MKAT Editor User Manual

MKAT Software

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MODIFICATIONS

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1.300	06/July/2017	APK	Updated to include latest changes
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4.0	11/01/2021	DSM	EM/device sequence functionality & new document template
5.0	5/11/2021	CDVM	Expression Sub-Test
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1 Health & Safety

DANGER ELECTRIC SHOCK RISK.

Potentially high voltages exist when using MK equipment.

- Do not touch test interfacing, adaptors or UUT during test.
- Do not tamper with safety interlocks, protection, or warning devices. Regularly check these devices for correct operation.
- Ensure equipment is annually tested for electrical safety. Ensure equipment is earthed.
- Create a safe test area and keep others away.
- Use physical barriers and warning signs etc.

2 Abbreviations Used In This Manual

MKAT	MK Control Software
UUT	Unit Under Test or item to be tested.
DC	Direct Current
AC	Alternating Current
Xref	Cross Reference - actual UUT connection name (determined by interface)
HV	High Voltage >50Vdc / 30Vac
LV	Low Voltage ≤50Vdc / 30Vac
Hi-Pot	Hi Potential test. A High Voltage test using either AC or DC current.
LCR	Inductance (L), Capacitance (C) & Resistance (R) meter
EM	Energisation Module (may be referred to as EEM)
PSU	Power Supply Unit
TP	Test Point
Net	Test point(s) group - normally defined by connection list.
Netlist	List showing nets to be tested - in shorts, insulation and Hi-Pot tests

3 GENERAL INFORMATION

3.1 Before You Begin

3.1.1. FAMILIARISATION

Before using the MKAT test system, it is strongly advised that you have read all of the manuals provided and ensure that you are familiar with the concepts in operating this form of automatic test equipment.

3.2 About This Manual

This manual is designed in such a way that a first-time user of the MKAT system will, by following this manual, be taken through the MKAT software in a logical manner. Those users more familiar with the MKAT may wish only to use this manual as a reference.

3.3 MKAT Operating Concepts

The MKAT software operates on the following concepts:

a) The user manufactures a piece of equipment (UUT), which is tested by conventional means and known to be of the required quality standard.

b) The MKAT 'learns' about the UUT characteristics by being programmed by the user. The MKAT can automatically learn the UUT connections. They can be programmed manually, or they can be imported from an external source.

c) New build items of the same design can now be tested by the MKAT by being compared against the information acquired in B above. The operator simply selects the item with the same part number (or some equivalent parameter) from the index.

The test referred to in c) above consists of one or more of the following stages.

1) Continuity comparison on the connections of the UUT on the index against the UUT being tested. *Referred to as the positive test or continuity test.*

2) A check through the UUT to ensure that no connections exist, which were not present in the UUT on the index. *Referred to as the negative test or shorts test.*

3) Assuming the successful completion of 1) and 2) above, a high voltage insulation test can be performed. This test takes each point in turn to a specified high voltage whilst all other points are connected together. The resistance is then measured and compared against a threshold.

As an alternative to or in addition to option 3) above, a high voltage hi-pot test can be performed if required, which subjects the UUT to a specified high voltage and compares the leakage current against a threshold.

For twisted pair configurations, a capacitance test can be performed which will compare the capacitance against threshold parameters.

External equipment can also be connected and switched through the MKAT switching matrix.

If an insulation test and hi-pot test are selected, the hi-pot test will only commence if the insulation test is successful without any point failures.

In the event of the hi-pot test being performed before the insulation test, then the insulation test will only commence if the hi-pot test is successful.

All test sections described are supported by screen, print to file and printer reports, if required.

3.4 MKAT Electrical Concepts

Even if the operator is familiar with automatic test equipment, the following basic concepts will help to understand the MKAT operation.

The MKAT measures resistances or volt drops by applying a fixed current and using a voltmeter to measure the dropped voltage. If a resistance value is required, then a simple ohm's law calculation is performed. For higher resistances then the internal impedance of the MKAT is also taken into consideration.

For a four-wire measurement, the resultant value will be a close accurate value of the UUT. For a two-wire measurement, the resultant value is likely to contain an element due to the connecting interface.

3.4.1. What Test Current Should I Use?

It is always best to use the maximum test current available; this will give the greatest volt drop which can be measured with the highest accuracy. It will also stress the UUT more which may show a potential problem.

Never select a test current which will damage the UUT or a current which result in too much power dissipation in a resistive load.

3.4.2. What is Voltage Limit?

The test current is supplied from a power supply which produces approximately 42 volts on most MKAT systems. If the current is supplied into an open circuit i.e., no current flows, then 42 volts will appear across the UUT.

The voltage limit is a programmable limit to this open circuit voltage and is typically set to 30 volts.

If the UUT has a maximum voltage requirement, then the voltage limit can be lowered accordingly.

3.4.3. Auto Learn and Shorts Test Methodology

MKAT will apply the current from point one to all other points. If the voltage measured is equal to voltage limit i.e., open circuit, then MKAT will move on to point two etc. If the voltage measured is less than clamp i.e., a connection, then a binary split will be performed until the end points are established.

The current will be applied, and voltage read to establish the connection value.

Auto learn and shorts test will only learn and test values within the electrical constraints of the programmed current and voltage limit. Values outside these parameters will be missed by the auto learn or show up as open circuits by the shorts test. To cover the maximum range for auto learn and shorts test, select the minimum current and maximum voltage limit.

3.4.4. Low Voltage Testing Methodology (Continuity Test)

MKAT will scan the list of expected connections, apply the current set up in the continuity test parameters and measure the resultant voltage. The voltage or resistance will then be compared to the limits, and a result produced. If the voltage limit is reached when the current is applied, then a > maximum resistance will be reported.

3.4.5. Low voltage short circuit

MKAT will take each net list (a set of points that are common) and test them using low voltage to all other net lists defined within the shorts sub-test. If a short circuit is found (i.e., low resistance so voltage limit is not reached), then the MKAT will use a binary chop to determine which other net list it is shorted to. It will then remove that net list from the list to be tested against and repeat. This will allow the system to find any number of shorted net lists. If selected by the programmer, the system can also determine the resistance path between each point on both the shorted nets and show the lowest 10 resistance paths on the report. This is so that a user can quickly identify where the short is between the nets. Note this is limited to 1000 measurements to prevent too much data being generated. If two very large nets are shorted together, e.g., netlist1 contains test points 1,2,3,4 and netlist2 contain test points 10,11 we measure the resistance between 1->10, 1->11,2->10, 2->11, 3->10, 3->11, 4->10, 4->11.

3.4.6. High Voltage Testing Methodology (Insulation and Hi Pot)

MKAT will then take each net list, as defined in the insulation sub-test, and test against each additional net list defined within that sub-test. The sequence of how this is done is detailed below.

An insulation resistance or leakage current calculation is then performed, and a comparison made with the values previously defined to produce a result.

It is possible that the high voltage test will report values not detected by the low voltage test because of the constraints of the low voltage test detailed above.

High Voltage DC and AC Ramp Test Algorithm

This is the normal algorithm applied during high voltage testing of AC and the most DC systems and consists of the following stages:

a. Relays Switched On

The appropriate test points (from and to) are switched onto the bus.

b. Ramp Up

This is a programmable ramp in which the high voltage is increased in a controlled manner until the high voltage potential is achieved. If not achieved, then the software acts accordingly and reports as such.

c. Pre-Dwell

This is a programmable dwell where the high voltage remains present to allow for any capacitive effects.

d. Measure Dwell

This is a programmable period over which numerous readings of leakage current are made to establish the insulation resistance or Hi Pot value.

e. Ramp Down

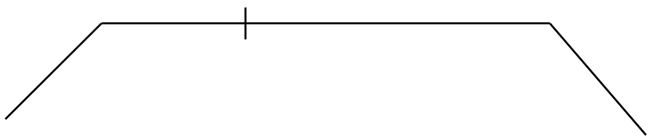
This is a programmable ramp in which the high voltage is decreased in a controlled manner until the high voltage potential is removed.

f. Safety Dump

This is a programmable time for which the safety dump is activated to discharge any residual potential. The high voltage is then checked to ensure that it has been discharged.

g. Relays Switched Off

The appropriate test point sources and monitors (signal and sense) are switched off the bus. The complete cycle then repeats.



Ramp Up Pre dwell Measure Dwell Ramp Down

If required, you can select the option 'find which nets failure is shorted to.' This will use the same binary splitting algorithm as short circuit detection to determine the net against which the HV has failed. You can choose to split the 'to' nets or the 'from' nets by toggling the 'Perform find by splitting' option.

Note that in some circumstances it may not be possible to determine the shorted net, as there could be more than one resistance path.

Note on some large systems, if a short / HV fail has been detected, then the system may need a longer pre-dwell on the next measurement to ensure correct operation. The amount of time can be adjusted by the “After HV Failure, adjust pre-dwell time by a factor of”. This parameter will multiple the pre-dwell of the next parameter by this value.

4 SOFTWARE USER INTERFACE

MKAT software has been written with the primary intention of being simple to use, the aim being that familiarisation is quick and consistent in its use. As such the software is split into two major parts: the MKAT Editor and the MKAT Runner. The ***Editor*** is a desktop application that allows an operator to create test programs not only for MKAT, but any MK test products. The ***Runner*** is designed to facilitate the shop floor operation of connecting to and testing of the UUT. Refer to the MKAT Runner Software Manual for information about running a test and interacting with the MKAT hardware.

Please note that this document only covers program creation and editing within the MKAT Editor software. For details of configuration creation and editing, please refer to the "MKAT Runner Software Manual.docx" document. The only exception to this is the *System Mask* feature which can be configured in the Editor but is not currently available in the Runner. This feature is detailed at the end of this document.

On start-up you can select from the front screen which items you wish to edit / create. On the RHS will be a list of items that you have recently edited. The MK Editor is not only used to create / edit test programs for MK's range of products, but also MKAT hardware configurations. To be able to create a MKAT program, you will also need the configuration of the system that you intend to run the program on. This is so that the editor can ensure test points are available and ensure that you have access to the correct externally programmable devices. If you create a program with the incorrect configuration loaded, then the program may not load or run correctly in the MKAT runner.

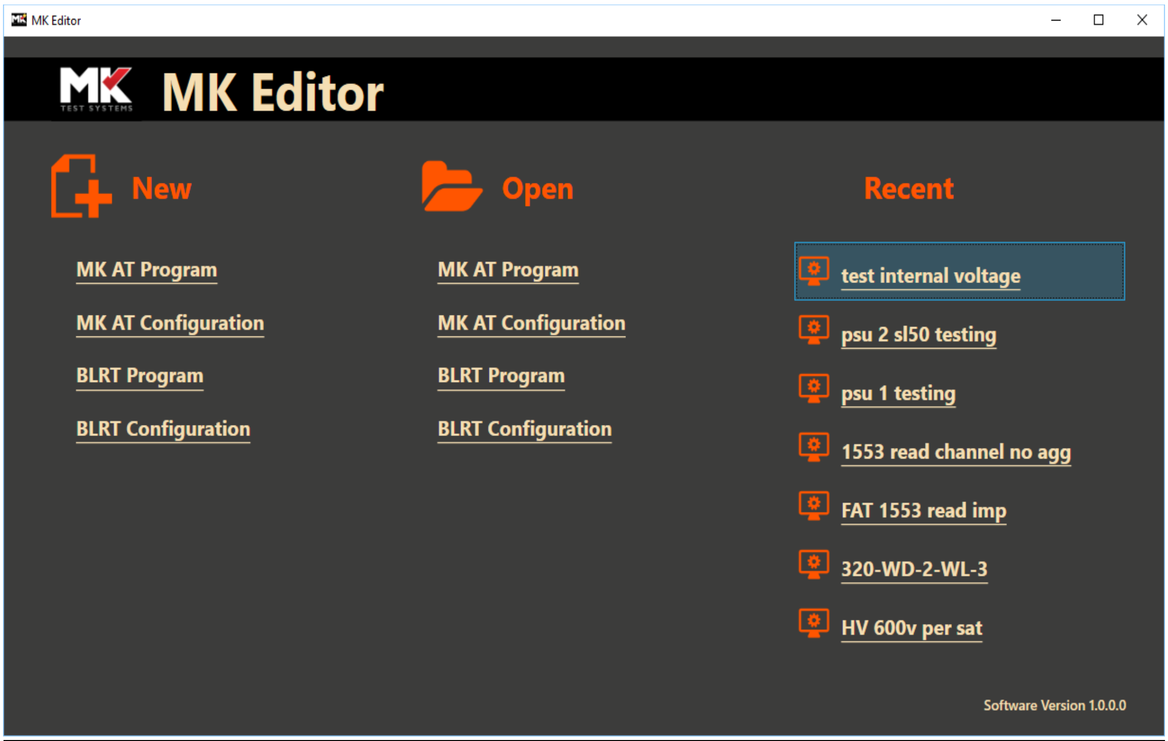


Figure 1: MK Editor Menu.

4.1 Creating a program

When you select the ***MKAT Program*** from the front screen, the Editor opens on the ***Sub-Tests*** tab by default. Selecting the ***Options*** tab opens the following screen:

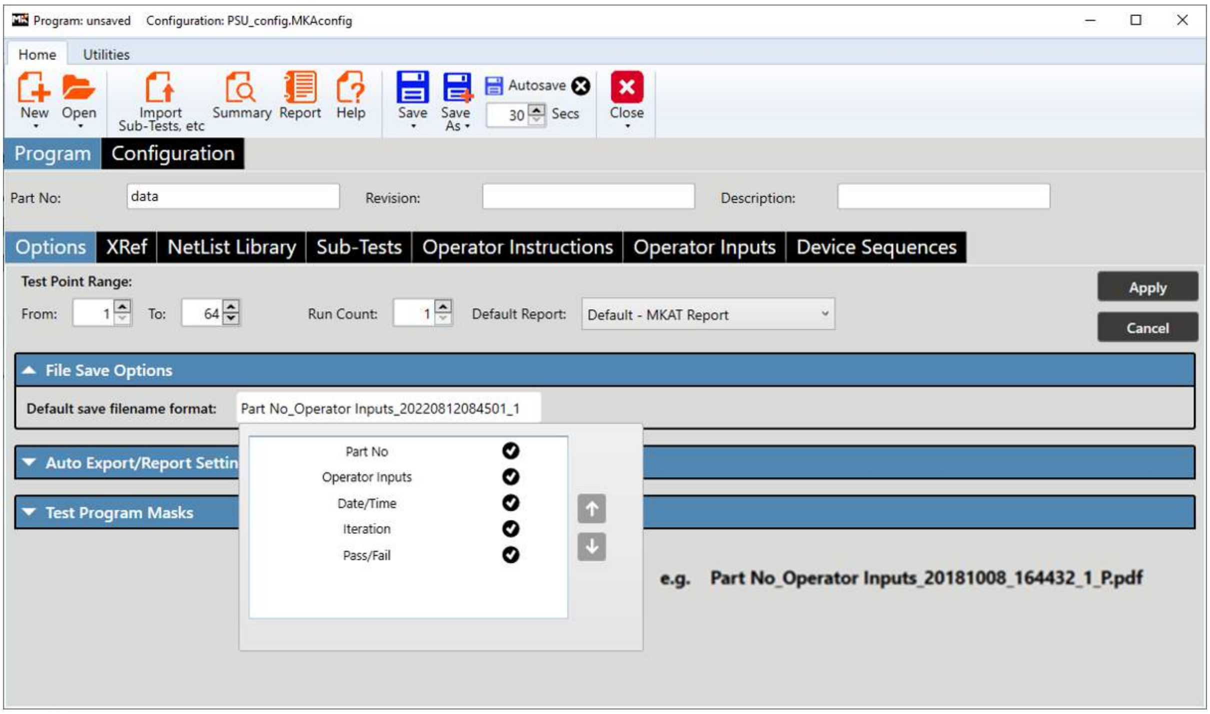


Figure 2: Main MKAT program creation screen.

On this screen, the default "Options" tab is selected. Here you can enter details about the UUT and define the test point range which needs to be used for this program. Test points outside of this range will not be considered in use so will be excluded for shorts and HV testing. If there are points that do not need to be tested, then these a can be added to the test program masks section i.e., these are points that are within the test point range but still do not need to be included in any tests. Import and Export of masks to "XML" or "TSV" formats can also be carried out.

File Save Options allows for configuration of the filename used when exporting files following a test. The filename can be constructed from the components shown and reordered using the up and down arrows.

The Auto Export/Report Settings section allows for the selection of defined reports which are automatically exported at the end of the test run. Selecting the "Add" button allows an export in any combination of either "PDF", "Print" and "XML".

As of version 10.10.1 the filenames can be configured individually for each auto export file.

Pass/Fail Key:

- E: Error
- F: Fail
- P: Pass
- U: Untested / Partially tested
- X: Aborted

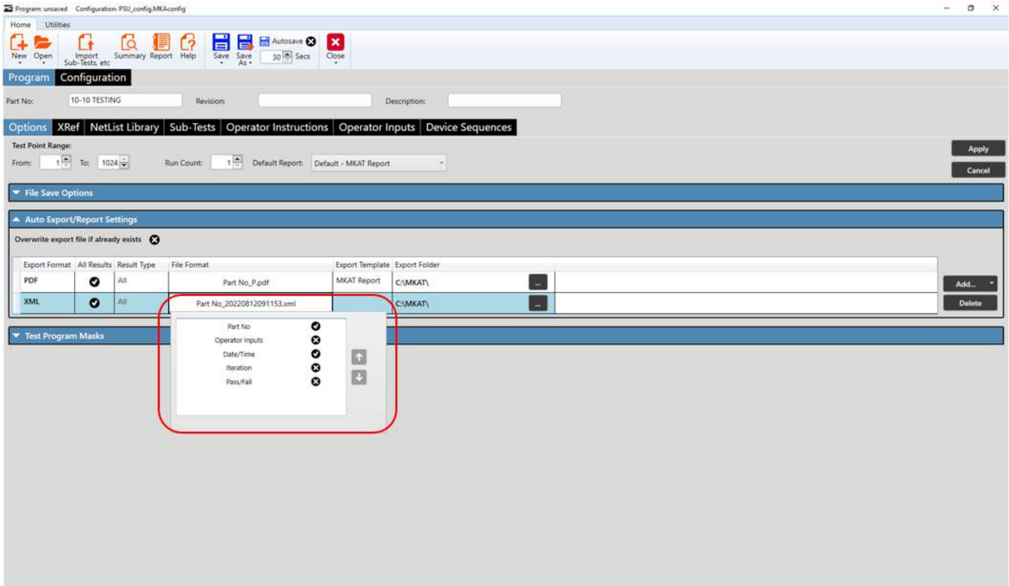


Figure 3: Auto Export/Report Settings.

4.2 Menu options

This allows you to abandon the current program and or configuration and start with a new one. Note: please ensure you save the current one if you want to save your changes.

This will allow you to open an already existing program or configuration. Note: you can have only one of each type open at the time, so please ensure you saved your work before opening a new one.

This allows you to view the program as a report. The reports can be saved as PDF and can be printed.

This allows you to view and analyse exported XML result data from the runner. If you wish to “re-generate” a report and / or just view them on screen, then select this option. This will show the screen below.

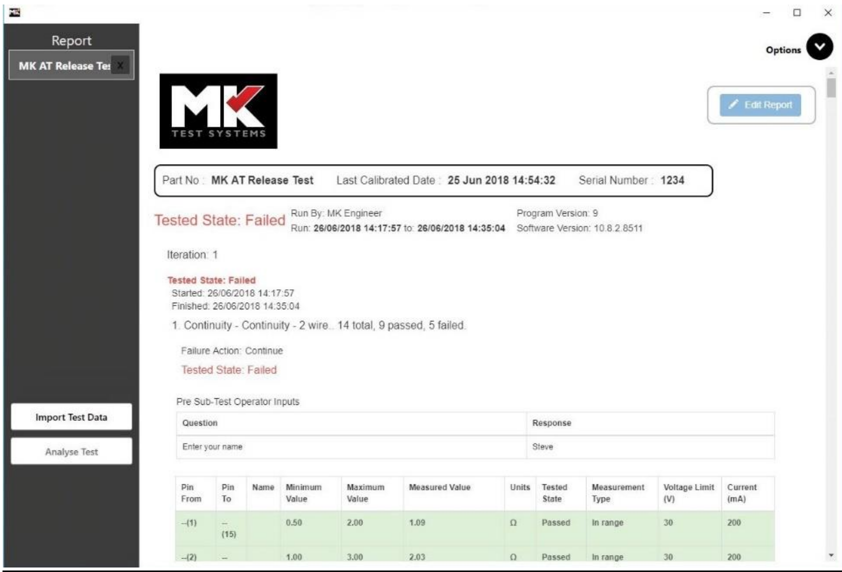


Figure 4: Viewing /Analysing Report Data

From this screen you can use the “Import Test Data” option to select one or more XML results file. Selecting any individual report on the LHS will display that result data. Selecting the ‘Analyse Test’ will produce a “trend” analysis report as shown below:

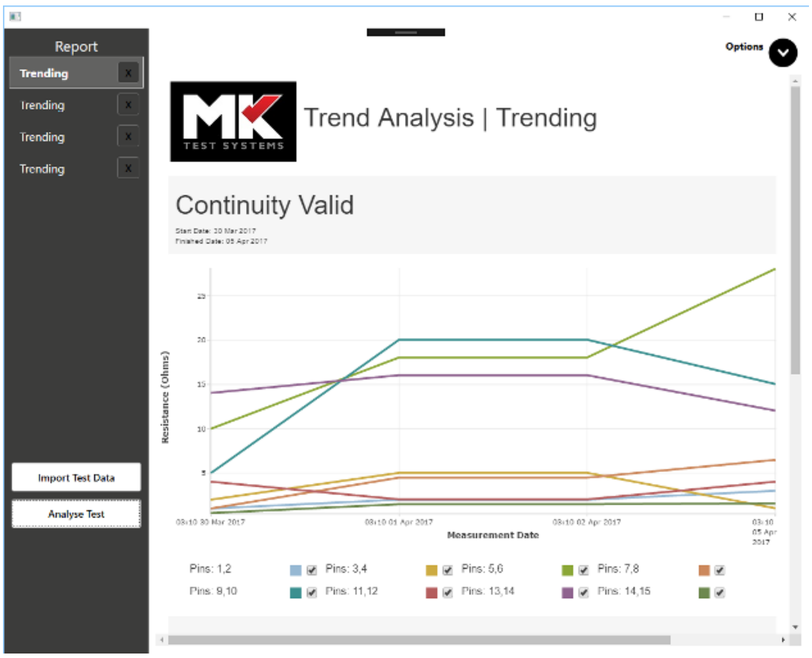
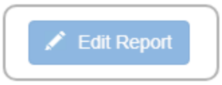


Figure 5: Trend Analysis Report.

Note your SubTest parameters must be the same in each SubTest (unedited) for the matching / trend analysis. Each parameter in a SubTest is given a unique ID when it is generated, and this is used to match the parameters together.

4.3 Editing Reports



The Edit Report button allows the user to customise the layout of the report for viewing. Pressing the button enables four main options: “Import Layout”, “Export Layout”, “Save Changes” and “Cancel”. Two options also appear: “Show each net on a new line” and “Max. rows to show for nets:”. The “Edit Report” button caption also changes to “Reset Report”. See the following screenshot:

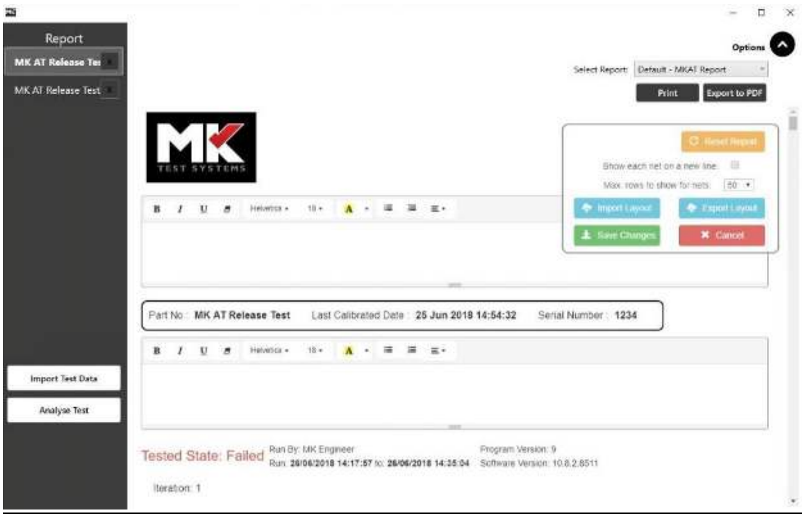


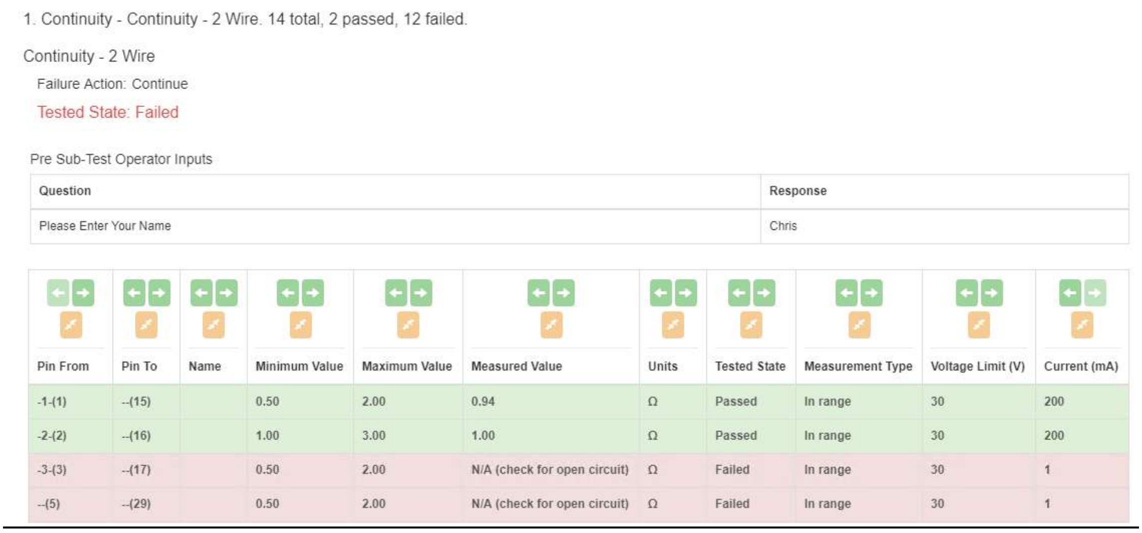
Figure 6: Edit Report.

The import and export layout functions allow saving to and importing from a “.json” file. Importing will see the current view updated to the view as defined in the ”.json” file.

Selecting the “Show each….” option will force any multiple test points in a net to be shown individually on the next line, rather than appended on one line.

If the “Max. rows..” option is selected, the report will only show the number of lines as chosen in the drop down.

Table columns can also be edited. The green arrows  allow for the column positions to be reordered and the orange buttons allow the columns to be hidden.



1. Continuity - Continuity - 2 Wire. 14 total, 2 passed, 12 failed.

Continuity - 2 Wire

Failure Action: Continue

Tested State: Failed

Pre Sub-Test Operator Inputs

Question	Response
Please Enter Your Name	Chris

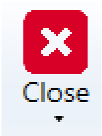
Pin From	Pin To	Name	Minimum Value	Maximum Value	Measured Value	Units	Tested State	Measurement Type	Voltage Limit (V)	Current (mA)
-1-(1)	--(15)		0.50	2.00	0.94	Ω	Passed	In range	30	200
-2-(2)	--(16)		1.00	3.00	1.00	Ω	Passed	In range	30	200
-3-(3)	--(17)		0.50	2.00	N/A (check for open circuit)	Ω	Failed	In range	30	1
--(5)	--(29)		0.50	2.00	N/A (check for open circuit)	Ω	Failed	In range	30	1

Figure 7: Changing Report Parameters.

The layout changes can be saved to the report template using the Save Changes button. The changes will then be applied automatically whenever this template is used. Formatting can also be reset to the original template layout using the Reset Report button. There is also provision for the addition of a custom header, sub-header, and a footer.

Save the currently loaded program or configuration.

Save the currently loaded program or configuration to a new file.



Close the currently loaded program or configuration.

4.4 Creating XRef for the program

Test programs in MKAT are all related to MK test point (TP) numbers. These however will not necessarily be meaningful to end users. You can therefore provide a cross reference (XRef) between the TP's and your connectors. Because all TP numbers are consecutive in both two wire and four wire mode you will have to enter both 2 wire and 4 wire XRefs.

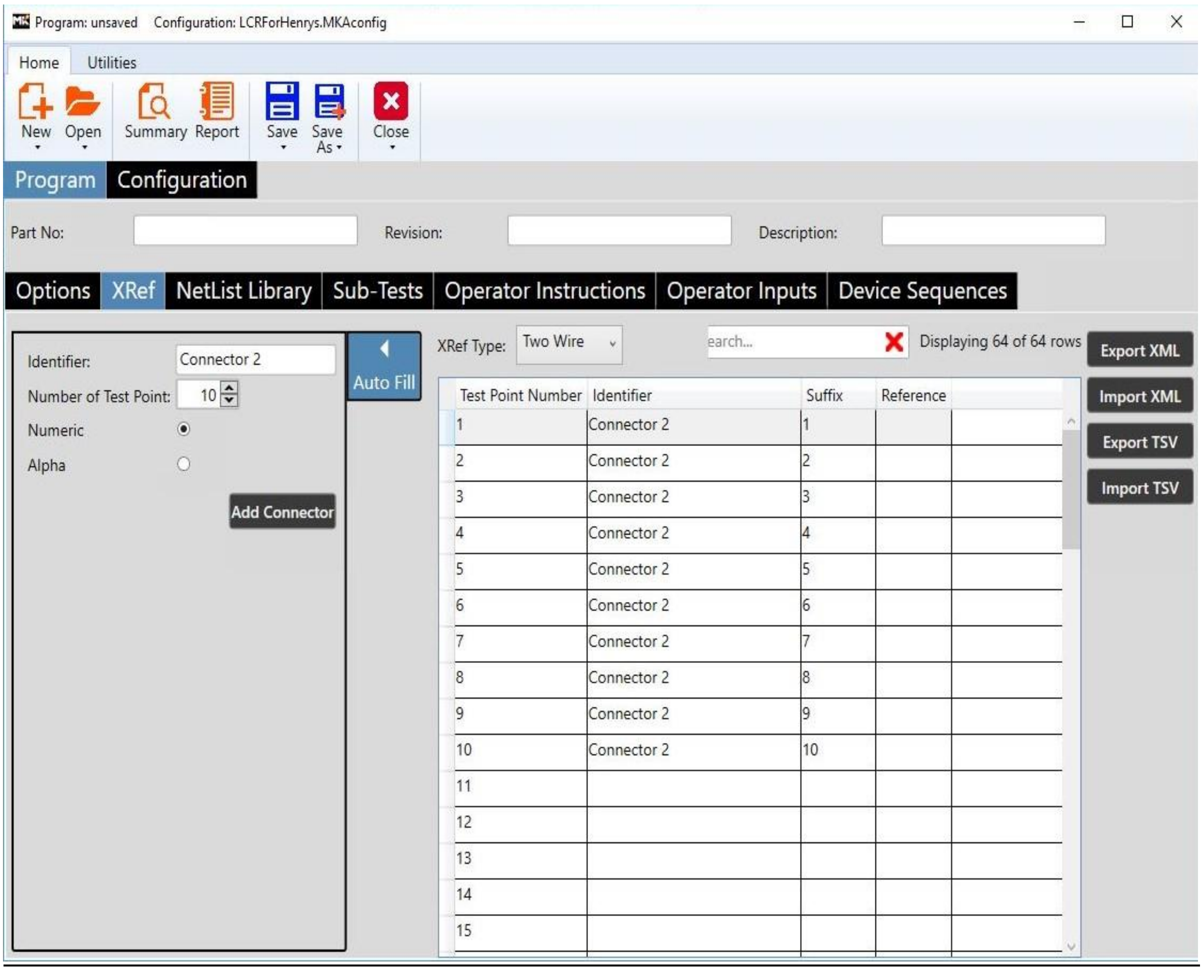


Figure 8: Entering Xref's.

The operator may manually enter Xref data line by line, however this is likely to be time consuming if there are a large group of test points. To assist in part automating the process, the operator can select the “Auto Fill” button, which will reveal the “Add Connector” options as shown. There are also the options to import and export Xrefs in XML or TSV format to further assist in speeding up the process.

Additional XRef Fields can be added if required using the Add XRef Column button, shown below. These fields can be reordered using the *arrow* buttons at the top of each column or deleted using the *x* button. This additional XRef data is displayed everywhere the XRef information is normally displayed and can be formatted in the *Parameters* section of *Configuration*.

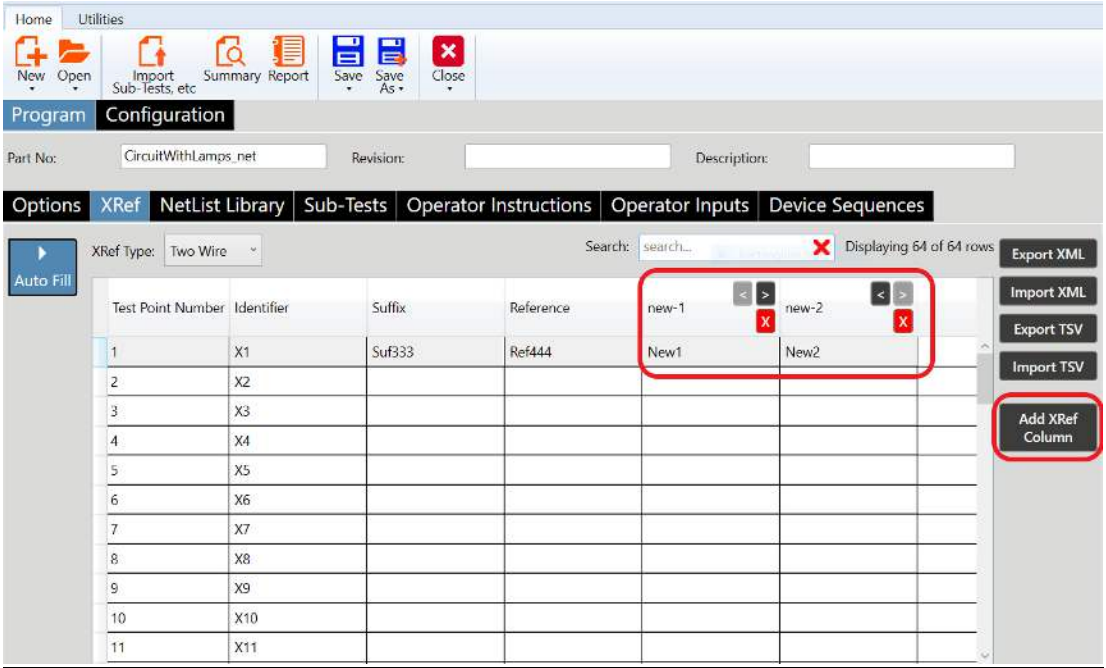


Figure 9: Adding Xref columns.

4.5 Adding netlist to the library

If you require more control on how HV tests are carried out, you can create your own netlist libraries. Using this feature will allow you to define not only the netlists but also the ability to “group” netlists together. This will then allow you to perform “group” to “group” HV testing rather than just net to net testing.

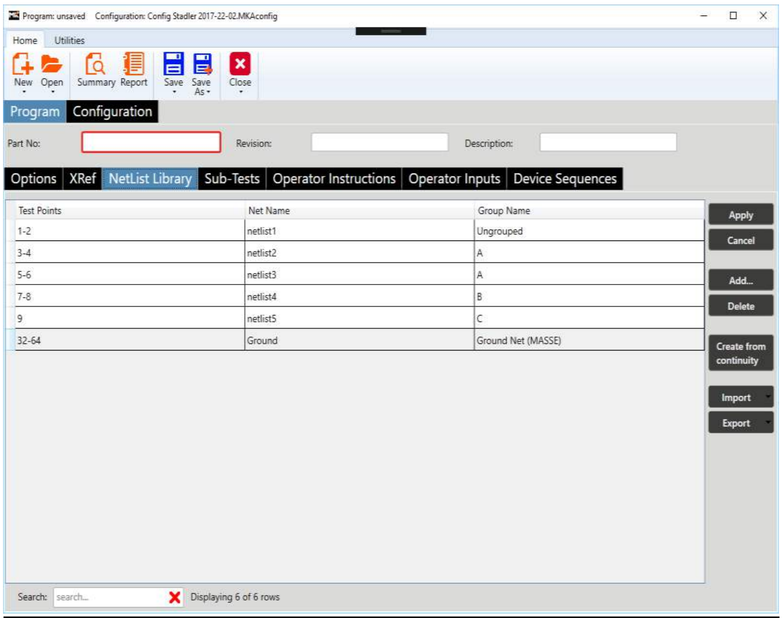


Figure 10: Simple example of netlists with groups.

4.6 Sub-test creation

When creating / editing a sub-test, the sub-test tab will switch to a wizard mode to help guide you through the steps required to create the sub-test.

The first step, *Sub-Test Type*, allows you to name and select the type of test. You cannot change the type of sub-test when editing an existing sub-test. If this is necessary, you would have to delete it and create a new test of the correct type.

The next step allows you to define the “defaults” applicable for the selected sub-test type.

Next you define the connection / net lists and parameters that are applicable for that test.

The next screen allows you to define the options for this sub-test. These are the “actions” that execute when a “fail” condition occurs.

Operator instructions are next. These can be defined as pre sub-test, post sub-test, post sub-test on pass, or post sub-test on fail. If you have not yet created the operator instruction, then you can simply switch to that tab, create the instruction then switch back to the sub-test tab and add it.

The Operator Input screen enables predefined operator inputs to be assigned to the sub-test. These are created in the *Operator Input* tab. See: Adding operator instructions

The Ems/External Devices screen enables predefined device sequences, such as turning on a power supply, to be assigned to the sub-test. These are created in the *Device Sequences* tab. See: Adding Device Sequences

You need to ensure that you have selected the correct “test mode”, i.e., ensure that you select two wire (or deselect it to use four wire measurement).

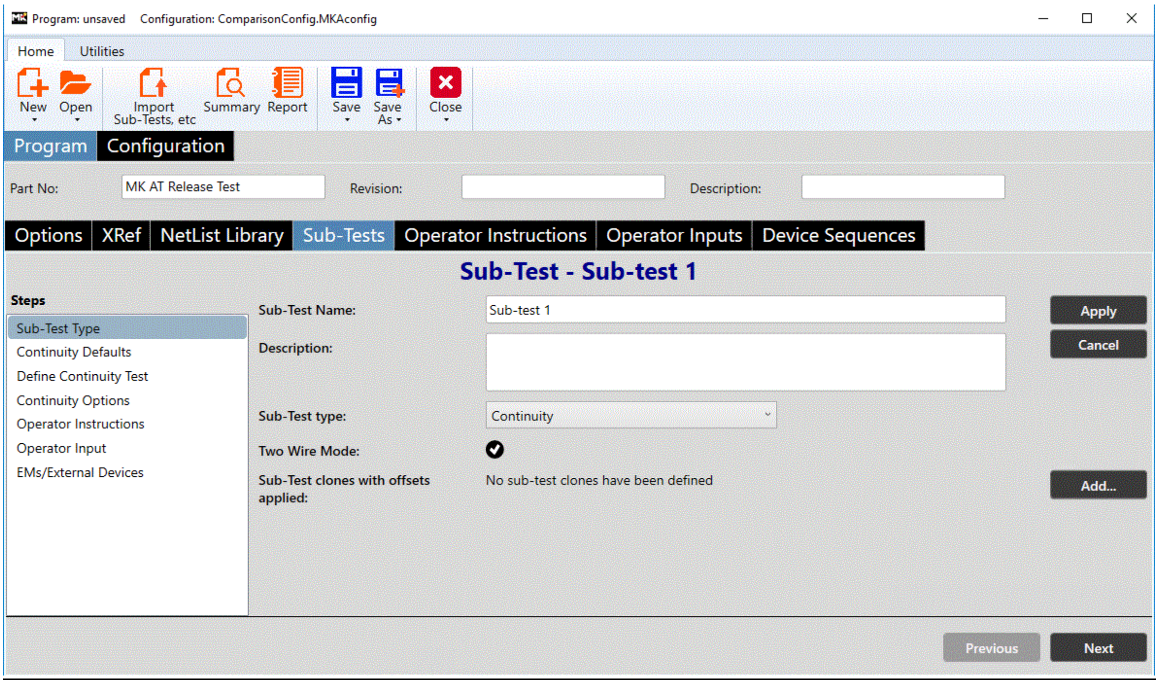


Figure 11: Edit/Create SubTest Wizard.

If you have edited a sub-test but do not wish to retain the changes, selecting ‘Cancel’ will revert any changes made. To ensure that your changes are saved, you must press the ‘Apply’ button.

Once you have created and selected the sub-test type that you wish to create, you will see a set of sub-test specific screens, as detailed in the following sections:

4.6.1. CONTINUITY SUB-TEST CREATION.

The first continuity specific defaults screen appears as shown below:

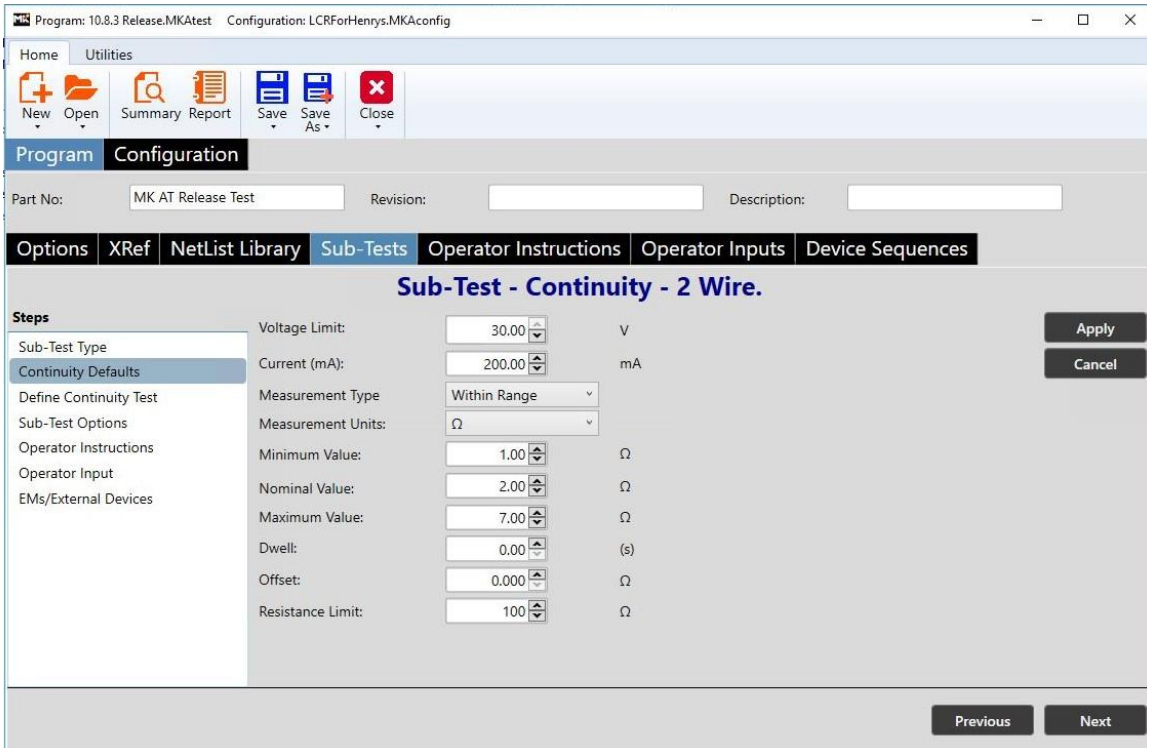


Figure 12 : Continuity defaults screen.

This screen allows you to set the default parameters that are used when you add a new continuity measurement.

- Voltage Limit: This is the maximum voltage that the system will deliver (note this may not be the actual test voltage, as we are working in constant current mode. This is the voltage that will not be exceeded if we discover open circuits etc).
- Current: This is the current that you wish to test with. Please note that this must be set to an appropriate value for the resistance you are attempting to measure.
- Measurement type: This allows you to specify how you wish to apply the limits, and hence the pass / fail of the test. There are 3 measurement types:
    - Within Range: the measured value must be within the specified range to pass.
    - > Min: the measured value must be greater than the specified minimum to pass.
    - < Max: the measured value must be less than the specified maximum to pass.
- Nominal value: This is the nominal value that you expect the resistance to be.
- Minimum value. Used for the test pass criteria, depending on measurement type.

- Maximum value: Used for the test pass criteria, depending on measurement type.
- Dwell: time in seconds that the system will wait after the current has been applied, and before taking a measurement. Required if the connection needs time to charge.
- Offset: an offset resistance to be subtracted from the measured value during testing.
- Resistance limit: This is the maximum resistance that the system will attempt to measure (the overall system limit for LV is 100K Ohm). The greater this value is over the nominal value, the more measurements the MKAT will make at different current settings from those specified in the test. This can make the system run slower if there are many connections that are failing the initial measurement. If finding the actual resistance measured is not required, then this value can be set close to the maximum value (10% above is recommended).

The next screen allows you to define the connections you wish to test.

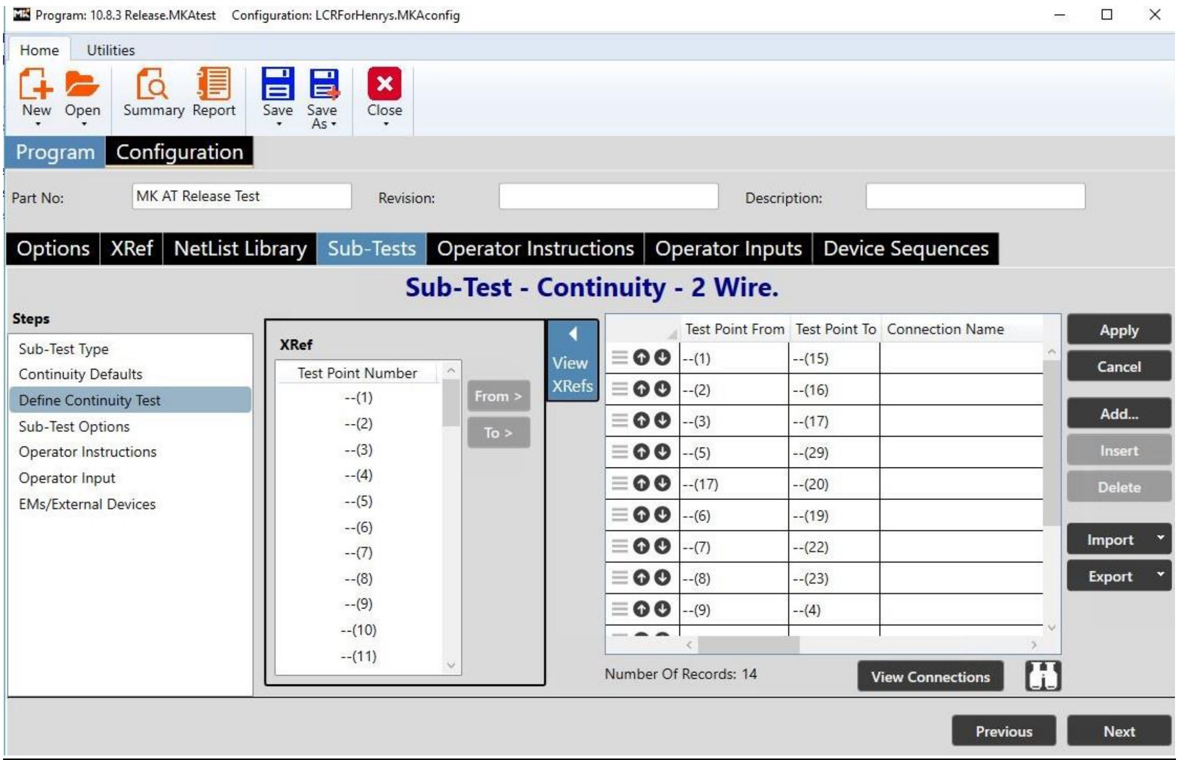


Figure 13: Define continuity screen showing the *View Xref* section expanded.

Here you can add or edit the connections and the parameters which are used to measure the connection. Each item added will have the default values applied from the previous screen. If you click in the cell, you can edit the entered value. You can either enter the test point number directly in the “from” and “to” test point columns, or they can be selected from an existing Xref. The Xref data can be viewed by selecting the *View Xrefs* button, as shown in the above example, then the “*From >*” and “*To >*” buttons can be used to populate the fields directly. If you edit a test point, you can only enter the test point number. When the edit is complete, the cell will then show the test point, complete with Xref formatting, if this has been defined.

You can import or export data directly to or from this list in either XML or tab separated value (TSV) formats. This will allow you edit or create the connections in other editors and re-import them, if required.

The *View Connections* button provides a graphical representation of the connections that have been defined in the continuity sub-test. This opens in a new window as shown below:

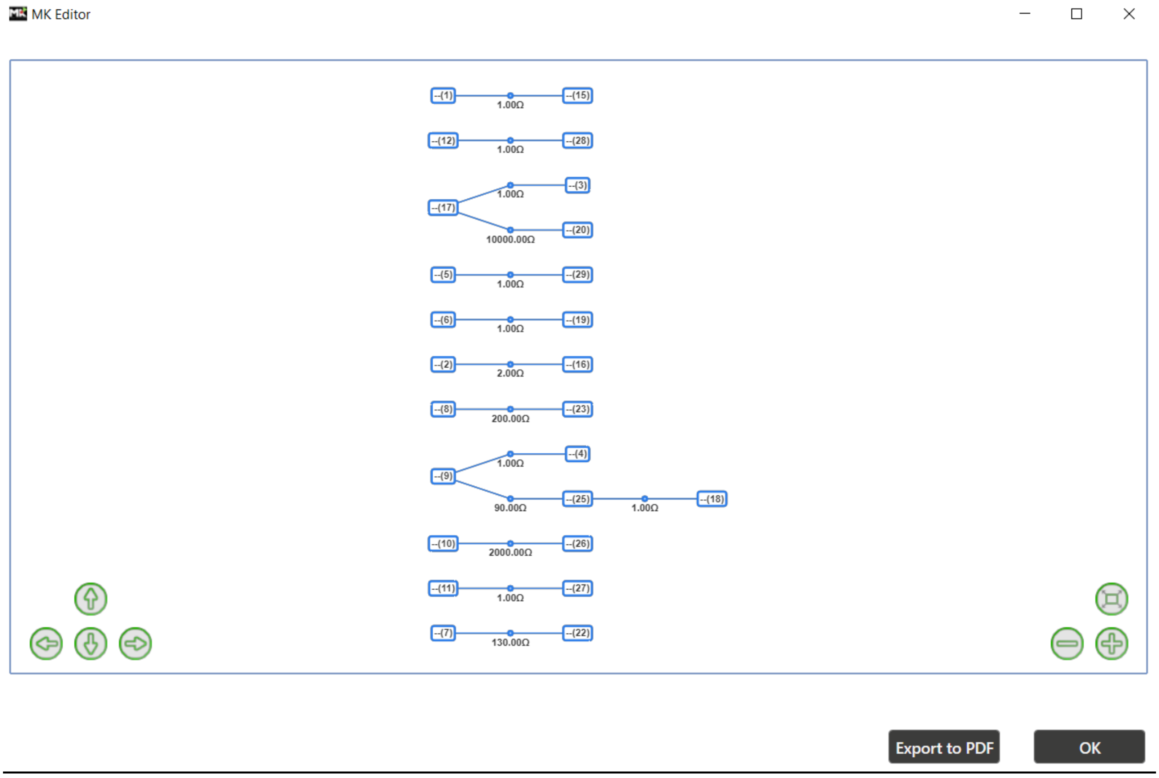


Figure 14: Graphical connections view .

The connections are labelled with their Xref names, if available, along with their test point number in brackets and the resistance values shown are the nominal values for the connection. The layout diagram can be navigated using the arrow buttons and the plus and minus buttons zoom in and out and the  button fits the layout to the window. The diagram can be exported to PDF, if required, using the *Export to PDF* button.

The *Sub-Test Options* screen allows you to define what will happen if the system encounters a failure whilst testing.

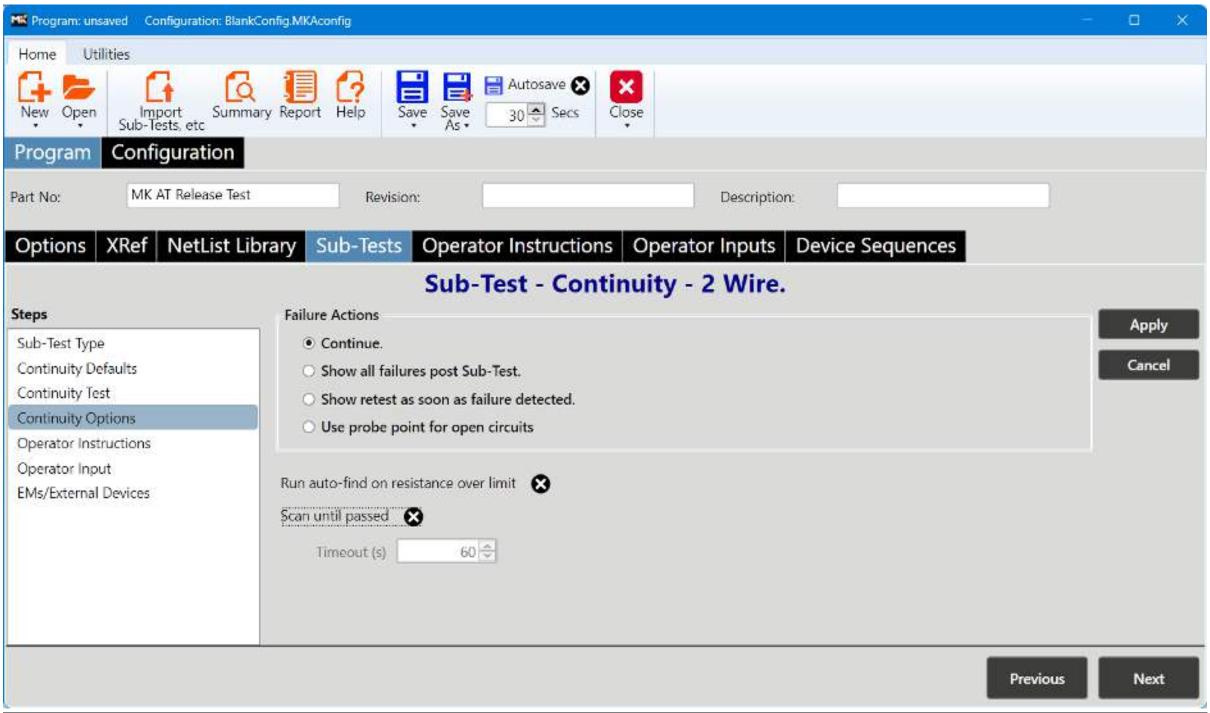


Figure 15: Options to be applied when measurement fails.

- Continue: the system will just continue to the next measurement and record the failed item.
- Show all failures post Sub-Test: This will "pause" the testing and show the operator all the failures in that sub-test. Each failed item is shown with the option to re-test the item, or skip. If retest is selected, the system will test that item again. If it still fails it will remain in the list. If the item passes, it is removed from the list and the final overall report will not reflect the new passed state. If the Skip option is selected, then the original failed state will be reported on the final report. This option allows you to fix any continuity failures before moving on to the next sub-test.
- Show retest as soon as failure detected: This is similar to the above option, but it will show the retest screen as soon as the first failure is detected, so only one failure will ever be shown. The other actions work the same as the Show all post sub-test option.
- Use probe point for open circuits: if a failure is recorded, the re-test screen loads with the option to use the probe point for diagnosis.
- Run auto-find on resistance over limit. This assists in finding mis-wires, etc. If a continuity test fails with resistance over limit (possibly an open circuit) both ends of the continuity connection are tested to detect if there are any short circuits to these test points. This is reported so the user knows where the mis-wire has occurred.
- Scan until passed. This option will continuously scan each connection in turn, waiting for a passed measurement before moving on. When running, the screen will show the *Connection Name* field to the user so they know how to make the connection – this could worded in the form of an instruction e.g. "Please connect probe to x". If no passed measurement is reached within the specified *Timeout (s),* the connection will be marked as a failure and will move on to the next measurement.

The Operator Instruction screen allows any of the predefined operator instructions to be assigned to this sub-test. The *Show* option gives control over when the operator instruction is displayed in the test program. The options are:

- During SubTest (with the additional option to hide at the start of the test)
- Post SubTest - Always
- Post SubTest - Failed
- Post SubTest - Passed
- Pre-SubTest

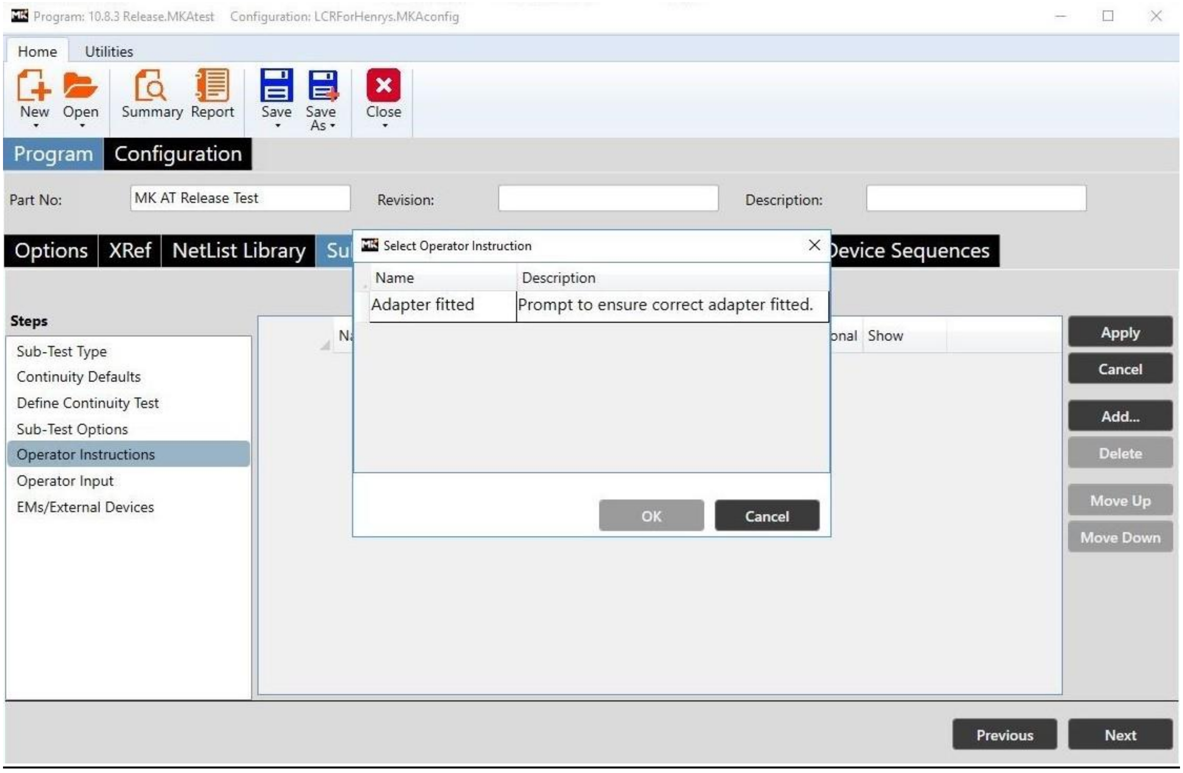


Figure 16: Selection of the operator instruction to be added to the SubTest.

The Operator Input screen allows any of the predefined operator inputs to be assigned to this sub-test. The *Show* option gives control over when the operator input is displayed in the test program. The options are:

- Post SubTest - Always
- Post SubTest - Failed
- Post SubTest - Passed
- Pre-SubTest

The EM's/External Devices screen allows for predefined device sequences to be assigned to this sub-test.

4.6.1.1. Continuity test polarity

In most cases a continuity test is used to measure the resistance of a connection or conductor e.g., copper wire. Therefore, the direction or polarity of the test current is not important as the resistance measurement obtained will be the same in either direction.

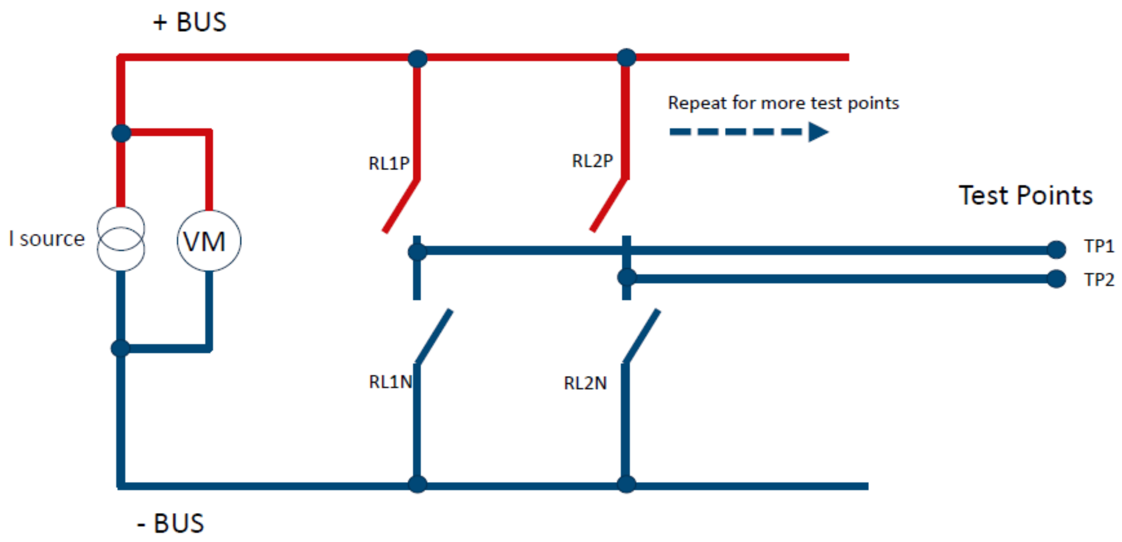


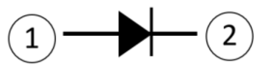
Figure 17: Typical 2 wire relay board.

In practice the direction of the test current through the connection or conductor is determined by the FROM and TO test points.

The FROM pin is connected to the negative (-ve) side of the current source, and the TO pin is connected to the positive (+ve) side. So, for a connection FROM = 1 to TO = 2, in the above example **RL1N** and **RL2P** will be energised. The current will therefore flow from test point **2** to test point **1**.

4.6.1.2. Testing a diode

Therefore, in order to test a diode as shown below, the continuity test should be set up as follows:



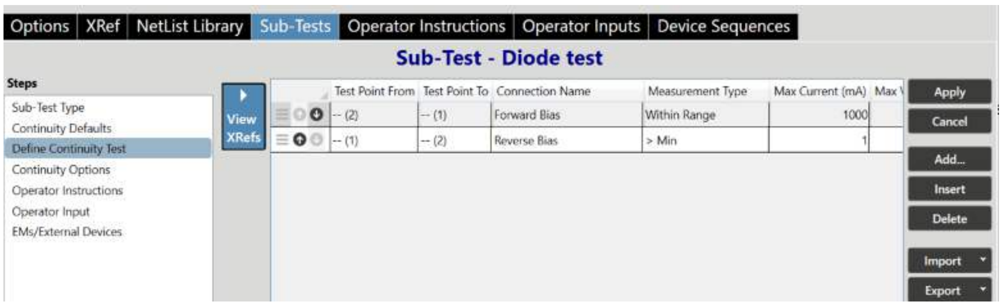


Figure 18: Diode Test

The continuity test is as follows:

Forward bias	FROM 2	TO 1	(low resistance)
Reverse bias	TO 1	FROM 2	(open circuit)

Note, as a diode is an active device, the forward bias resistance will be determined and vary with the applied current.

4.6.2. SHORT CIRCUIT DETECTION

Short circuit sub-tests are designed to quickly identify any low resistance shorts circuits that may exist in a UUT or interface. The sequence of screens is like those for a continuity test. You first select the defaults values that you wish to use to find short circuits.

The next screen allows you to define the “netlists”. A net list is a collection of test points that are common (or need to be treated as common) and will be tested together to find any low resistance connection to all other net lists defined WITHIN the sub-test. It is important to remember that only netlists defined are used to find shorts, so if you wish to exclude something from testing then it is simple task to delete that net from the list. When you are first presented with the screen, you will be shown the following dialog:

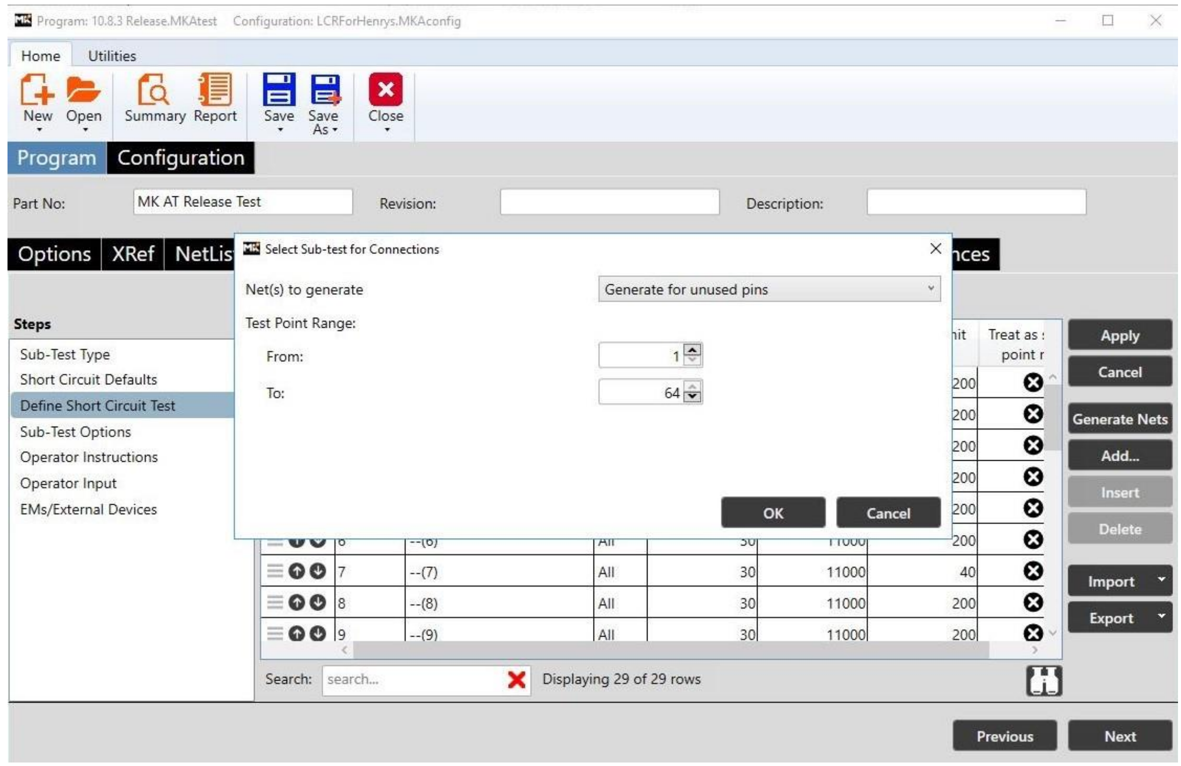


Figure 19: Generating netlists for unused pins dialog.

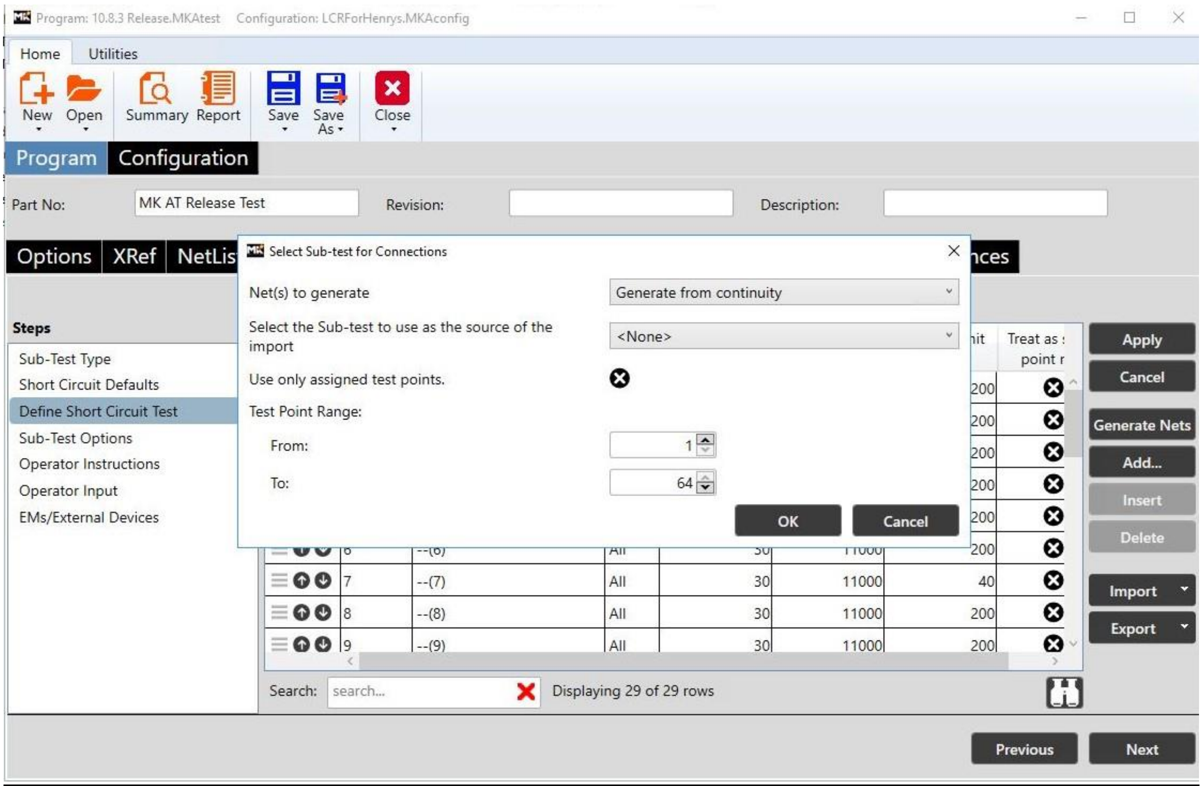


Figure 20: Connection selection dialog to generate netlists.

This allows you to automatically generate the netlists from a continuity sub-test and control the test point range that is used to generate the nets. Using this option, the software will automatically search for any common connections within the continuity program and generate the netlist.

You can also select the ‘Generate from unused pins’ option. This will use the list of nets currently defined and generate a single net with all the other pins in it. It will also select the “treat as single point nets” option. This means that although there could be many points in the net, when testing we will treat them as individual nets. If a short is found to any point in that net, then the software will report which point it is. This is a quick and easy way to add a large amount of “unused” test points that you want to ensure are not connected but need to know which point has failed if there is a problem.

If you wish you can then edit the auto generated list afterwards, note that the auto generate clears the current list of nets before generation.

You can also create netlists manually. Enter a set of single points, and use the “,” separator e.g., 1,5,8. This would be test points, 1, 5 and 8 included in a single net. You can also enter a range of test points using the “–“separator, so 1-10 would be test points 1 to 10 inclusive. You can mix and match the syntax so 1, 4-8, 24, 55-58 is a valid entry.

Editing the remainder of the short circuit screens are like editing the continuity screen.

4.6.3. Insulation sub-tests

Extreme care must be taken when creating high voltage insulation tests.

Incorrect setup may result in personnel injury and/or damage to equipment. Please ensure you understand the hardware system configuration first. Ensure tests are set up to test "TO" earthed UUT test points. Testing FROM earthed points may result in equipment damage.

The internal high voltage DC power supply is used for insulation tests.

The creation of this sub-test is very similar to the short circuit sub-test, with only the number and type of default parameters changing. There is one minor change in the way the test is carried out. Short circuit is a forward only search, so once we have tested netlist A to netlist B, we do not need to test netlist B to netlist A, but for insulation testing we do. If you wish to test in one direction only, set the voltage of the netlist to 0 or delete the test from the list. This will mean that you will test to that TP from the other TP, but never from it. This can be useful when testing screened cables etc. By setting the voltage on the next to TP to 0, it will be shown in the report as being masked. Insulation tests may fail as follows:

HV Fail — *due to the HV power not achieving voltage - normally due to low resistance/ excessive load.*

HV Flash — *due to flash detector detecting transient current due to flashover/breakdown during test.*

HV insulation — *insulation resistance measured below minimum value or outside of a range.*

Insulation resistance is calculated using Ohms Law where:

Insulation Resistance (Ω) = Voltage Applied (V) / Measured Leakage Current (A)

e.g., measuring 0.000010 (10µA) during a 500Vdc insulation test gives:

500/0.000010 = 50,000,000Ω or 50MΩ

By default, the insulation resistance measurement will be the **lowest** value recorded during the measurement period. However, this may be changed to "**average**" in the *Measurement to use pass/fail* drop-down box, where the average resistance measurement is recorded over the measurement period. The pass/fail criteria will be determined by the measurement type.

>Min — most common to ensure insulation is greater than a specified value.

< Max — will only pass if insulation is lower than a specified value - rarely used.

Within Range — can be uses to measure an expected insulation or high value resistance.

4.6.3.1. 1 V ALL testing

This method is normally used to define an insulation test. In this case each net (common group of test points) is tested against all other nets. The netlists may be generated as follows:

- continuity test (connections list) from any SubTest.
- from unused pins in a range of test points.
- generate for all nets in a group..

4.6.4. AC AND DC HI-POT SUB-TESTS

Extreme care must be taken when creating Hi-Pot tests. Incorrect setup may result in personnel injury and/or damage to equipment. Please ensure you understand the hardware system configuration first. Ensure tests are set up to test "TO" earthed UUT test points. Testing FROM earthed points may result in equipment damage.

The internal high voltage DC or AC power supplies are used for hi-pot tests.

The setup and control of these tests are almost identical to insulation sub-tests, the only thing that will change are the default parameters. For AC and DC Hi Pot tests, the default measurement used for determining a pass or fail is *highest* leakage current measurement. This can be changed to *average* measurement if required.

During, Hi-pot test the **Highest** leakage current value during the measurement period is normally used . However, changed to the average current during the measurement period by selecting **Average** in the *Measurement to use pass/fail* drop-down box.

The pass/fail criteria will be determined by the measurement type.

>Max	most common to ensure leakage current is below a specified value.
> Min	will only pass if leakage current is higher than a specified value - rarely used.
Within Range	can be uses to measure an expected resistance / leakage value.

4.6.5. Comparison sub-tests

The functionality exists to automatically create a comparison sub-test from any Continuity, Insulation or Hi Pot sub-test (hereafter referred to as the donor). The comparison sub-test can have its Pass / Fail criteria set as a percentage of the donor measurements. The percentage is determined by editable Offset and Tolerance fields, and the software calculates these from the donor sub-test as its measurements are executed. The Offset is a number, the Tolerance is a percentage. These are subtracted or added to the minimum and maximum values, respectively.

The comparison type is selected when adding a new sub-test, in the same manner as described for continuity, shorts etc sub-tests. During creation, a donor sub-test must be selected for comparison to. More than one comparison sub-test for a given donor may be created. The donor and comparison are then effectively linked. The donor sub-test will always be displayed first in the MK Editor run order, with any comparison sub-tests listed below. The comparison sub-test may be deleted, with the donor remaining, but if the donor sub-test is deleted, any associated comparison sub-test(s) are also automatically deleted.

Branching to a comparison sub-test (“On Pass” or “On Failure”) is not permitted. The order of the sub-tests can be amended using the “Move Up” and “Move Down” buttons, however, the donor sub-test is always ordered before, and therefore executed prior to the comparison sub-test.

The following rules apply when comparison sub-tests are updated:

- If the measured value is over the maximum value of the test, both the minimum and maximum values of the comparison measurement are set to the maximum.
- The same applies if measured value is below minimum: values of the comparison measurement are set to the minimum.
- During continuity, if the test results in an open circuit, the comparison minimum and maximum are set to maximum.
- During HV, if a measurement is beyond the upper limit, the comparison maximum is set to the system maximum (usually 1000MΩ).
- The same applies if the measured value during HV is below minimum: values of the comparison measurement are set to the system minimum.

The comparison sub-test results are displayed on the report the same as any other sub-test results.

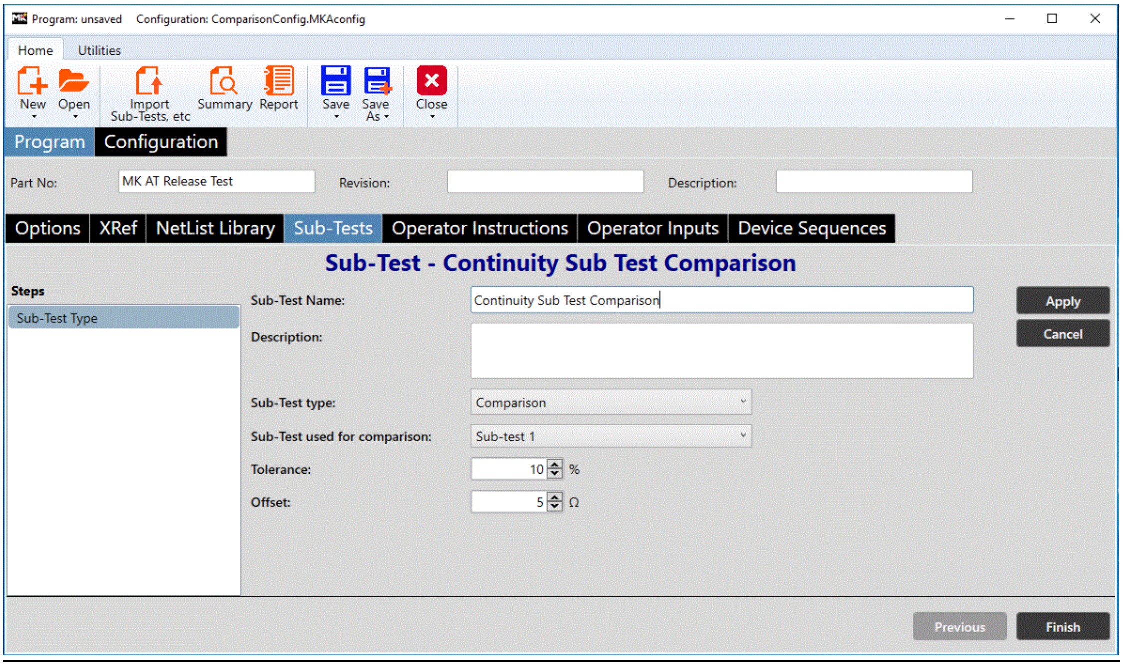


Figure 21: Comparison sub-test type.

4.6.6. Real Time Scanning Sub-Test

As of release 10.14, a new test type called Real Time Scanning (RTS) has been introduced. This test type is only compatible with systems fitted with RTS modules. The test type performs a continuous continuity test, switching test points on RTS modules at high speed. This provides quick feedback and can operate with a partially connected UUT making this a useful tool during hook up for larger systems as the state of the UUT can be seen as devices are connected. The options are the same as for Continuity, with tabs for specifying defaults limits, defining test points, adding operator inputs and instructions and the option to add external device sequences.

4.6.7. Expression Sub-Test

The expression sub-test allows for more complex data analysis. Results from previously run sub-tests can be compared and mathematical functions applied to create a custom expression. Operator Inputs from previously run sub-tests or *Pre Test* Operator Inputs can also be used in expression definitions. Expressions can be grouped and combined together to create a series of rules that will be evaluated at runtime, giving an overall pass of fail.

Expression subtests are set up in two stages:

1. *Define Variables*: This section defines the data that is going to be used in the expression

   Name: Variable name to be used in the expression.

   Sub-Test or Operator Input: Any sub-test run previously or *Pre Test*/*Iteration* Operator Input.

   Parameter or Operator Input: The sub-test parameter or *Sub-Test* Operator Input to be used.

   Value: The specific value to be assigned to the variable.

   Run expression for all parameters in selected sub-tests: This option causes the expression to be evaluated for each parameter in the sub-test selected.

2. *Define Expression:* This section defines the expression to be evaluated.

   Add rule: Add a new rule. Where multiple rules exist, they can be either evaluated using *AND* or *OR* logic as required.

   Add Group: Create a group or rules that can be evaluated together and compared to another group using *AND* or *OR* logic as required.

   Test Expression: This function can be used to check that the expression is going to behave as expected. Each defined variable can be given a theoretical value and the expression evaluated.

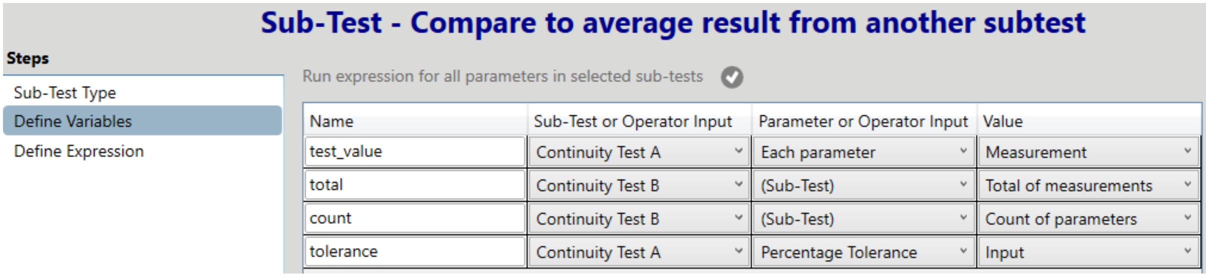
Further details of the mathematical functions available to be used in custom expressions are available from the *Define Expression* screen by selecting the help button.

Example: Compare each result from one sub-test with the average result of another subtest.

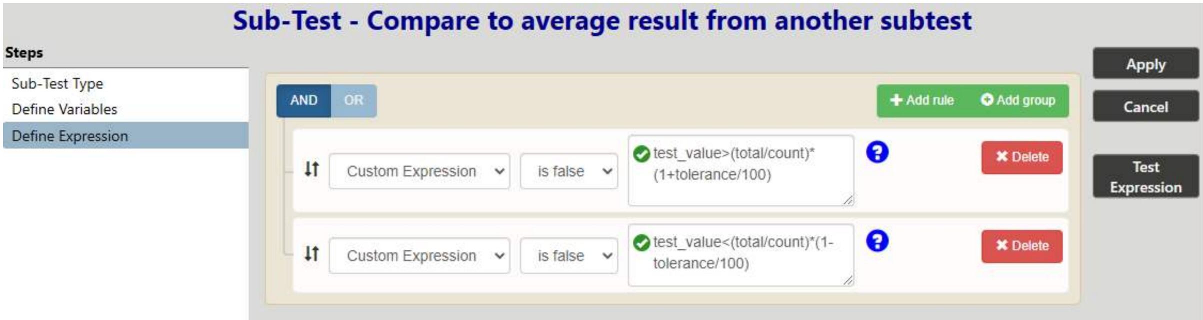
In the example below, each measurement from the subtest *Continuity Test A* is assigned to the variable *test_value* in turn. The total of all measurements in sub-test *Continuity Test B* will be assigned to the variable *total* and the number of measurements to the variable *count*. Finally, the operator input *Percentage Tolerance* is assigned to variable *tolerance.*

The expression then uses these variables to check that each test value from Continuity A is not greater or less than the average result from the Continuity Test B, plus or minus the tolerance. The *Test Expression* function can be used to check the expected results.

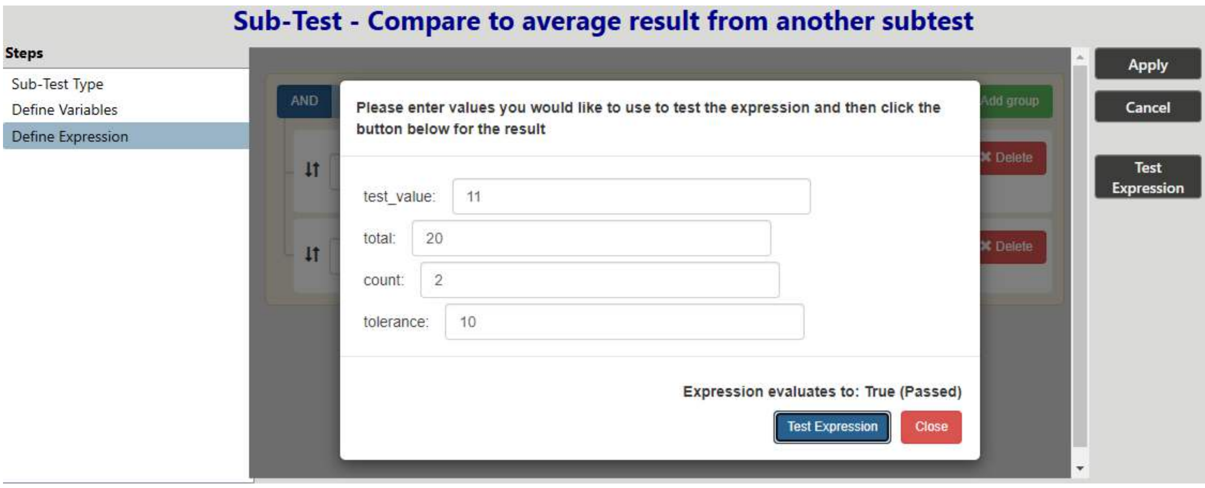
Define Variables:



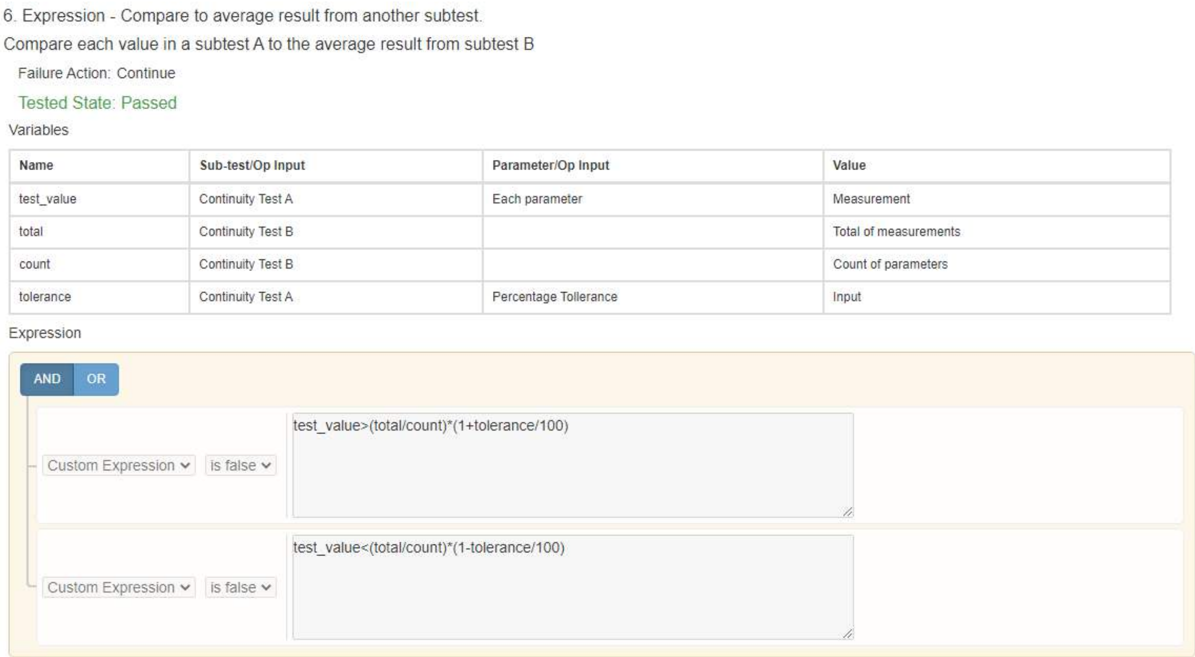
Define Expression:



Test Expression:



Reporting: Expression subtests can be included on the results report. By default, the defined variables and the expression definition will be shown but both of these sections can be hidden, if required, using the *Edit Report* function.


6. Expression - Compare to average result from another subtest.

Compare each value in a subtest A to the average result from subtest B

Failure Action: Continue

Tested State: Passed

Variables

Name	Sub-test/Op Input	Parameter/Op Input	Value
test_value	Continuity Test A	Each parameter	Measurement
total	Continuity Test B		Total of measurements
count	Continuity Test B		Count of parameters
tolerance	Continuity Test A	Percentage Tollerance	Input

Expression

AND OR

Custom Expression is false test_value>(total/count)*(1+tolerance/100)

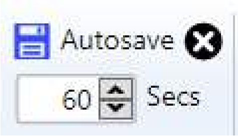
Custom Expression is false test_value<(total/count)*(1-tolerance/100)

4.7 Saving the Program and Configuration

Changes to programs and configurations are not automatically saved by default. If you wish to save changes, you can save the program or configuration via the save menu option. If you wish to save your program or configuration to another file, then use the save as option, and then you can specify the new name and location.

4.7.1. Autosave

If checked the autosave feature will save changes made to the program or configuration at the specified interval. This value has a minimum of 30 seconds.



4.8 Editing Sub-Tests

The next tab is the sub-test tab. This is where you can create and define the running order of Subtests to be run against the UUT.

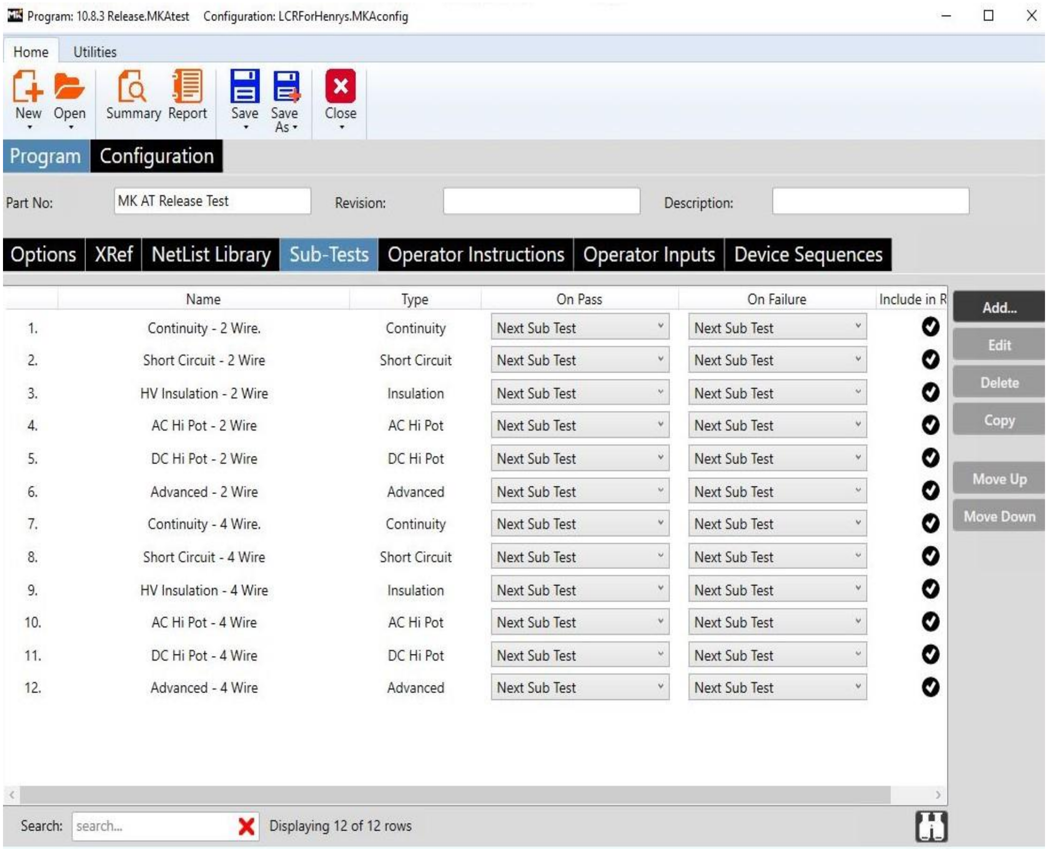


Figure 22: List of SubTests created for this program; in the order they will be run.

.

In the sub-test selection screen, you change add, edit, and delete a sub-test. You can also change the order in which they run (the order is from the top of the screen down in sequence). If you wish to perform a “branch” then you select which sub-test you wish to execute next in the “On Pass” / “On Fail” columns. The software will jump to that position when the condition is met and continue from there. You can also copy a sub-test, which will be added as the last sub-test.

From release 10.12, sub-test dependency was introduced. This allows setting a sub-test to have the option of another sub-test as *required.* A drop-down list will be available to allow the user to select any other sub-test as required. The default option will be *None*. When the program is opened in the Runner sub-test selection window and a sub-test is selected, any required sub-tests will be automatically selected and disabled.

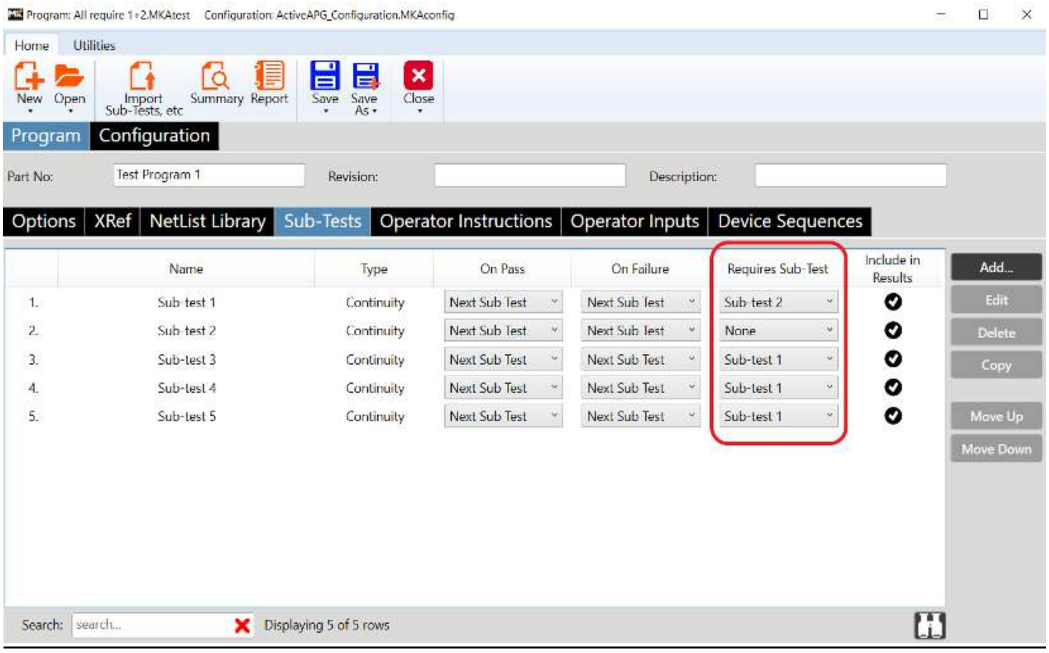


Figure 23: Setting up a "Requires SubTest" option.

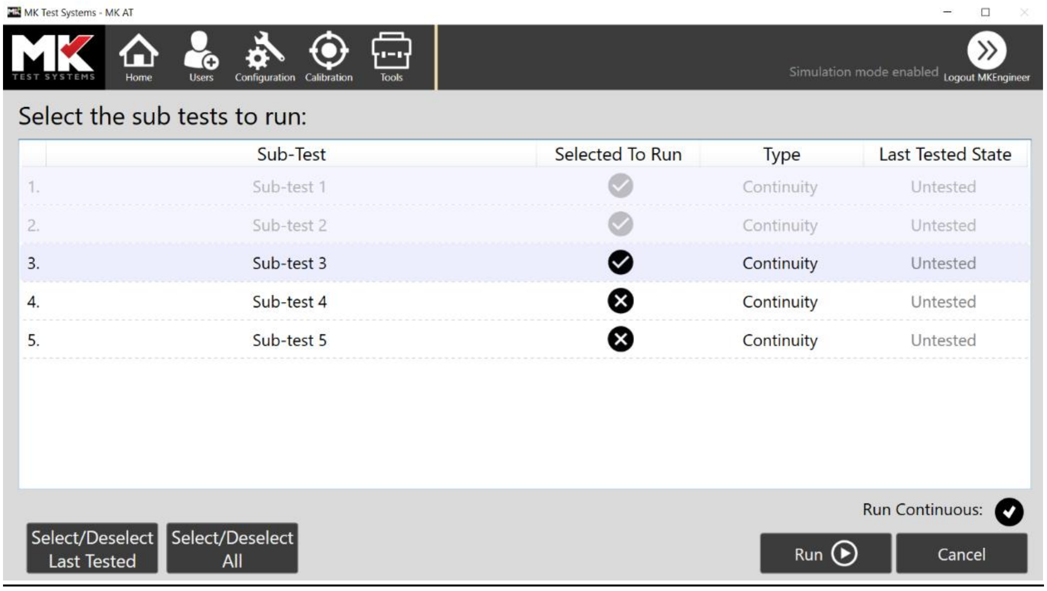


Figure 24: Demonstration of SubTest selection with "Requires SubTest" option above.

For programs that contain a large number of sub-tests, there is a search / find facility provided by clicking on the binocular icon at the foot of the screen. This will load up a small window in which you can enter text. If you then select Find Previous or Find Next, the software will search for this text within the “Name” column and jump to that sub-test if it finds a match.

4.8.1. Continuity

To add a continuity test you add a new sub-test, enter the sub-test name (or leave the default generated name). On the next screen you can select the defaults for each continuity measurement. These are the values that will be used when a new measurement is added to the next screen. These can be overridden for any item, so it is best to set these to the more commonly used values. You can then quickly add connections, just changing the ones that the defaults are not applicable for.

4.8.2. Shorts

Adding a shorts test is very similar to adding a continuity test. The steps that you follow are identical, but the data required for the defaults is different. Also, when creating a test, you can generate the net list (the list of common connections) direct from a continuity sub-test e.g. If you have a continuity test containing the following connections:

From	To
1	2
1	3
1	4
5	6
5	7
8	9

If you select this continuity SubTest as the source of data and ensure that the test point range used covers a larger range than the test points used in the continuity SubTest for example, we will use the test point range 1 to 10. The shorts test generated will contain the net lists *1-4 5-7,8,9* and *10*. So you will end up with 4 nets to be tested to each other, note that for any test points that are in the test point range that are not part of a continuity measurement will be added as single point nets, this is so you can prove that there are no short circuits to pins that are not connected.

4.8.3. HV (Insulation and AC)

These tests are created in the same way as the short circuit. The only difference is in that HV testing is done in both directions i.e., all nets are tested to all other nets in the list, in both directions. If there is a net that you only wish to test to and not from, then you set the voltage for that net to 0, as shown below.

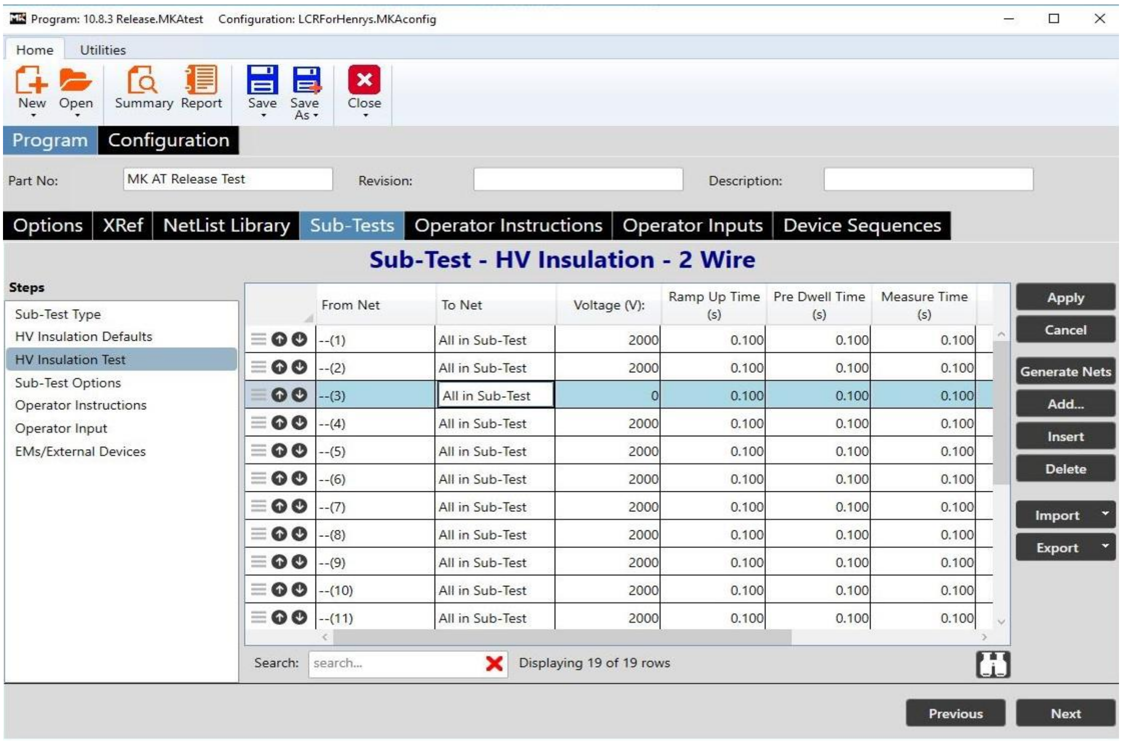


Figure 25: HV test with masked points.

HV Insulation tests default to using the lowest measurement to determine a pass or fail. This can be changed so that the average measurement is used instead, see the example below.

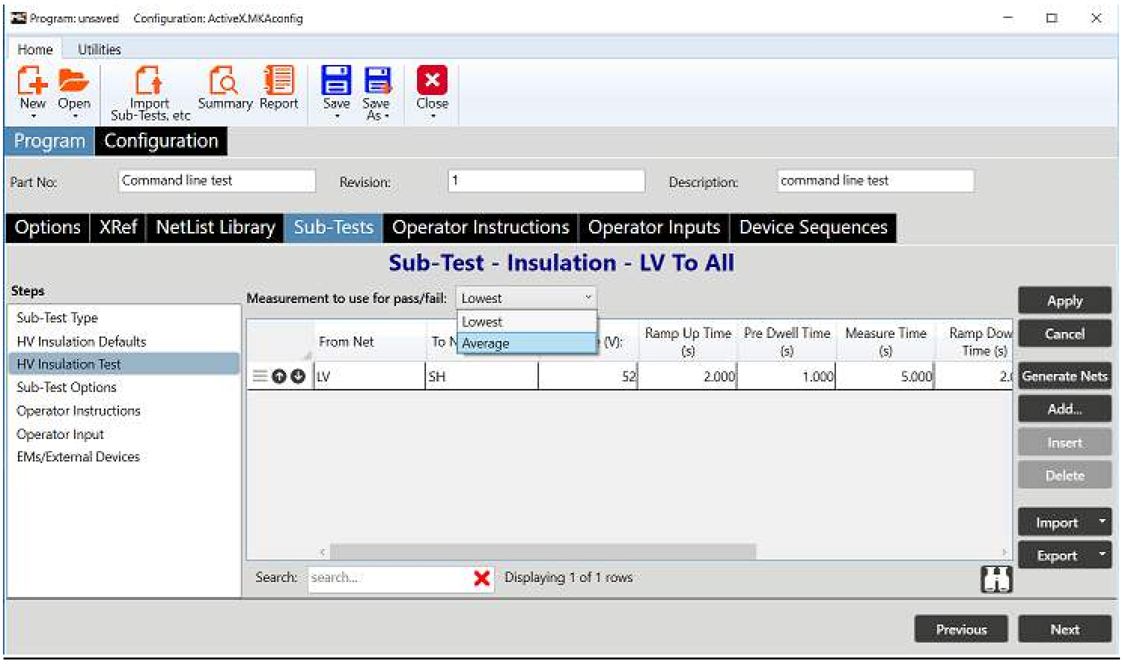


Figure 26: Setting HV test measurement type.

If you have used the netlist library feature, you can select the netlists in the FROM and TO nets from the library. Below are some examples of how you could use them.

1: Simple nets to all in sub-test:

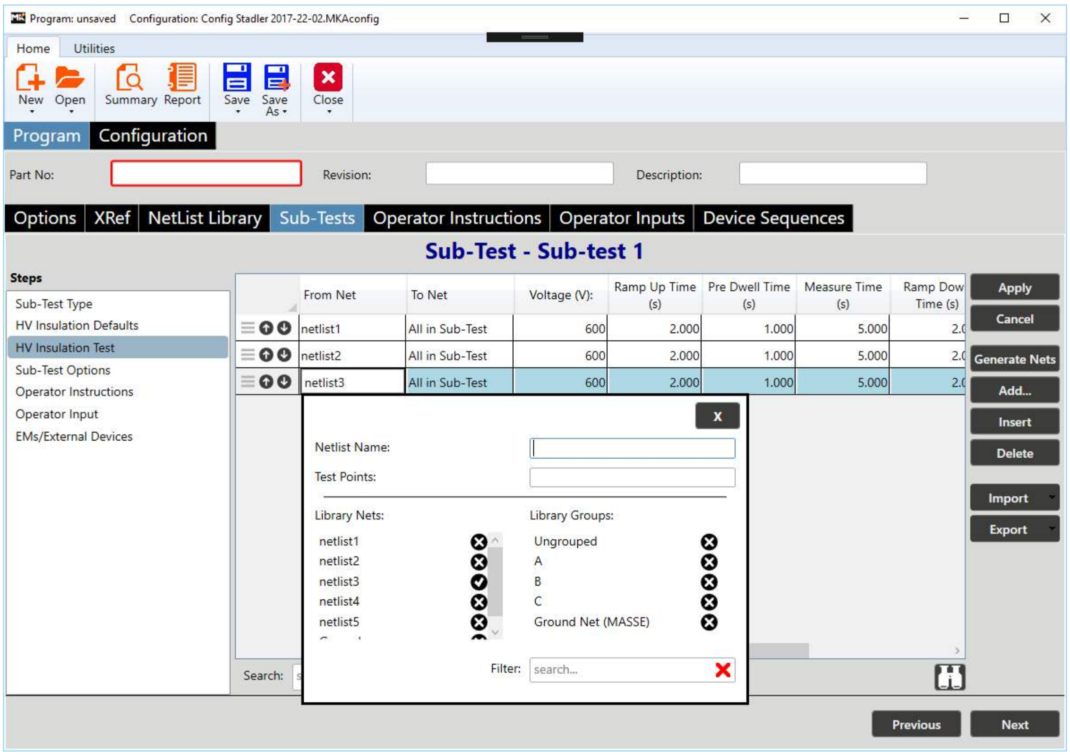


Figure 27: Select the FROM and TO net you wish to test.

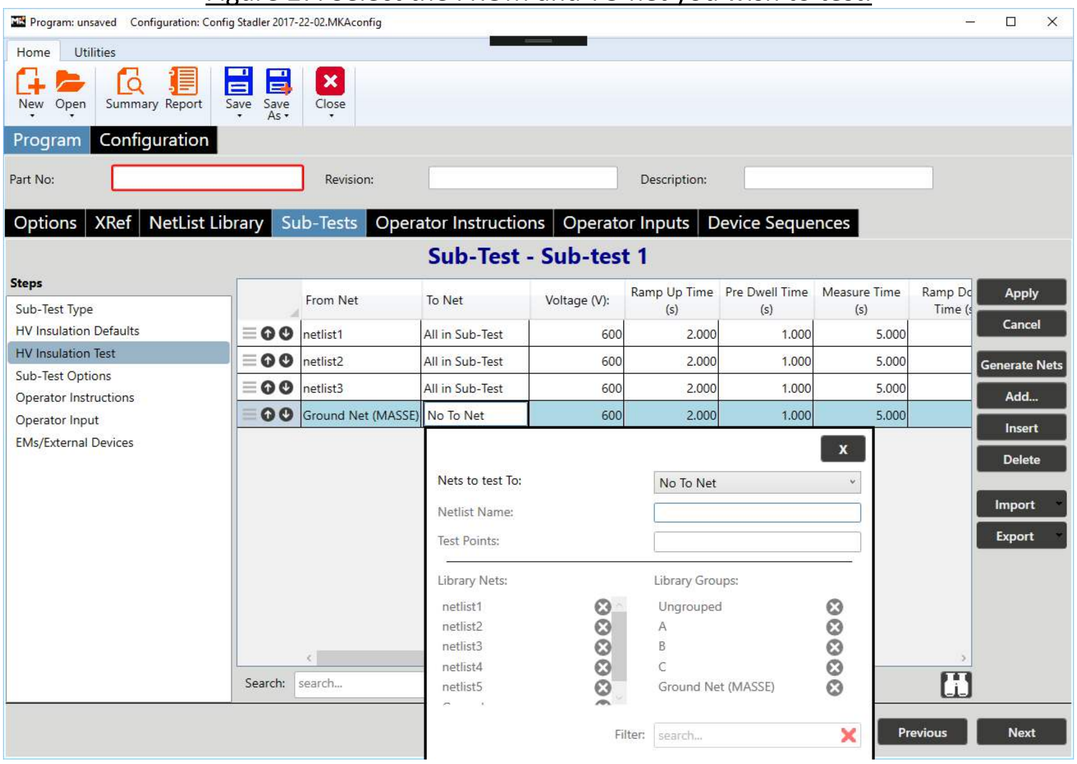


Figure 28: testing TO ground, but not FROM a ground net.

3: Group to group testing. The example below shows how you would use the netlists and the grouping from the library section to perform a simple group to group test.

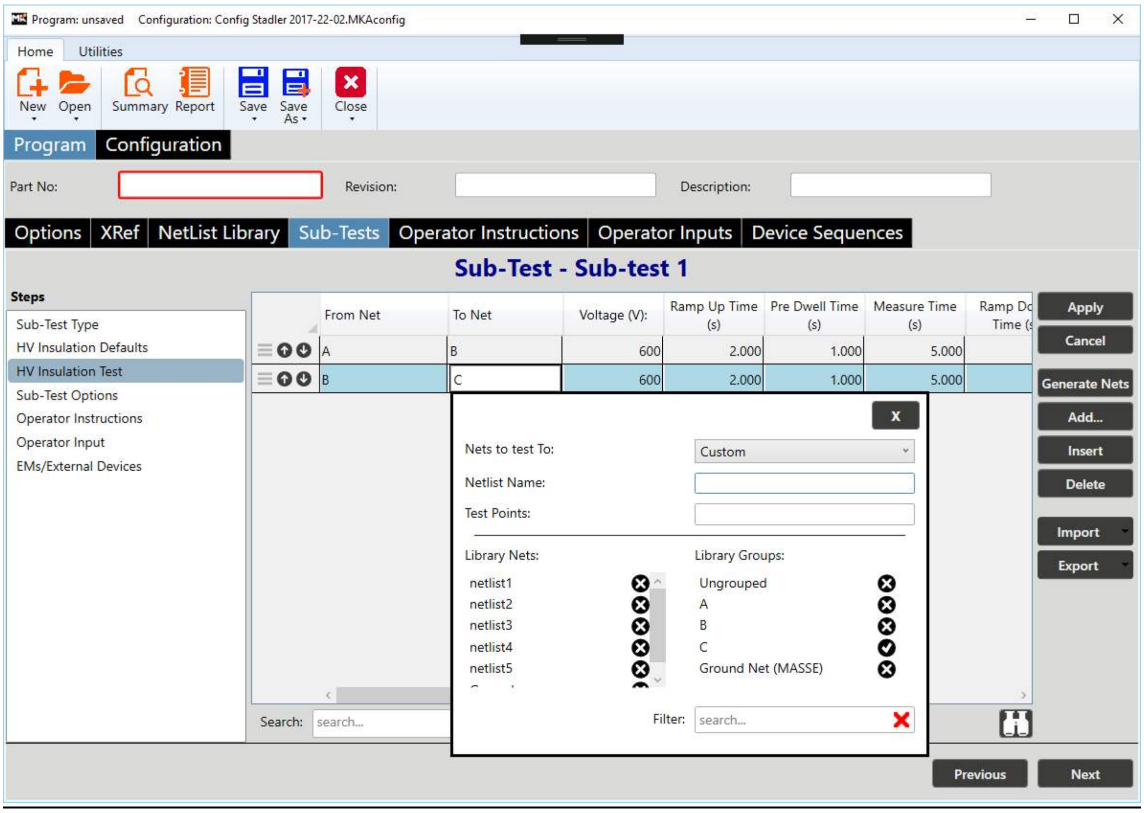


Figure 29: Group to Group testing.

4.8.4. External Device

If your system has an external device fitted such as an LCR, external meter, or oscilloscope option, then you will need to use this sub-test type to read the value and set the limits. Different external device that you are reading from may require input of different parameters and values.

4.8.5. Advanced

The advanced sub-test is designed to allow you to carry out more complex measurements, and/or use more than one device to measure or compare data. This advanced test is used to create the Calibration Verification programs, as these need to display the internal meter value, and compare with an operator entered value. A pass / fail will then be calculated on a percentage difference between the values. This gives an idea of how this advanced sub-test type can be used. Below is a set of screen shots showing the steps required to create an advanced sub-test. This test type can also be used for volt drop testing, and time to reach value test (such as time to open / close). For the timed reading function, a pass is true if the value to reach is achieved after the minimum time, and is maintained until the maximum time, so if the value is reached before the minimum time it is a fail. If the value to reach is triggered after the minimum time but then drops out of the limit before the maximum time, this is also a fail.

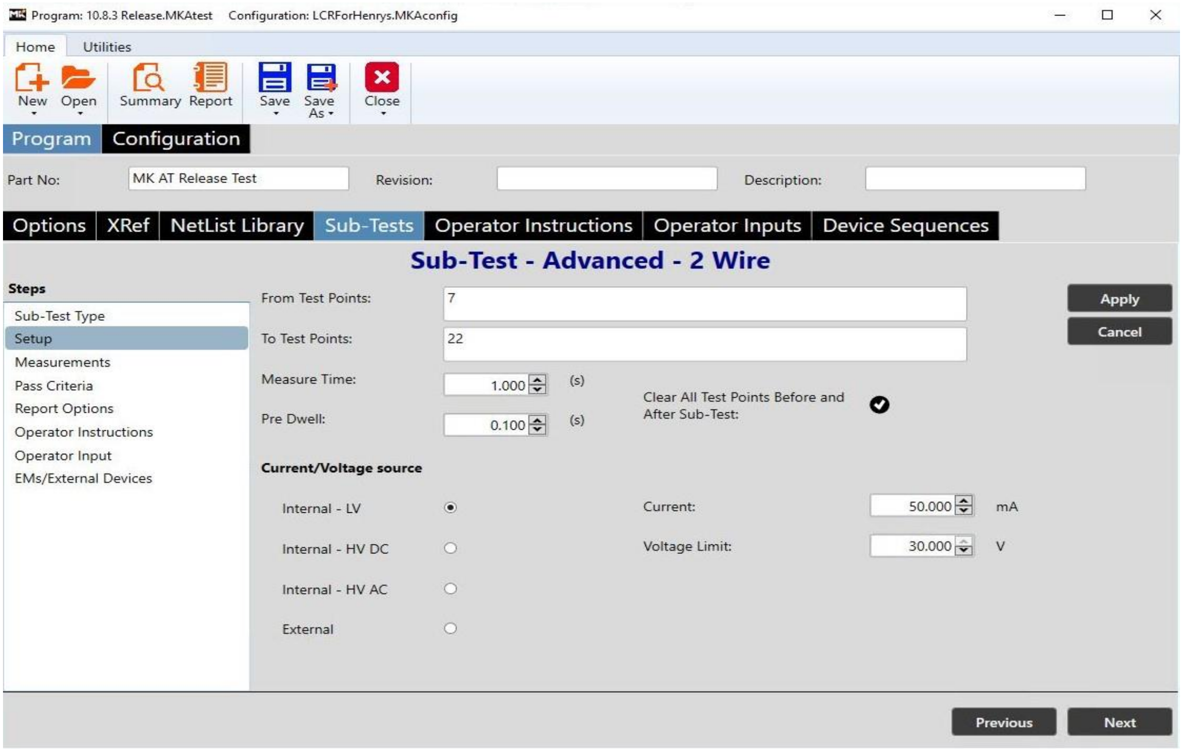


Figure 30: Advanced SubTest set up screen.

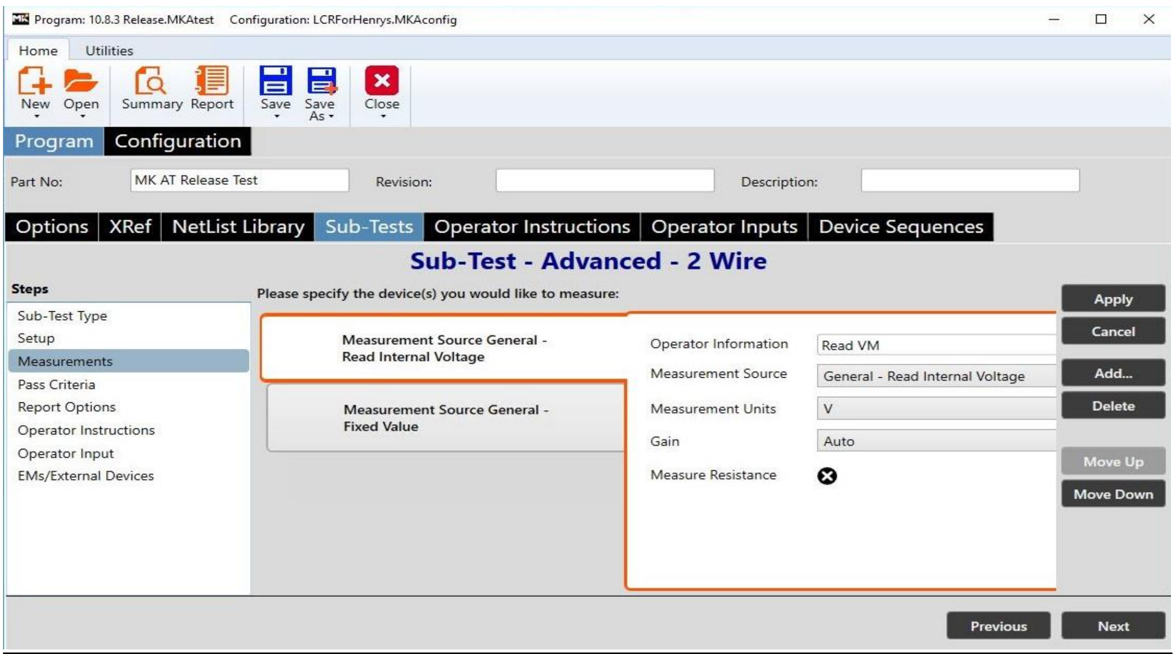


Figure 31: Setup one or measurements to be taken, and or values to be used.

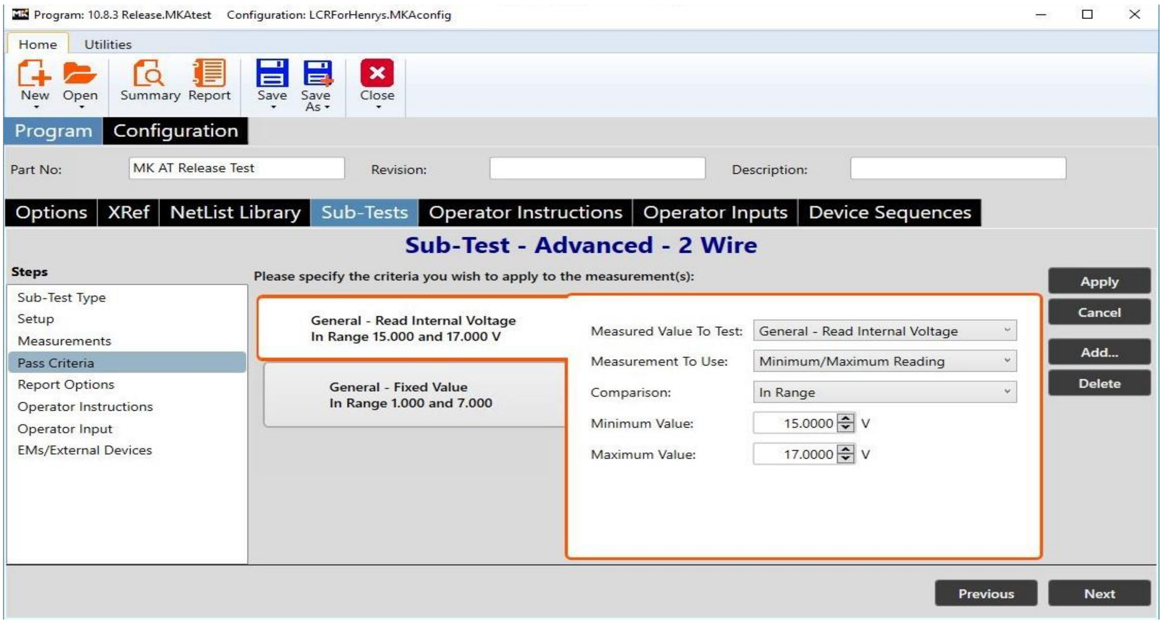


Figure 32: Setup of advanced SubTest pass criteria, note that you can have many pass criteria defined.

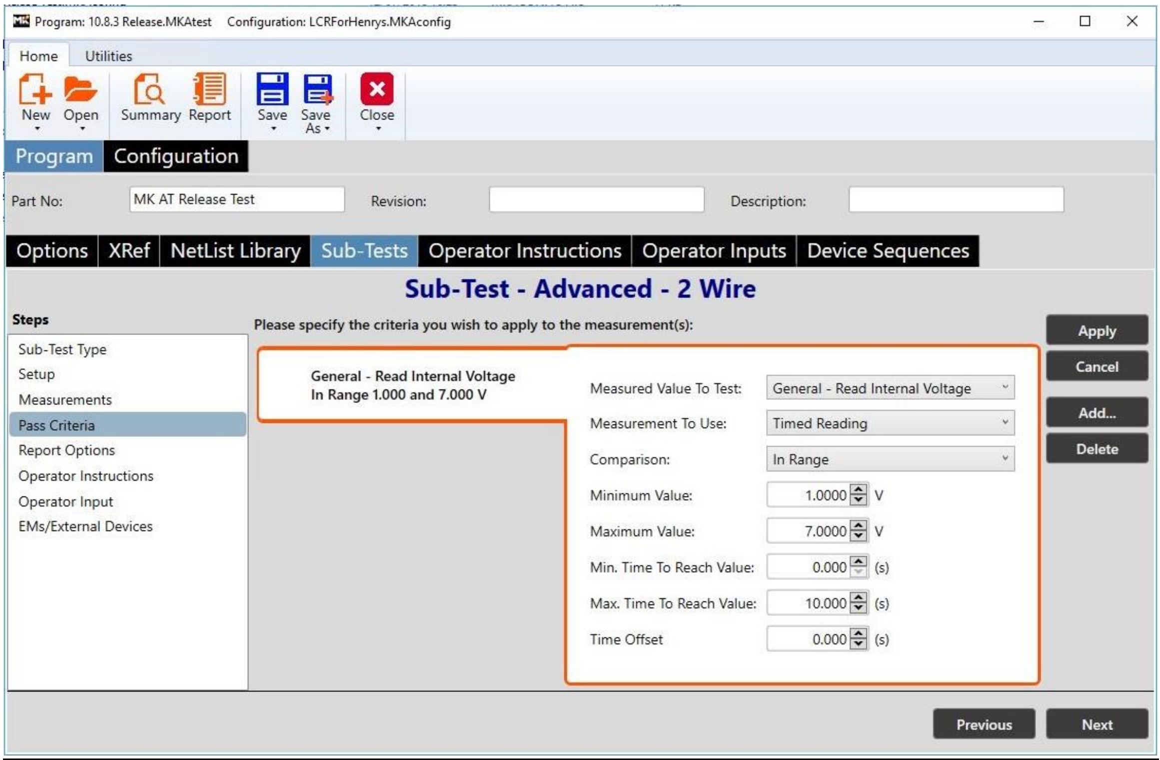


Figure 33: Advanced SubTest setup for timed measurement.

The other options are similar for all test programs, i.e., the addition of operator instructions, inputs and device sequences is the same for the advanced sub-test as they are for other sub-tests.

As of version 10.10.1 there are additional pass criteria.

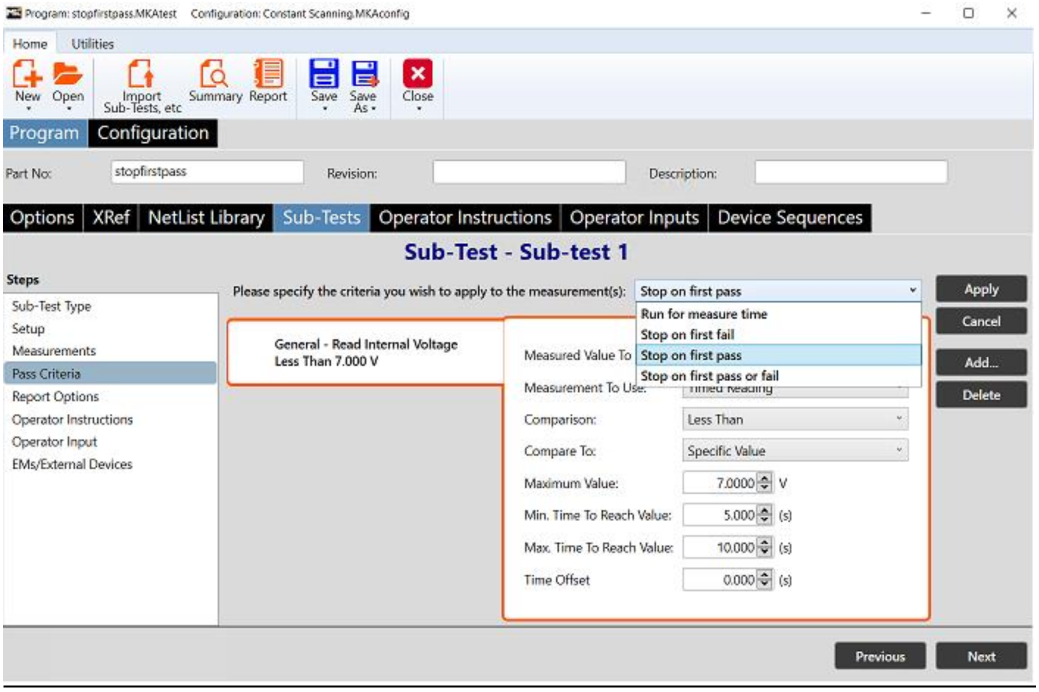


Figure 34: Changing pass criteria.

- Stop on first pass:
  - Test stops immediately with a pass status as soon as the target is achieved inside the specified time window. For all other cases, the test will continue for the specified Measurement Time.
- Stop on first fail:
  - Test stops with a fail status as soon as a failure is measured. In the example above a reading of less than 7v at any time outside of the 5-10 second time window will end the test immediately with a fail status.
  - Where the target is achieved the test will continue for the specified Measurement Time then the test will stop with a pass status.
- Run for measure time:
  - In all conditions, the test will run to the end of the specified Measurement Time. The only condition that will result in a pass status is when the target is achieved in the specified time window.
- Stop on first fail or pass:
  - The test will stop immediately under pass or fail conditions.

4.8.6. Advanced Netlist Sub-Test type

From release 10.12, a new Advanced sub-test type has been added to allow multiple advanced tests to be performed automatically. For example, measurements from multiple sliprings can be captured and displayed on a single graph and synchronised using a measurement trigger. This test type can also be used to take multiple capacitance readings from an external LCR meter.

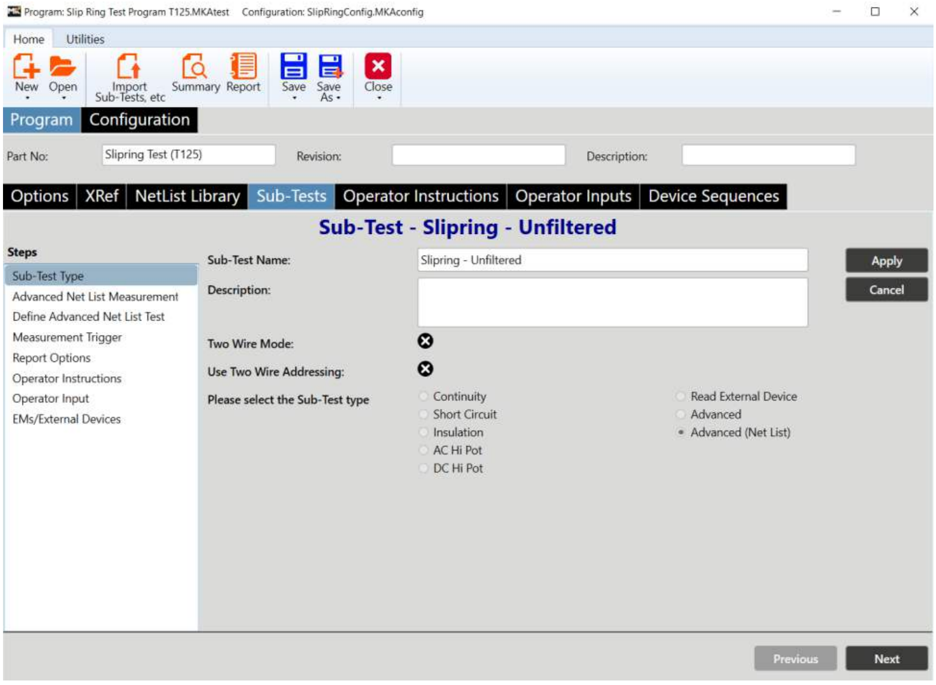


Figure 35: Slipring SubTest.

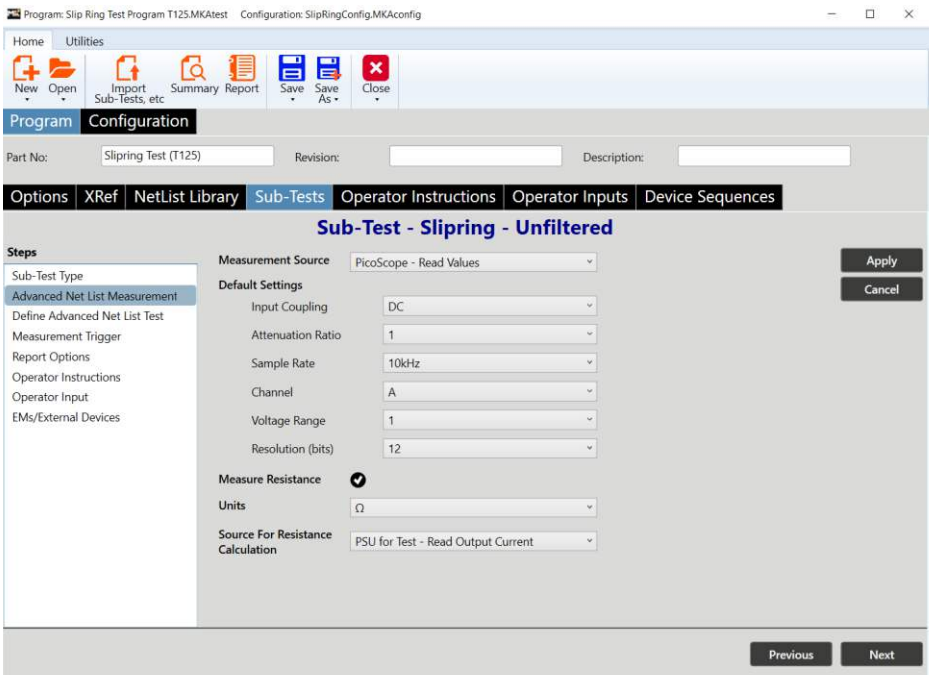


Figure 36: Oscilloscope settings.

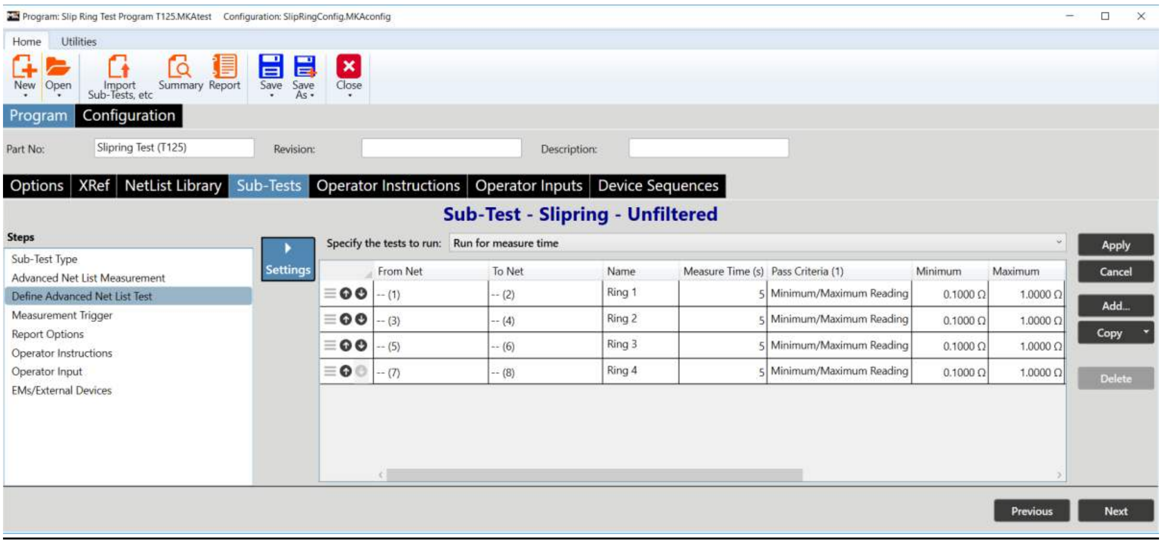


Figure 37: Setting up individual rings (connections).

Device settings can be modified per test as required.

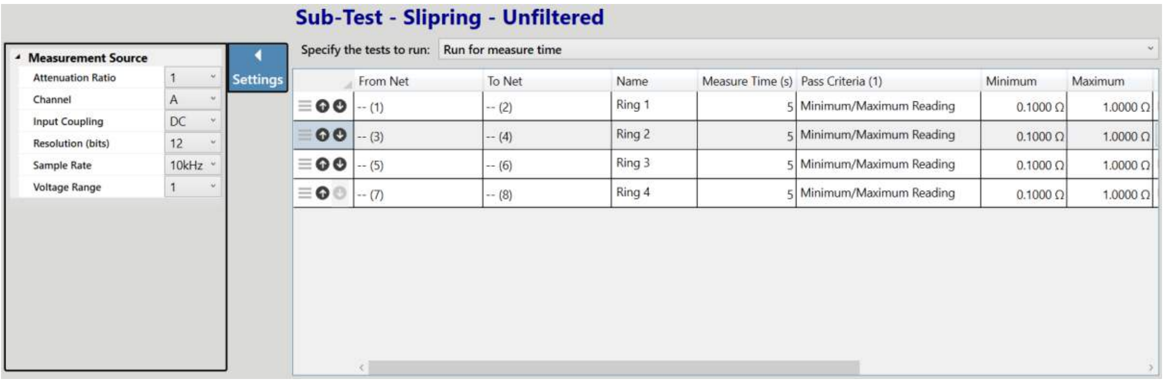


Figure 38: Changing measurement source settings per ring (connection).

There is support for 2 pass criteria and device sequences can be triggered before and after each test.

Figure 39: Setting devices per ring (connection).

For Pico Scope measurements, the Measurement Trigger can be configured to either just start measurement on trigger or start and stop measurement on trigger.

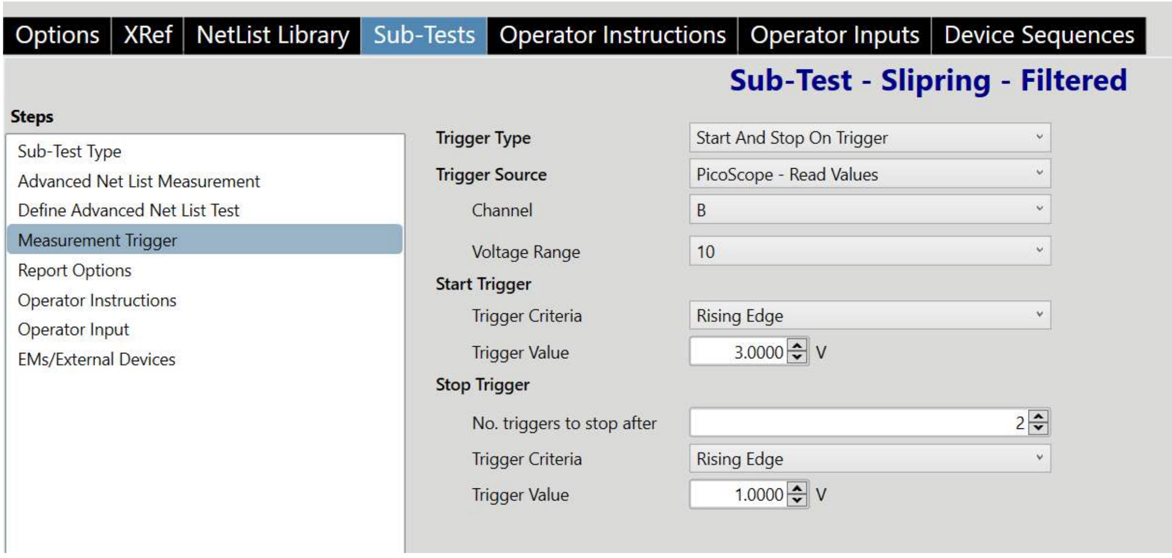


Figure 40: Setting Trigger Input

For Pico Scope measurements, the results can be plotted on a single graph:

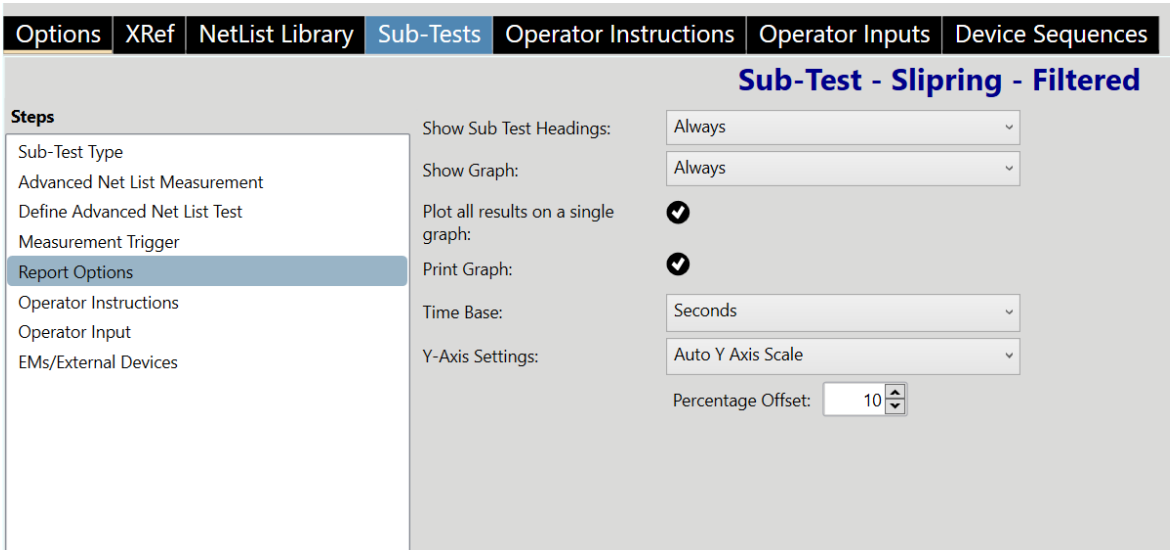


Figure 41: Setting graphical parameters.

Chart showing the resistance data for multiple sliprings:

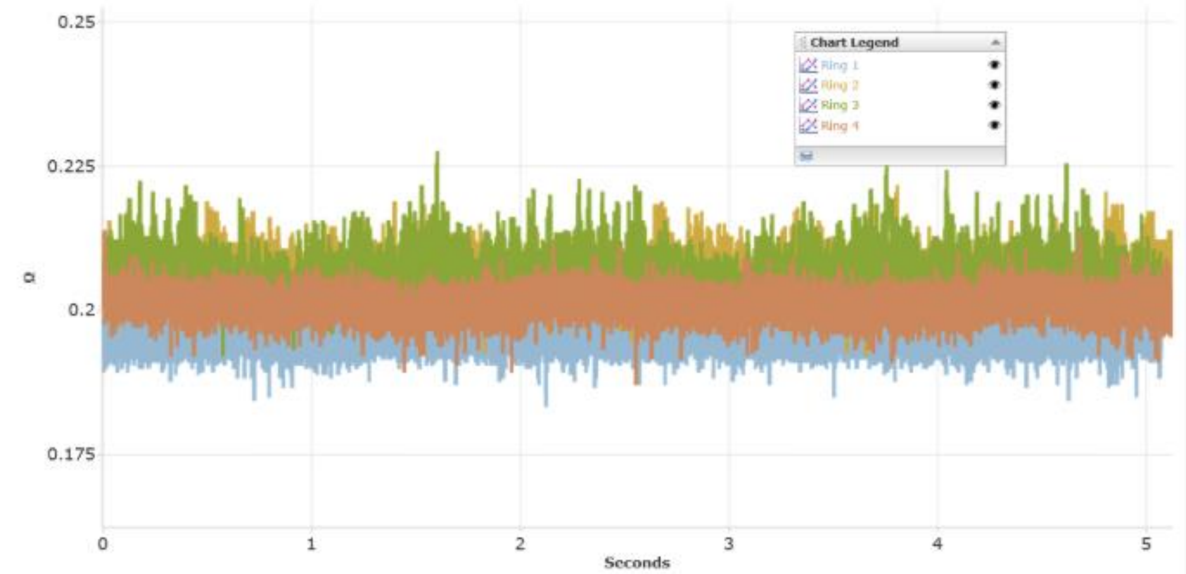


Figure 42: Typical slipring resistance trace.

4.8.7. Real Time Scanning Sub-Test type

Add a new sub-test and complete the sections for test name and description then select Real Time Scanning from the sub-test type drop down. The Two Wire Mode selection is disabled as the RTS modules test in 4 wire mode. By default, the test does not check for the presence of all devices as the system is able to process connections to remote modules dynamically. If you wish to override this, uncheck the *Skip Active Xref Pre Check* option.

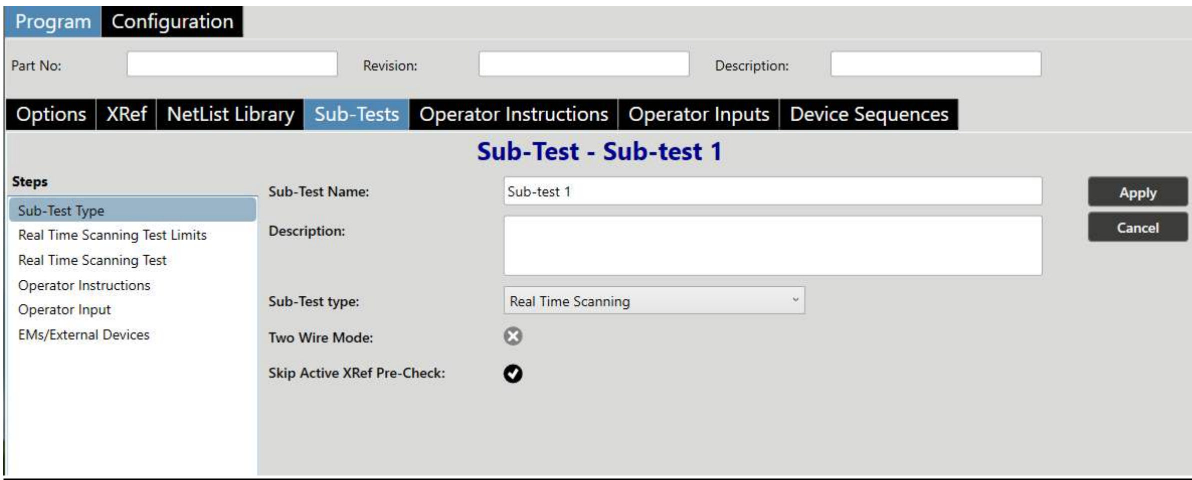


Figure 43: Setting up RTS SubTest.

In the Test Limits tab, the user can specify various limits used by the RTS sub-test:

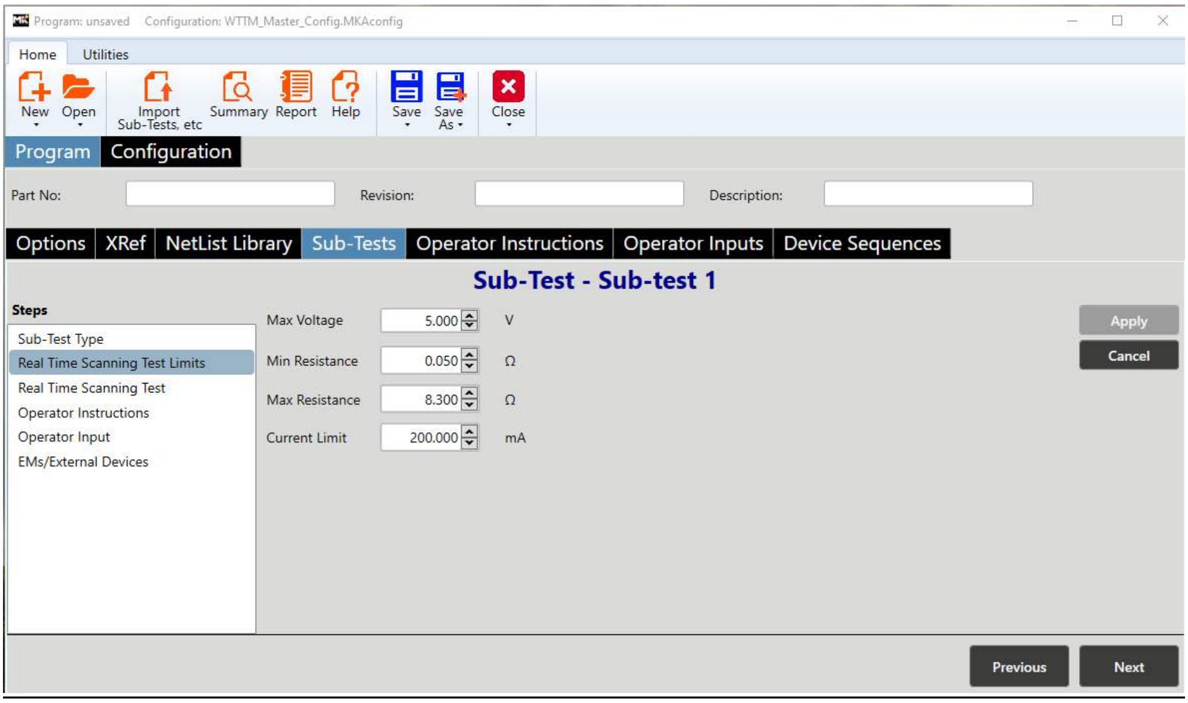


Figure 44: RTS test limits.

The next 4 tabs allows the user to specify the test points to test, operator inputs, instructions, and device sequences in the same way as for continuity tests.

4.8.8. COMMAND LINE RUNNER

A command line application can be run from an advanced test type, with the return value being used to determine a pass or fail. The *Measurement Source* is *General- Execute Command Line* and the field *Command Line* holds the path to the application to run.

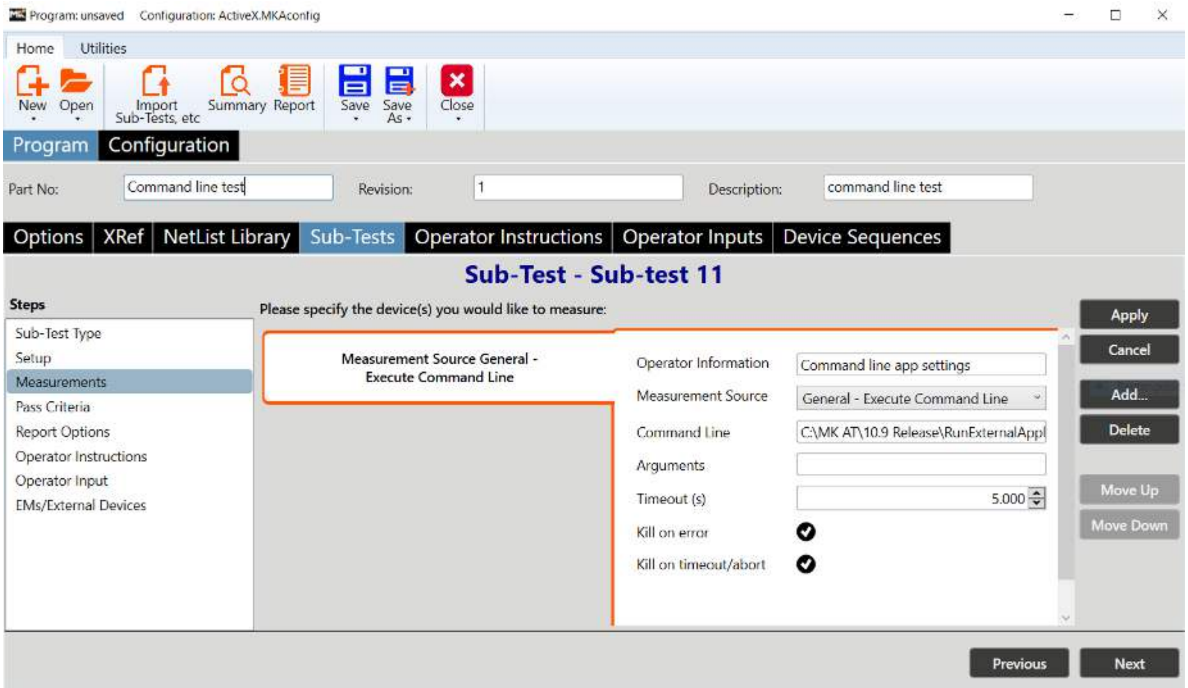


Figure 45: Command line set up.

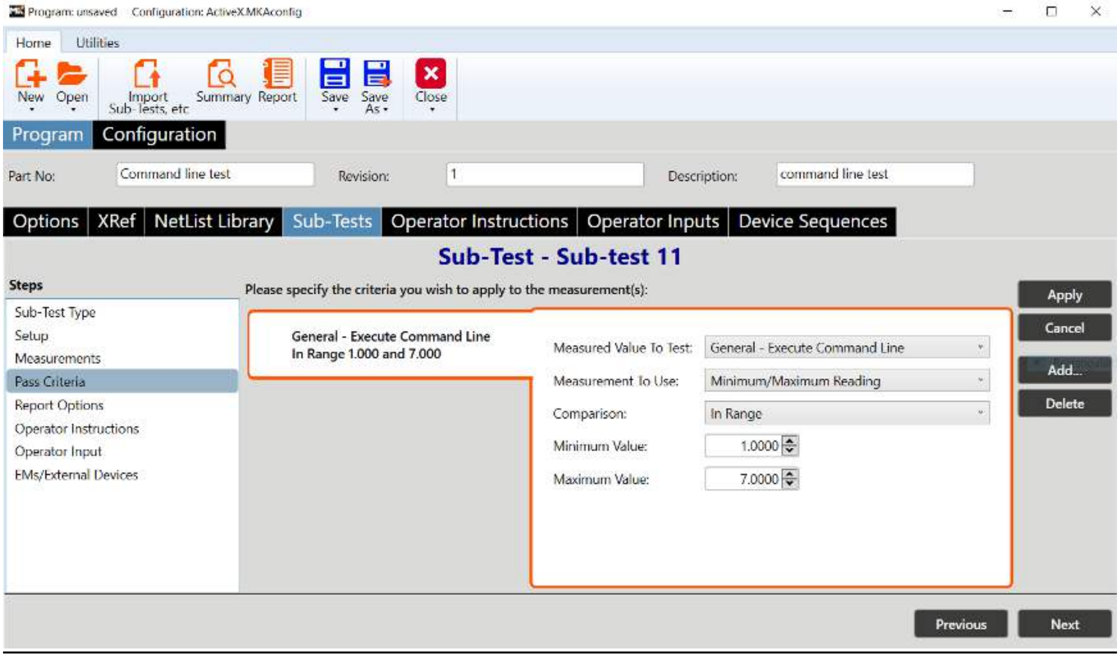


Figure 46: RTS Pass Criteria

4.8.9. Adding Operator Instructions

Operator instructions are embedded rich text documents. The initial screen shows you a list of operator instructions that you have defined within the test program. Each operator instruction can be used any number of times across the SubTest's, and within a SubTest. When adding instructions to a SubTest you can define when they are shown - pre-SubTest, post-SubTest, post-SubTest when failed, post-SubTest when passed.

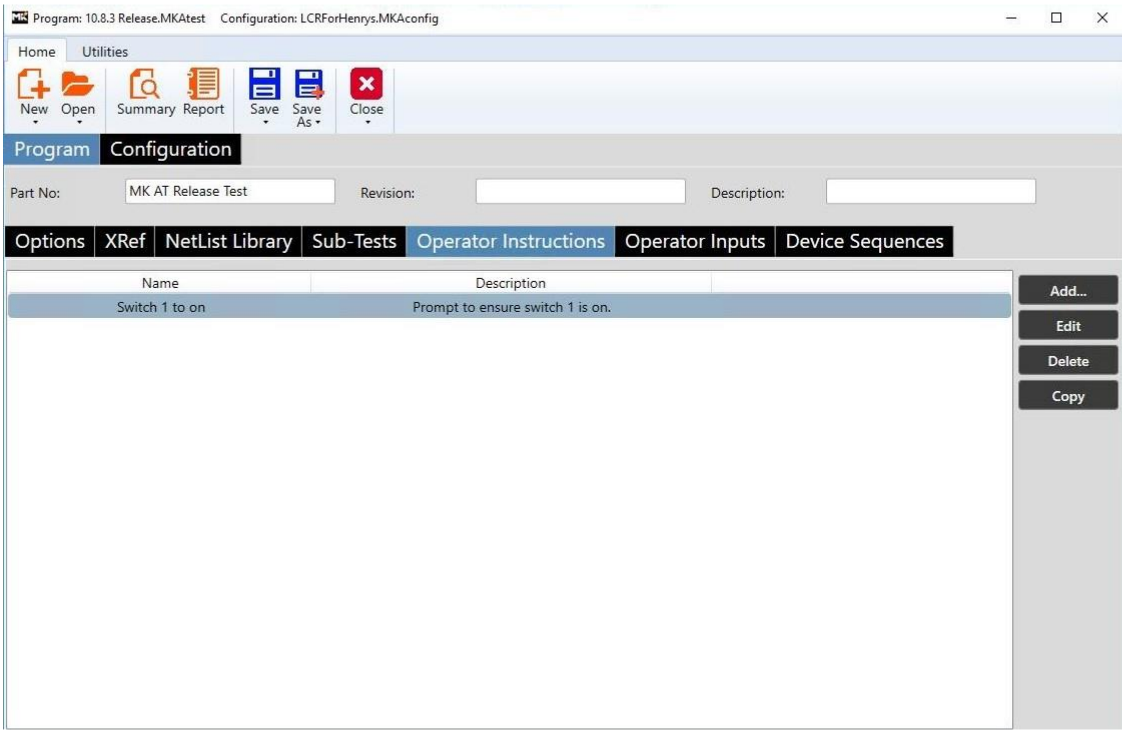


Figure 47: List of operator instructions available to program.

From release 10.14, support for video and documents has been added. To add media, select the media button and enter the details of the file.

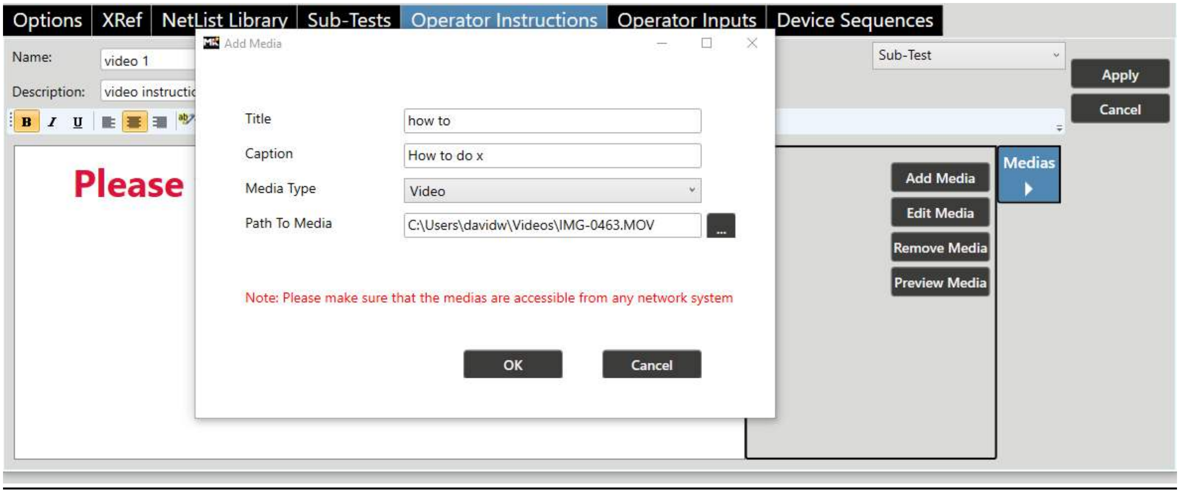


Figure 48: Video and document support.

It is important to make sure the media will be accessible from the runner as these files are not embedded in the test file. Instead, they must be manually copied onto the runner at the same location or the files must be selected from a networked drive that can be mounted from the runner.

The rest of the operator instruction is completed as before allowing the user to enter formatted text and select a run order.

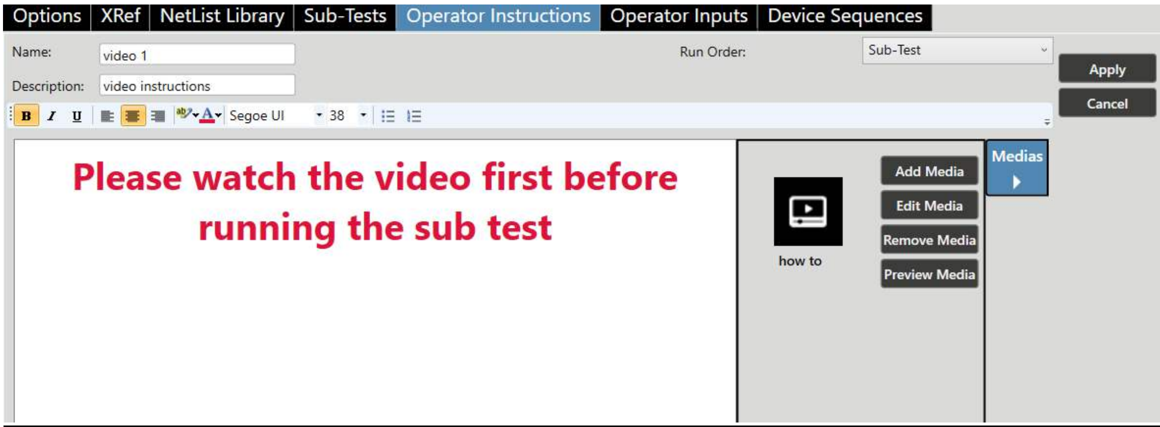


Figure 49: Media editing.

4.8.10. ADDING OPERATOR INPUTS.

There are 3 types of operator input: Text, Value and Question and Answer. For each type, you enter the question or message that will be displayed to the operator, along with the data entry field appropriate to the input type. Details of the input types are as follows:

- Text input. This is a simple non-validated data entry.

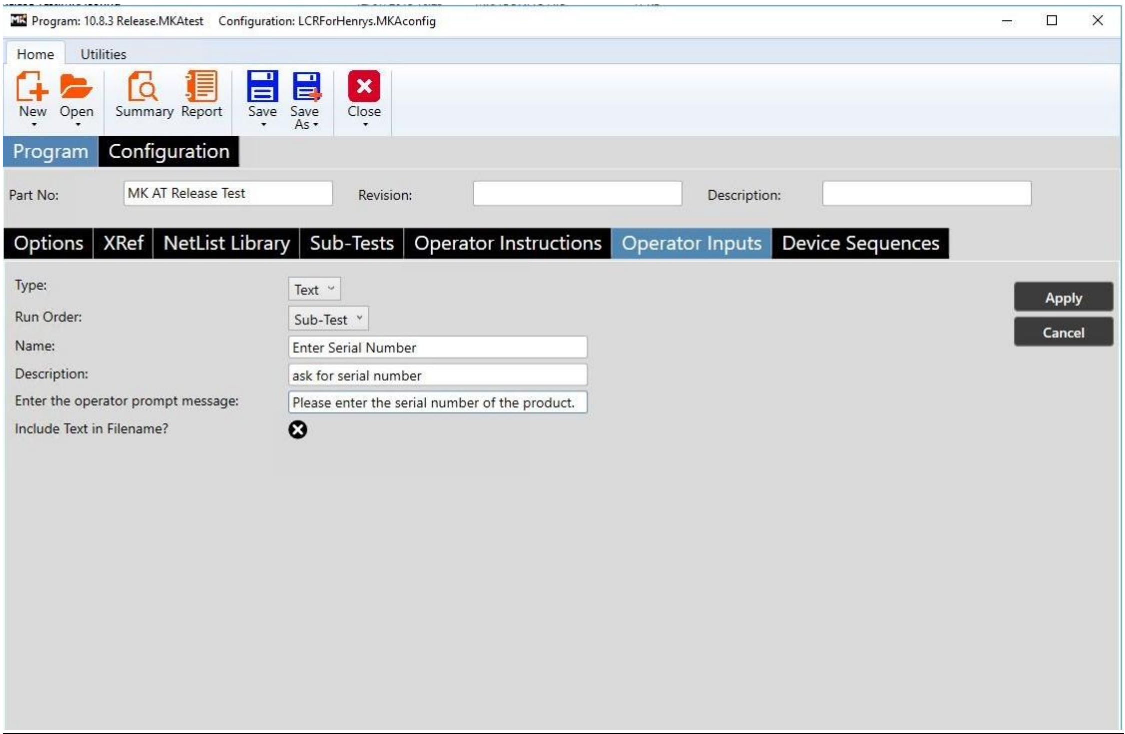


Figure 50: Adding operator inputs.

- Value input. This allows a SubTest to pass / fail if the value entered is outside the specified limits. You can specify the type of limit to be applied, as shown in the following screen shot.

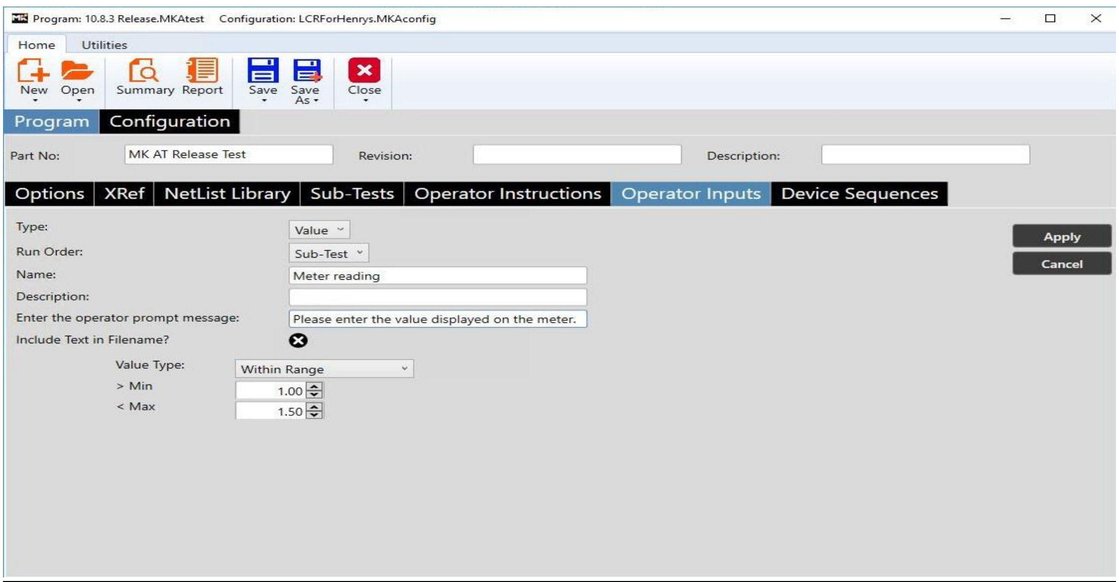


Figure 51: Inputting numerical values.

- Question and Answer: A question along with several possible answers can be entered. One of the answers can be set to be the default answer and this one with be automatically selected when the operator input is displayed. Answers can also be set to *Pass Test* which allows them to influence the outcome of the test.

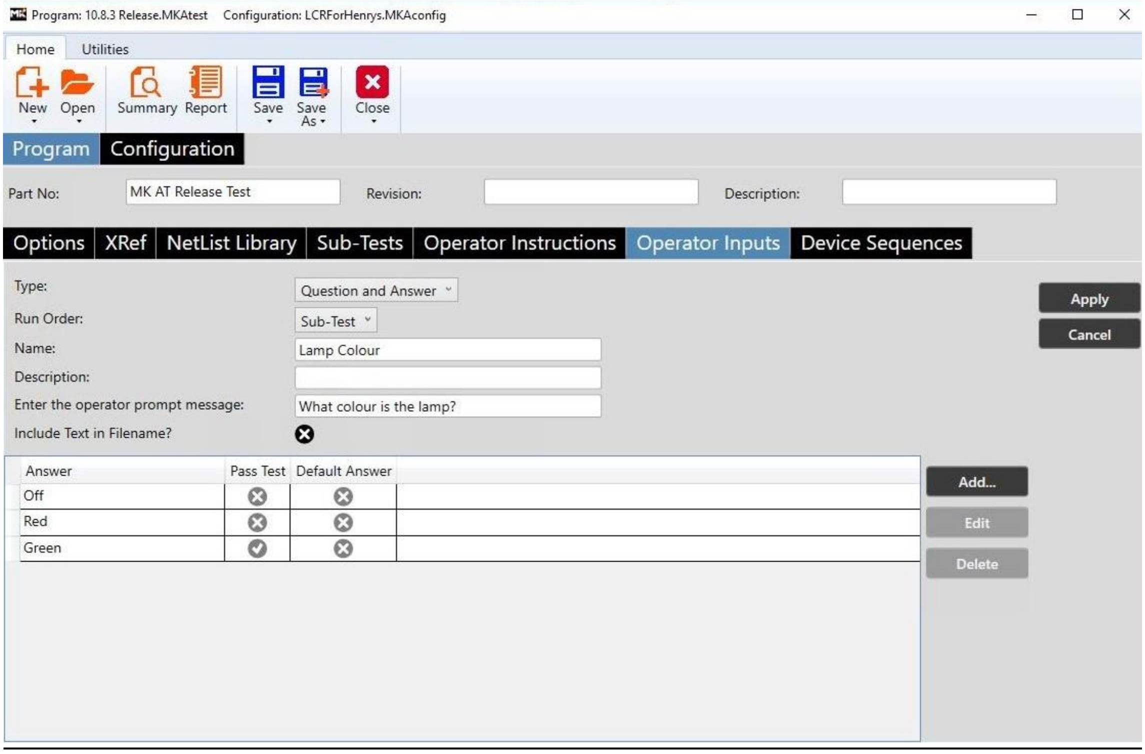


Figure 52: Creating a question with many answers. Each with SubTest Pass / Fail state.

4.9 Adding Device Sequences

A device sequence is a series of commands to be executed on external, or some internal devices - such as EM's. Depending on your system configuration, you may see different devices available in the drop-down menu that are available.

A single named device sequence can be made up of any number of commands, but we recommend that you restrict a sequence to one device or small group of commands. This will allow better re-use of commands. For example, if you have a single sequence to set a voltage and output, it will not be easy to reuse. However, you could have a separate set voltage and set current commands, then a new sequence to just turn the power supply on. This way you could re-use the power supply 'on' sequence again. Also, if you find that you need to add a delay to allow a power supply to activate, then it would be easy to add to one power supply 'on' sequence, rather than having to find many sequences where you may have to use the 'on' command.

Device sequences may be added within each SubTest in the **EM's/External Devices** step and may be executed as follows:

Post SubTest-Always	Executed before always at the end of the SubTest.
Post SubTest-Failed	Executed only if the SubTest failed.
Post SubTest-Passed	Executed only if the SubTest passed.
Pre-SubTest	Always executed at the beginning of the SubTest.

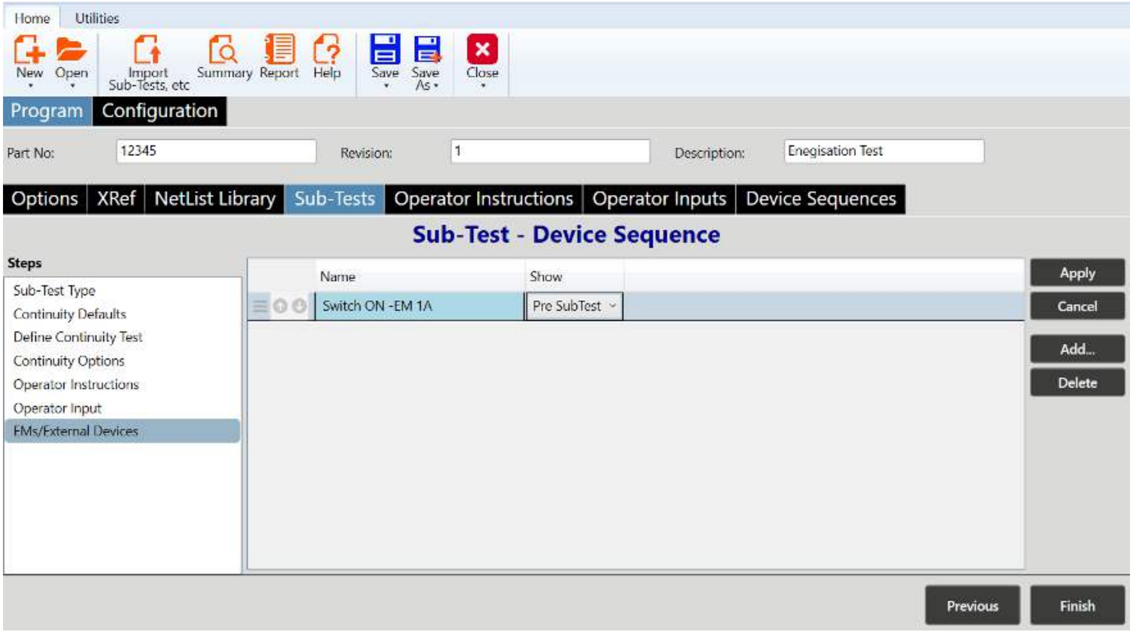


Figure 53: Adding a device sequence to a SubTest.

4.9.1. Energisation Modules (EM's) - If Fitted

Please check if EM cards have been installed in the test system and if so, identify which type is fitted. The MKAT software should be configured to the correct card(s) to allow programming.

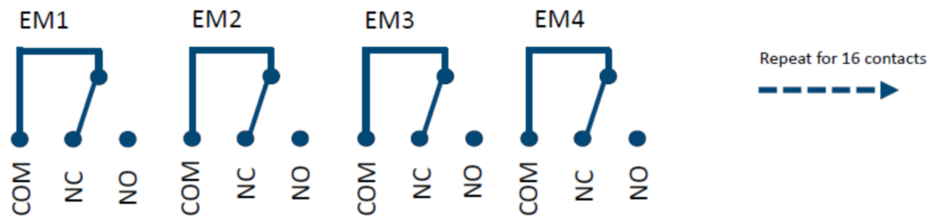
Extreme care must be taken when programming EM's.

EM Cards are installed to provide switching of power and signal circuits. Incorrect switching may result in personnel injury and/or damage to equipment. Please ensure you understand the hardware system configuration first. Remember EM contacts will remain energised unless specifically commanded to be switched off.

4.9.1.1. EM Type D5 (Changeover Contacts) - AM4-0161

Select **Device Sequences** Tab and name the device sequence. Click **Add** and in the EM/External Device field select **Excitation Module Changeover** from the drop-down list. In the Command field select the required action from the drop-down list. For Switch on or Switch off commands select the required EM Point. Click Add to add more EM contacts/commands or other device actions within the device sequence. Click **Apply** to save the device sequence.

For this type of EM, EM point refers to the relay contact number. There are 16 contacts per card. EM point (contacts) are determined by the user interface.



- All contacts rated up to 5A @ 30Vdc/250Vac .
- Each EM board fitted with 2 off 37Way D Connectors. 8 x EM contacts per D connector (24 pins)
- Total 16 contacts per board – EM 1-8 (top D) EM9-16 (lower D).

EM D5 (Changeover) type - contact arrangement

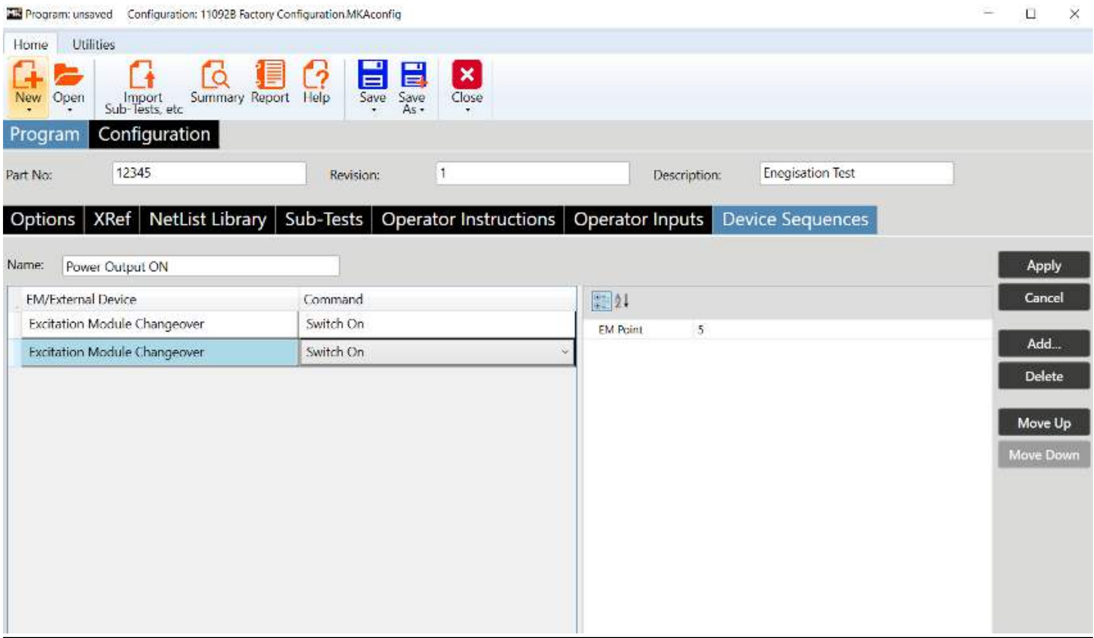
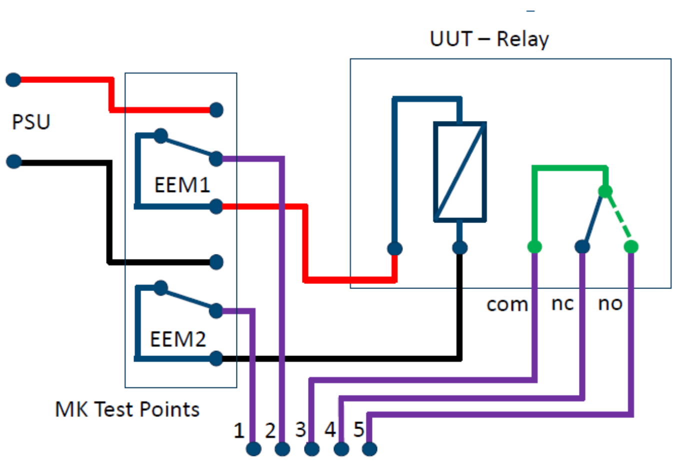


Figure 54: Creating a changeover EM device sequence.



Typical use of EM D5 (changeover) type for testing a relay.

The above figure shows how two contacts of a D5 EM can be configured to test a relay. We assume in this example the PSU is not controlled and its output is permanently on. A test program is created, and two device sequences are created as follows:

Relay ON	set EM1 & EM2 ON.
Relay OFF	set all contacts to OFF.

A continuity SubTest named "Relay OFF" is created to test the Relay OFF state as follows: With no device sequence, both EM (EEM) contacts 1 & 2 will not be switched. MK test points 1 & 2 are connected across the relay coil to measurement the relay coil resistance. Test points 3, 4, & 5 ensure correct OFF state of the contact i.e., COM to NC - connected, COM to NO - open circuit.

A further continuity SubTest "Relay ON" is created and the device sequence "Relay ON" and "Relay OFF" are added as Pre-SubTest and Post-SubTest -Always respectively. Test points 3,4, & 5 ensure correct ON state of the contact i.e., COM to NC - open circuit, COM to NO - connected. At the end of the continuity test, the Relay OFF device sequence will switch the relay OFF. Screens shown below:

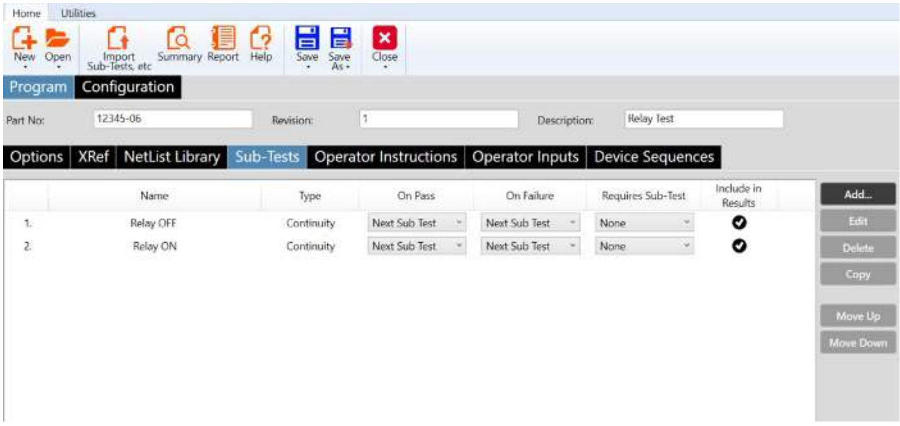


Figure 55: Adding SubTest's.

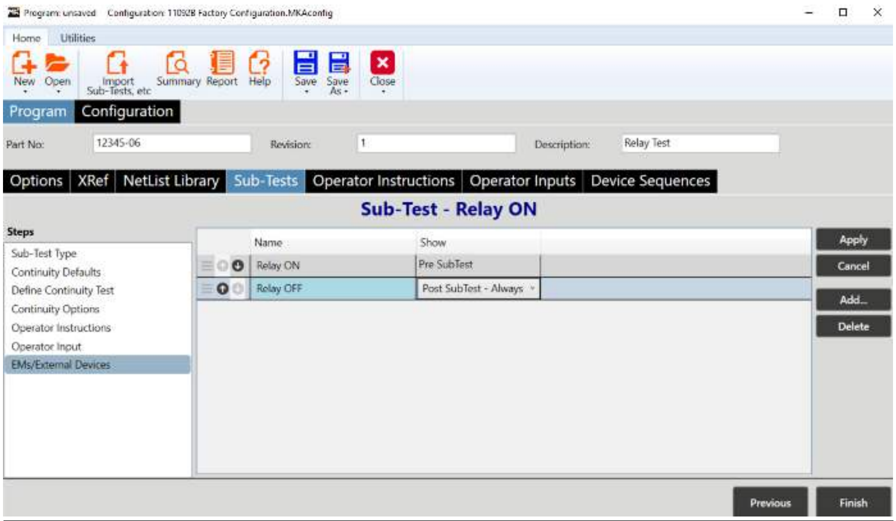


Figure 56: Adding device sequences.

4.9.1.2. EM Type D12 (Bus A/B Contacts) - AM4-0162

Select **Device Sequences** Tab and name the device sequence. Click **Add** and in the EM/External Device field select **Excitation Module A/B** from the drop-down list. In the Command field select the required action from the drop-down list. For EM Switch A, EM Switch B and EM Switch Off commands select the required EM Point. Click Add to add more EM contacts/commands or other device actions within the device sequence. Click **Apply** to save the device sequence.

For this type of EM, the EM point refers to the relay contact number. There are 64 contacts per card. Each can either be not switched (isolated from either Bus), to Bus A or Bus B. Ensure you understand how Bus A and B are connected in the system hardware. If connecting buses to a DC power supply. MK normally recommend Bus A is connected to the -ve terminal as shown below:

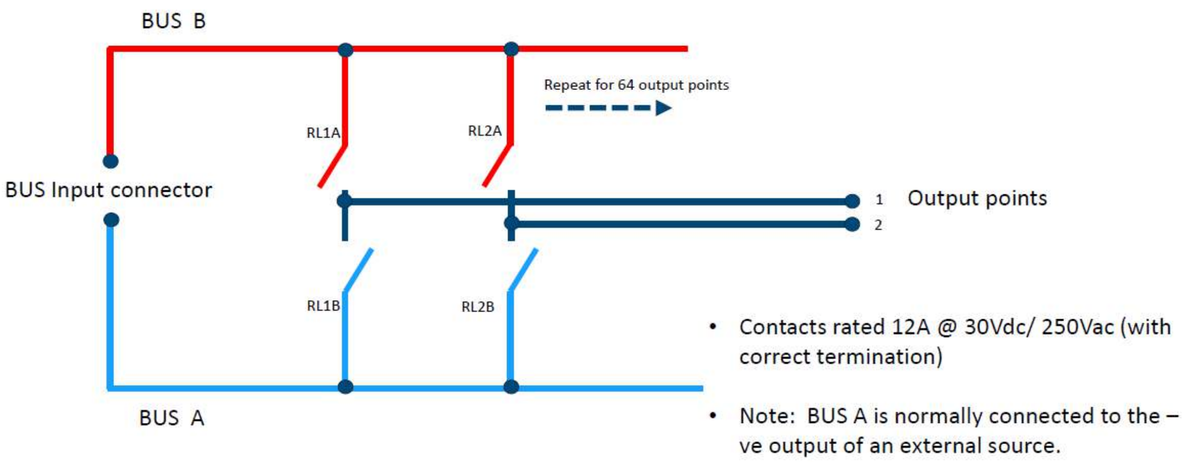


Figure 57: EM D5 changeover - layout.

The MKAT software will not allow any contact number to be switched to both Bus A & Bus B, as this will effectively short circuit the Buses, and power source connected to them.

4.9.2. Bus Isolation Boards - If Fitted

Bus Isolation Board(s) may be fitted in the MK equipment to connect and isolate other third-party measurement equipment to/from the MK measurement bus e.g., an LCR meter. Normally, third-party equipment must be isolated from the MK measurement bus via the isolation board to prevent damage to it due to energy present on the bus while performing other tests e.g., High Voltage insulation tests etc.

Isolation boards may also be used to switch in a particular hardware configuration or function e.g., re-routing measurement bus in high voltage systems.

Up to 2 off isolation boards may be fitted and by default are designated as Bus Isolation A and Bus Isolation B. The designation may be modified in the MKAT system configuration to reflect their actual hardware function e.g., Bus Isolation A may be renamed as LCR Meter.

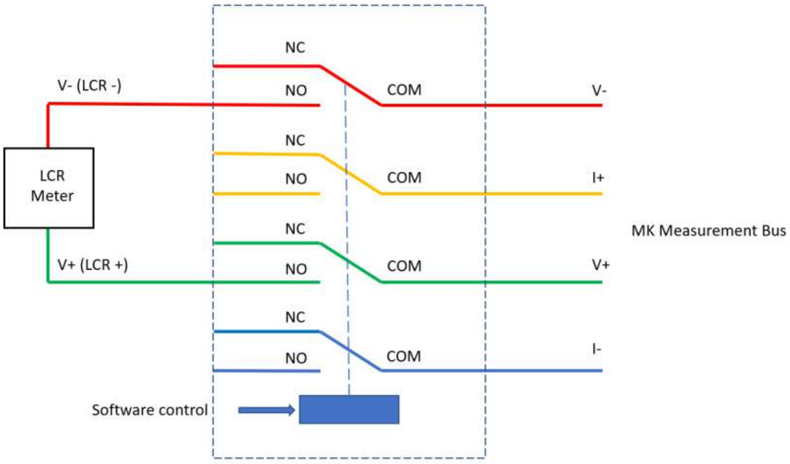


Figure 58: Bus Isolation Board - layout.

Extreme care must be taken when programming Isolation Boards.

Incorrect switching may result in personnel injury and/or damage to equipment. Please ensure you understand the hardware system configuration first. Remember an Isolation Board will remain energised unless specifically commanded to be switched off.

To program, select **Device Sequences** Tab and name the device sequence. Click **Add** and in the EM/External Device field select General from the drop-down list. In the Command field select Switch Relay from the drop-down list. Select required isolation board (designated name) and select on (switch device to bus/ perform function) or Off (isolate device/ stop function). Click **Apply** to save the sequence.

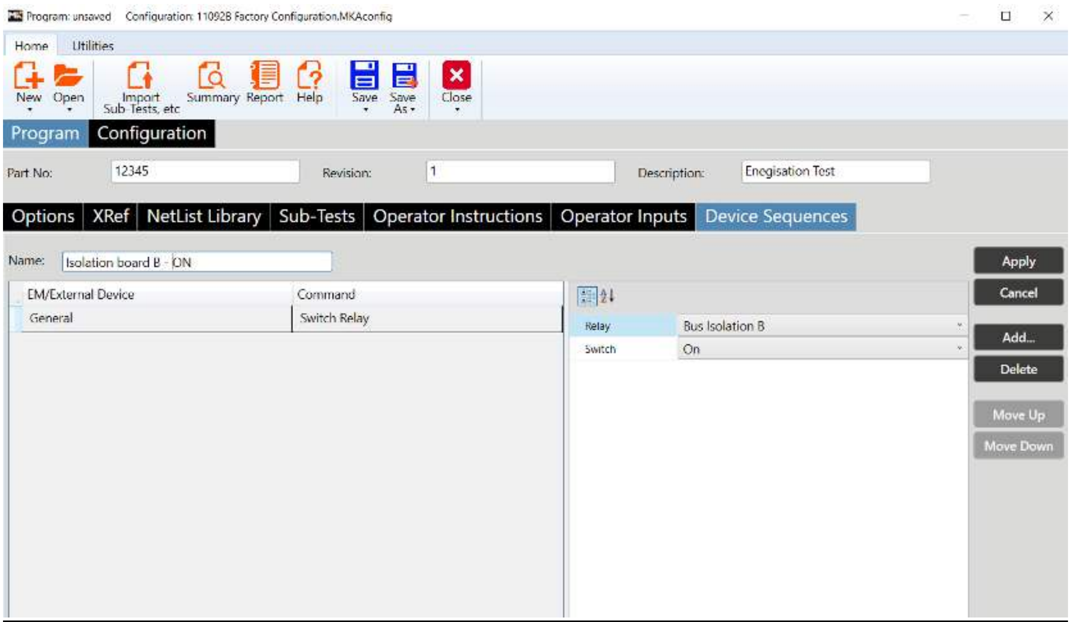


Figure 59: Switching an isolation board in a device sequence.

4.9.3. Time Delay

Time delays may be added into test programs and/or functions using device sequences.

To program, select **Device Sequences** Tab and name the device sequence e.g., Time delay-1 minute. Click **Add** and in the EM/External Device field select **General** from the drop-down list. In the Command field select **Delay** from the drop-down list. Enter delay time required in milliseconds i.e., 1000 = 1 second or 60000 = 1 minute

4.9.4. Internal Set Current /Voltage

A device sequence may also be used to set the MK equipment internal source current and voltage (Vmax). For example, the internal source may be used to energise a low-power device/ indicator. In this case we recommend both current and voltage (Vmax) are set in the same sequence.

To program, select **Device Sequences** Tab and name the device sequence e.g., Energise 12Vdc Lamp. Click **Add** and in the EM/External Device field select **General** from the drop-down list. In the Command field select **Set Internal Current** from the drop-down list. Enter current e.g., 100mA. Click **Add**, select General from the drop-down list. In the Command field select **Set Internal Voltage**. Enter voltage e.g., 12Vdc.

Remember in this example, if 4 wire mode (if available) is selected, ensure a 4-wire interface is connected across the lamp - to allow voltage or Vmax circuit to operate. Always check internal source polarity before connecting across external devices.

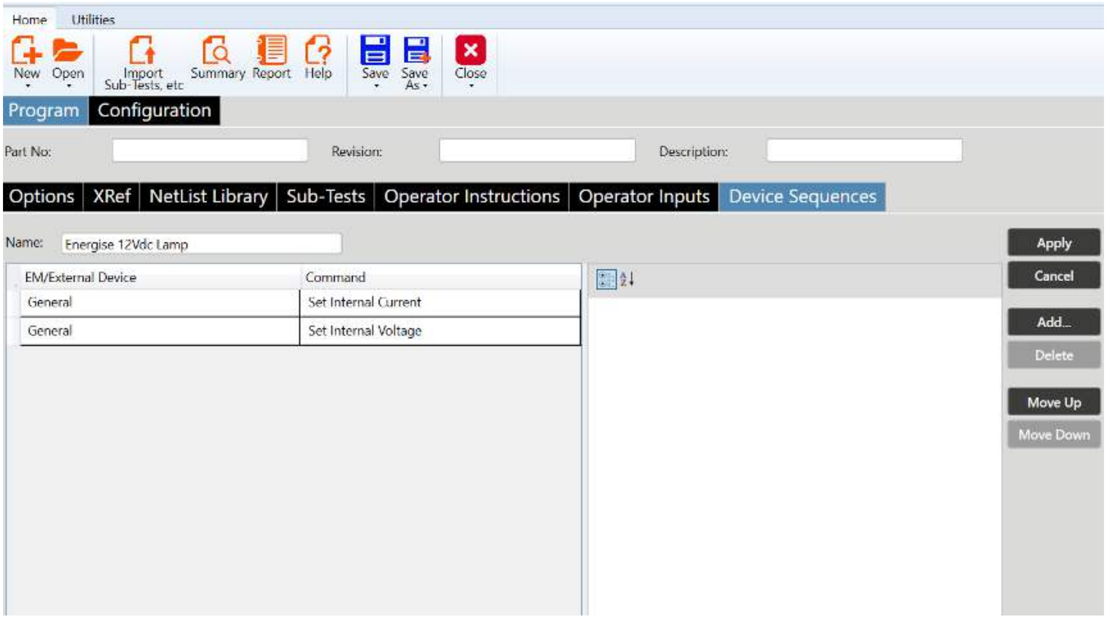


Figure 60: Setting the internal source current & voltage.

4.9.5. External Devices - If Fitted

MK Equipment may incorporate specified third-party equipment into the hardware design. Examples are as follows:

Device Type	Manufacturer & Model	Function
Power Supply (DC)	TTI QL355P	Energisation 35V 5A
Power Supply (DC)	TTI TSX3510	Energisation 35Vdc 10A
Power Supply (DC)	TDK-Lambda GENH 35-25	Energisation 35Vdc 25A
Power Supply (DC)	TDK-Lambda GENH 150-5	Energisation150Vdc 5A
Power Supply (DC)	TDK-Lambda GEH 150-22	Energisation 150Vdc 22A
LCR Meter	Agilent U1731C	Capacitance/ Inductance measurement
Voltmeter	London DVM AC /DVM DC	DC/AC voltage measurement
Oscilloscope	PicoScope 4262	Oscilloscope

Note, this is only a selection of devices available for installation into MK equipment.

For example, an external TSX3510P 35VDC 10A power supply may be used for the energisation of equipment under test e.g., a 24Vdc motor. In most cases this equipment may be controlled using MKAT software. All equipment that is installed and available for MKAT control should appear in **Device Sequences** tab**.**

To program, select **Device Sequences** Tab and name the device sequence e.g., Power Supply ON. Click **Add** and in the EM/External Device field select ***required device*** from the drop-down list e.g., power supply. Select the required command in the Command field e.g. set a current, voltage, switch output on.

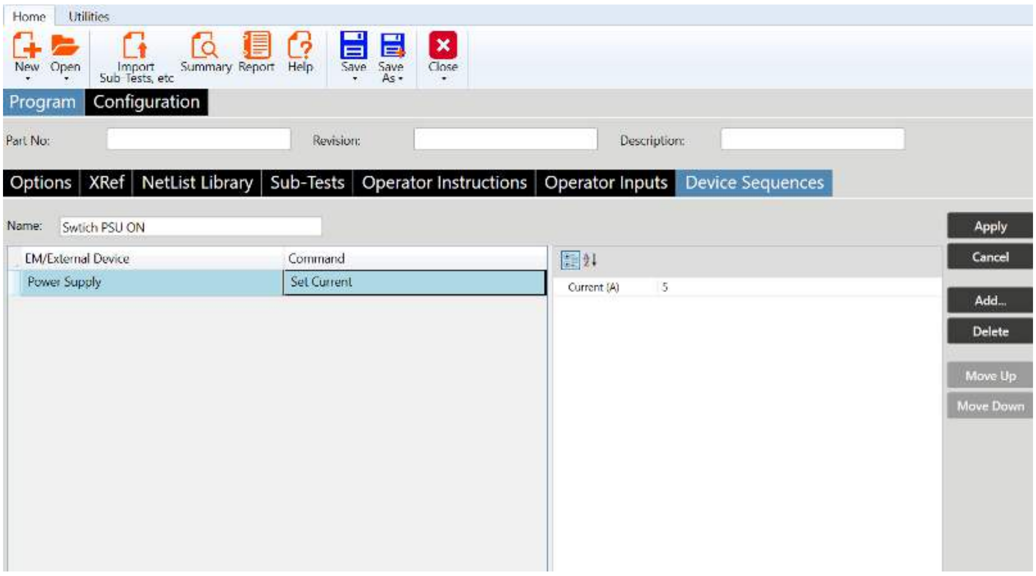


Figure 61: Setting an external source current (e.g., power supply).

Note: for most third-party equipment, device sequences are used to set an output, or set a measurement range, scope time base etc on the equipment. Output values will be limited by device specification i.e., PSU output current be limited to maximum output of the PSU installed.

To retrieve data back from the equipment e.g., read actual current, read actual voltage, retrieve a scope trace, create a “read external device” sub test type and define the external measurement source. Remember to use device sequences and EM’s/External Devices section in the SubTest to the set the device output or set up range etc.

4.10 Importing Sub-Tests

Sub-tests, Operator Inputs, Operator Instructions, and Device Sequences can be imported using the *Import Sub-Tests* button, shown below.

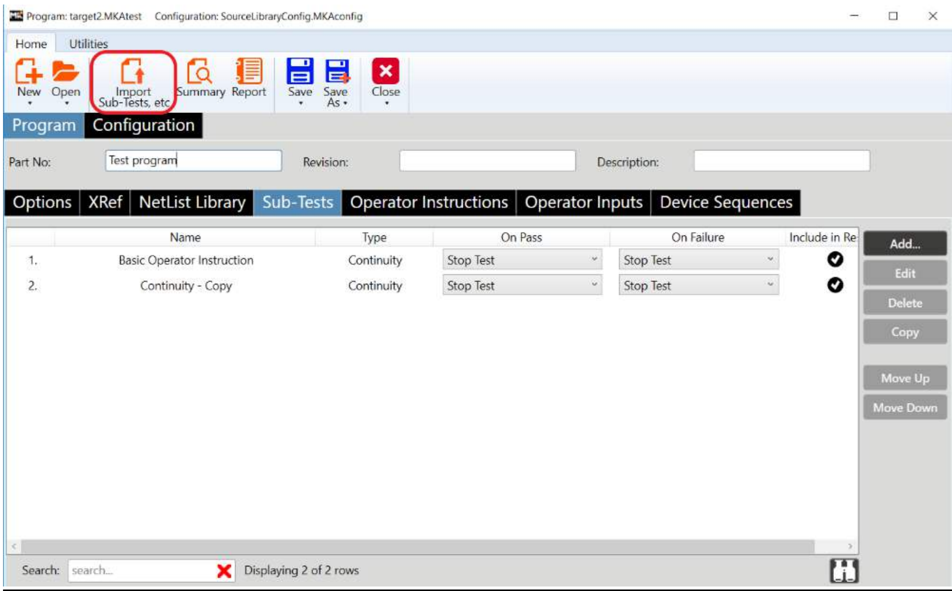


Figure 62: Import of SubTest's.

This feature allows sub-tests from existing programs to be imported. Any associated operator inputs, operator instructions or device sequences that are used in the selected sub-tests will be imported as well.

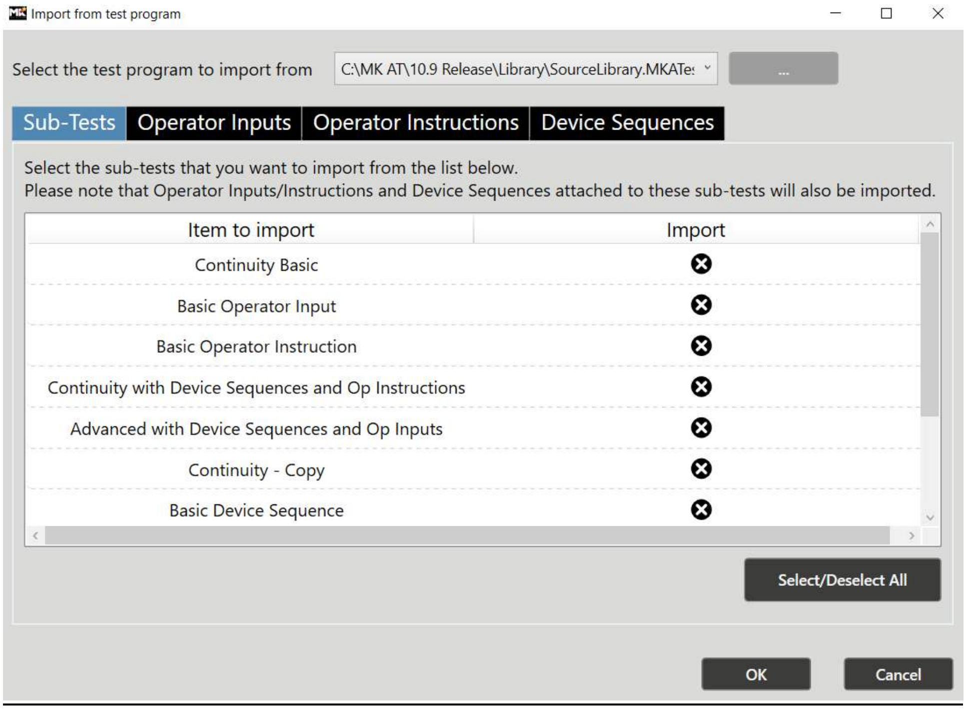


Figure 63: Importing SubTest's from another program.

Operator inputs, operator instructions and device sequences can also be imported independently of their associated sub-tests if required.

If the source program is changed, there is the option to update any changes to the imported sub-tests. This is done by selecting the Import Sub-Tests button again and any available changes are listed under the Updates tab:

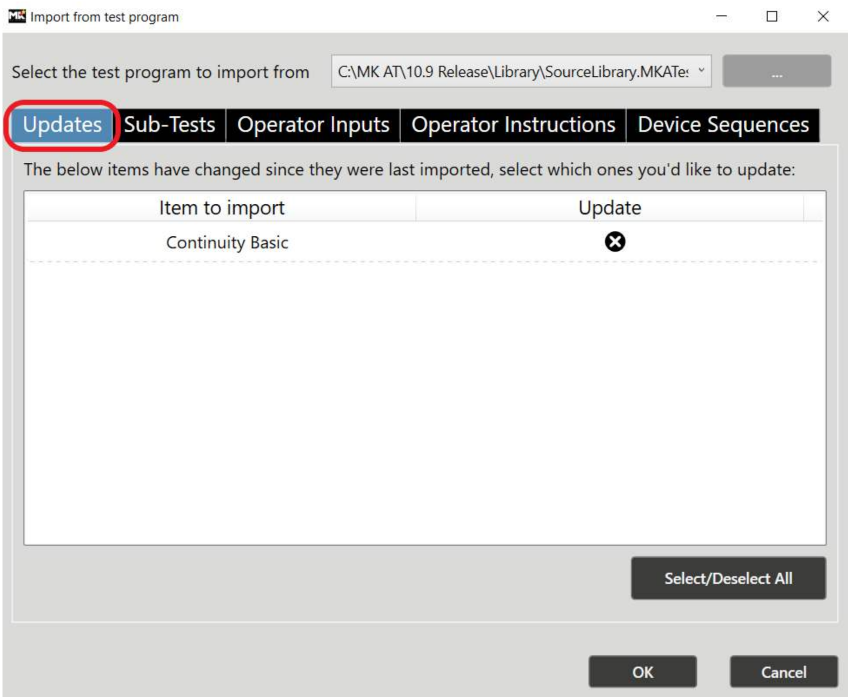


Figure 64: Updates tab.

4.10.1. Automatically Update Test Programs from a Master Program

Changes made to the master template can be pushed to all child programs that imported from the template.

The import window shown below lists all test programs that have imported from this template.

If the child program has nothing to update from the template, they will be marked as *This item is up to date*.

Where updates are available, there will be the option to update the child program.

The *Break Link* option removes the link between the template and child program and prevents it from appearing in the update listing again.

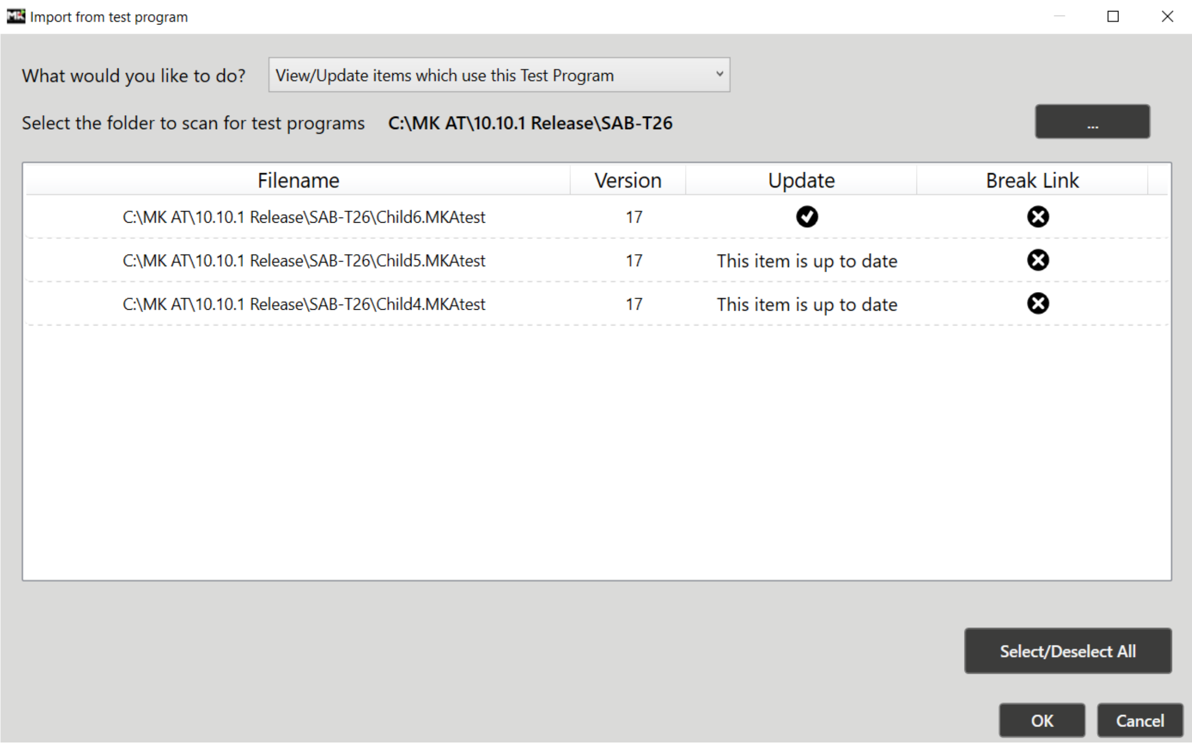


Figure 65: Automatic Updates.

4.11 Sub-Test Cloning

Sub-tests can now be cloned from release 10.13. This allows the same test to be run multiple times but using a different range of test points:

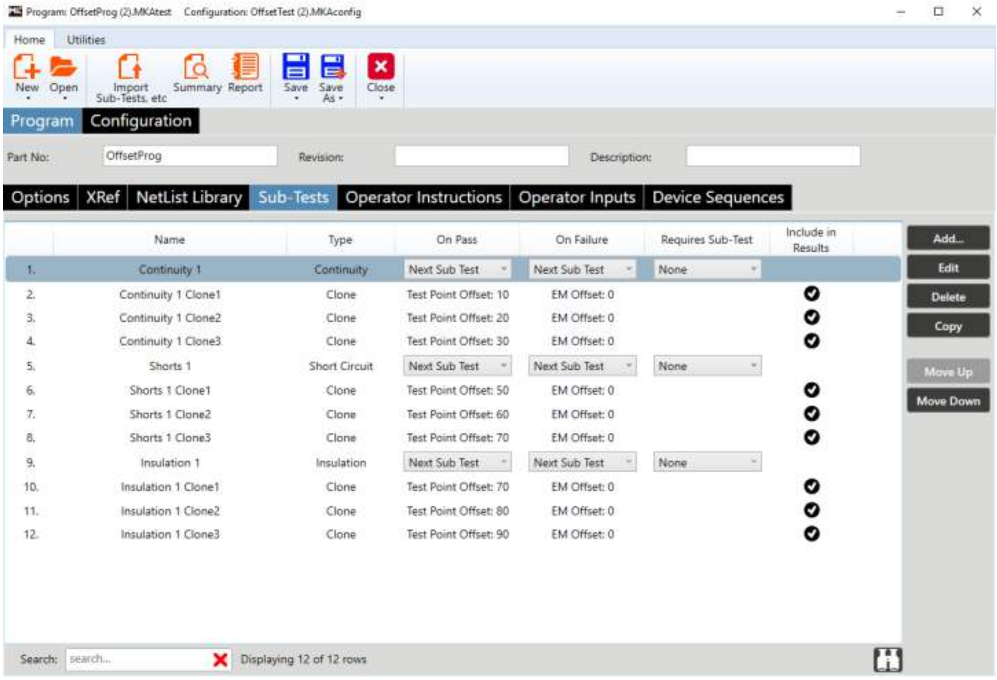


Figure 66: Clones 1

To clone a sub-test, edit the master sub-test and then select Add on the Sub-Test Type screen.

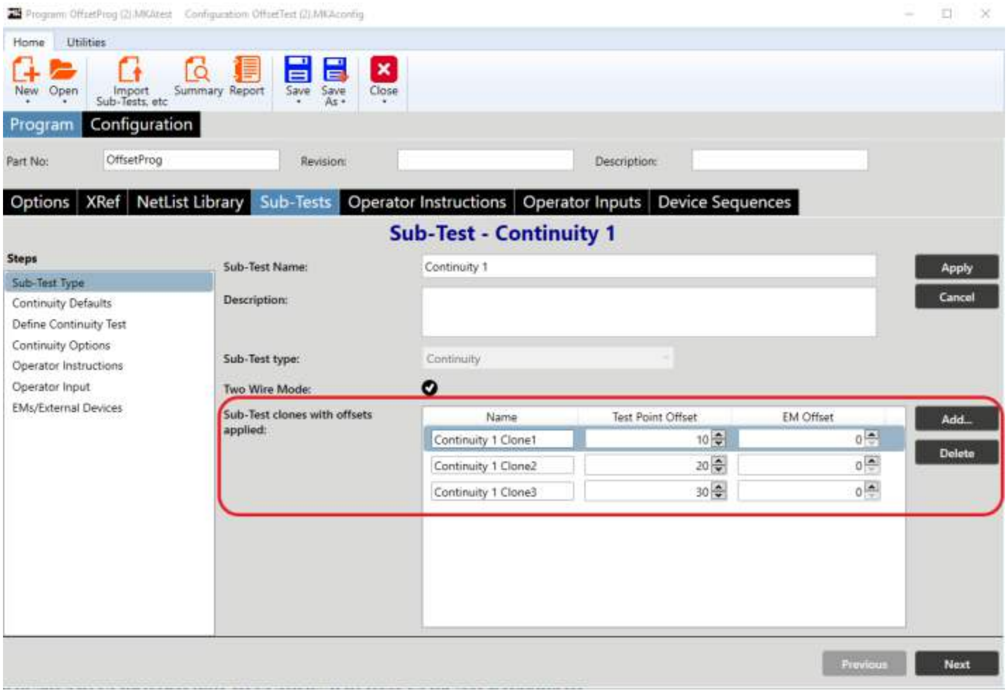


Figure 67: Clones 2.

The only parameters that can be altered for the cloned sub-test are:

- Name
- Test Point Offset
- EM Offset

All other parameters remain identical to the original sub-test.

The original sub-test does not run, it is just used to specify the test parameters. On Pass branching is triggered if all associated cloned sub-tests pass. On Fail branching is triggered as soon as the first cloned sub-test of a group fails.

5 UTILITIES MENU

Clicking on the Utilities menu allows access to two different menu options: “APG” and “Verify test results". See the following screenshot:

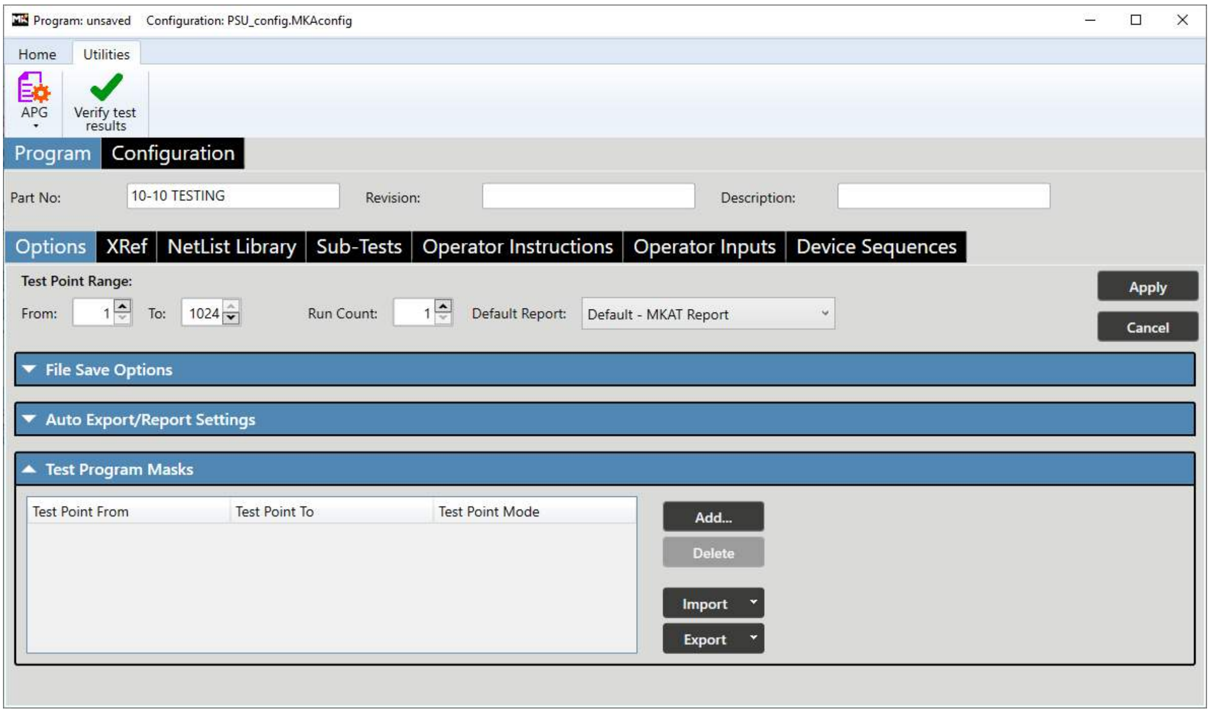


Figure 68: Utilities menu.

5.1 APG menu option

Selecting the "APG" menu option will reveal a drop-down menu of five different APG options. These options are not covered in this document. Please instead refer to the following documentation for a description of these options:

1. MKAT Standard APG Manual
2. MKAT Component Library Manual
3. MKAT active component APG and File Structure Reference Manual
4. Gen 2 – Active component APG and File Structure Reference Manual

5.2 Verify test results menu option.

Selecting the "Verify" option opens a dialog to allow navigation to, and selection of a test result file. Once selected, the software will run a check to ensure the results have not been altered externally and notifies the user of the result.

6 CONFIGURATION

Configuration features are covered by the Runner manual so please refer to *MKAT Runner Software Manual.docx* for details. The only exception to this is System Mask which is not currently available in the Runner.

6.1 System Mask

A test point or range of test points can be added to the system mask table which means that they become globally masked and will be excluded from all test programs run on the system. Note that masking can also be applied to individual programs as outlined in the *Creating a program* section.

To add an entry, select the *Add* button and enter a Start Test Point and End Test Point. From the *Apply To* drop-down menu select whether the mask should apply to two wire, four wire or both and then select the Apply button to confirm. The mask can be changed using the *Edit* button and removed using the *Delete* button.

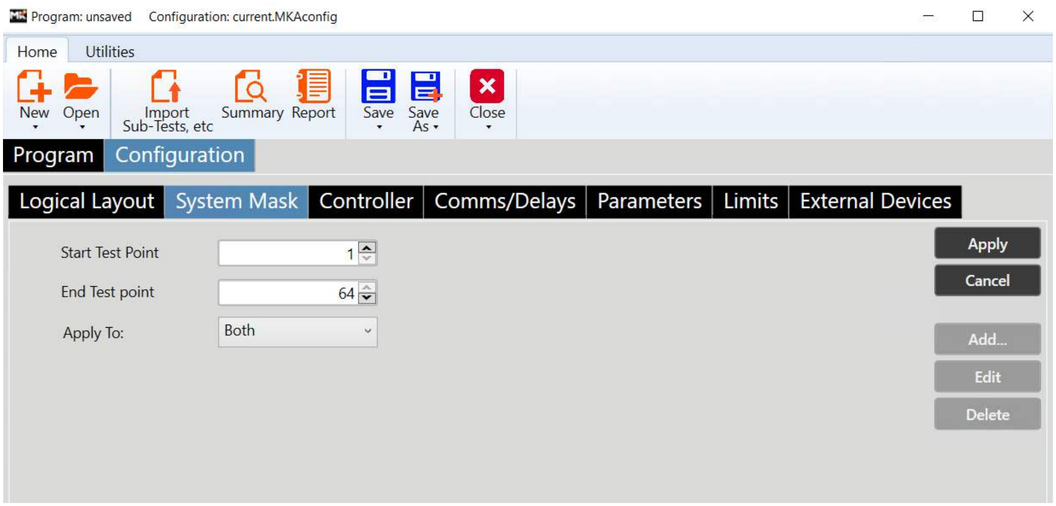


Figure 69: System mask 1.

In the example below, test point 1 has been globally masked for both 2 and 4 wire tests, test points 2 to 6 have been masked for 2 wire tests and test points 9 and 10 have been masked for 4 wire tests:

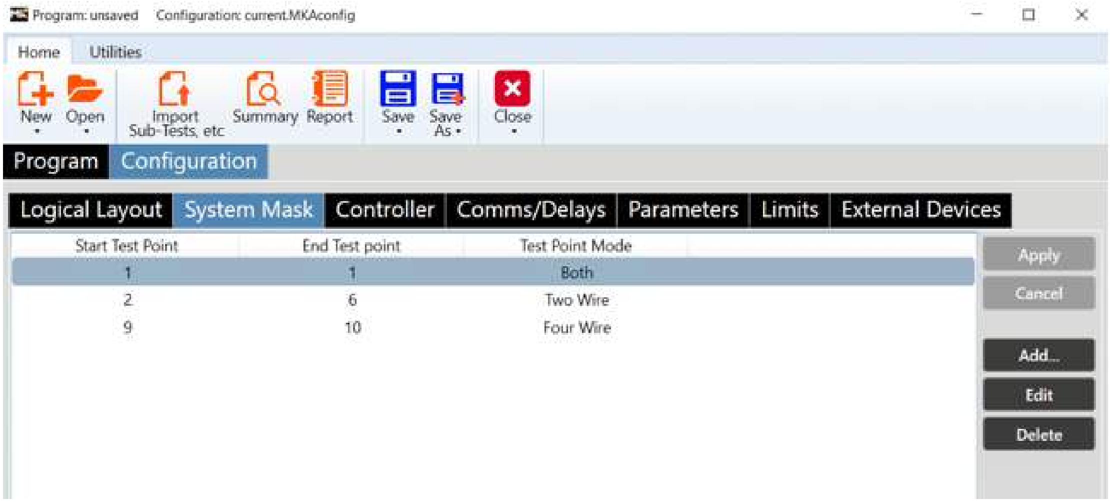


Figure 70: System Mask 2.

7 Notes