Testing procedure (during the test)

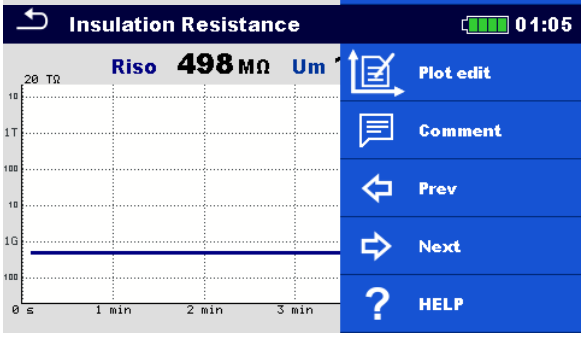
Observe the displayed results and statuses
Check for eventual messages, warnings

6.2.3 Single test result screens



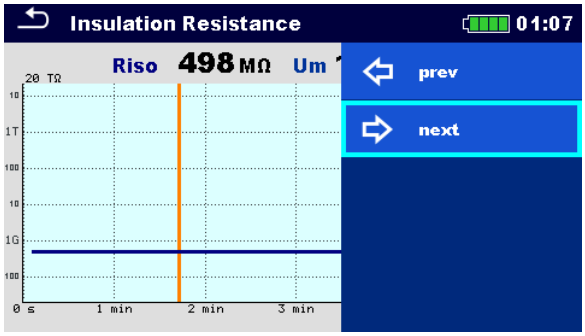






Start test	Start a new single test
Save	Save the result
Parameters	View parameters
Comment	Add comment to the measurement
Prev	Go to previous screen
Next	Go to next screen
Help	View help screens
Plot edit	Enter plot editor

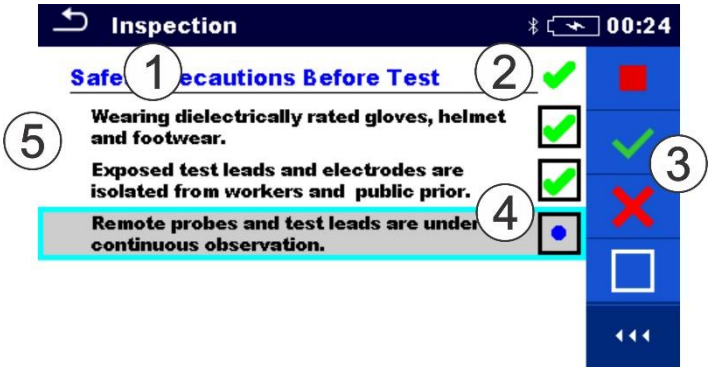
Operations on graphs



	Select measurement result in graph
next	Set cursor to next measurement
prev	Set cursor to previous measurement

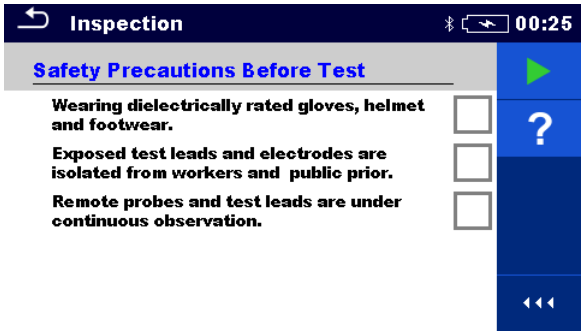
6.3 **Single test (inspection) screens**

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.



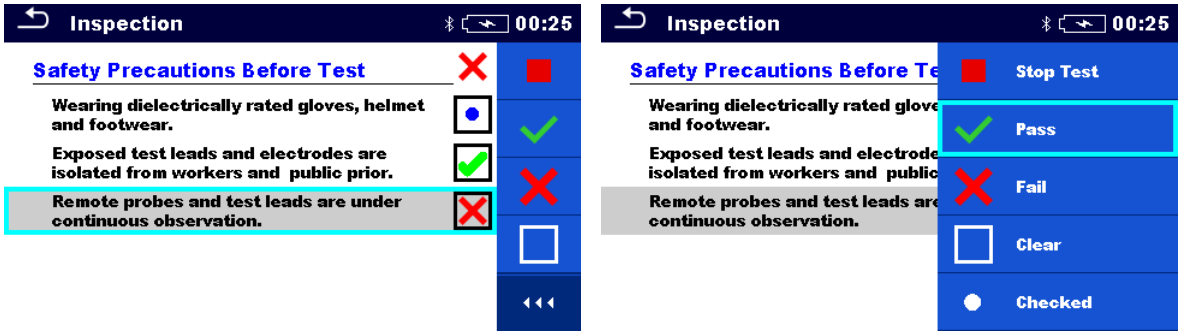
1	Selected inspection
2	Overall status
3	Control panel (Options)
4	Status fields
5	Items

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 items, apply Pass or Fail or Checked or Clear	Apply or clear the status of an individual item

Hint

Tap on ☐ or use ↵ key to set status.

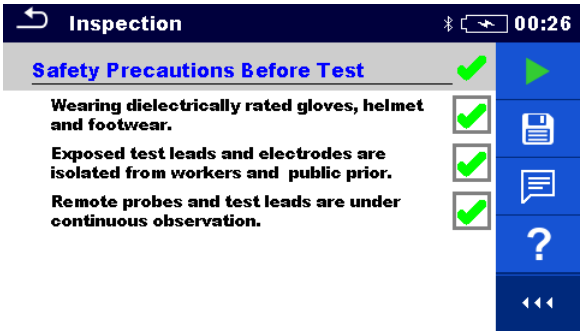
Rules for automatic applying of statuses

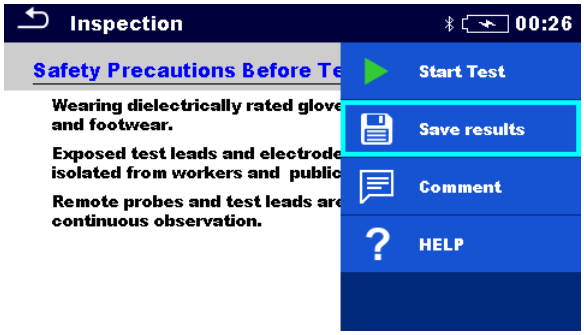
The parent items will automatically get a status on base of statuses in child items	• The fail status has highest priority. A fail status for any item will result in a fail status in all parent items and an overall fail result. • If there is no fail status in child items the parent item will get a status 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



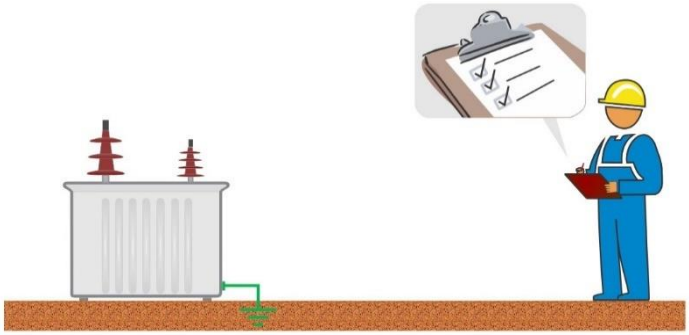


Start test	Start a new inspection
Save results	Save the result
Comment	Add comment to the inspection
Help	View help screens

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.

6.3.4Help screens

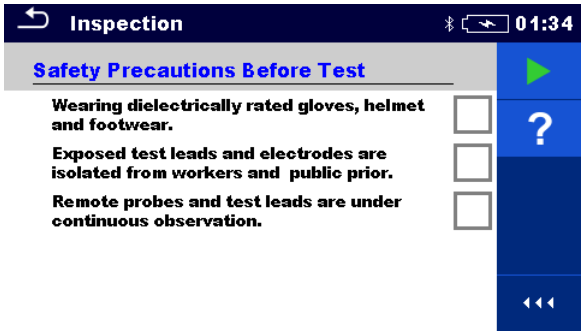
Help screens contain diagrams for proper connection of the instrument.



Help	Open help screen
on ,	Go to other help screens

6.4 Single test measurements

6.4.1 Inspection



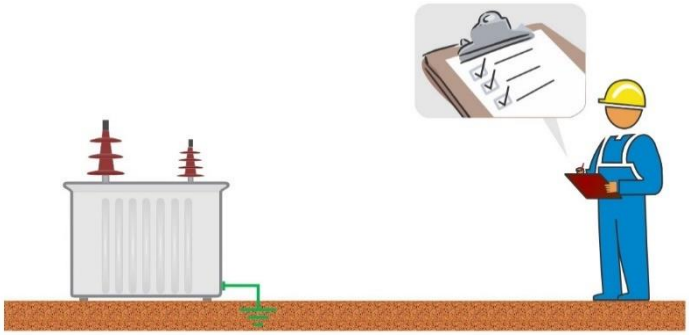
Test results / sub-results

.....Pass

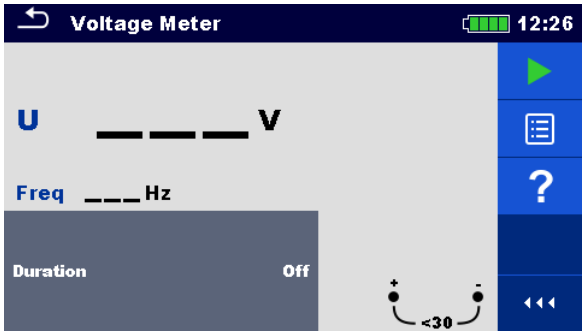
.....Fail

.....Checked

Test circuit



6.4.2Voltage and Frequency

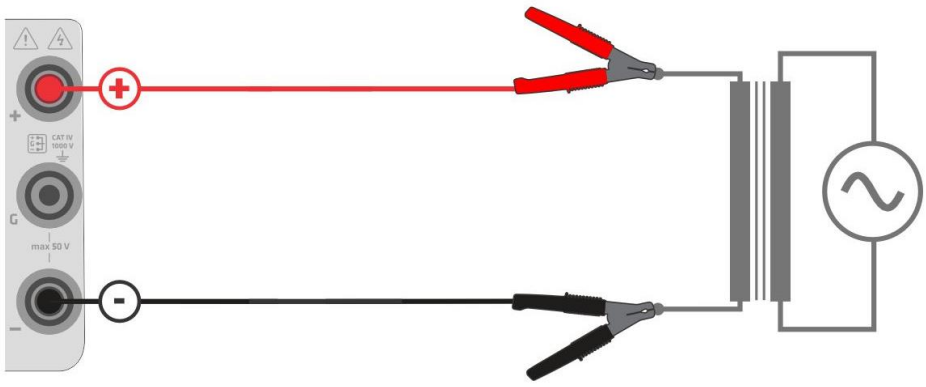


Test results / sub-results
U .....Voltage (True RMS)
Freq.....Frequency (dominant frequency)

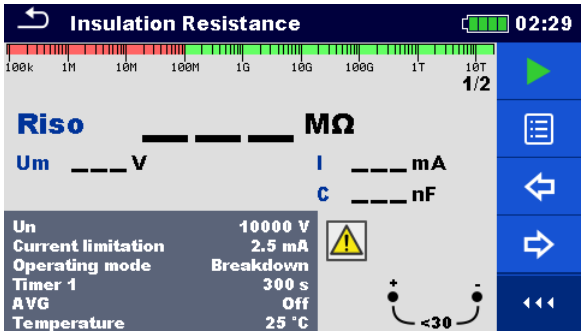
Test parameters

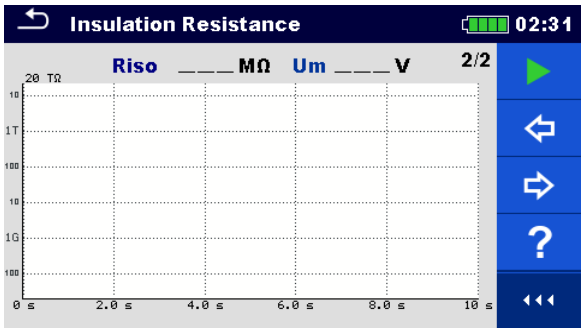
Duration	Duration: [Off, Custom, 2 s ... 30 s]

Test circuits



6.4.3Insulation resistance





Test results / sub-results

Riso	Insulation resistance
Um	Measured voltage
I	Measured current
C	Capacitance (displayed after measurement)
Time	Elapsed time (displayed during measurement)
Start	Delayed start [3, 2, 1]

Test parameters

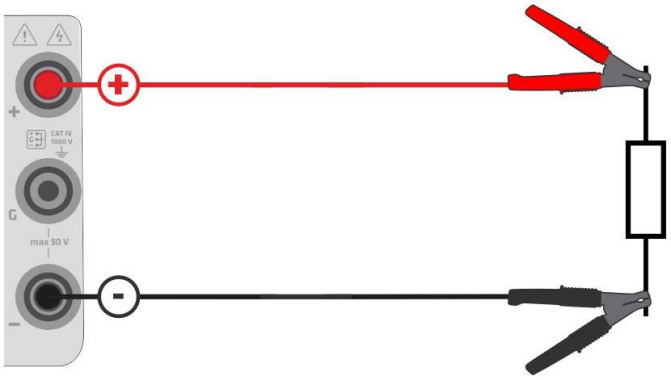
Un	Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]**
Current limitation	Current capability: Mains supply [0.5 mA ... 4.0 mA] Battery supply [0.5 mA ... 2.5 mA] Burn mode [0.5 mA, 1.0 mA]
Operating mode	[Breakdown, Burn] Breakdown: measurement ends if test current suddenly exceeds the limit value Burn mode: measurement doesn't stop if test current suddenly exceeds the limit value
Timer 1	Test duration [Custom, 5 s ... 600 s]
AVG	Averaging factor (moving average) [Off, 5 ... 200]
Temperature	[Off, Custom] Test object temperature (informative value)

*MI 3211, **MI 3215

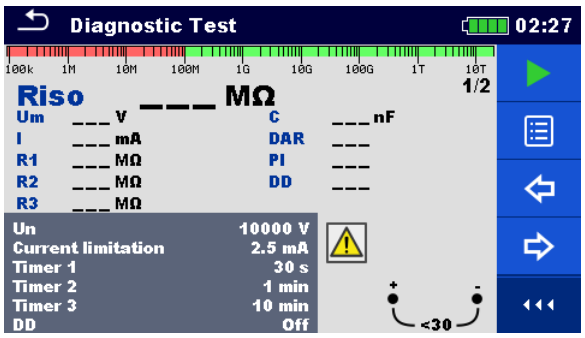
Test limits

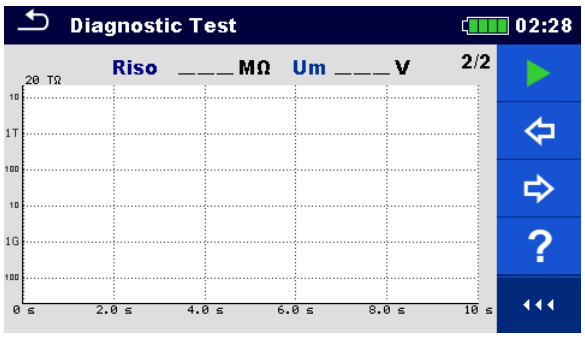
Limit	Low Limit Riso: [Off, Custom, 100 kΩ ... 100 GΩ]

Test circuits



6.4.4 Diagnostic Test





Test results / sub-results

Riso	Insulation resistance
Um	Measured voltage
I	Measured current
R1	Resistance at timer 1
R2	Resistance at timer 2
R3	Resistance at timer 3
C	Capacitance (displayed after measurement)
DAR	Dielectric absorption ratio
PI	Polarization index
DD	Dielectric discharge
Time	Elapsed time (displayed during measurement)
Start	Delayed start [3, 2, 1]

Test parameters

Un	Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]**
Current limitation	Current capability: Mains supply [0.5 mA ... 4.0 mA] Battery supply [0.5 mA ... 2.5 mA]
Timer 1	Test duration [Custom, 5 s ... 600 s]
Timer 2	Test duration [Custom, 1 min ... 100 min]
Timer 3	Test duration [Custom, 1 min ... 100 min]
DD	Dielectric discharge test [Off, On]
AVG	Averaging factor (moving average) [Off, 5 ... 200]
Temperature	[Off, Custom]

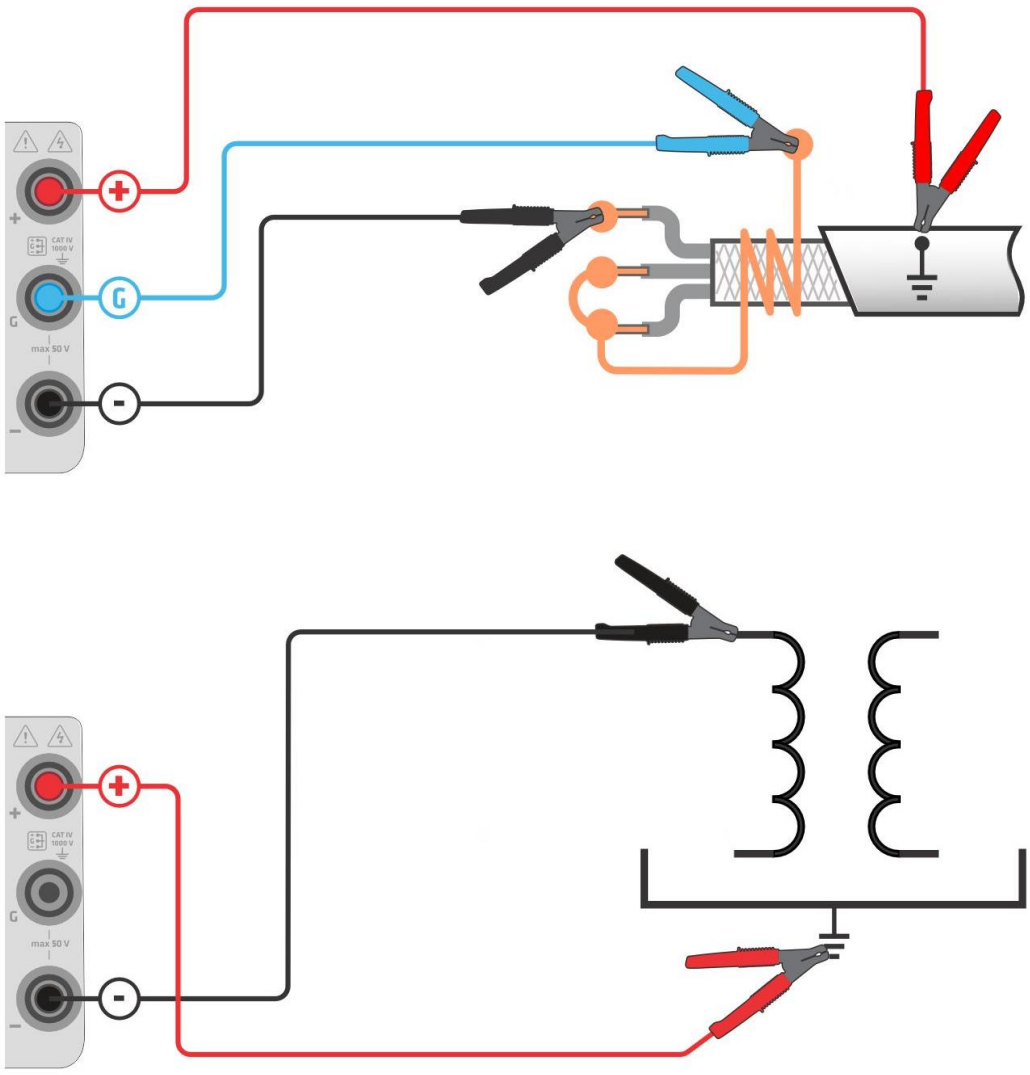
	Test object temperature (informative value)

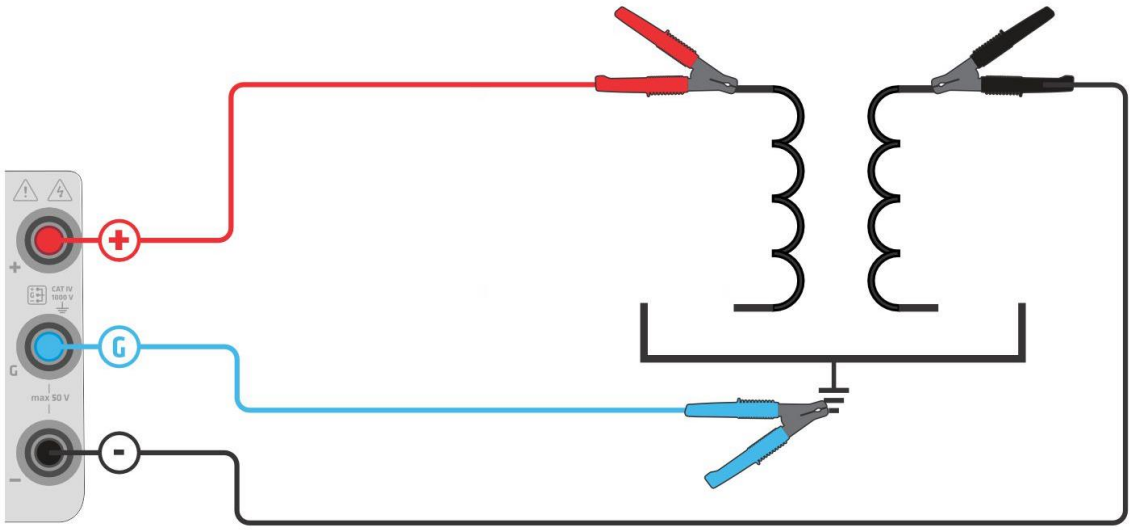
*MI 3211, **MI 3215

Test limits

Limit	Low Limit Riso: [Off, Custom, 100 kΩ ... 100 GΩ]

Test circuits





Note

Calculated results:

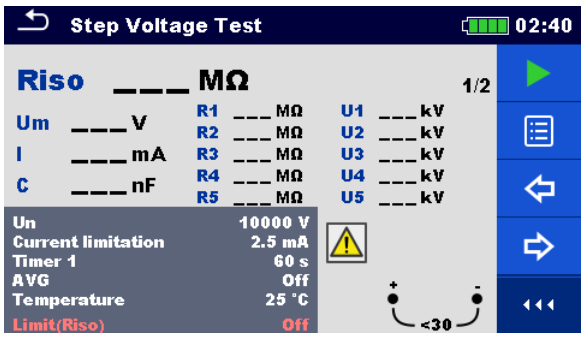
- $PI = R3/R2$
- $DAR = R2/R1$
- $DD = Idis/(U * C)$

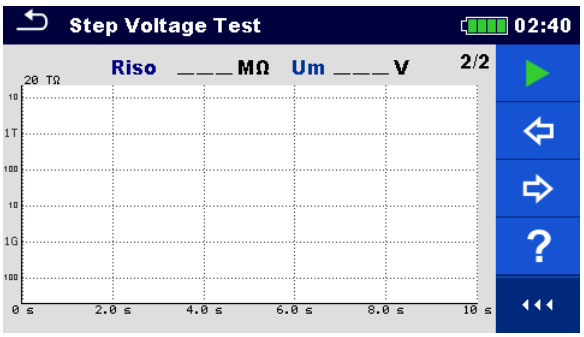
Idis ..... Discharging current after 1 minute in nA

U ..... Test voltage in Volts

C ..... Capacitance of test object in µF

6.4.5Step Voltage Test





Test results / sub-results

Riso	Insulation resistance
Um	Measured voltage
I	Measured current
C	Capacitance (displayed after measurement)
R1	Insulation resistance at U1
R2	Insulation resistance at U2
R3	Insulation resistance at U3
R4	Insulation resistance at U4
R5	Insulation resistance at U5
U1	Voltage step 1
U2	Voltage step 2
U3	Voltage step 3
U4	Voltage step 4
U5	Voltage step 5
Time	Elapsed time (displayed during measurement)
Start	Delayed start [3, 2, 1]

Test parameters

Un	Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]**
Current limitation	Current capability: Mains supply [0.5 mA ... 4.0 mA] Battery supply [0.5 mA ... 2.5 mA]
Timer 1	Test duration [Custom, 30 s ... 600 s]
AVG	Averaging factor (moving average) [Off, 5 ... 200]

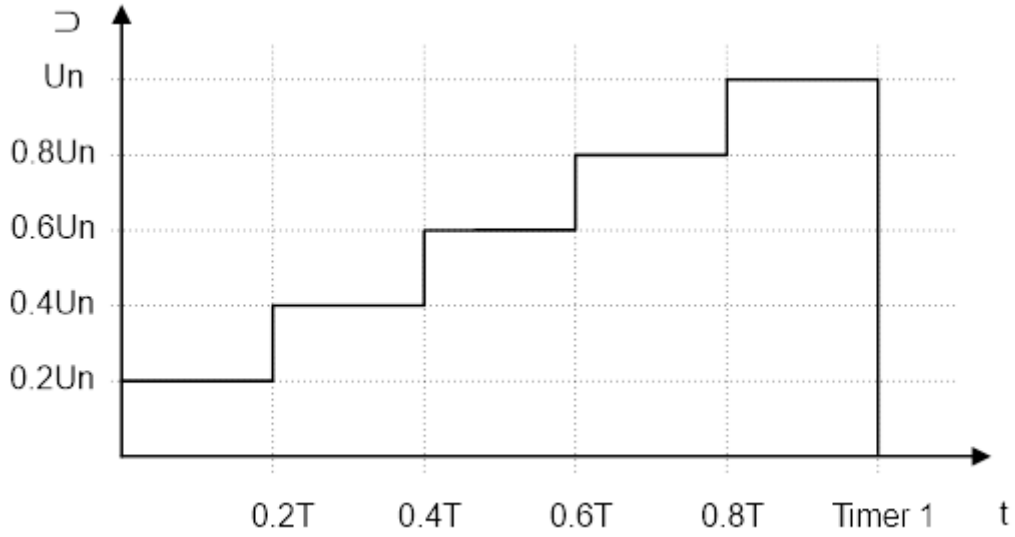
Temperature	[Off, Custom] Test object temperature (informative value)

*MI 3211, **MI 3215

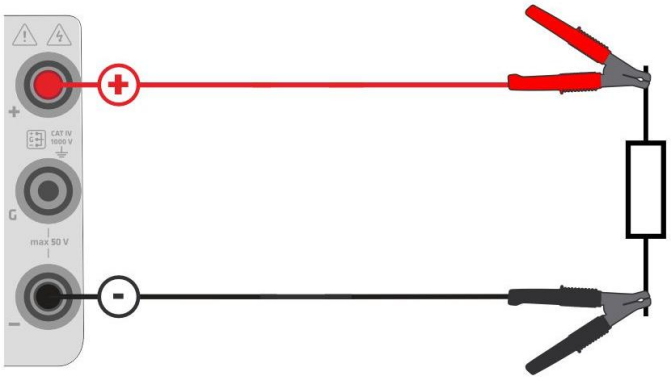
Test limits

Limit	Low Limit Riso: [Off, Custom, 100 kΩ ... 100 GΩ]

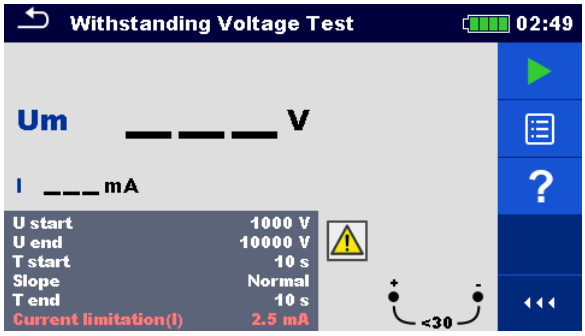
Testing voltage



Test circuits



6.4.6 Withstanding Voltage Test



Test results / sub-results

Um	Measured voltage
I	Measured current

Test parameters

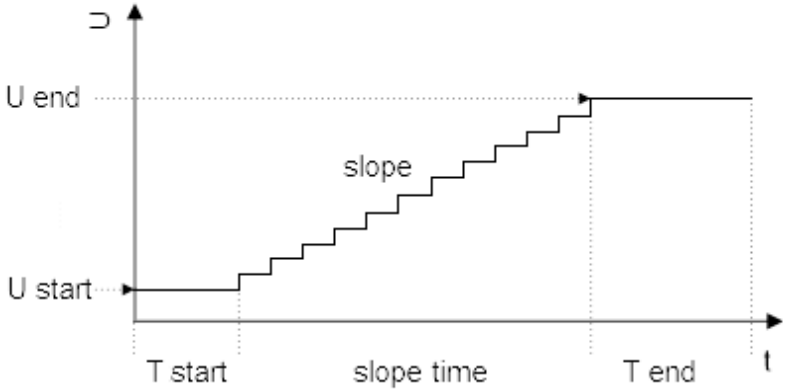
U start	Start test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]**
U end	End test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]**
T start	Test duration at U start [Custom, 5 s ... 60 s]
Slope	Slope [Slow, Normal, Fast] • Slow (500 V/min) • Normal (1000 V/min) • Fast (2000 V/min)
T end	Test duration at U end [Custom, 5 s ... 60 s]

*MI 3211, **MI 3215

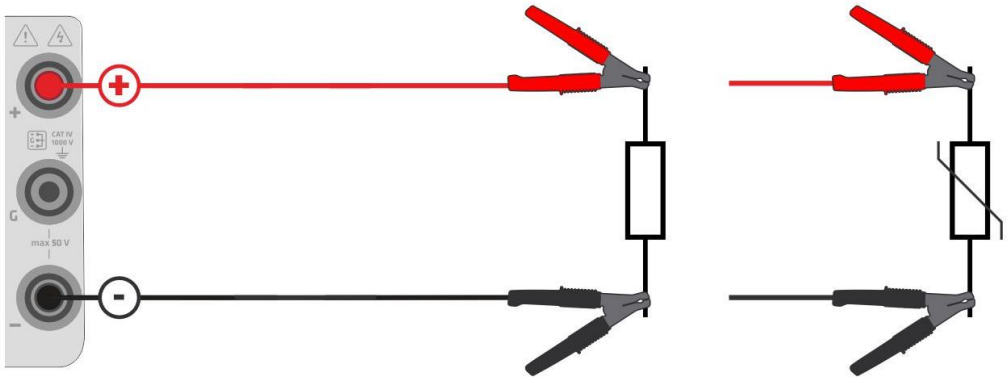
Test limits

Current limitation	Current limitation: Mains supply [0.5 mA ... 4.0 mA] Battery supply [0.5 mA ... 2.5 mA]

Testing voltage



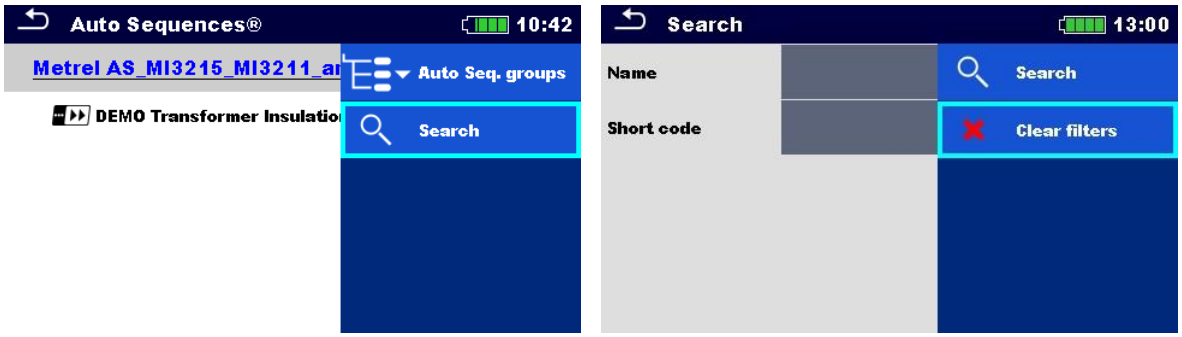
Test circuits



7 Auto Sequences®

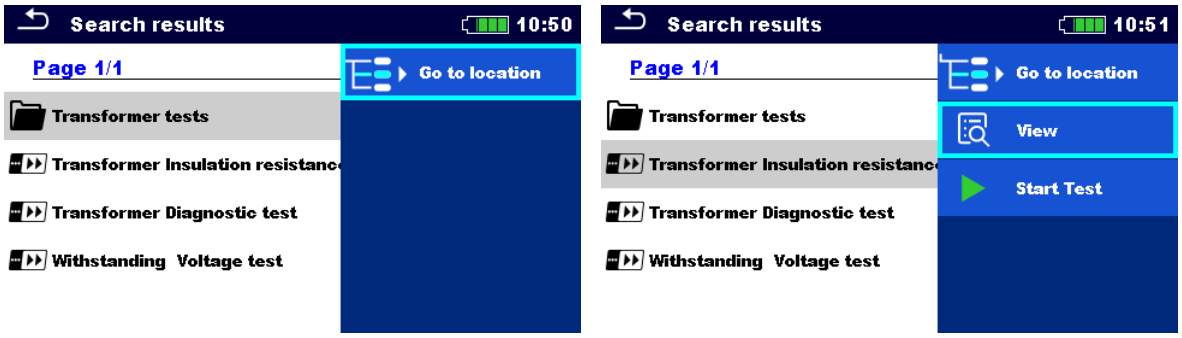
Auto Sequences® are pre-programmed sequences of measurements. The Auto Sequences® can be pre-programmed on PC with the Metrel ES Manager software and uploaded to the instrument. On the instrument parameters and limits of individual single test in the Auto Sequence® can be changed / set.

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

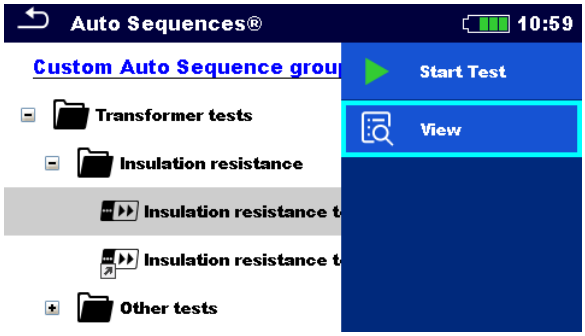
Go to location	Go to location in Auto Sequences® menu
Start Test	Start Auto Sequence
View	View Auto Sequence

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.

Insulation resistance test	The original Auto Sequence®.
Insulation resistance test_Shortcut	A shortcut to the original Auto Sequence®.



Start Test	Start of Auto Sequence®
View	Detailed view of Auto Sequence®

7.2 Auto Sequence®

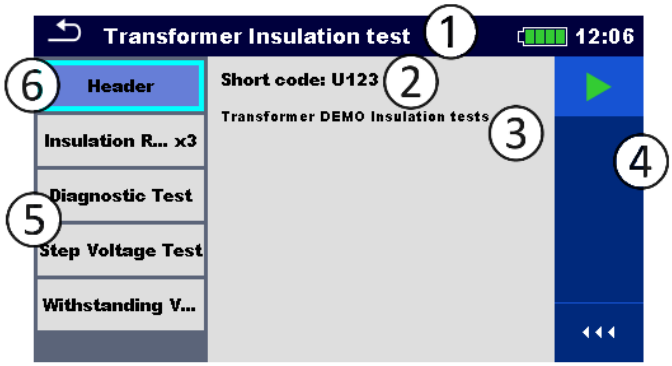
Carrying out Auto Sequences® step by step

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

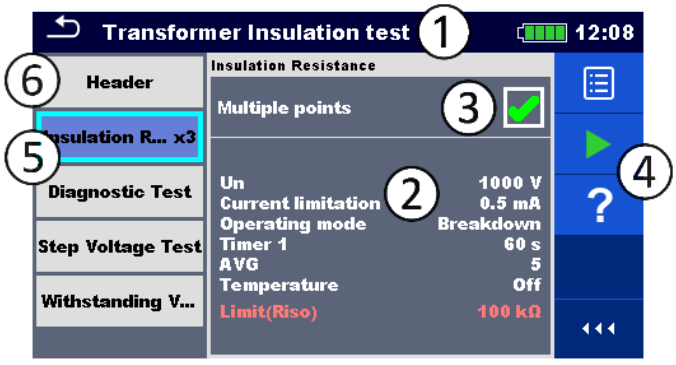


Header is selected:

1	Auto Sequence® name
2	Short code
3	Description
4	Control panel (Options)
5	Single tests
6	Header

Options:

Start Test	Start of Auto Sequence®



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

Options:

Parameters	View/edit parameters
Start Test	Start of Auto Sequence®
Help	View help screens

Enable multiple points testing: set Multiple points, see Managing multiple points.

7.2.2 Indication of Loops

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.

7.2.3 Managing multiple points

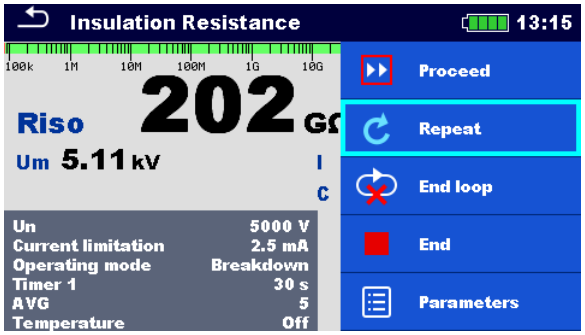
If the test object has more than one test point for an individual single test and the selected Auto Sequence® predicts only one test point (one single test) it is possible to change the Auto Sequence® appropriately. Single tests with enabled Multiple points ticker will be executed in a continuous loop. It is possible to exit the loop anytime at the end of each individual measurement.

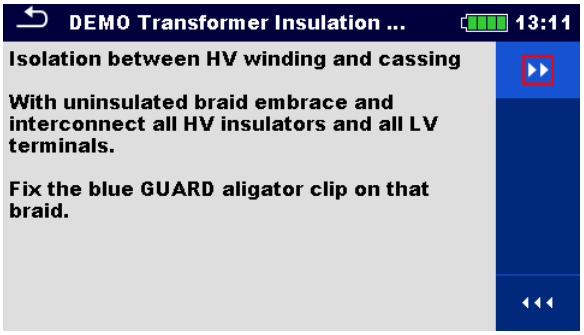
The Multiple points setting is valid only for the actual Auto Sequence®. If the user often tests objects with more than one test points it is recommended to program a special Auto Sequence® with pre-programmed loops.

7.2.4 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 sound On / Off mode



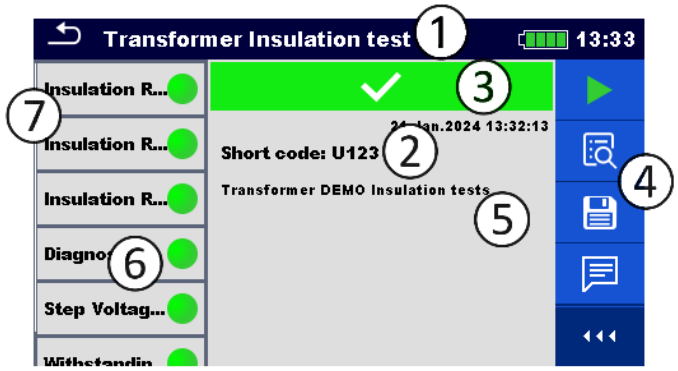


The offered options in the control panel depend on the selected single test, its result and the programmed test flow.

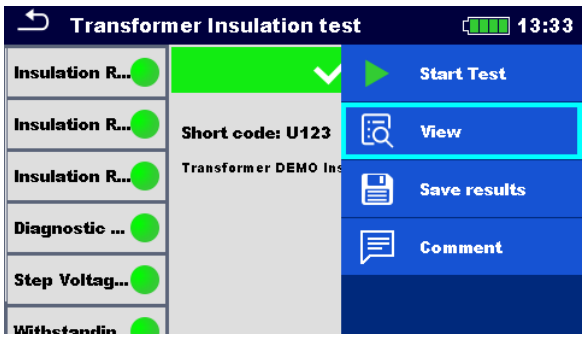
Proceed	Proceeds to the next step in the test sequence.
Repeat	Repeat the measurement.
End loop	Exit the loop of single tests and proceeds to the next step.
End	End the Auto Sequence® and go to result screen.
Parameters	View parameters/limits of single test.
Comment	Add comment

7.2.5 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 are 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



Result screen options:

Start Test	Start a new Auto Sequence®
View	View results, parameters and limits of individual measurements.
Comment	Add comment to Auto Sequence
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.

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 Li – ion battery pack guidelines

Li – ion rechargeable battery pack requires routine maintenance and care in their use and handling. Read and follow the guidelines in this Instruction manual to safely use Li – ion battery pack and achieve the maximum battery life cycles.
Do not leave batteries unused for extended periods of time – more than 6 months (self – discharge). Rechargeable Li – ion battery pack has a limited life and will gradually lose their capacity to hold a charge. As the battery loses capacity, the length of time it will power the product decreases.

Storage:

- Charge or discharge the instruments battery pack to approximately 50% of capacity before storage.
- Charge the instrument battery pack to approximately 50% of capacity at least once every 6 months.

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 ES Manager PC software. There are three communication interfaces available on the instrument: RS-232, USB, and Bluetooth. Instrument can also communicate to various external devices (Android devices).

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 Serial port connector using the RS232 serial communication cable.
- USB communication: connect a PC USB port to the instrument USB communication port connector using the USB interface cable.
- Switch on the PC and the instrument.
- Run the Metrel 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.

10 Technical specifications

10.1 **Insulation Resistance, Diagnostic Test, Step Voltage Test, Withstanding Voltage Test**

Nominal test voltage range ..... (50 V ... 10 kV)*, (50 V ... 15 kV)**
Voltage step ..... 50 V (50 V ... 1 kV)
100 V (1 kV ... 10 kV)*
100 V (1 kV ... 15 kV)**
Voltage output accuracy ..... -0 %, +10 % ± 10 V

Maximum short circuit / maximum load charge current ..... 3.7 mA - 4 mA
Charging rate for capacitive load ..... < 2.7 s/ µF at 10 kV*, (mains supply),
< 4.2 s/ µF at 10 kV* (battery supply)
< 4.0 s/ µF at 15 kV** (mains supply),
< 6.3 s/ µF at 15 kV** (battery supply)
Current capability at Un ..... > 3.7 mA (mains supply),
..... > 2.4 mA (battery supply)

Automatic discharge ..... yes
Discharging rate for capacitive load ..... (< 240 ms / µF, from 10 kV to 30 V)*,
(< 1.6 s / µF, from 15 kV to 30 V)**
Discharging resistance ..... (41 kΩ ± 10 %)*, (255 kΩ ± 10 %)**

Bar graph range ..... (0 ... 20 TΩ)*, (0 ... 35 TΩ)**(logarithmic scale)
Guard resistance ..... < 2 kΩ
Input AC current noise rejection ..... up to 8 mA
Input AC voltage noise rejection ..... up to 1.5 kV

Adjustable filtering options ..... Off, moving average (selectable factor AVG)
Measuring refresh rate ..... ca 1/s, first result after ca (0.7 * AVG) seconds

Insulation resistance Riso - measuring ranges

Range	Resolution
0.01 MΩ ... 9.99 MΩ	10 kΩ
10.0 MΩ ... 99.9 MΩ	100 kΩ
100 MΩ ... 999 MΩ	1 MΩ
1.00 GΩ ... 9.99 GΩ	10 MΩ
10.0 GΩ ... 99.9 GΩ	100 MΩ
100 GΩ ... 999 GΩ	1 GΩ
1.00 TΩ ... 9.99 TΩ	10 GΩ
10.0 TΩ ... 20.0 TΩ* 10.0 TΩ ... 35.0 TΩ**	100 GΩ

Measuring range in dependence on nominal voltage (Un)

Un	Range (full scale resistance R_{FS})
<100 V	100 GΩ
<250 V	200 GΩ
<500 V	500 GΩ
<1000 V	1 TΩ
<2500 V	2 TΩ
<5000 V	5 TΩ
<10 kV	10 TΩ
10 kV	20 TΩ
<15 kV**	20 TΩ**
15 kV**	35 TΩ**

Accuracy in dependence of test voltage (at typical Riso values)

Riso	Voltage	Accuracy
1.5 TΩ** 30 TΩ**	15 kV**	± 6 % of reading ± 20 % of reading
1 TΩ 20 TΩ	10 kV	± 6 % of reading ± 20 % of reading
250 GΩ 5 TΩ	5 kV	± 5 % of reading ± 13 % of reading
100 GΩ 2 TΩ	2 kV	± 5 % of reading ± 13 % of reading
50 GΩ 1 TΩ	1 kV	± 5 % of reading ± 13 % of reading
25 GΩ 500 GΩ	500 V	± 5 % of reading ± 13 % of reading
5 GΩ 100 GΩ	100 V	± 5 % of reading ± 13 % of reading

Accuracy at any other Uiso, Riso values can be calculated:

$$Accuracy(\%) = \pm\left\{\left[\left(1.05 + \frac{0.07 \times 10^{-9}}{\frac{Uiso}{Riso}}\right) - 1\right] \times 100\right\}$$

Current I

Range	Resolution	Accuracy
0.00 nA ... 9.99 nA	10 pA	±(5 % of reading + 7 D)
10.0 nA ... 99.9 nA	100 pA	± 5 % of reading
100 nA ... 999 nA	1 nA	
1.00 µA ... 9.99 µA	10 nA	
10.0 µA ... 99.9 µA	100 nA	
100 µA ...999 µA	1 µA	
1.00 mA ... 5.00 mA	10 µA	

Voltage Um

Range	Resolution	Accuracy
30 V ... 999 V	1 V	±(3 % of reading + 3 D)
1.00 kV ... 9.99 kV	10 V	
10.0 kV ... 16.0 kV**	100 V**	

Capacitance C

Range	Resolution	Accuracy
20 nF ... 999 nF	1 nF	±(5 % of reading + 3 D)
1.00 μF ... 9.99 μF	10 nF	
10.0 μF ... 50.0 μF	100 nF	

Voltage range ..... (500 V ... 10 kV)*, (500V ... 15 kV)**
Influence of parallel resistance..... accuracy valid for R >10 MΩ

Dielectric absorption ratio DAR

Range	Resolution	Accuracy
0.01 ... 9.99	0.01	Calculated value
10.0 ... 100.0	0.1	

Polarization index PI

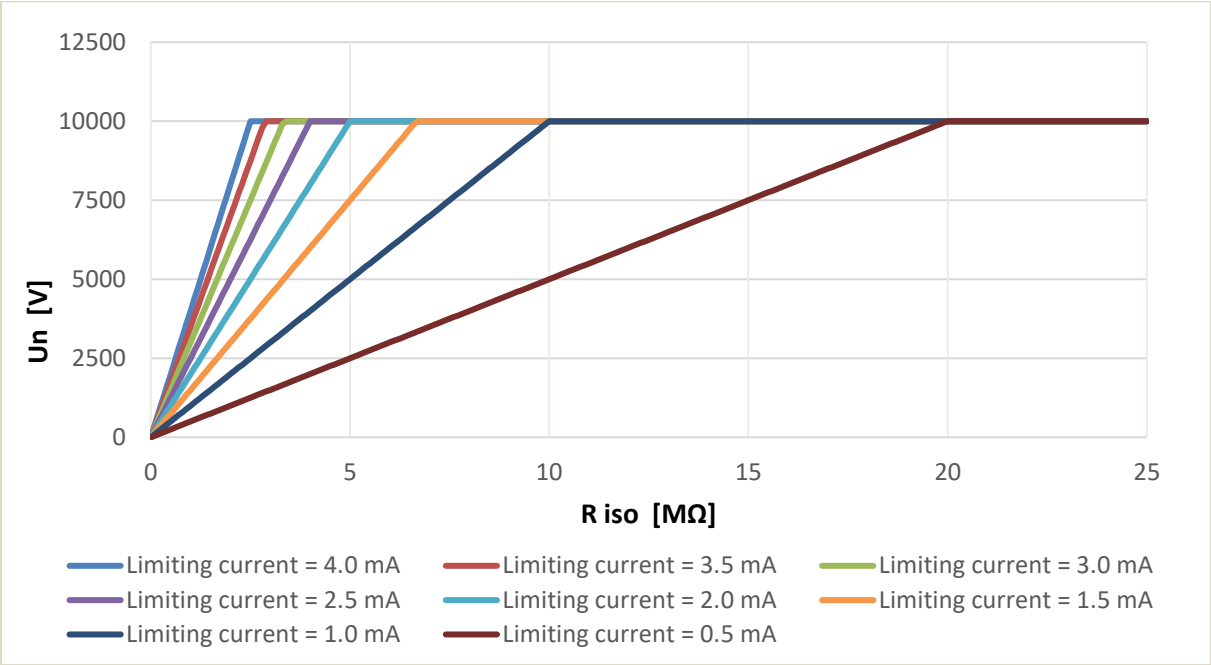
Range	Resolution	Accuracy
0.01 ... 9.99	0.01	Calculated value
10.0 ... 100.0	0.1	

Dielectric discharge test DD

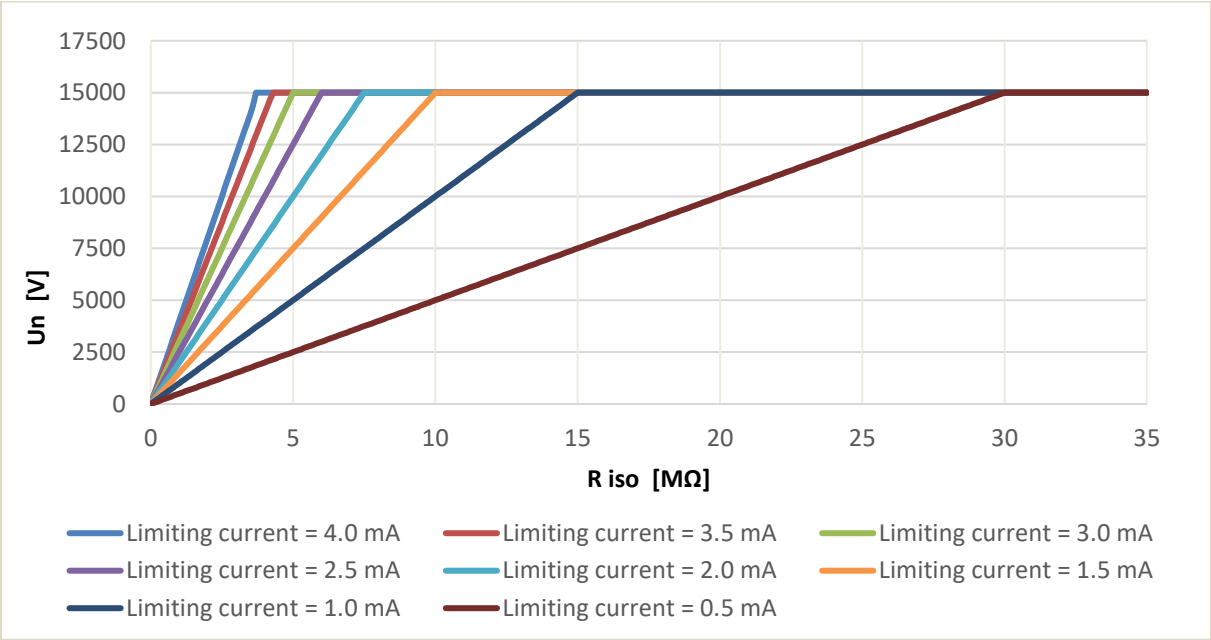
Range	Resolution	Accuracy
0.01 ... 9.99	0.01	Calculated value
10.0 ... 100.0	0.1	

Capacitance range ..... 20 nF ... 50 μF

HV generator current capability* (mains supply)



HV generator current capability** (mains supply)



*MI 3211, **MI 3215

10.2 **Voltage Meter**

	Range	Resolution	Accuracy
U	30.0 V ... 199.9 V	0.1 V	±(2 % of reading + 3 D)
	200 V ... 999 V	1 V	

	Range	Resolution	Accuracy
f	45.0 Hz ... 65.0 Hz	0.1 Hz	±(0.2 % of reading + 1 D)

Result type..... True RMS
Nominal frequency range ..... DC, 45.0 Hz to 65.0 Hz
Input resistance MI 3215..... ca 255 kΩ @ 1000 V, ca 1 MΩ @ 50 V
Input resistance MI 3211 ..... ca 41 kΩ @ 600 V, ca 1 MΩ @ 50 V

10.3 **General data**

Battery power supply ..... 14.4 V DC (4.4 Ah, Li-ion pack)
Battery charging time..... 4 h (deep discharge)

Battery operation time:
Auto - off timer..... 15 min (idle state)

Measurement	Condition	Operation Time
Idle state Voltage	Brightness = High	> 24 h
Insulation Resistance	Brightness = High 100 MΩ load @ 15 kV, continuous testing	> 4.5 h
	Brightness = High 100 MΩ load @ 10 kV, continuous testing	> 6 h

Nominal mains power supply ..... 100 ... 240 V_{AC}, 45 ... 65 Hz, 100 VA
Overvoltage category..... 300 V CAT II
Protection classification..... reinforced insulation ⧈
Measuring category..... (600 V CAT IV)*, (1000 V CAT IV)**
Pollution degree 2
Degree of protection..... IP 65 (case closed) / IP 40 (case open)
Dimensions (w × h × d)..... 36 cm x 16 cm x 33 cm
Weight ..... 6.2 kg*, 6.3 kg**, (without accessories)
Sound / Visual warnings ..... yes
Display ..... 4.3'' (10.9 cm) 480 × 272 pixels TFT colour display with touch screen

EMC:
Emission ..... Class A
Immunity ..... Industrial EM environment

Reference conditions:
Reference temperature range ..... 25 °C ± 5 °C
Reference humidity range..... 40 %RH ... 60 %RH

Operation conditions:
Working temperature range ..... -20 °C ... 50 °C
Maximum relative humidity ..... 90 %RH (0 °C ... 40 °C), non-condensing
Working nominal altitude ..... up to 3000 m
Operation ..... Indoor use

Storage conditions:

Temperature range..... -20 °C ... 70 °C
Maximum relative humidity ..... 90 %RH (-10 °C ... 40 °C)
80 %RH (40 °C ... 60 °C)

USB communication:
USB ..... USB 2.0 Hi speed interface
Connector..... standard USB connector - type B

Bluetooth communication:
Bluetooth module ..... class 1

Data:
Data storage capacity..... 8 GB internal SD memory card
PC software..... yes

*MI 3211, **MI 3215

Specifications are quoted at a coverage factor of k = 2, equivalent to a confidence level of approximately 95 %.
Accuracies apply for 1 year in reference conditions. Temperature coefficient outside these limits is 0.2 % of measured value per °C, and 1 digit.

Appendix A Structure objects

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

Symbol	Default name	Description
	Node	Node
	Project	Project
	Location	Location
	Element	Universal element

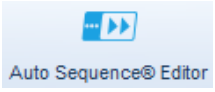
Appendix B Profile Notes

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

Appendix C Programming of Auto Sequences® on Metrel ES Manager

The Auto Sequence® Editor is a part of the Metrel ES Manager software. In Auto Sequence® Editor an Auto Sequence® can be pre-programmed and organized in groups, before uploaded to the instrument.

C.1 Auto Sequence® Editor workspace

To enter Auto Sequence® Editor's workspace, select 

in Home Tab of Metrel ES Manager PC SW. Auto Sequence® Editor workspace is divided in four main areas.

On the left side ❶,structure of selected group of Auto Sequence® is displayed. In the middle part of the workspace ❷, the elements of the selected Auto Sequence® are shown. On the right side, list of available single tests ❸ and list of flow commands ❹ are shown.

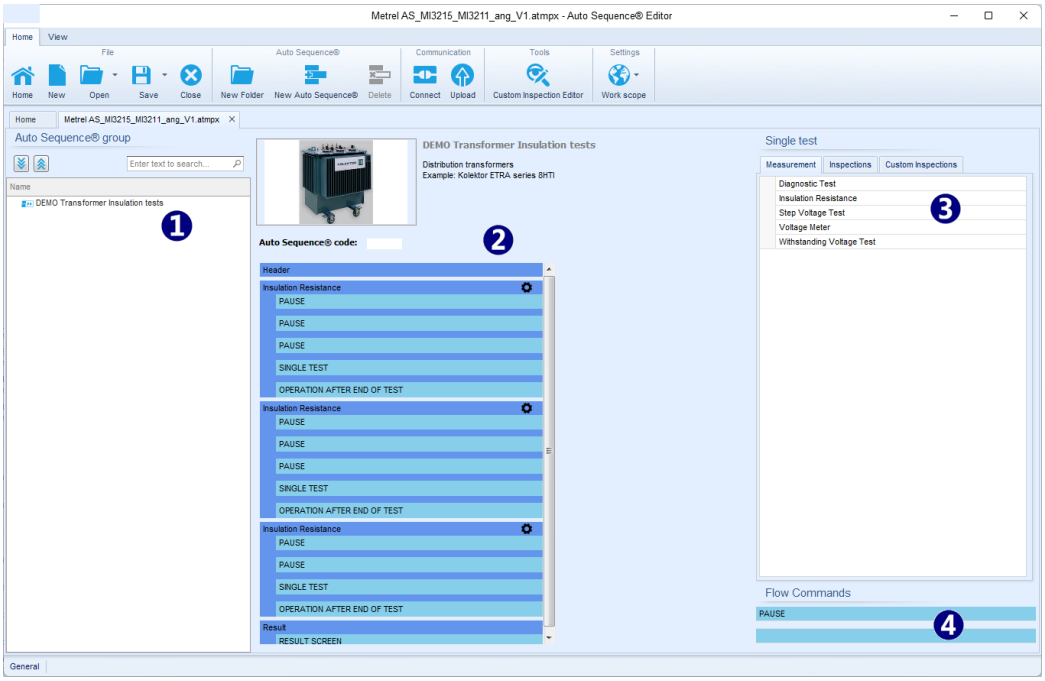


Figure C.1: Auto Sequence® Editor workspace

An Auto Sequence® ❷ begins with Name, Description and Image, followed by the first step (Header), one or more measuring steps and ends with the last step (Result). By inserting appropriate Single tests (measurements, inspections and custom inspections) ❸ and Flow commands ❹ and setting their parameters, arbitrary Auto Sequences® can be created.

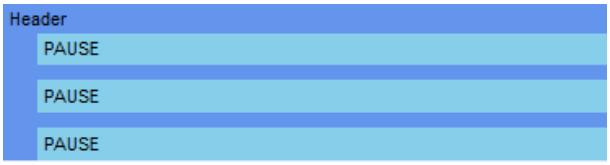


Figure C.2: Example of an Auto Sequence® header

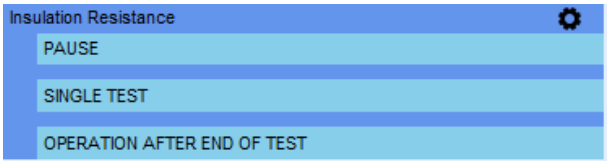


Figure C.3: Example of a measurement step

Figure C.4: Example of an Auto Sequence® result part

C.2 Managing groups of Auto Sequences®

The Auto Sequences® can be divided into different user defined groups of Auto Sequences®. Each group of Auto Sequences® is stored in a file. More files can be opened simultaneously in Auto Sequence® Editor.
Within Group of Auto Sequences®, tree structure can be organized, with folders / subfolders containing Auto Sequences®. The three structure of currently active Group is displayed on the left side of the Auto Sequence® Editor workspace, see Figure C.5.

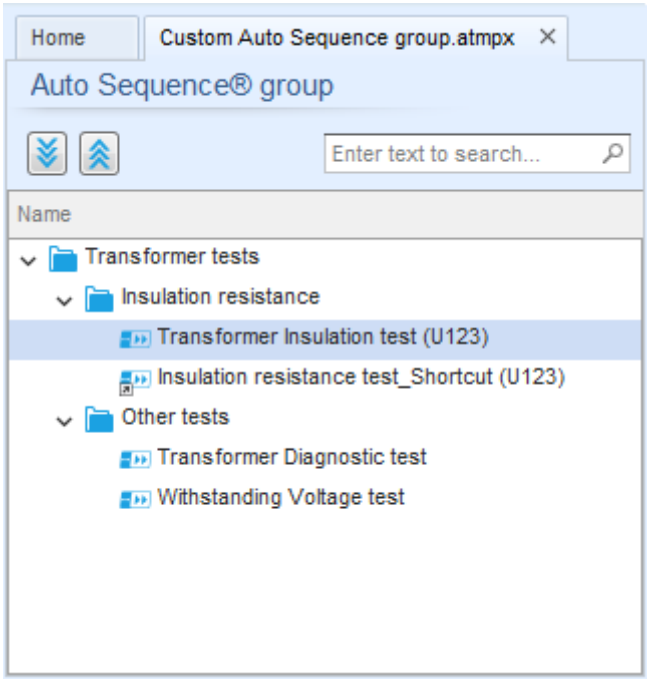


Figure C.5: Group of Auto Sequences® tree organization

Operation options on Group of Auto Sequences® are available from menu bar at the top of Auto Sequence® Editor workspace.

File operation options:

	Opens starting Auto Sequence® Editor screen.
	Opens a file (Group of Auto Sequences®).
	Creates a new file (Group of Auto Sequences®).
	Saves / Saves as the opened Group of Auto Sequences® to a file.
	Closes the file (Group of Auto Sequences®).

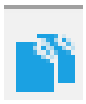
Group of Auto Sequence® view options:

	Expand all folders / subfolders / Auto Sequences®.
	Collapse all folders / subfolders / Auto Sequences®.
	Search by name within Auto Sequence® group. See Appendix C.2.2 Search within selected Auto sequence® group for details.

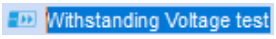
Group of Auto Sequences® operation options (also available by right clicking on Folder or Auto Sequence®):

	Adds a new folder / subfolder to the group
	Adds a new Auto Sequence® to the group
	Deletes: -the selected Auto Sequence® -the selected folder with all subfolders and Auto Sequences®

Right click on the selected Auto Sequence® or Folder opens menu with additional possibilities:

	Auto Sequence®: Edit Name, Description and Image (see Figure C.6). Folder: Edit folder name
	Auto Sequence®: Copy to clipboard Folder: Copy to clipboard including subfolders and Auto Sequences®
	Auto Sequence®: Paste it to selected location Folder: Paste it to selected location
	Auto Sequence®: Creates shortcut to selected Auto Sequence®

Double click on the object name allows name edit:

DOUBLE CLICK	Auto Sequence® name: Edit Auto Sequence® name  Folder name: Edit folder name 

Drag and drop of the selected Auto Sequence® or Folder / Subfolder moves it to a new location:

DRAG & DROP	"Drag and drop" functionality is equivalent to "cut" and "paste" in a single move.  move to folder  insert

C.2.1 Auto Sequences® Name, Description and Image editing

When EDIT function is selected on Auto Sequence®, menu for editing presented on Figure C.6 appear on the screen. Editing options are:
Name: Edit or change the name of Auto Sequence®.
Description: Any text for additional description of Auto Sequence® can be entered.
Image: Image presenting Auto sequence® measuring arrangement can be entered or deleted.

▪▪▪	Enters menu for browsing to Image location.
✖	Deletes the Image from Auto Sequence®.

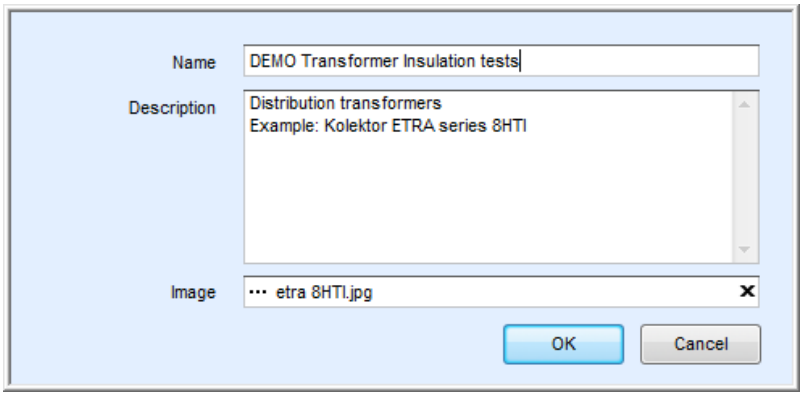


Figure C.6: Editing the Auto Sequence® header

C.2.2 Search within selected Auto sequence® group

By entering the text into search box and click on the search icon, found results are highlighted with orange background and first found result (Folder or Auto Sequence®) is focused. Click on the Search icon again focus next search result. Search functionality is implemented in Folders, Subfolders and Auto Sequences® of selected Auto Sequence® Group.

Search text can be cleared by selecting the Clear button.

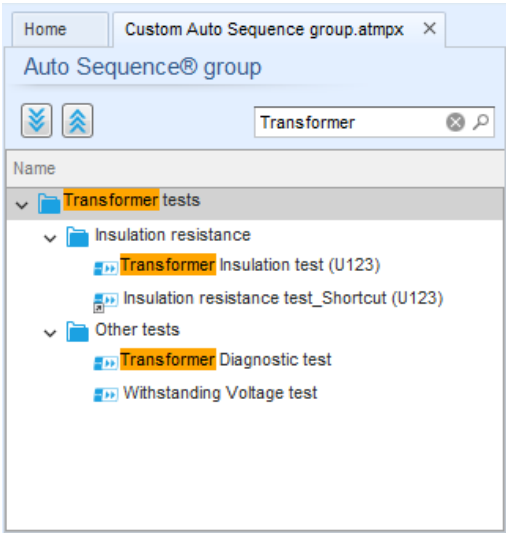


Figure C.7: Example of Search result within Auto Sequence® group

C.3 Elements of an Auto Sequence®

C.3.1 Auto Sequence® steps

There are three kinds of Auto Sequence® steps.

Header

The Header step is empty by default. Flow commands can be added to the Header step.

Measurement step

The Measurement step contains a Single test and the Operation after end of test flow command by default. Other Flow commands can also be added to the Measurement step.

Result

The Result step contains the Result screen flow command by default. Other Flow commands can also be added to the Result step.

C.3.2 Single tests

Single tests are the same as in Metrel ES Manager Measurement menu.
Limits and parameters of the measurements can be set. Results and sub-results can't be set.

C.3.3 Flow commands

Flow commands are used to control the flow of measurements. Refer to chapter *C.5 Description of flow commands* for more information.

C.3.4 Number of measurement steps

Often the same measurement step has to be performed on multiple points on the device under test. It is possible to set how many times a Measurement step will be repeated. All carried out individual Single test results are stored in the Auto Sequence® result as if they were programmed as independent measuring steps.

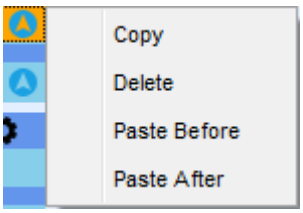
C.4 Creating / modifying an Auto Sequence®

If creating a new Auto Sequence® from scratch, the first step (Header) and the last step (Result) are offered by default. Measurement steps are inserted by the user.

Options:

Adding a measurement step	By double clicking on a Single test a new measurement step will appear as the last of measurement steps. It can also be dragged and dropped on the appropriate position in the Auto Sequence®.
Adding flow commands	Selected flow command can be dragged from the list of Flow commands and dropped on the appropriate place in any Auto Sequence® step.
Changing position of flow command inside one step	By a click on an element and use of  keys.
Viewing / changing parameters of flow commands or single tests.	By a double click on the element.
Setting number of measurement steps	By setting a number in the  field.

Right click on the selected measurement step / flow command



Copy – Paste before
A measurement step / flow command can be copied and pasted above selected location on the same or on another Auto Sequence®.
Copy – Paste after
A measurement step / flow command can be copied and pasted under selected location on the same or on another Auto Sequence®.
Delete
Deletes the selected measurement step / flow command.

C.5 Description of flow commands

Double click on inserted Flow Command opens menu window, where text or picture can be entered, external commands can be activated and parameters can be set.
Flow commands Operation after end of test and Results screen are entered by default, others are user selectable from Flow Commands menu.

Pause

A Pause command with text message or picture can be inserted anywhere in the measuring steps. Warning icon can be set alone or added to text message. Arbitrary text message can be entered in prepared field Text of menu window.

Parameters:

Pause type	Show text and/or warning (check ☑ to show warning icon) Show picture (▪▪▪ browse for image path)
Duration	Number in seconds, infinite (no entry)

Operation after end of test

This flow command controls the proceeding of the Auto Sequence® in regard to the measurement results.

Parameters:

Operation after end of test – pass – fail – no status	The operation can be individually set for the case the measurement passed, failed or ended without a status.	
	Manual –	The test sequence stops and waits for appropriate command (Enter key) to proceed.
	Auto –	The test sequence automatically proceeds.

Result screen

This flow commands control the proceeding after the Auto Sequence® has ended.

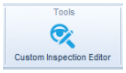
Parameters:

Auto save ☑	Auto Sequence® results are stored in the momentary workspace. A new Node with the date and time will be created. Under the Node, Auto Sequence® results will be stored. Up to 100 Auto Sequence® results can be automatically stored under the same node. If more results are available, they are split to multiple nodes. Auto save Flow setting is disabled by default. Note: This flow command is active only if Auto Sequence® is started from the Auto Sequence® Main menu (not from the Memory organizer).

C.6 Custom Inspection programming

Arbitrary set of tasks dedicated to specific user defined Inspections can be programmed with application of Custom Inspection Editor Tool, accessible from Auto Sequence® Editor workspace. Custom Inspections are stored in dedicated file *.indf with user defined name. For application of Custom Inspections as a single test within Auto Sequence® group, appropriate file containing specific Custom Inspection should be opened first.

C.6.1 Creating and editing Custom Inspections

Custom Inspection Editor workspace is entered by selecting 

icon from Auto Sequences® main menu. It is divided in two main areas, as presented on *Figure C.8*.

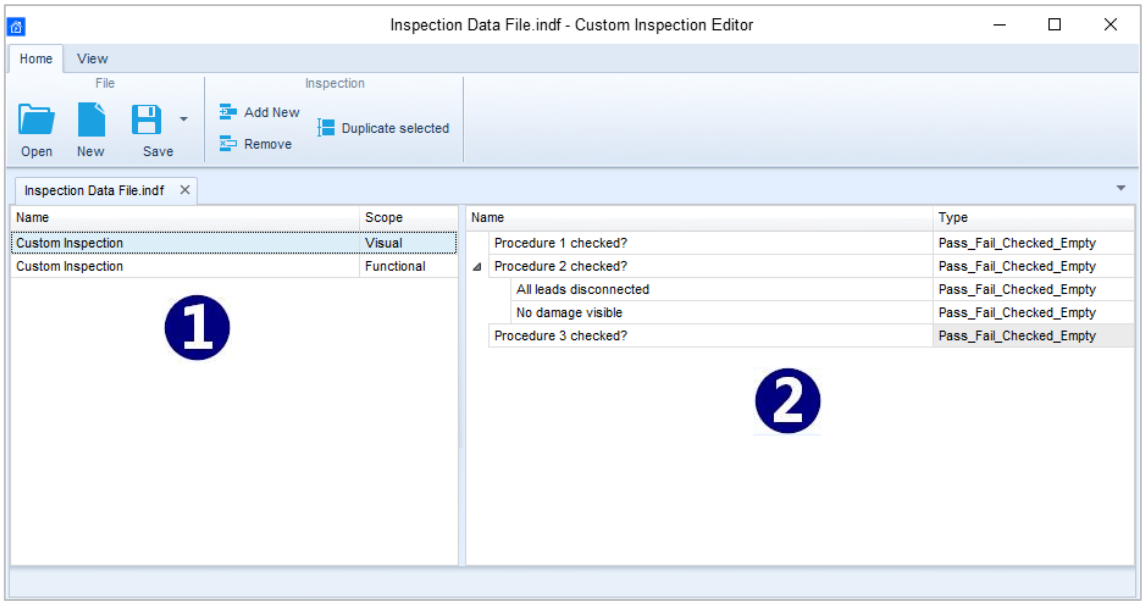
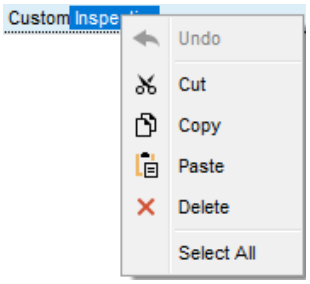


Figure C.8: Custom Inspection Editor Workspace

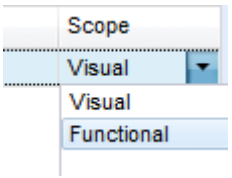
Custom Inspection Editor Main menu options:

	Opens existing Custom Inspection Data file. By selecting, menu for browsing to location of *.indf file containing one or more Custom Inspections data appear on the screen. Selected file is opened in dedicated tab marked with file name.
	Creates a new Custom Inspection Data file. New tab with empty workspace is opened. Default name of the new tab is Inspection Data File; it could be renamed during Save procedure.
	Save / Save as Custom Inspection Data file opened on active tab. Menu for browsing to the folder location and editing of file name is opened. Browse to the location, confirm overwriting, if file already exists or edit file name to save it as a new Custom Inspection Data file.
	Add New Custom Inspection. New inspection with default name Custom Inspection and default scope Visual appear on the editor workspace. It contains one Item task with default name Custom Inspection and default Type Pass_Fail_Checked_Empty. Default Name and Type can be edited – changed.
	Remove selected custom inspection. To select inspection, click to the inspection Name field. To remove it, select icon from editor main menu. Before removal, user is asked to confirm deletion.
	Duplicates selected Custom Inspection. Selected Custom Inspection including Scope and all Custom Inspection items and sub-items, or only selected Custom Inspection Item or sub-item including Type can be duplicated.

Edit Name and Scope of Inspection

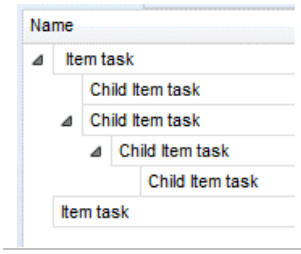


Inspection Name edit:
Click to the Inspection Name field to start editing it.
Drag cursor, with left mouse button pressed, to select letters and words. Position cursor and double-click to select word of the name. Actions could be performed with keyboard also.
Press right mouse button to activate Edit menu and select appropriate action as presented on the left figure. Menu is case sensitive; options currently not available are greyed out.

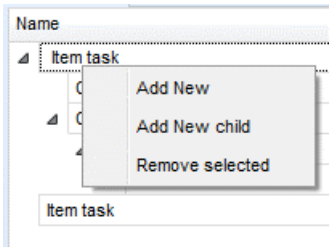


Inspection Scope edit:
Click to Inspection Scope field to open selection menu presented on left figure. Options:
Visual is intended for observation of test object
Functional allows functional test of observed object

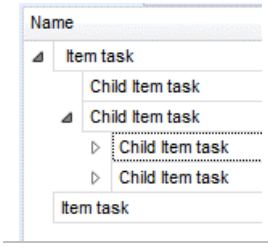
Edit Item task structure of Inspection



Item tasks of the selected Inspection are listed in Name column on the right side of Editor workspace.
Each Item task can have Child Item tasks, Child Item can have its own Child Item tasks and so on.
Arbitrary tree structure of Item tasks and subtasks can be built as presented on left figure.



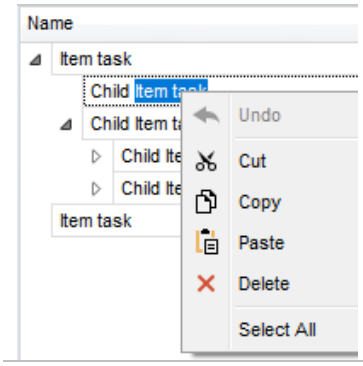
ADD New Item task procedure:
Position cursor above Item task Name and apply right mouse click to select Item task and open menu with options:
Add New: new Item task is added on the top tree level
Add New Child: new child Item task is added under selected Item
Remove selected: delete selected Item task with all subtasks
Default Name of New Item task is Custom Inspection, default Type Pass_Fail_Checked_Empty and both can be edited – changed.



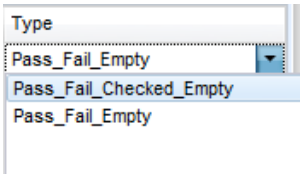
Item tasks containing Child Item tasks are marked with triangle in front of their Name.
Click on triangle mark:

- collapse Item task tree structure
- expands Item task tree structure

Edit Name and Type of Item task



Edit Name of Item task:
Click to the Item task Name field to start editing it.
Drag cursor, with left mouse button pressed, to select letters and words. Position cursor and double-click to select word of the name. Actions could be performed with keyboard also.
Press right mouse button to activate Edit menu and select appropriate action as presented on the left figure. Menu is case sensitive; options currently not available are greyed out.

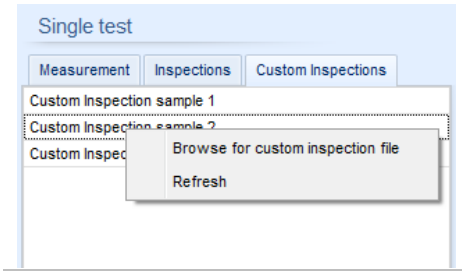


Edit Type of Item task:
Click to Item Type field to open selection menu presented on left figure. Selectable checkbox status assignment options are:
Pass_Fail_Checked_Empty: Pass, Fail, Checked, Empty (default)
Pass_Fail_Empty: Pass, Fail selection, Empty (default) value

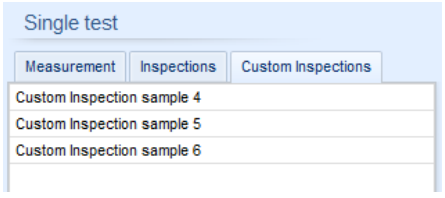
C.6.2 Applying Custom Inspections

Custom inspections can be applied in Auto Sequences®. Direct assignment of Custom inspection to the Metrel ES manager structure objects is not possible.
After custom created Inspection Data file is opened, available inspections are listed in Custom Inspections tab of Single test area of Auto Sequence® Editor, see chapter *C.1 Auto Sequence® Editor workspace* for details.
Custom Inspection is added to Auto sequence as a Single test, see chapter *C.4 Creating / modifying an Auto Sequence®* for details.

Opening / changing Inspection Data File



Position cursor within Custom inspections List area and apply mouse right click to open Option menu:
Refresh: Refresh content of already opened Inspection Data file.
Browse for custom Inspection file:
Menu for browsing to folder location of new Inspection Data file is opened.



After confirmation of selection, new Inspection Data file is opened and list of available Custom Inspections is changed.
Note:
If Metrel ES Manager Work scope is changed, opened Inspection Data file remains active and available Custom Inspections remains the same.

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