# MI 3211 TeraOhmHP 10 kV
# MI 3215 TeraOhmHP 15 kV

## Instruction manual

*Ver. 1.4.4, code no. 20 753 388*

METREL®

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

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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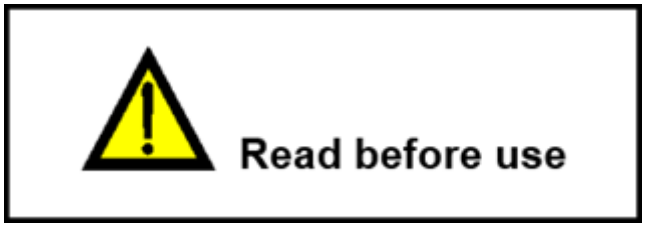
## 1.1 **Warnings and notes**




### 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.

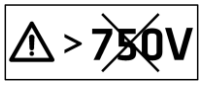
| | |
|---|---|
| Working with the instrument – safety precautions for insulation tests | Make sure that the tested object is disconnected (mains voltage disconnected) and de-energized before connecting the test leads and starting the measurement<br>Always connect accessories to the test equipment and 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!<br>In case of a capacitive test object, automatic discharge of the object may not be done immediately after finishing the measurement.<br>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):<br>U < 50 V: test will start normally<br>MI 3215: U = 50 V to 1000 V: test will start, noise icon will lit. Results may be impaired.<br>U > 1000 V: test will not start, noise icon will lit.<br>MI 3211: U = 50 V to 600 V: test will start, noise icon will lit. Results may be impaired.<br>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 (Quick Guide)
- Metrel ES Manager*

## 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 (Quick Guide)
- Metrel ES Manager*

*Metrel ES Manager and all documentation can be downloaded free of charge from Metrel Web server (*https://www.metrel.si/en/downloads/*) or Metrel Documentation center (*https://doc.metrel.si/*).

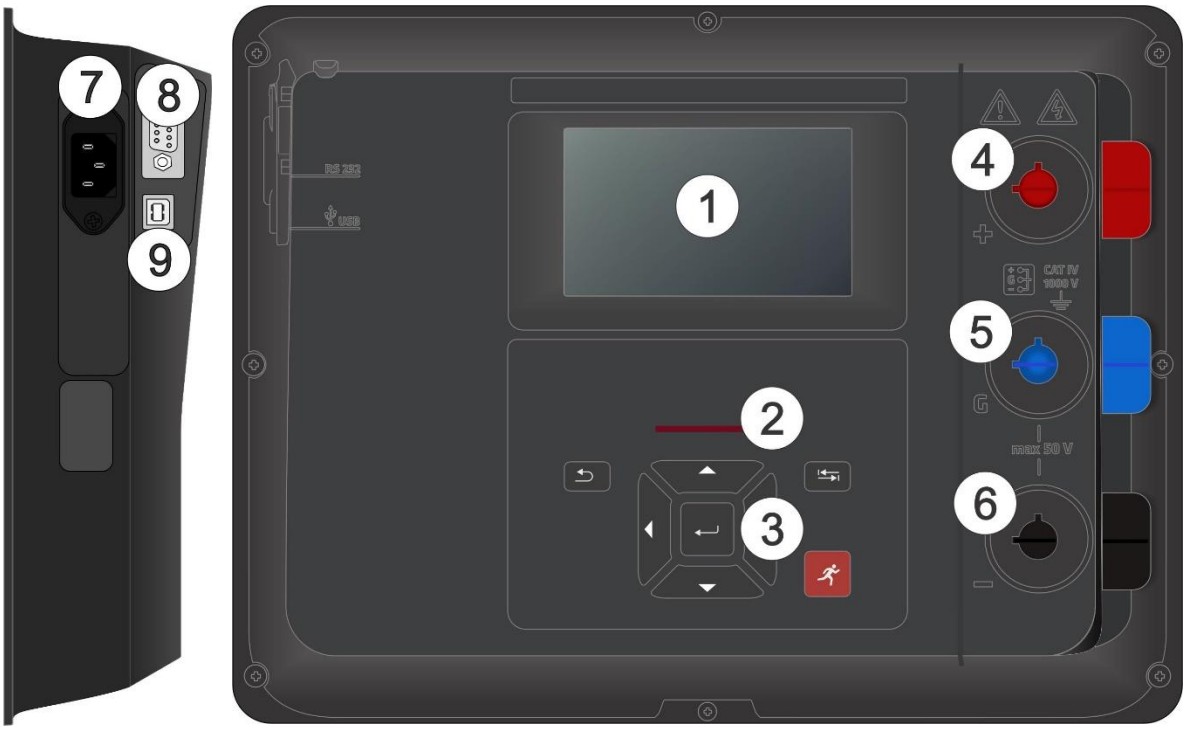
See the attached sheet "*Included in the Set*".

## 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

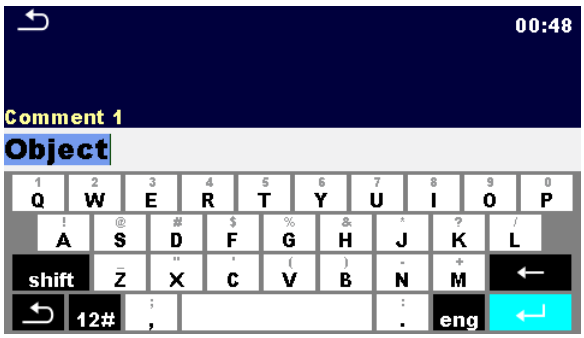
| | |
|---|---|
|  | Cursor keys are used to:<br>• select appropriate option;<br>• Left, right, up, down;<br>• In some functions: page up, page down. |
|  | Enter key is used to<br>• confirm selected option; |
|  | Run key is used to:<br>• start measurement if pressed and held for 3 s;<br>• stop measurement. |
|  | Escape, On/Off key is used to:<br>• return to previous menu without changes;<br>• abort / stop measurements<br>• switch On / Off the instrument;<br>• hard switch off (by hardware) the instrument if pressed and held for 5 s. |
|  | Option key is used to:<br>• expand column in control panel;<br>• Show detailed view of options. |

## 4.2 General meaning of touch gestures

| | |
|---|---|
|  | Tap (briefly touch surface with fingertip) is used to:<br>• Select appropriate option.<br>• Confirm selected option.<br>• Start and stop measurements. |

| | |
|---|---|
|  | Swipe (press, move, lift) up/ down is used to:<br>• Scroll content in same level.<br>• Navigate between views in same level. |
| long  | Long press (touch surface with fingertip for at least 1 s) is used to:<br>• Select additional keys (virtual keyboard). |
|  | Tap Escape icon is used to:<br>• Return to previous menu without changes.<br>• 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**

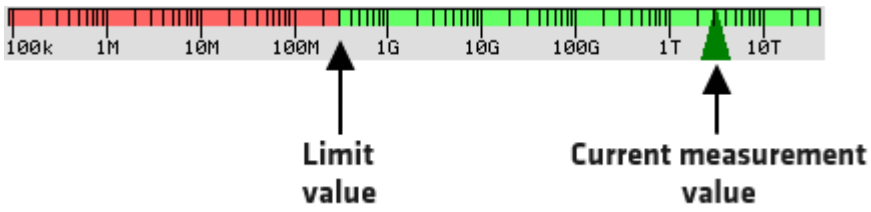
At start up and during operation the instrument performs various safety checks to ensure safety and to prevent any damage. If a safety check fails, an appropriate warning message will be displayed, and safety measures will be taken.

### 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).



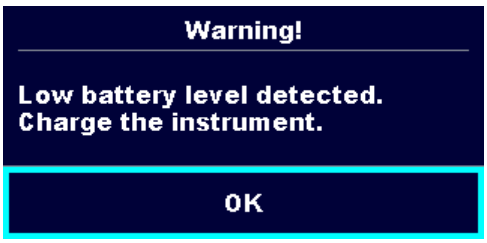

### **4.4.3** Battery

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. |

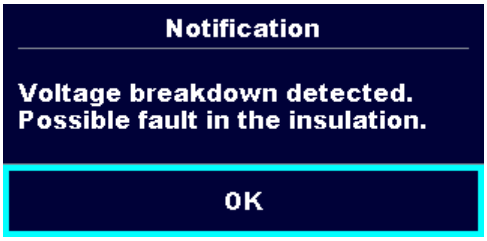
### **4.4.4** Messages

In the message field warnings and messages are displayed.



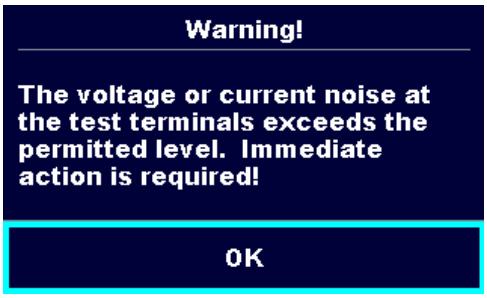

Low battery level is detected.

The measurement is aborted.



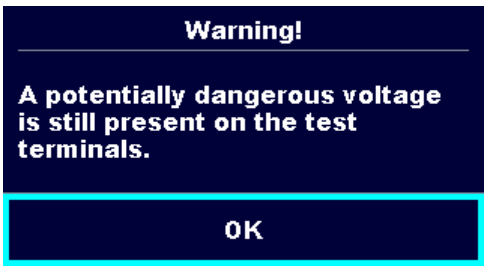

Voltage breakdown is detected.

The measurement immediately ends.



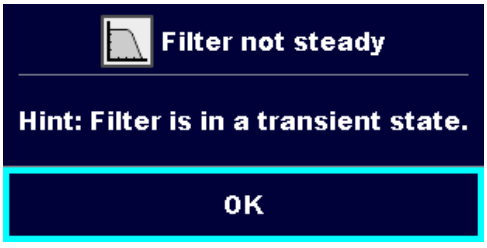

The voltage or current noise at the test terminals exceeds the permitted level. Immediate action is needed!

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

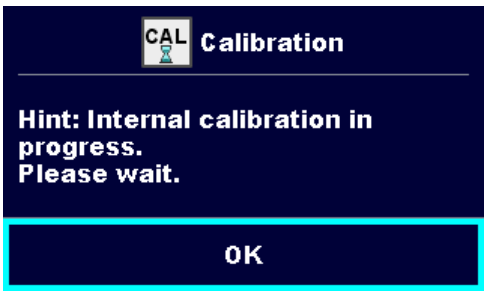
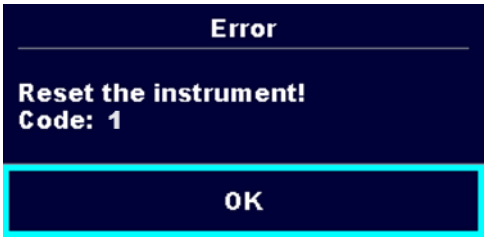



Voltage >50 V is still present on the test terminals and cannot be discharged automatically. Possible reasons:

- Presence of AC noise voltage on test terminals.
- Discharge circuit failure. Consider all safety precautions and manually discharge the test object.




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.<br>Measurement is not allowed to start. |
|  | Self-calibration error is detected.<br>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.<br>Result is inside predefined limits. |

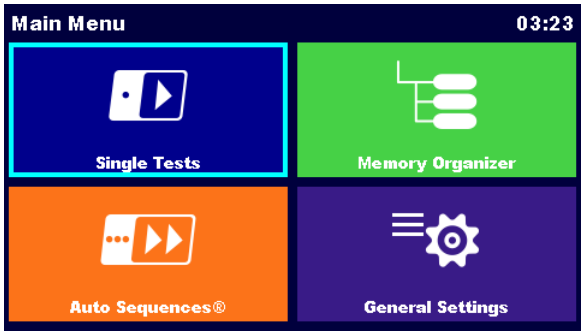
| | |
|---|---|
|  | Test failed.<br>Result is out of predefined limits. |
|  | Bluetooth communication active. |

**Hint**

For some icons more information is displayed if  on icon.

## 4.5 Instrument main menu

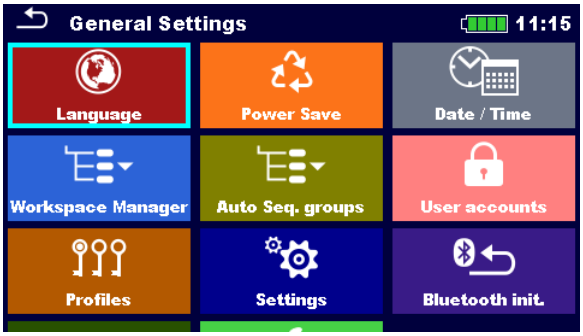
From the instrument Main Menu four main operation menus can be selected.

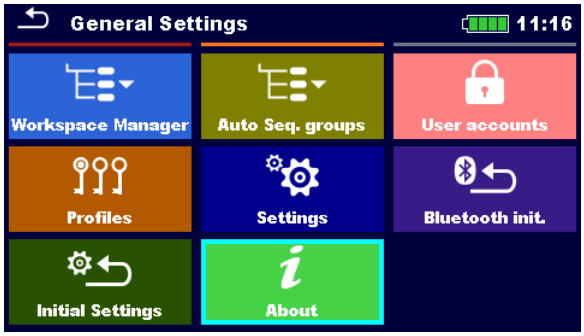



| | |
|---|---|
| Single Test | Menu for selecting single tests |
| Auto Sequences® | Menu for selecting Auto sequence® |
| Memory Organizer | Menu for working with structured test objects and measurements |
| General Settings | Menu for setup of the instrument |

## 4.6 General settings menu

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



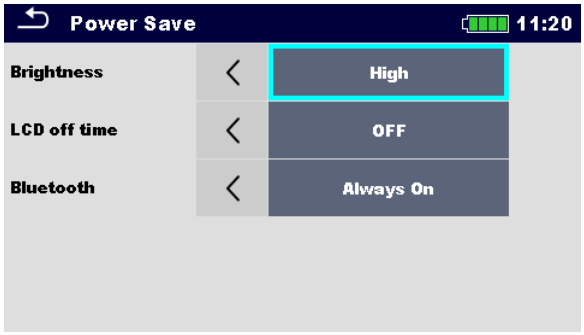




| | |
|---|---|
| Language | Language selection |
| Power Save | Brightness of LCD, enabling/disabling Bluetooth communication |
| Date / Time | Setting date and time |
| Workspace Manager | Managing project files |

| | |
|---|---|
| Auto Sequence® groups | Managing lists of Auto Sequences® |
| User accounts | Managing user accounts |
| Profiles | Instrument profiles<br>(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 |

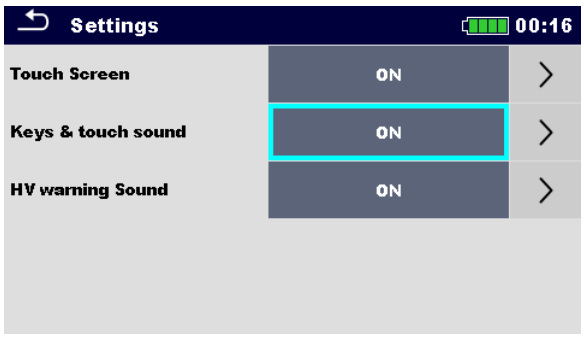
### 4.6.1 Power Save

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.<br>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.

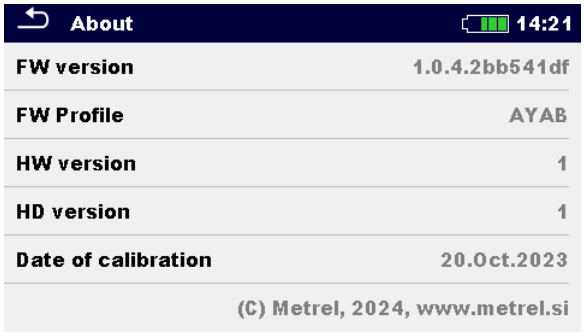
Note

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:

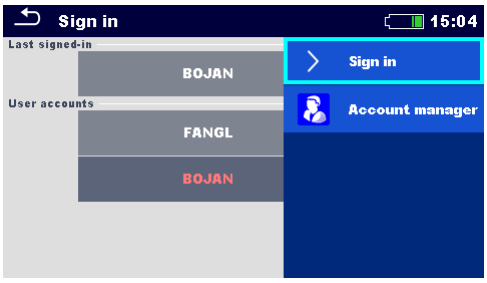
- Setting if signing in to work with the instrument is required or not.
- Adding and deleting new users, setting their user names and passwords.
- Setting the password for allowing Black Box operation.

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 |

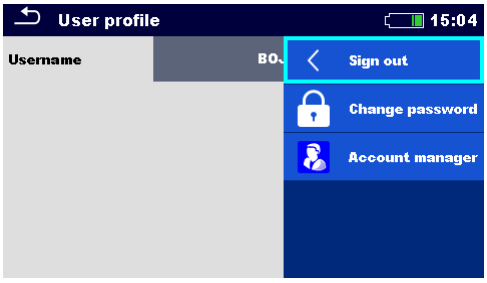
**Note**

- 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.



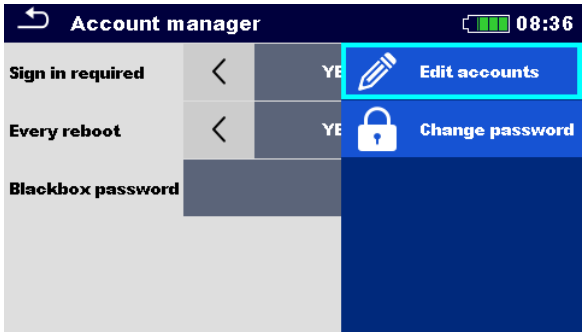

User sign out: select Sign out

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

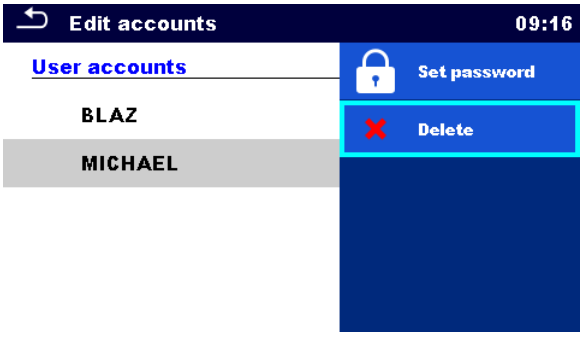
Account manager sign out: is automatic by exiting the Account manager menu.

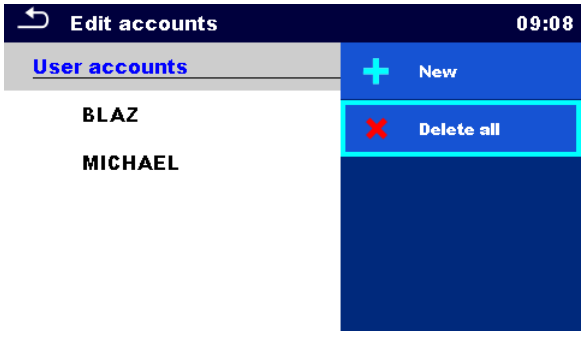
## 4.6.6 Managing accounts

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.

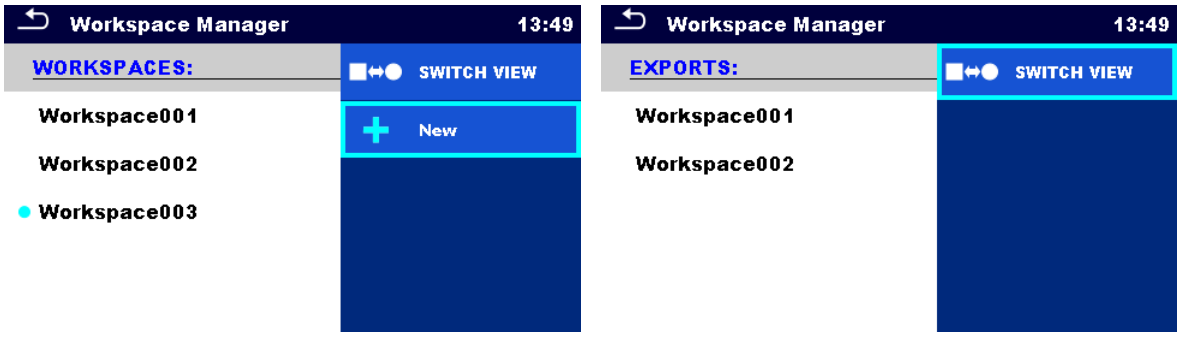
## 4.8 Workspace Manager

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

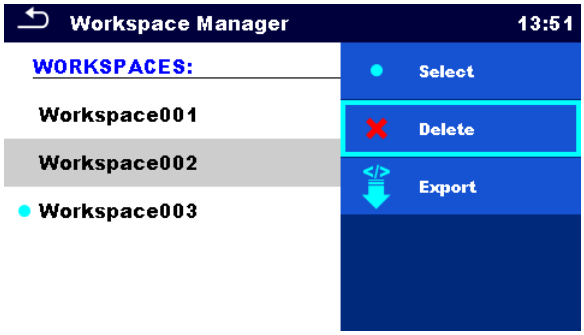
### 4.8.1 Workspaces and Export

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.

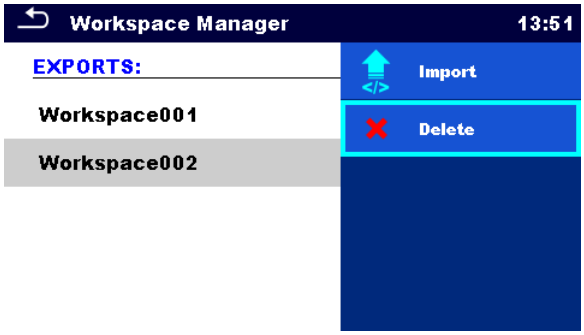
Export files can be read by Metrel applications that run on other devices. Exports are suitable for making backups of important works. To work on the instrument an Export should be imported first from the list of Exports and converted to a Workspace. To be stored as Export data a Workspace should be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



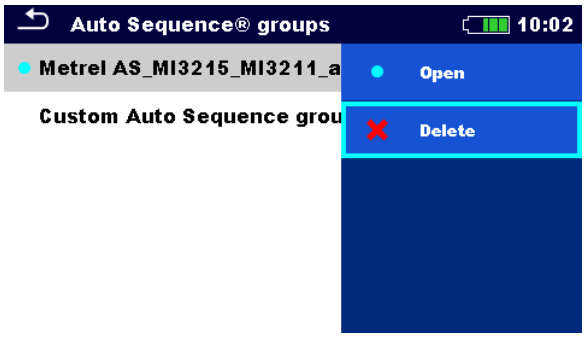

| | |
|---|---|
| Select | Open selected Workspace in Memory Organizer |
| Delete | Delete selected Workspace |
| Export | Export selected Workspace into an Export |




| | |
|---|---|
| Import | Import selected Export to a Workspace |
| Delete | Delete selected Export |

## 4.9 **Auto Sequence® groups**

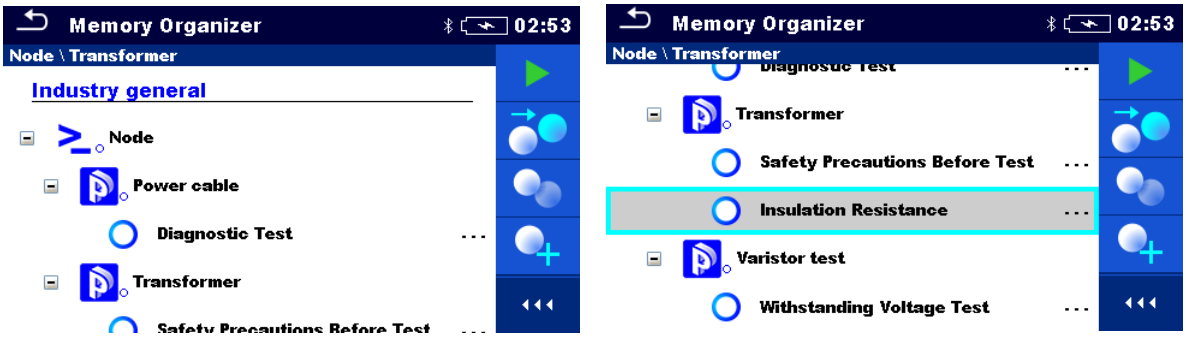
The Auto Sequences in the instrument can be organized by using lists. In a list a group of similar Auto Sequences is stored. The Auto Sequence® groups menu is intended to manage with different lists.
In Auto Sequence® groups menu lists of Auto Sequences® are displayed.



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

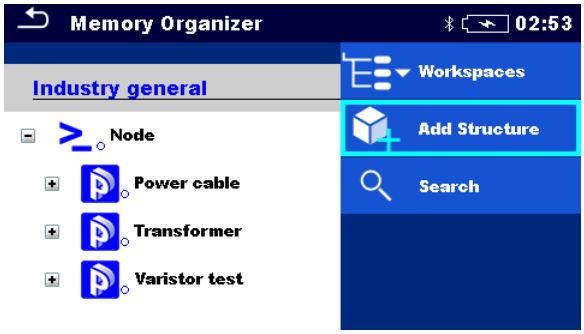
# 5 Memory Organizer

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

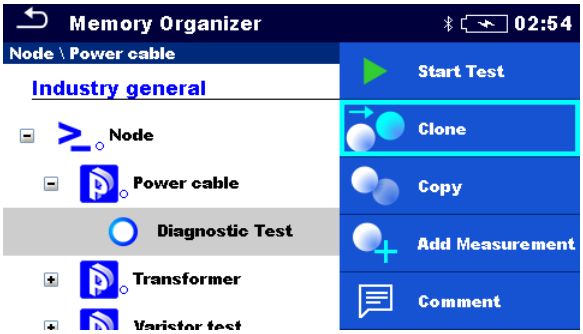


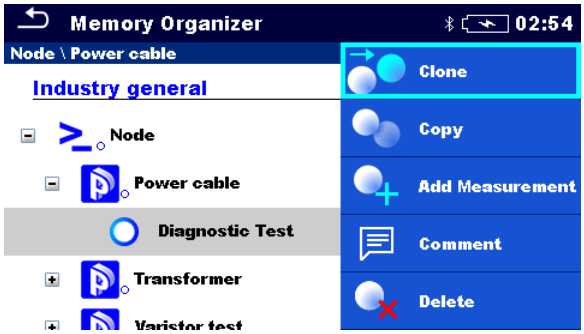

| | |
|---|---|
| Header line (Workspace), Workspaces | Go to Workspace Manager from Memory Organizer |
| Header line (Workspace), Search | Search for structure elements |

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

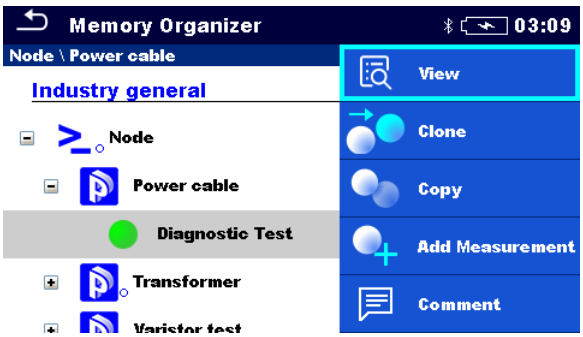
| | |
|---|---|
| Add a new node | Header line (Workspace), Add structure |

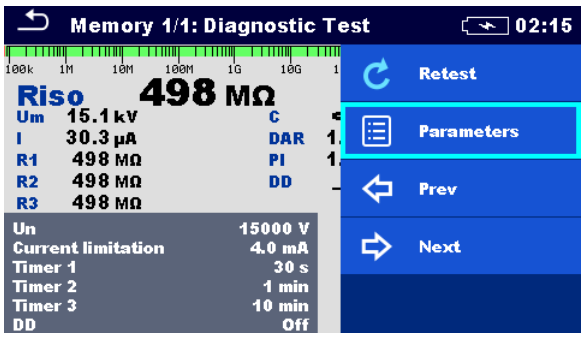
## 5.1.2 Operations on measurements




| | |
|---|---|
| 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 |

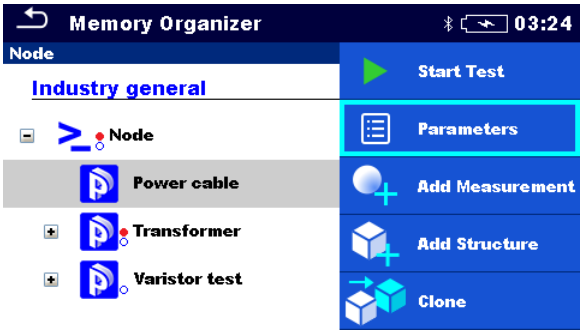
Overall statuses of Auto Sequence

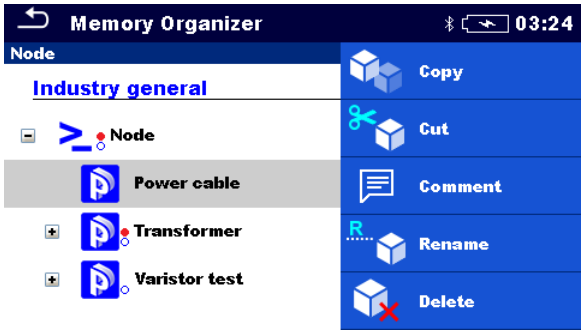
| | |
|---|---|
|  | At least one single test in the Auto Sequence passed and no single test failed |
|  | At least one single test in the Auto Sequence failed |
|  | At least one single test in the Auto Sequence was carried out and there were no other passed or failed single tests |
|  | Empty Auto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

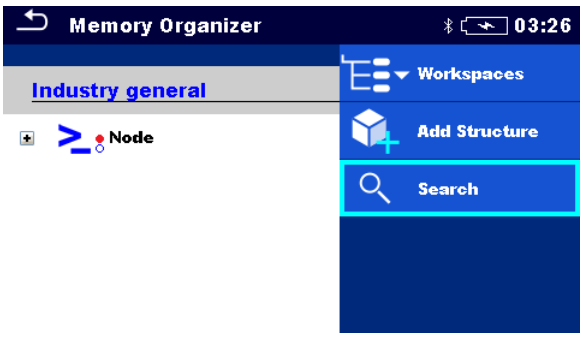


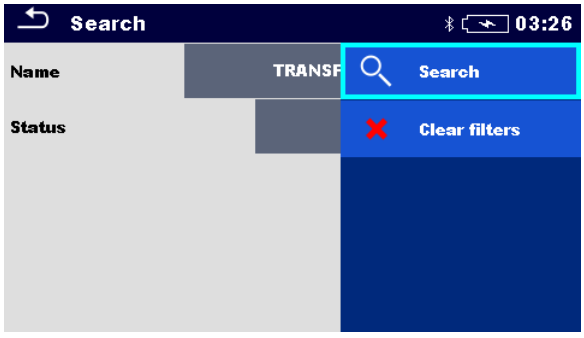




| | |
|---|---|
| Start Test | Start a new measurement (proceeds to menus for selection of measurement). |
| Parameters | View / edit parameters. |
| Add Measurement | Add a new empty measurement. Menu for adding new measurement will open. |
| Add Structure | Add a new structure object. Menu for adding 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. |

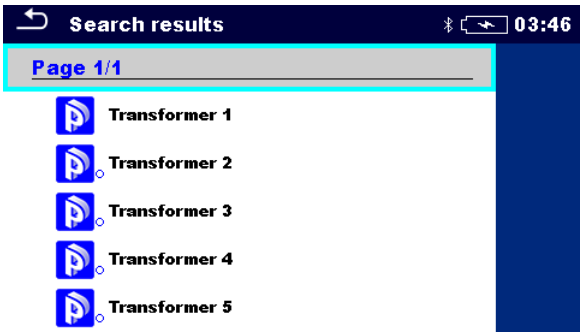
## 5.1.5 Searching in Memory Organizer

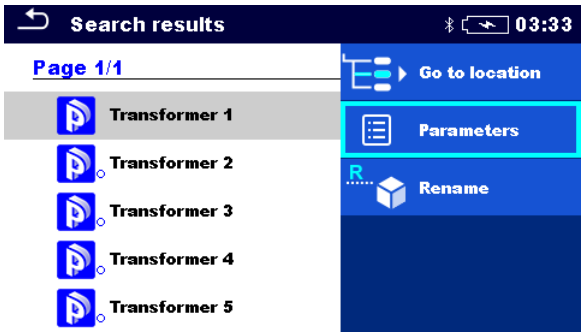
In Memory organizer it is possible to search for different structure objects and their parameters.




| | |
|---|---|
| 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.

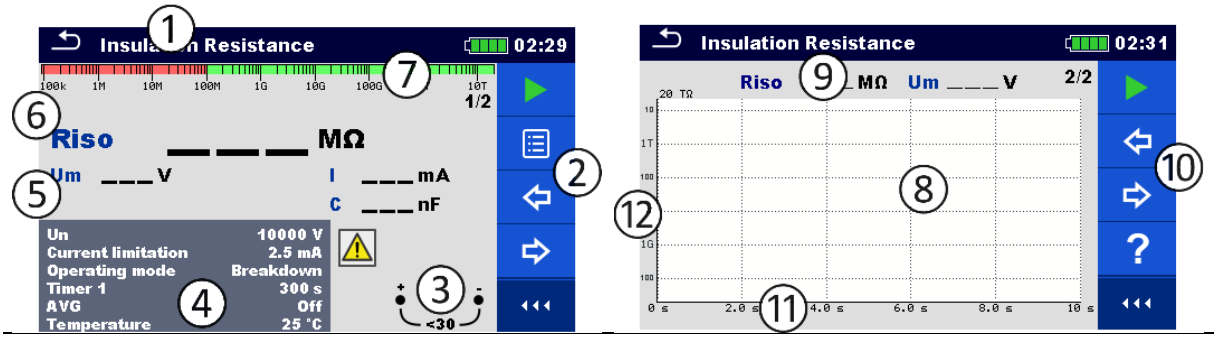
## 6.1 Selection modes

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 |

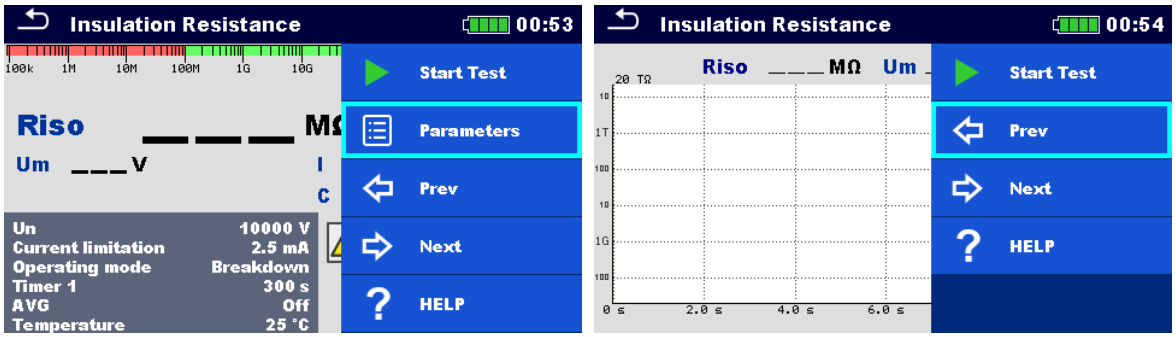
## 6.2 Single test screens

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 |

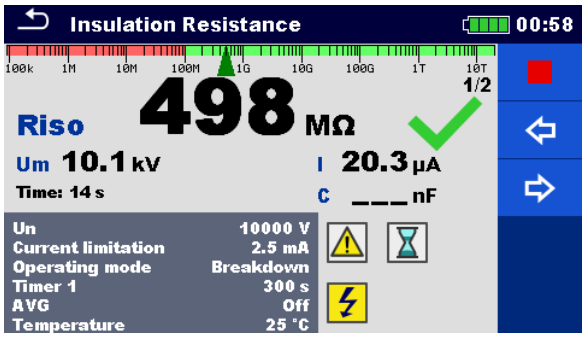
## 6.2.1 Single test start screens

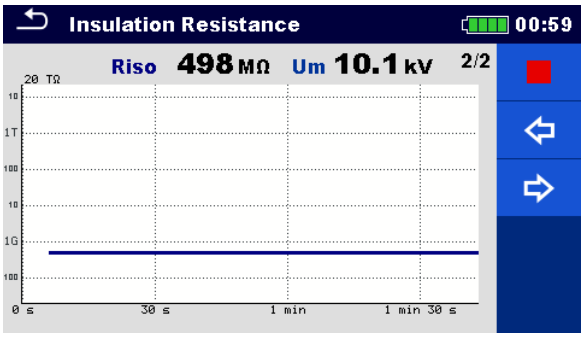



| | |
|---|---|
| Start test | Start single test (can't start on graph screen) |
| Parameters, or tap on Parameters field | Set parameters/ limits of single test |
| Prev | Go to previous screen |
| Next | Go to next screen |

| | |
|---|---|
| Help | View help screens |

## 6.2.2 Single test screens during test



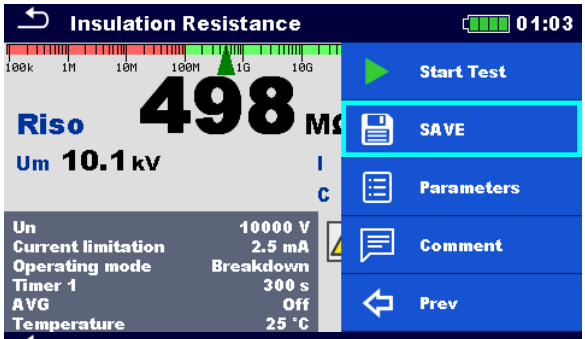



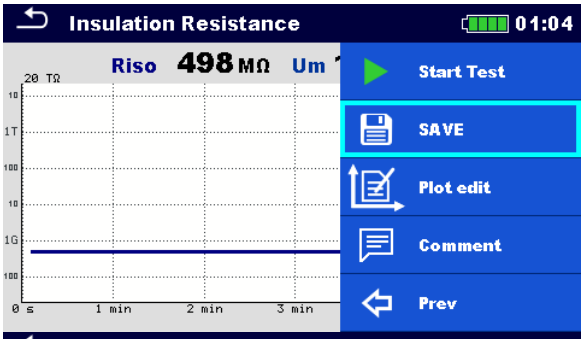

| | |
|---|---|
|  | End single test |
| Prev | Go to previous screen |
| Next | Go to next screen |

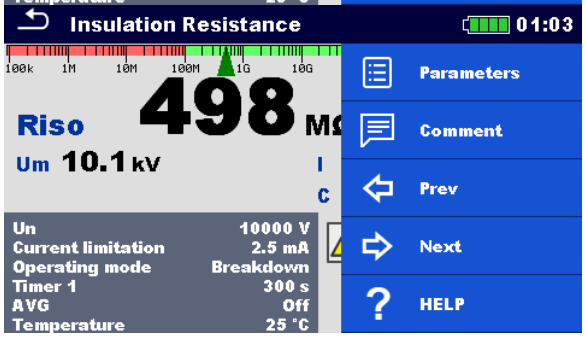
Testing procedure (during the test)

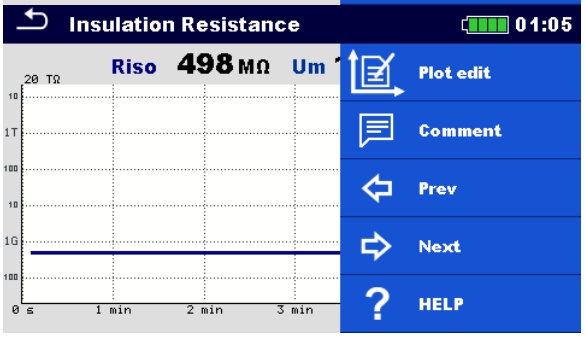
| |
|---|
| Observe the displayed results and statuses |
| Check for eventual messages, warnings |

## 6.2.3 Single test result screens



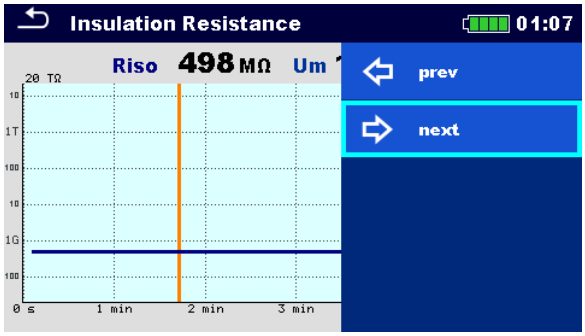



| | |
|---|---|
| Start test | Start a new single test |
| Save | Save the result |
| Parameters | View parameters |
| Comment | Add comment to the measurement |
| Prev | Go to previous screen |
| Next | Go to next screen |
| Help | View help screens |
| Plot edit | Enter plot editor |

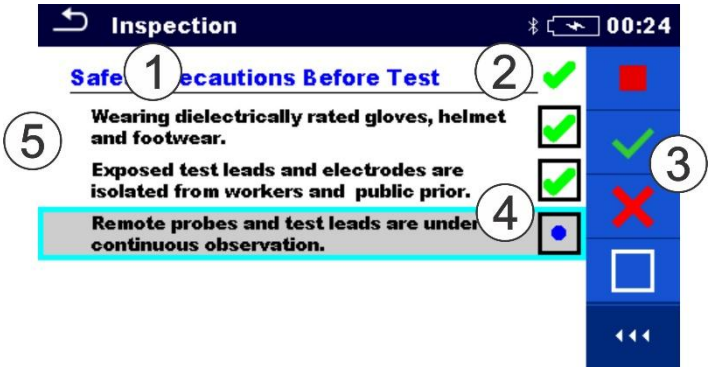
Operations on graphs




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

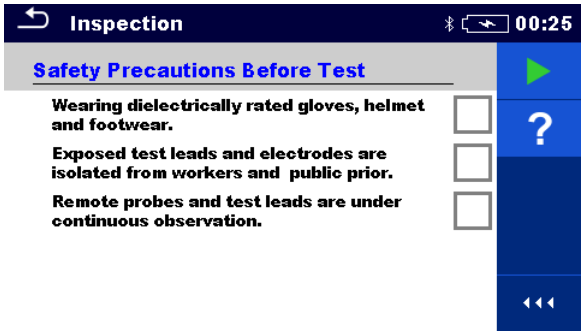
## 6.3 **Single test (inspection) screens**

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.



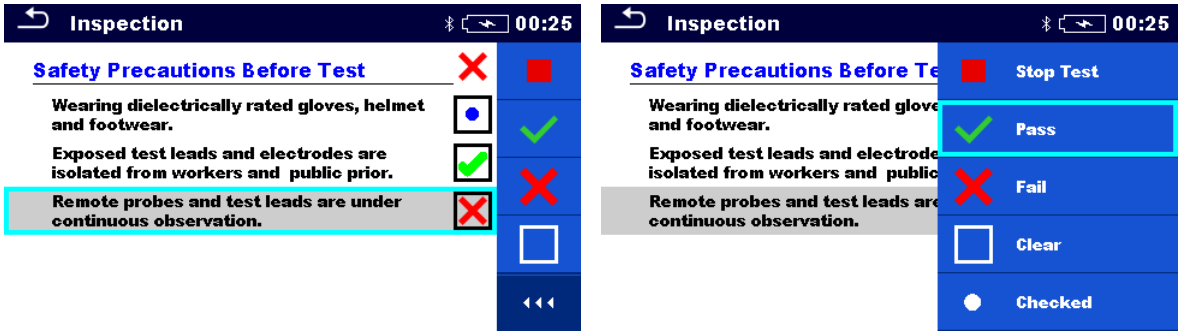

| | |
|---|---|
| 1 | Selected inspection |
| 2 | Overall status |
| 3 | Control panel (Options) |
| 4 | Status fields |
| 5 | Items |

### 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.

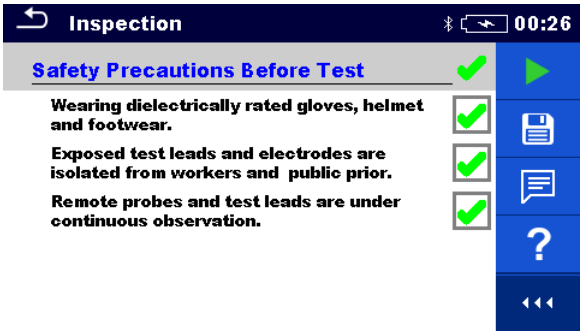
Rules for automatic applying of statuses

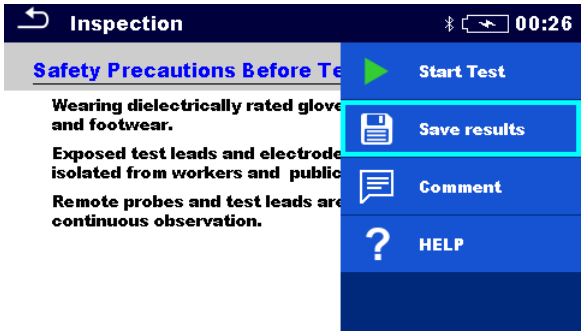
| | |
|---|---|
| The parent items will automatically get a status on base of statuses in child items | • The fail status has highest priority. A fail status for any item will result in a fail status in all parent items and an overall fail result.<br>• If there is no fail status in child items the parent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



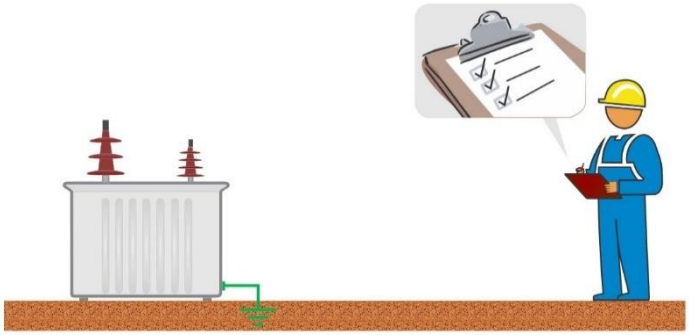




| | |
|---|---|
| Start test | Start a new inspection |
| Save results | Save the result |
| Comment | Add comment to the inspection |
| Help | View help screens |

| | |
|---|---|
| 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

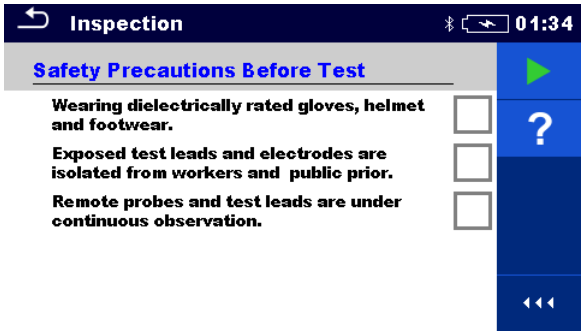
Help screens contain diagrams for proper connection of the instrument.



| Help | Open help screen |
|---|---|
| on , | Go to other help screens |

# 6.4 Single test measurements

## 6.4.1 Inspection



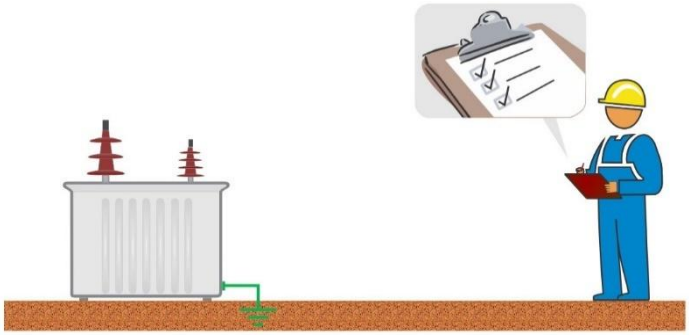

Test results / sub-results

.....Pass

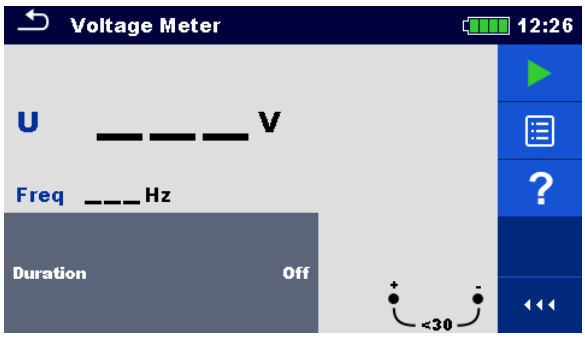
.....Fail

.....Checked

Test circuit



## 6.4.2Voltage and Frequency

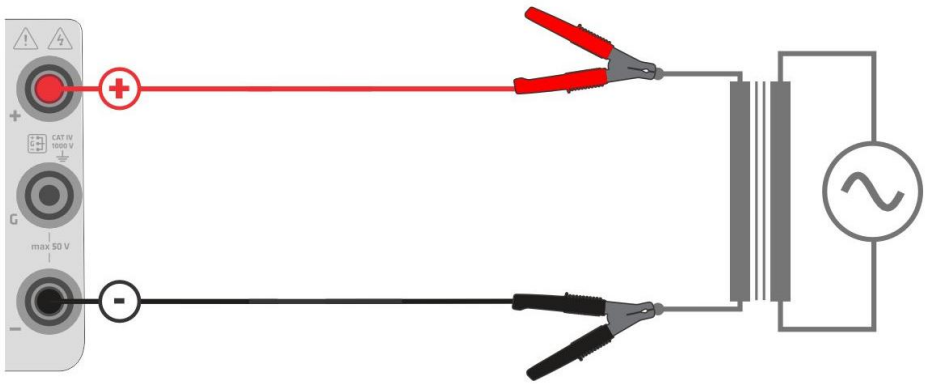



Test results / sub-results
U .....Voltage (True RMS)
Freq.....Frequency (dominant frequency)

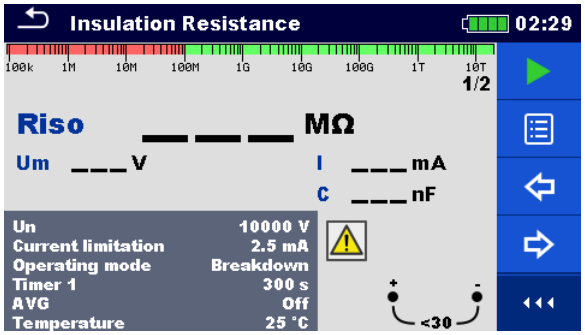
Test parameters

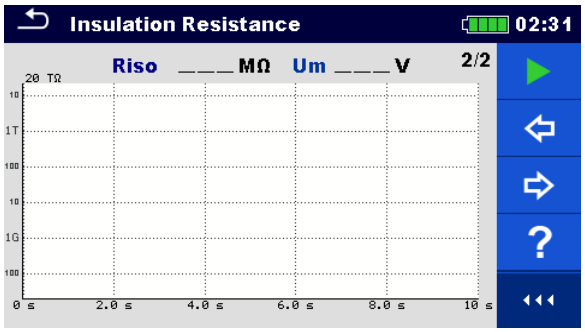
| | |
|---|---|
| Duration | Duration: [Off, Custom, 2 s ... 30 s] |

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

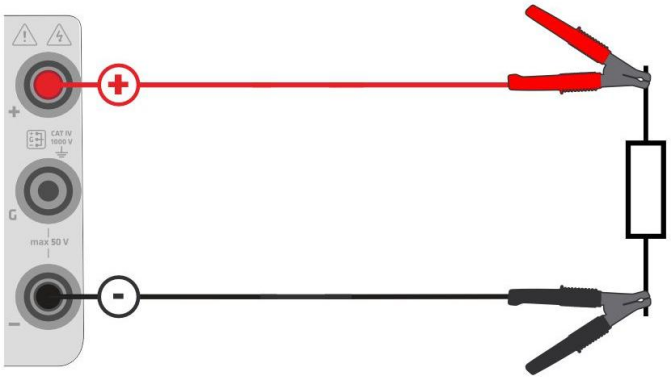
| | |
|---|---|
| Un | Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]** |
| Current limitation | Current capability:<br>Breakdown mode [0.5 mA ... 6.0 mA]<br>Burn mode [0.5 mA, 1.0 mA] |
| Operating mode | [Breakdown, Burn]<br>Breakdown: measurement ends if test current suddenly exceeds the limit value<br>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]<br>Test object temperature (informative value) |

*MI 3211, **MI 3215

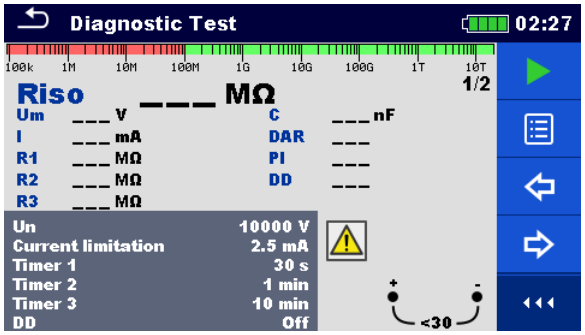
Test limits

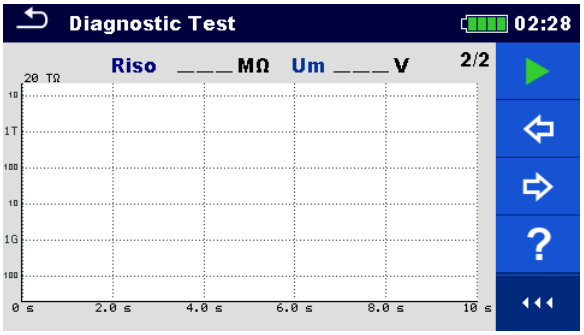
| | |
|---|---|
| Limit | Low Limit Riso: [Off, Custom, 100 kΩ ... 100 GΩ] |

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

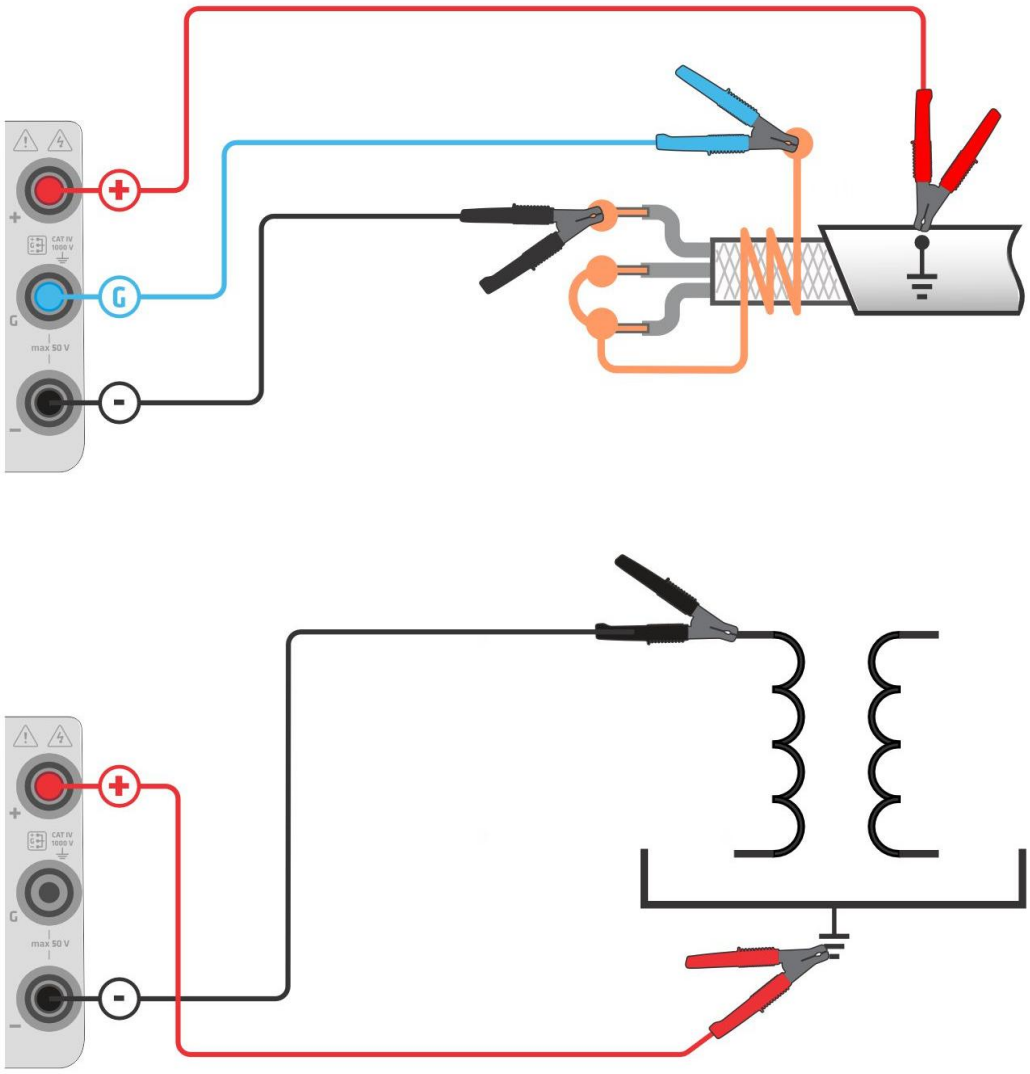
| | |
|---|---|
| Un | Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]** |
| Current limitation | Current capability [0.5 mA ... 6.0 mA] |
| Timer 1 | Test duration [Custom, 5 s ... 600 s] |
| Timer 2 | Test duration [Custom, 1 min ... 100 min] |
| Timer 3 | Test duration [Custom, 1 min ... 100 min] |
| DD | Dielectric discharge test [Off, On] |
| AVG | Averaging factor (moving average) [Off, 5 ... 200] |
| Temperature | [Off, Custom]<br>Test object temperature (informative value) |

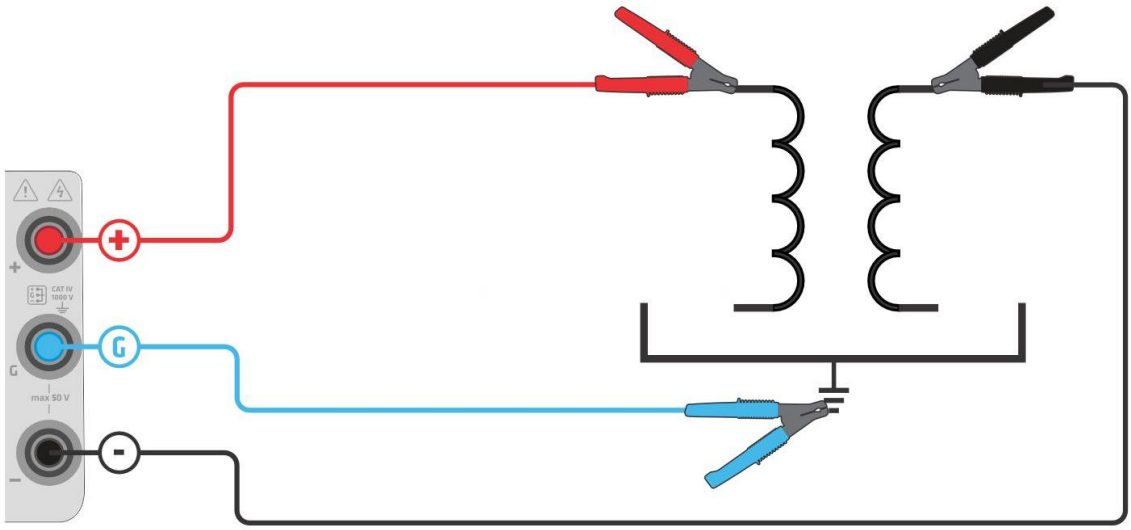
*MI 3211, **MI 3215

Test limits

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

Test circuits






**Note**

Calculated results:

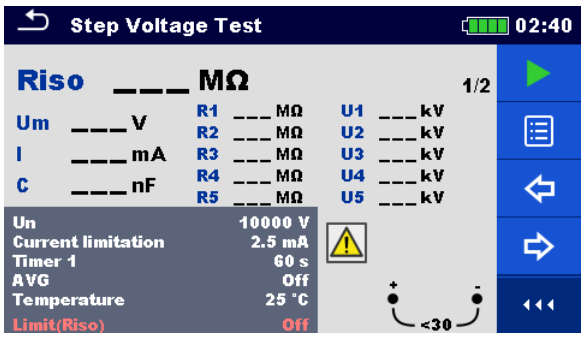
- $PI = R3/R2$
- $DAR = R2/R1$
- $DD = Idis/(U * C)$

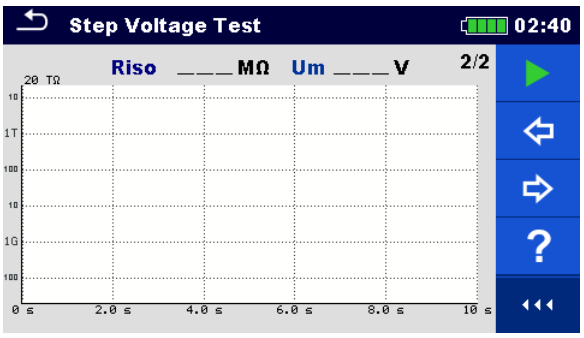
*Idis* ..... Discharging current after 1 minute in nA

*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

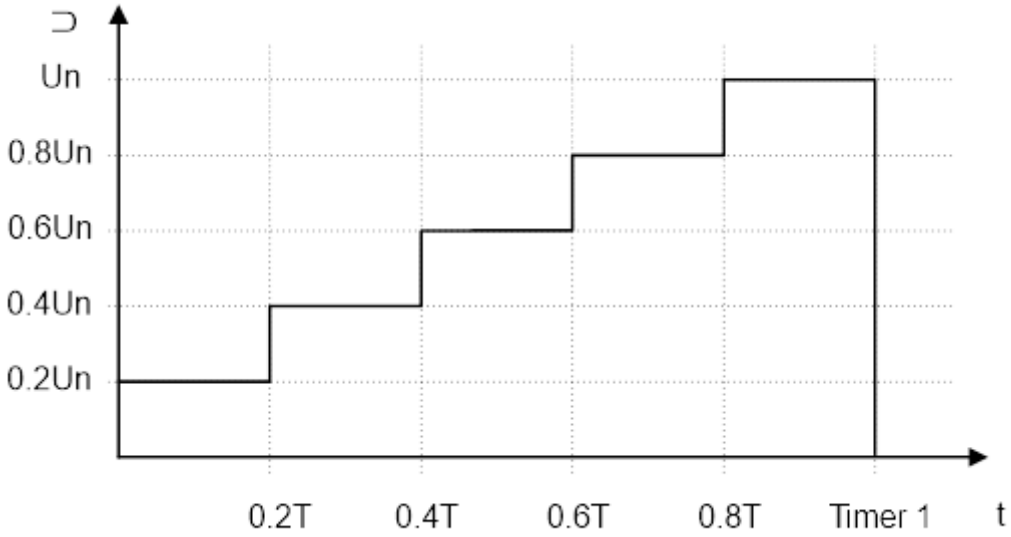
| | |
|---|---|
| Un | Test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]** |
| Current limitation | Current capability [0.5 mA ... 6.0 mA] |
| Timer 1 | Test duration [Custom, 30 s ... 600 s] |
| AVG | Averaging factor (moving average) [Off, 5 ... 200] |
| Temperature | [Off, Custom]<br>Test object temperature (informative value) |

*MI 3211, **MI 3215

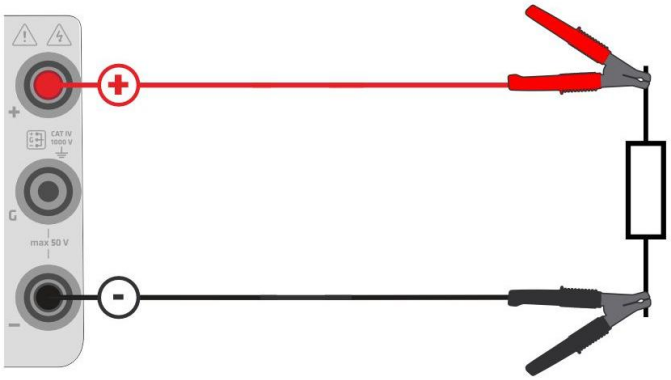
Test limits

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

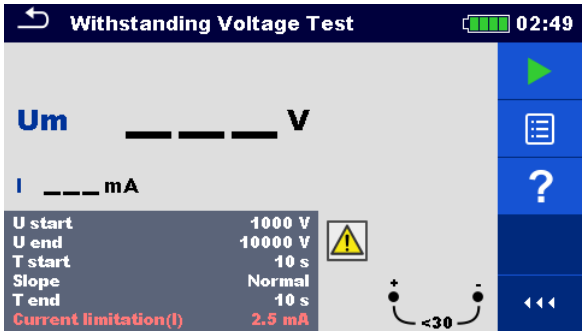
Testing voltage




Test circuits



## 6.4.6 Withstanding Voltage Test




Test results / sub-results

| | |
|---|---|
| Um | Measured voltage |
| I | Measured current |

Test parameters

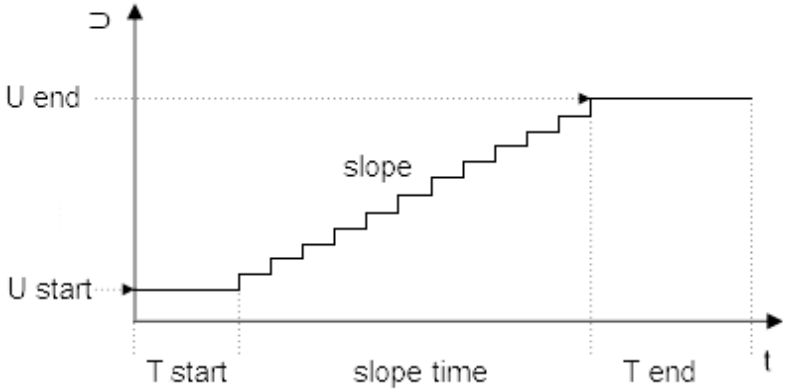
| | |
|---|---|
| U start | Start test voltage<br>[50 V ... 10000 V]*, [50 V ... 15000 V]** |
| U end | End test voltage [50 V ... 10000 V]*, [50 V ... 15000 V]** |
| T start | Test duration at U start [Custom, 5 s ... 60 s] |
| Slope | Slope [Slow, Normal, Fast]<br>• Slow (500 V/min)<br>• Normal (1000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

*MI 3211, **MI 3215

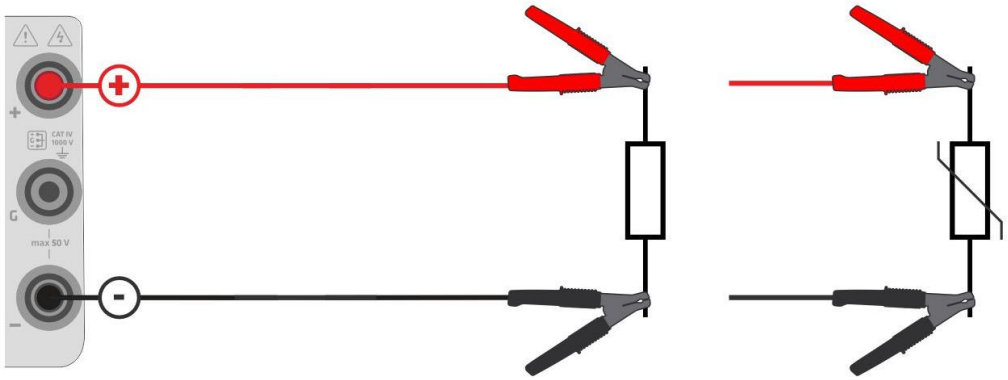
Test limits

| | |
|---|---|
| Current limitation | Current limitation:<br>Mains supply [0.5 mA ... 4.0 mA]<br>Battery supply [0.5 mA ... 2.5 mA] |

Testing voltage



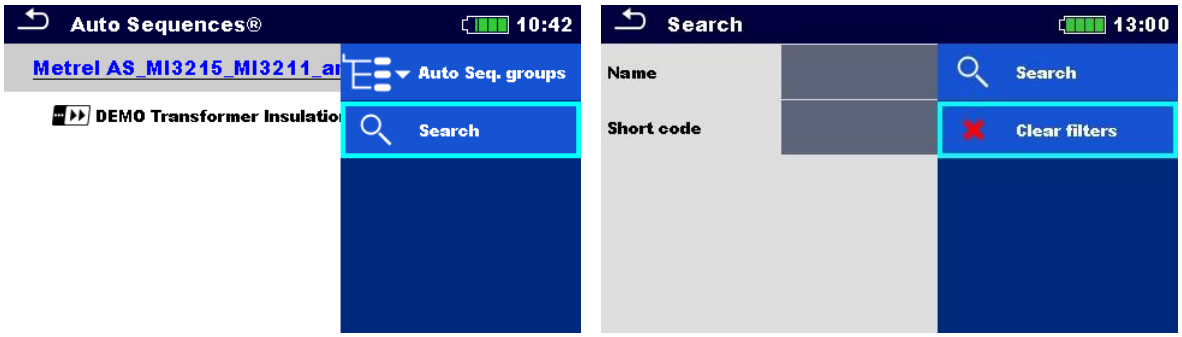

Test circuits



# 7 Auto Sequences®

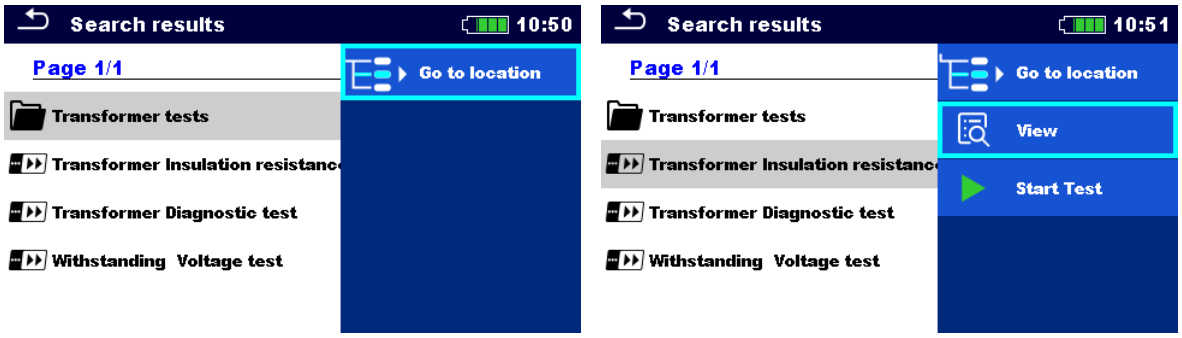
Auto Sequences® are pre-programmed sequences of measurements. The Auto Sequences® can be pre-programmed on PC with the Metrel ES Manager software and uploaded to the instrument. On the instrument parameters and limits of individual single test in the Auto Sequence® can be changed / set.

## 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 |

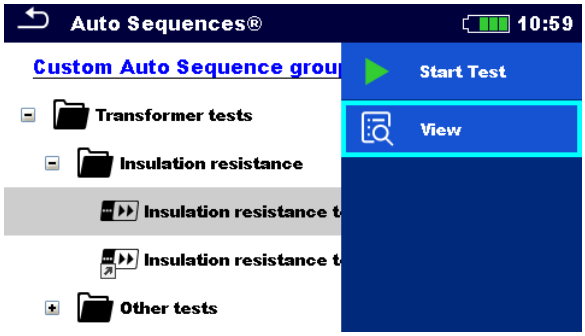
| | |
|---|---|
| Go to location | Go to location in Auto Sequences® menu |
| Start Test | Start Auto Sequence |
| View | View Auto Sequence |

### 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®

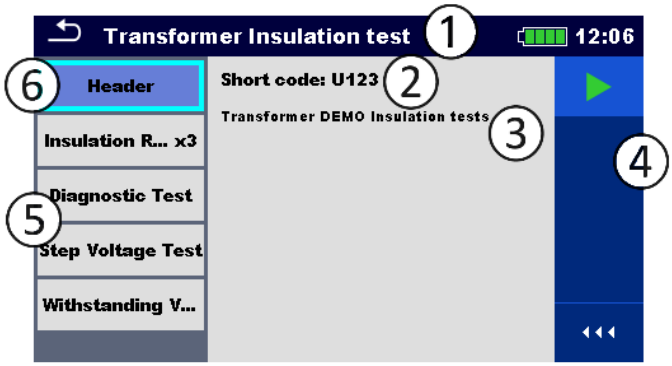
Carrying out Auto Sequences® step by step

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

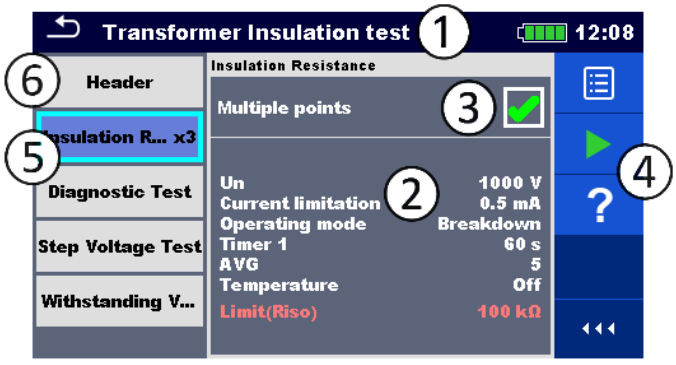



Header is selected:

| | |
|---|---|
| 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

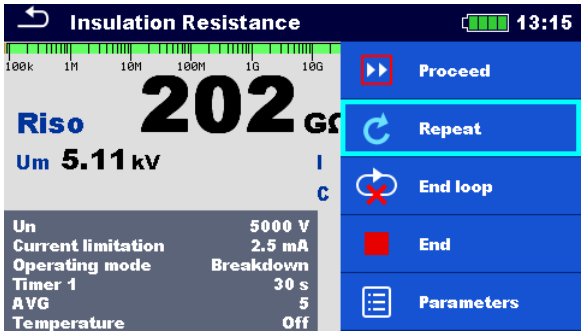

If the test object has more than one test point for an individual single test and the selected Auto Sequence® predicts only one test point (one single test) it is possible to change the Auto Sequence® appropriately. Single tests with enabled Multiple points ticker will be executed in a continuous loop.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

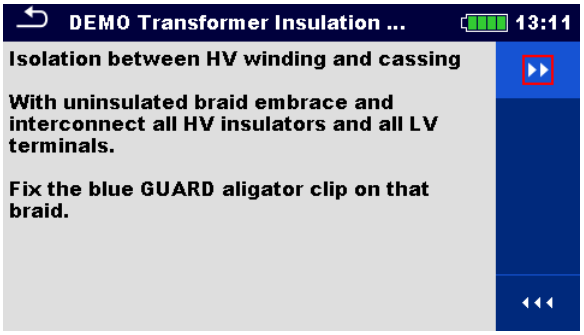
The Multiple points setting is valid only for the actual Auto Sequence®. If the user often tests objects with more than one test points it is recommended to program a special Auto Sequence® with pre-programmed loops.

### 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 |



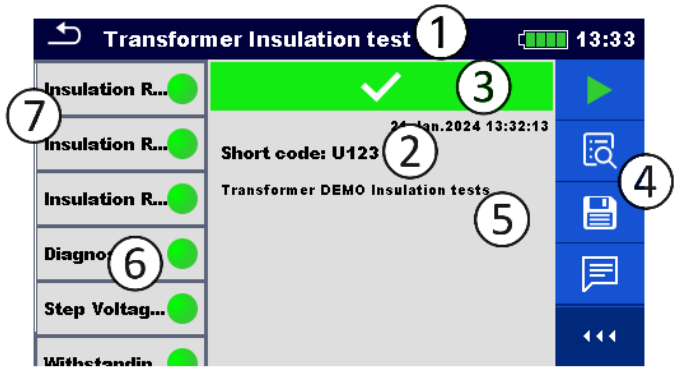




The offered options in the control panel depend on the selected single test, its result and the programmed test flow.

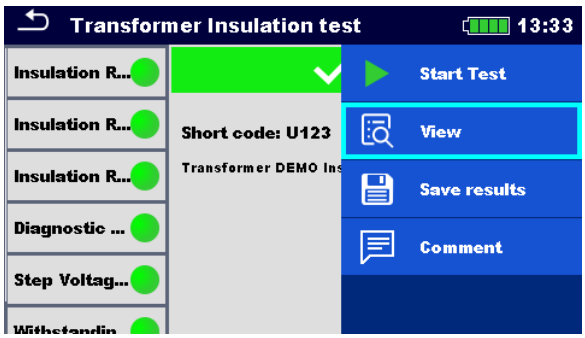
| | |
|---|---|
| Proceed | Proceeds to the next step in the test sequence. |
| Repeat | Repeat the measurement. |
| End loop | Exit the loop of single tests and proceeds to the next step. |
| End | End the Auto Sequence® and go to result screen. |
| Parameters | View parameters/limits of single test. |
| 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 current ..... 6 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 ... 35 TΩ) (logarithmic scale)
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

Influence of Guard terminal:
Reduction of surface leakage current, effected by parallel surface resistance, down to 250 kΩ, with max. additional resistance error <1 % on a 100 MΩ load.

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 ... 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 | 35 TΩ |
| ≤15 kV** | 35 TΩ |
| | |

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

| Riso | Voltage | Accuracy |
|---|---|---|
| 1.5 TΩ**<br>30 TΩ** | 15 kV** | ± 5 % of reading<br>± 20 % of reading |
| 1 TΩ<br>20 TΩ | 10 kV | ± 5 % of reading<br>± 20 % of reading |
| 250 GΩ<br>5 TΩ | 5 kV | ± 5 % of reading<br>± 13 % of reading |
| 100 GΩ<br>2 TΩ | 2 kV | ± 5 % of reading<br>± 13 % of reading |
| 50 GΩ<br>1 TΩ | 1 kV | ± 5 % of reading<br>± 13 % of reading |
| 25 GΩ<br>500 GΩ | 500 V | ± 5 % of reading<br>± 13 % of reading |
| 5 GΩ<br>100 GΩ | 100 V | ± 5 % of reading<br>± 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 ... 6.00 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 | |

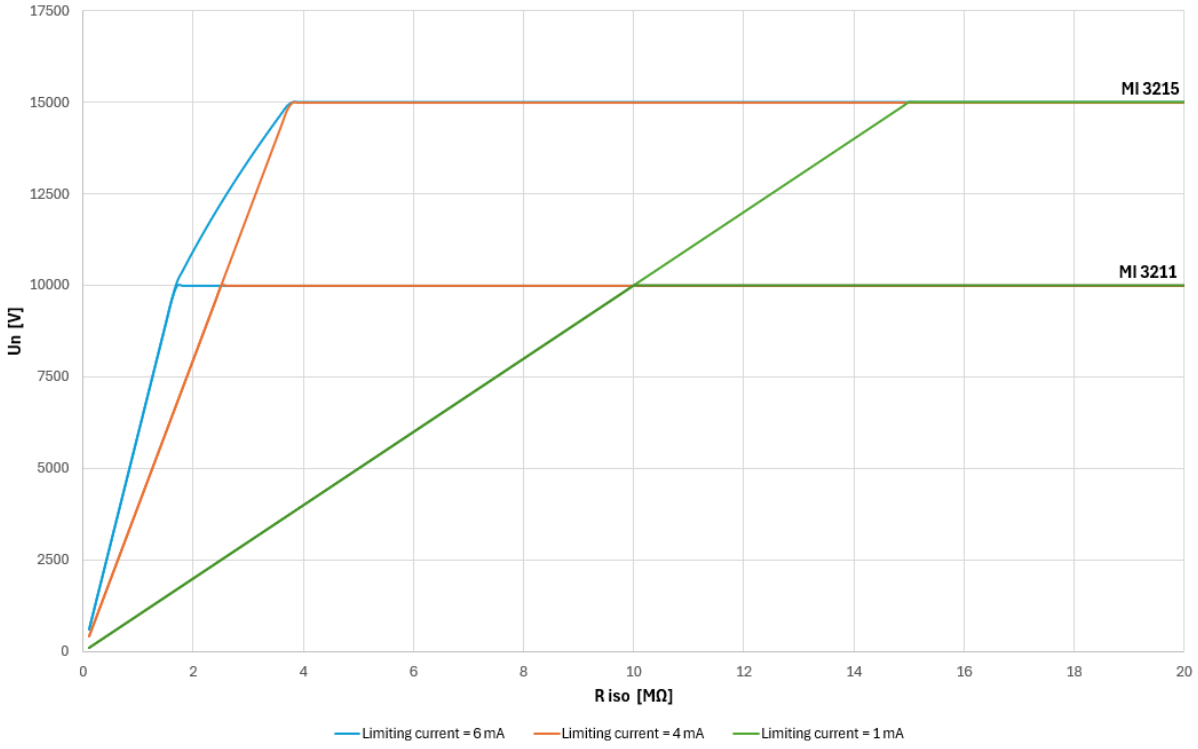
Dielectric discharge test DD

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

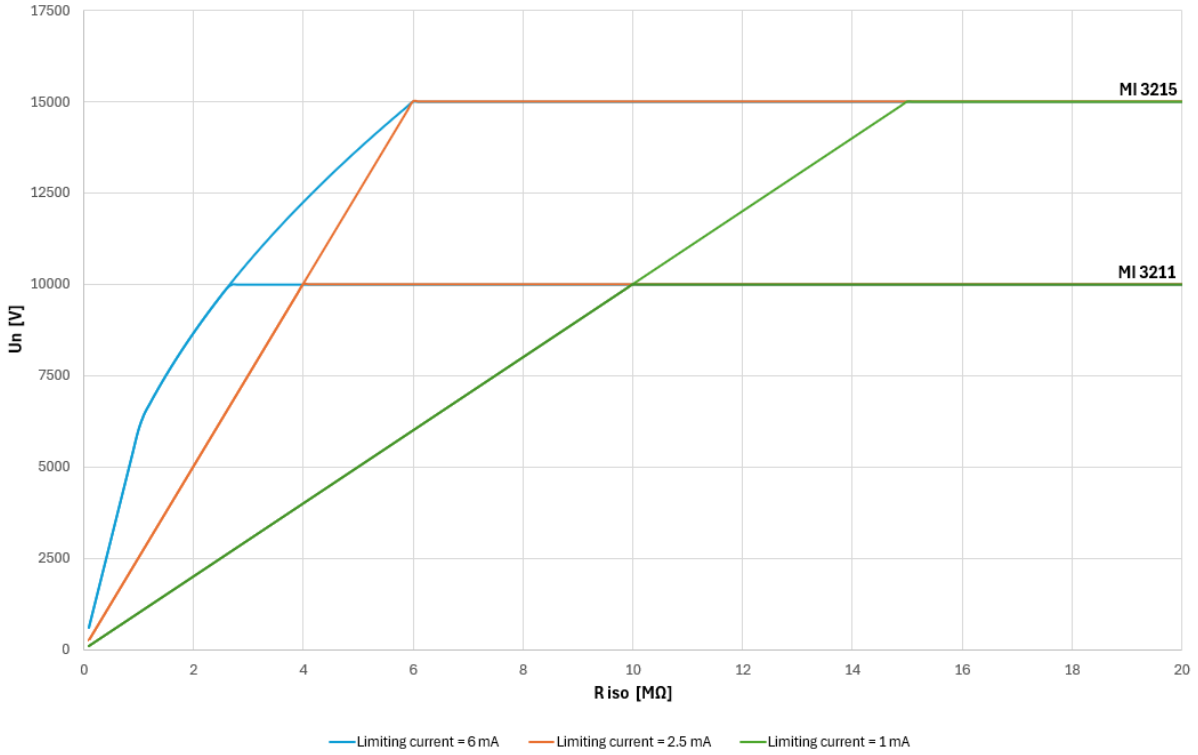
Capacitance range ..... 20 nF ... 50 μF

*MI 3211, **MI 3215

## HV generator current capability (Mains supply)




## HV generator current capability (Battery supply)



## 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<br>Voltage | Brightness = High | > 24 h |
| Insulation<br>Resistance | Brightness = High<br>100 MΩ load @ 15 kV, continuous testing | > 4.5 h |
| | Brightness = High<br>100 MΩ load @ 10 kV, continuous testing | > 6 h |

Nominal mains power supply ..... 100 ... 240 $V_{AC}$, 45 ... 65 Hz, 100 VA
Operating mains power supply..... 90 ... 260 $V_{AC}$, 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 |

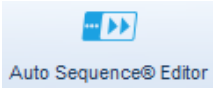
# Appendix B Profile Notes

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.

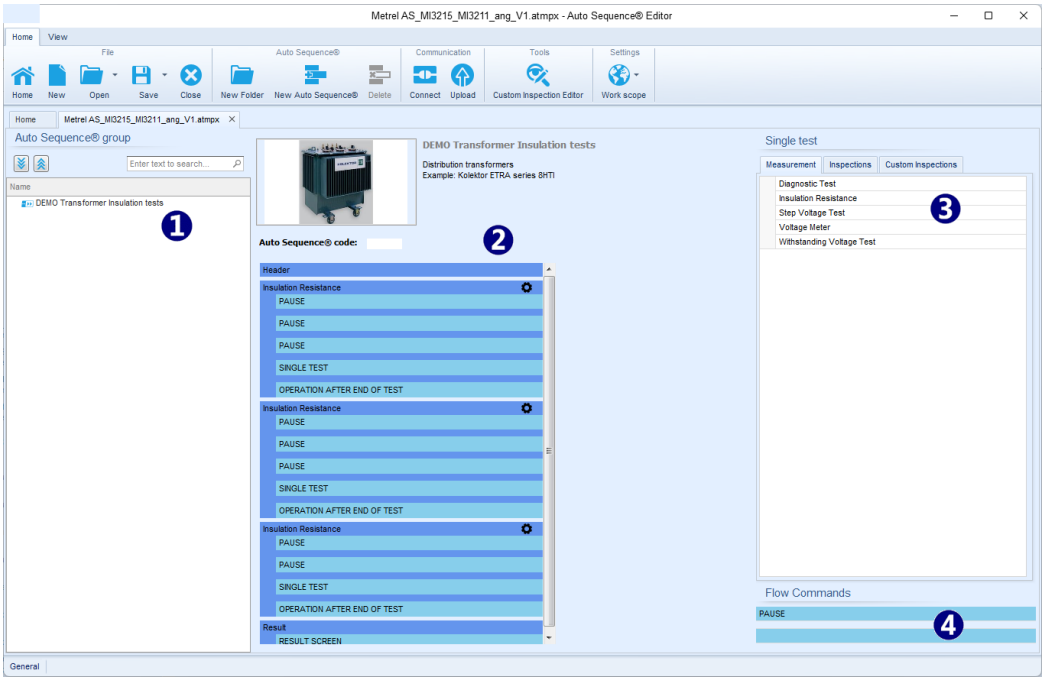



Figure C.1: Auto Sequence® Editor workspace

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.

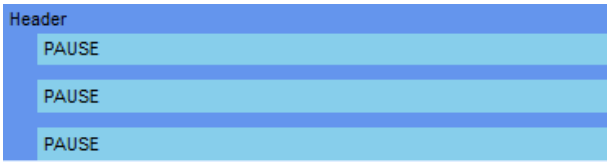



Figure C.2: Example of an Auto Sequence® header

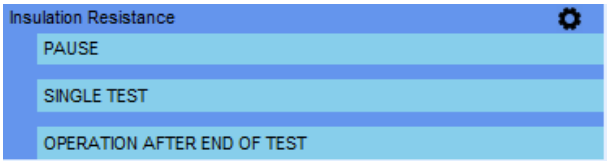



Figure C.3: Example of a measurement step


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.

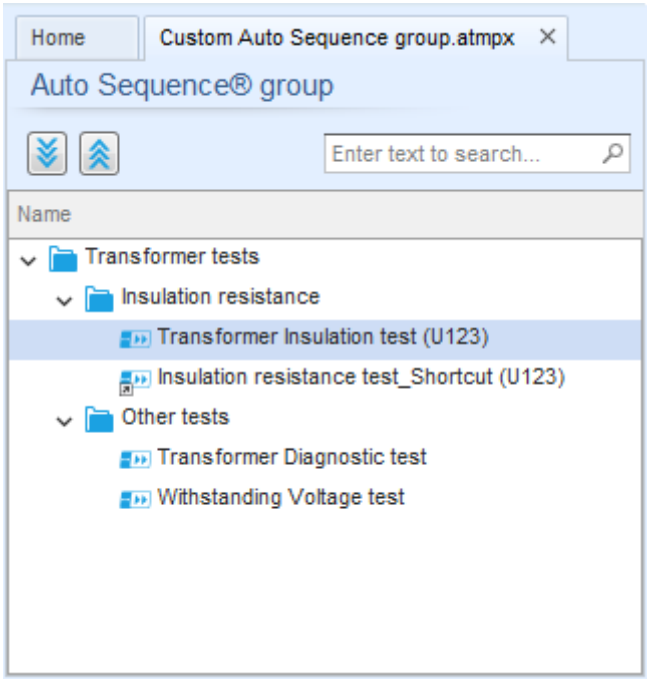



Figure C.5: Group of Auto Sequences® tree organization

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®). |

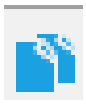
Group of Auto Sequence® view options:

| | |
|---|---|
|  | 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. |

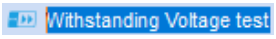
Group of Auto Sequences® operation options (also available by right clicking on Folder or Auto Sequence®):

| | |
|---|---|
|  | Adds a new folder / subfolder to the group |
|  | Adds a new Auto Sequence® to the group |
|  | Deletes:<br>-the selected Auto Sequence®<br>-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).<br>Folder: Edit folder name |
|  | Auto Sequence®: Copy to clipboard<br>Folder: Copy to clipboard including subfolders and Auto Sequences® |
|  | Auto Sequence®: Paste it to selected location<br>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  <br>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.<br>  move to folder<br>  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®. |

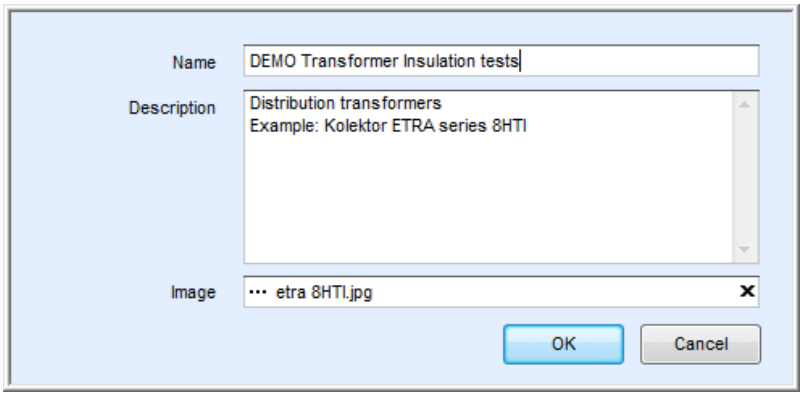



Figure C.6: Editing the Auto Sequence® header

### 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.

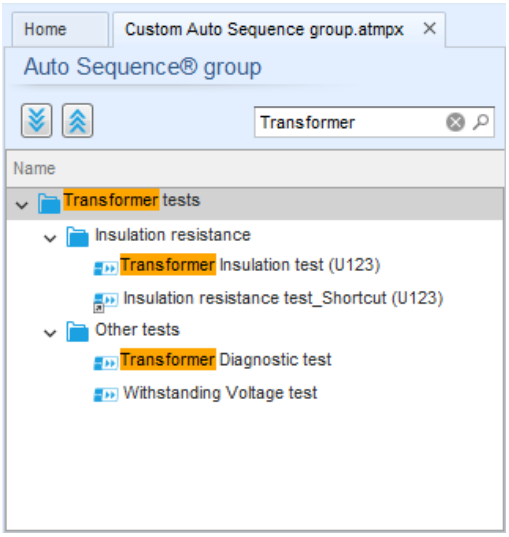



Figure C.7: Example of Search result within Auto Sequence® group

## 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.

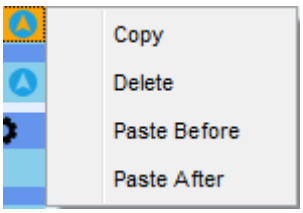
## C.4 Creating / modifying an Auto Sequence®

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)<br>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<br>– pass<br>– fail<br>– 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.

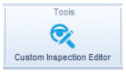
Parameters:

| | |
|---|---|
| Auto save ☑ | Auto Sequence® results are stored in the momentary workspace.<br><br>A new Node with the date and time will be created. Under the Node, Auto Sequence® results will be stored.<br><br>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.<br>Auto save Flow setting is disabled by default.<br><br>Note:<br>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*.

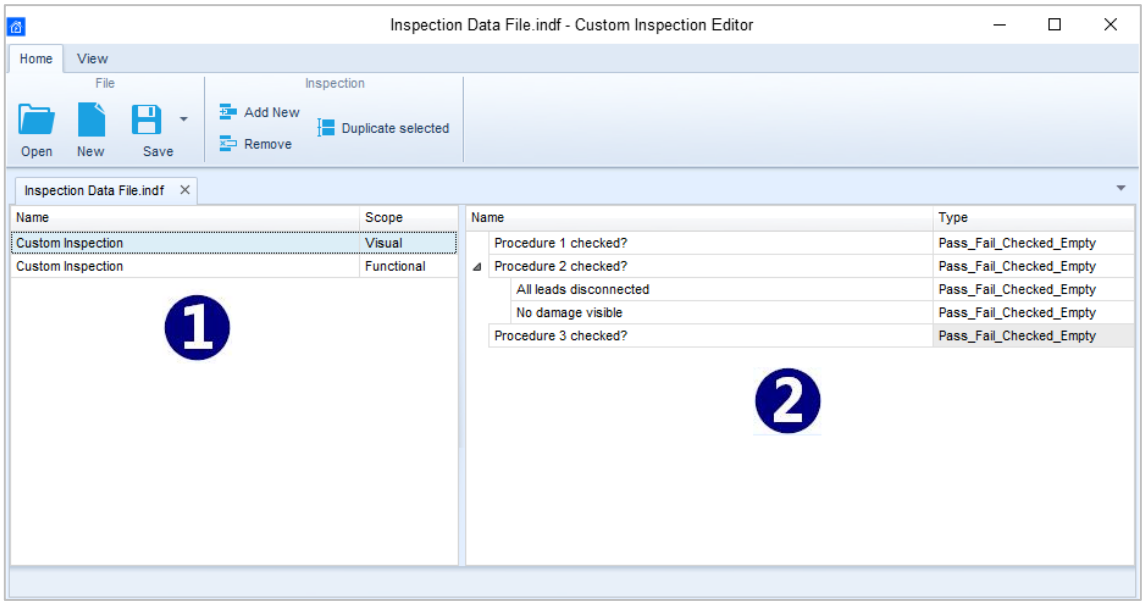
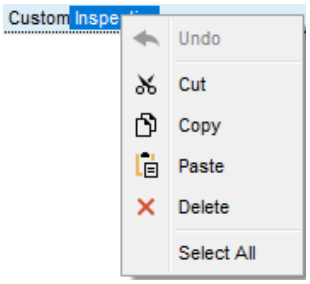



Figure C.8: Custom Inspection Editor Workspace

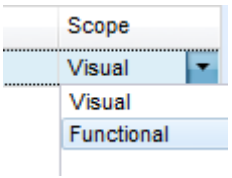
Custom Inspection Editor Main menu options:

| | |
|---|---|
|  | Opens existing Custom Inspection Data file.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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

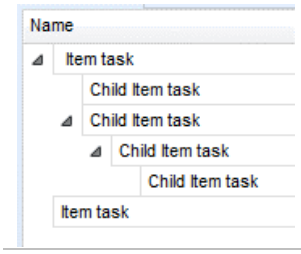



Inspection Name edit:
Click to the Inspection Name field to start editing it.
Drag cursor, with left mouse button pressed, to select letters and words. Position cursor and double-click to select word of the name. Actions could be performed with keyboard also.
Press right mouse button to activate Edit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

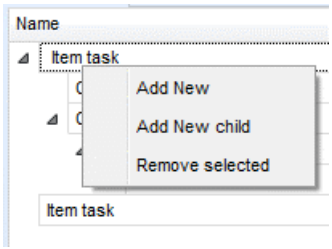



Inspection Scope edit:
Click to Inspection Scope field to open selection menu presented on left figure. Options:
Visual is intended for observation of test object
Functional allows functional test of observed object

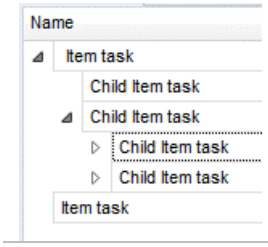
## Edit Item task structure of Inspection




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.



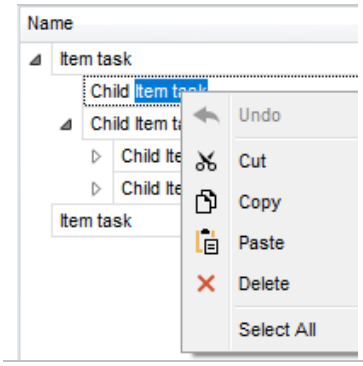

ADD New Item task procedure:
Position cursor above Item task Name and apply right mouse click to select Item task and open menu with options:
Add New: new Item task is added on the top tree level
Add New Child: new child Item task is added under selected Item
Remove selected: delete selected Item task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



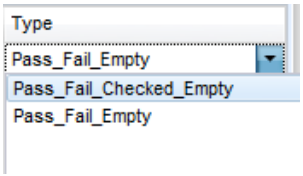

Item tasks containing Child Item tasks are marked with triangle in front of their Name.
Click on triangle mark:

- 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.

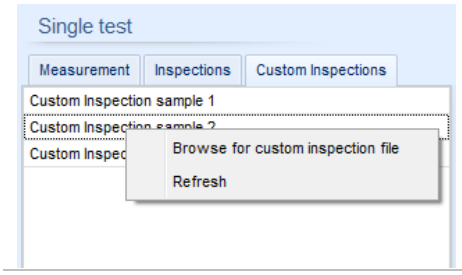



Edit Type of Item task:
Click to Item Type field to open selection menu presented on left figure. Selectable checkbox status assignment options are:
Pass_Fail_Checked_Empty: Pass, Fail, Checked, Empty (default)
Pass_Fail_Empty: Pass, Fail selection, Empty (default) value

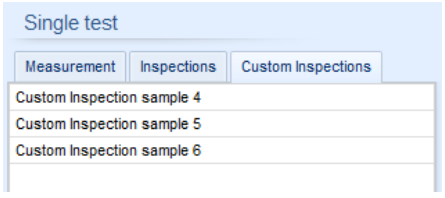
## C.6.2 Applying Custom Inspections

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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