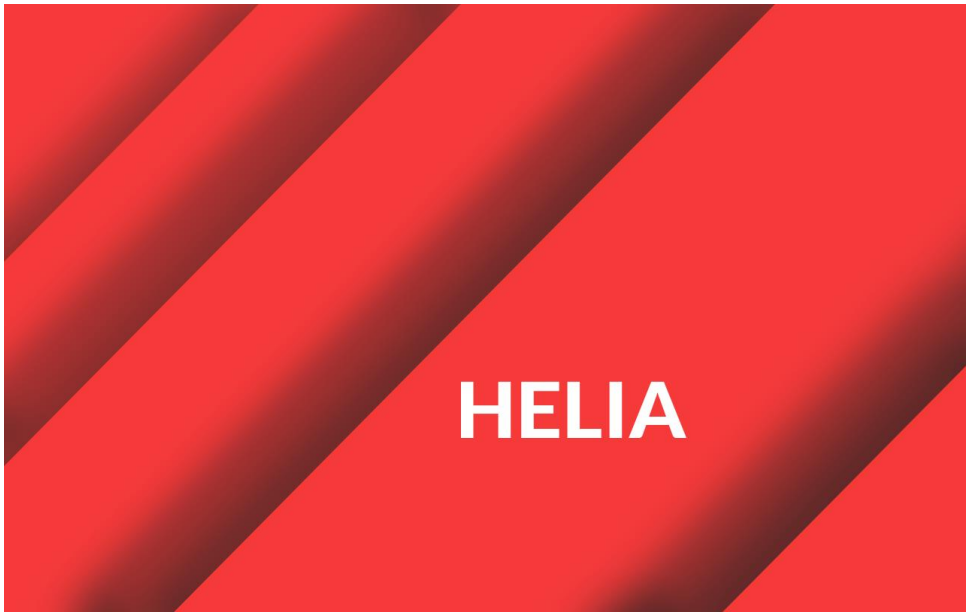
SCHLÖDER
PROFESSIONAL EMC EQUIPMENT

HELIA
Operating Manual



Software for Conducted Disturbances Tests

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1 Introduction

1.1 Software Description

HELIA is a comprehensive program with which conducted RF immunity tests can be performed. It supports both the ubiquitous tests according to IEC/EN 61000-4-6 with the typical coupling media CDN and EMCL, as well as BCI tests according to the well-known MIL-STD 461 E/F/G, ISO 11452-4 or various automotive standards. The software covers all aspects of the test, starting with the test level determination, the complete sweep with extensive DUT monitoring, up to the complete protocol. Each test performed can be saved as a "recording" and is thus available for detailed analysis at a later time. A "direct mode" as a playground for developers, where all settings can be modified directly, completes the program.

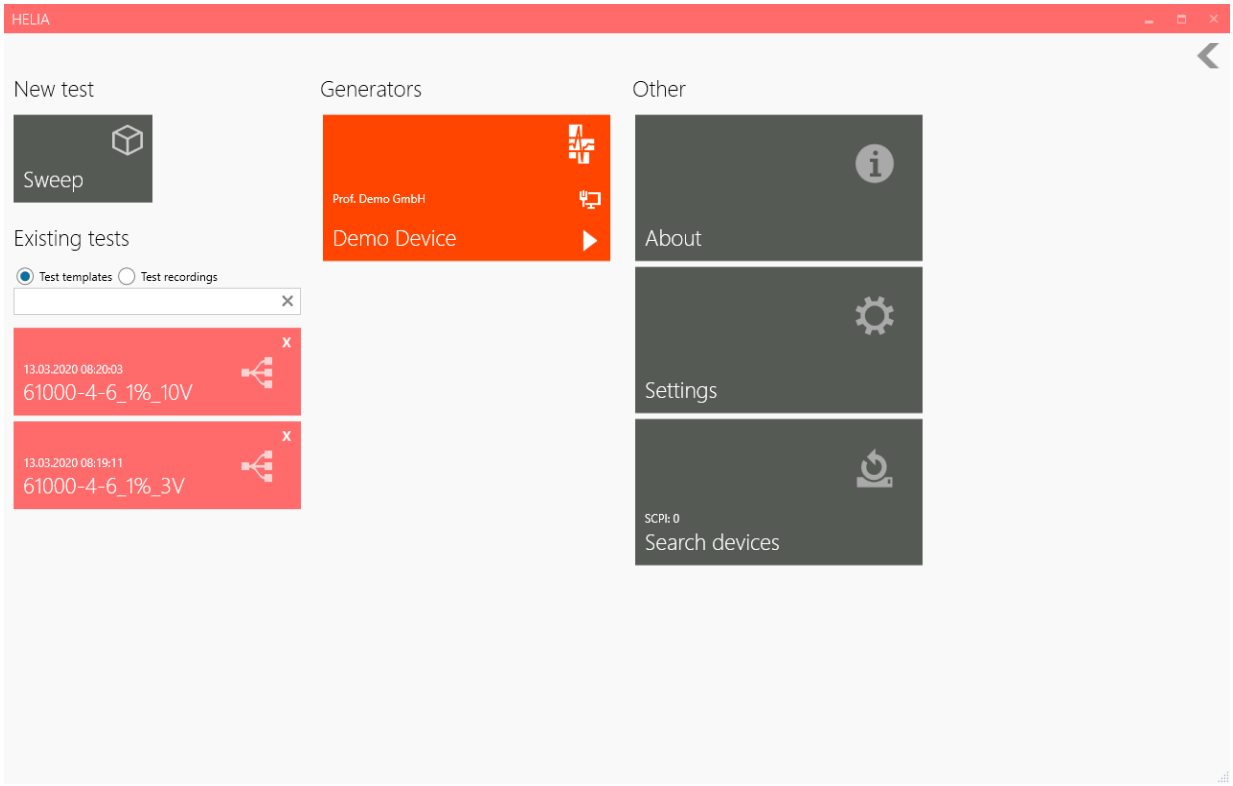
HELIA is available in two flavors: Besides the regular version there is a HELIA BCI Edition. For BCI testing, an additional licence for HELIA BCI Edition is required. Please upgrade your regular HELIA dongle if BCI testing is needed. Upgrades are available at your distributor.

1.2 Scope of Delivery

- USB thumb-drive including
  - These operating instructions
  - Application Software HELIA
- Hardware dongle

2 Operation via HELIA

2.1 Home Window



Once you have started the device, the Home window shown above will appear. This Home window is the starting point for each test to be performed.

On the following pages the tiles of this window are explained.

2.1.1 New test / Sweep

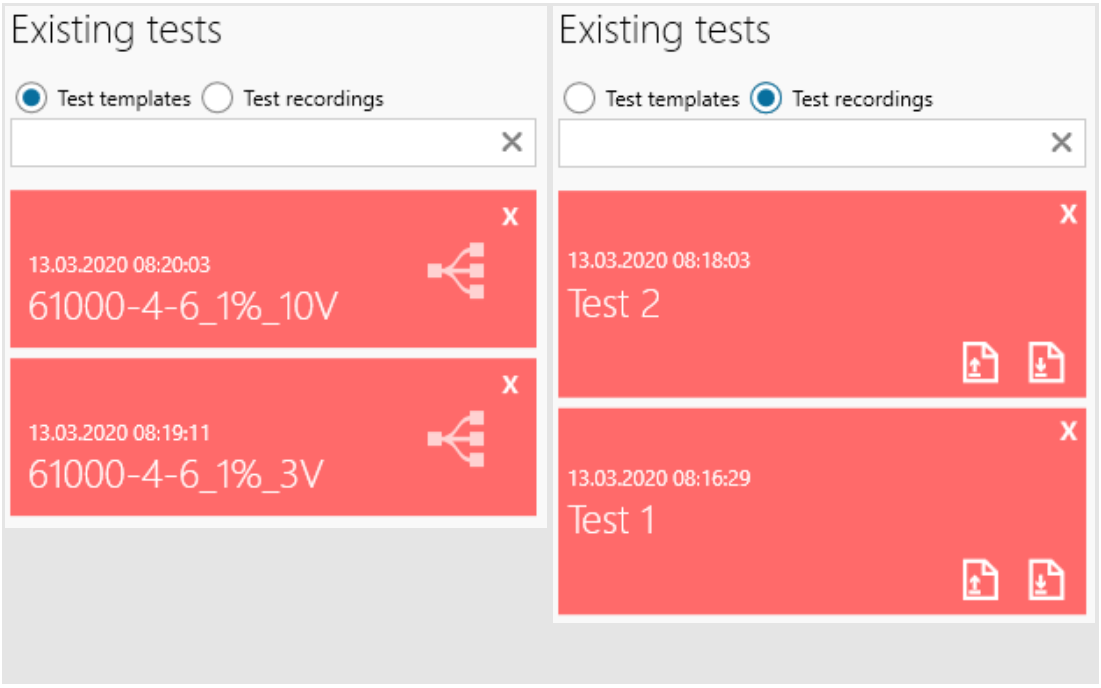
To create a new test, click on this tile. It opens a window to enter the desired settings for a frequency sweep. The test window and setting options are explained in more detail in a separate chapter.

2.1.2 Existing tests

This chapter covers two selectable functions.

Test templates / Test recordings

Select **Test recordings** to view data from already performed and stored frequency sweeps. Select **Test templates** to view your already stored test settings for specific frequency runs.

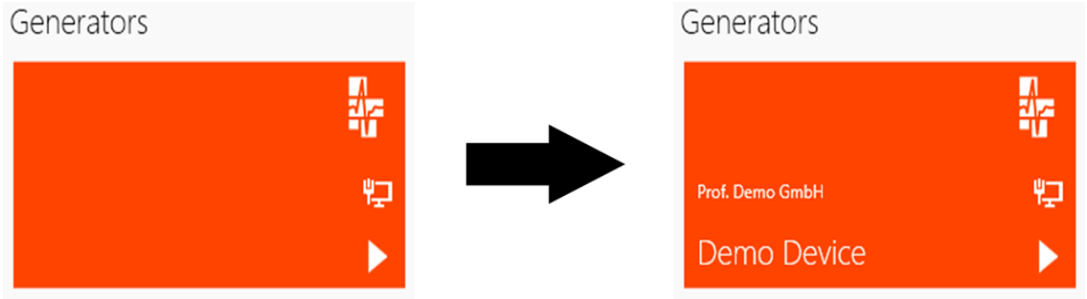


→ **Export Record**: this will export the selected record to your chosen default folder. A JSON and a comma-separated file will be generated.

→ **Import Record:** will import a selected record (only JSON format) to your record list

2.1.3 Generators

This tile shows all discovered devices that can be controlled by the program.



Within the red tile there are more choices:

direct mode and **CDN/EMCL test level determination**.

As soon as you click on one of these buttons within the red tile, you will be redirected to the corresponding test window. These are explained in a separate chapter.

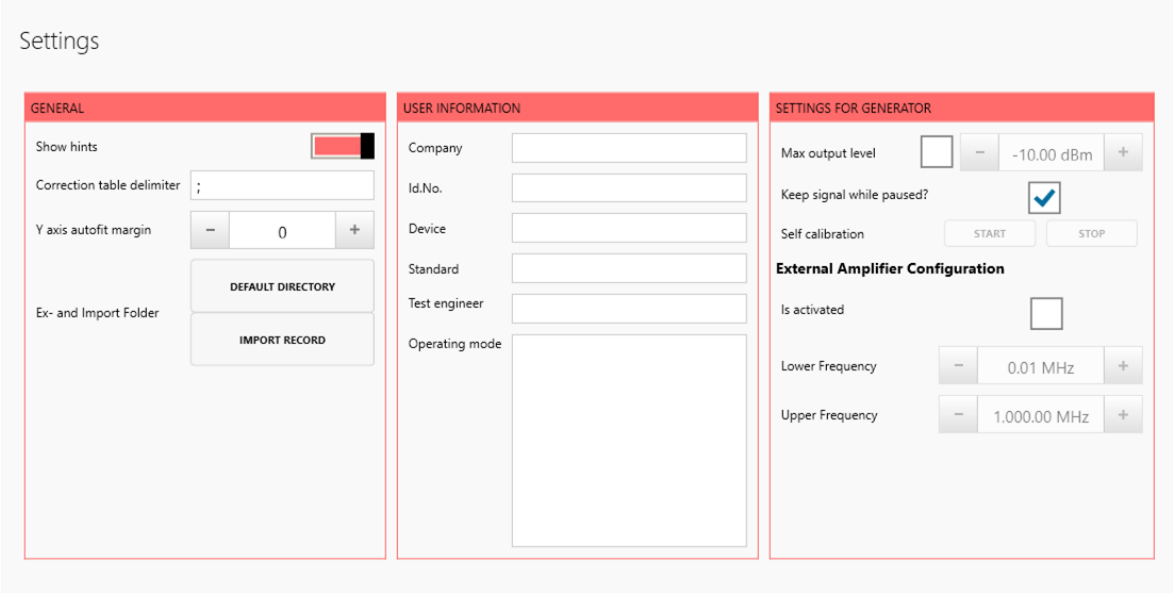
2.1.4 Other

If you click the **About** tile, information about the software is displayed.

The **Settings** tile will take you to a menu for basic settings. Detailed explanations can be found on the next page.

The tile **Search devices** shows you which additional connected devices were discovered (SCPI devices via VISA from National Instruments, e.g. multimeter).

2.2 Settings



2.2.1 General

Show hints: Here you can turn the hint feature on or off.

Correction table delimiter: The Correction table delimiter determines the delimiter for imported tables. By default, the semicolon is set. The supplied tables are all separated by a semicolon!

Y axis autofit margin: Defines the border to the display limits in pixels.

Ex- and Import Folder:

- **Default Directory: you have to select a default folder for your reportings to be im-/exported**
- **Import Record: here you can select a report (json formated) to be imported**

2.2.2 User Information

Company: Enter the name of your customer here.

Id.No.: Specifying an identification number makes it easier for you to find the test later on. It is included in the documentation.

Device: Enter the device name here. It is included in the documentation.

Standard: Specification of the standard for documentation.

Test engineer: To assign the test at later times to a person, enter the name of the person responsible for the test here.

Operating mode: Enter the device settings here. These will be included in the documentation.

2.3 Settings for Generator

Max output level: If selected, the generator level is limited to the value defined in the right field. In case of a possible overload, the test is aborted!

Keep signal while paused?: If selected, the generator output is kept activated/deactivated while a sequence is paused.

Self calibration: Currently deactivated for devices with directional coupler.

Important

Inadequate ground connection of the calibration plane or the CDN may result in very high amplifier output, which may destroy the 6 dB attenuator or the CDN. For unclear setups, first determine low voltage levels below 10 V with a pre-set maximum amplifier output level. An output level of-10 dBm is sufficient in all cases to determine reliable control values for each CDN and EMCL.

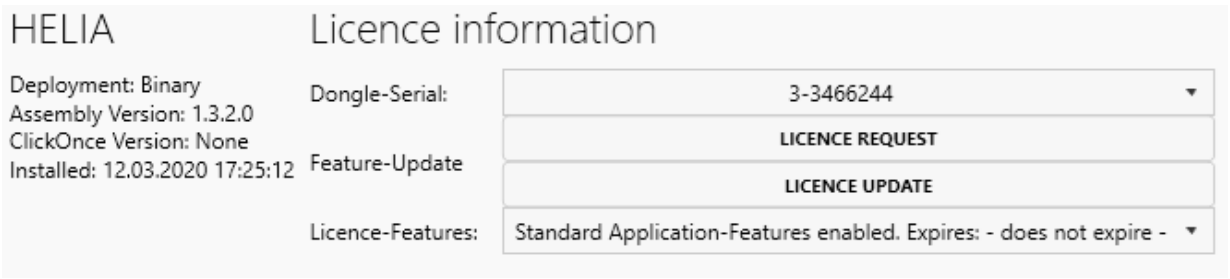
External Amplifier Configuration:

Depending on your instrumentation, operation with the built-in internal amplifier and an external amplifier is possible. The external amplifier is always connected to the “RF-out 2” output of the generator and fed back to the device via the "external Amplifier Input". For generator frequencies that lie between the defined lower and upper frequency limits, RF-Out 2 is activated instead of RF-Out 1. In addition, the amplifier path is switched over by the built-in RF coaxial relay when the frequency limits are exceeded or undershot.

Lower Frequency: Definition of the lower limit frequency of the external amplifier.

Upper Frequency: Definition of the upper limit frequency of the external amplifier.

2.4 Licence Information



Dongle-Serial: all connected dongles will be listed

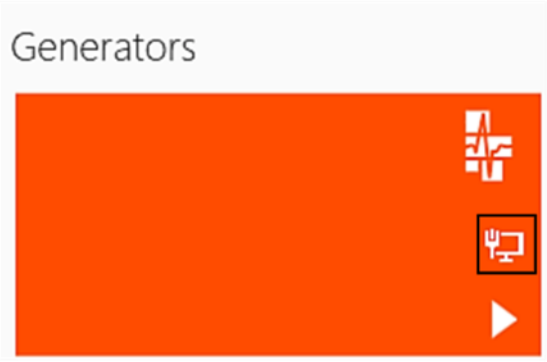
Feature-Update: *HELIA BCI Edition* is required to activate the current mode during sweeps. If current mode is needed: please save the generated file after pressing *LICENCE REQUEST* and send it to your distributor.

After receiving an expanded licence via e-mail you can activate the desired option by selecting the licence file by pressing *LICENCE UPDATE*.

Licence-Feature: your activated options are listed here

3 Test Level Determination

To perform a test according to EN/IEC 61000-4-6, you must first determine the test level for CDNs and EMCLs. Click on the icon for test level determination in the home window (red tile).

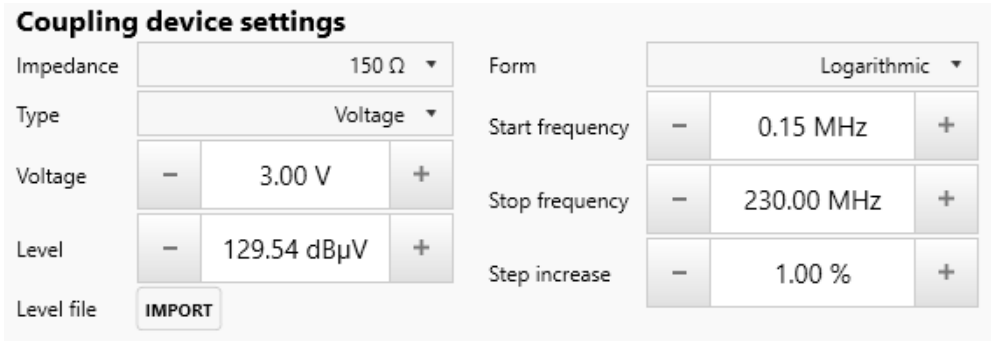


The encircled area on the right side of the border is the icon to press to perform a test level determination.

3.1 Test Window

3.1.1 Coupling device settings

Before the test level determination can be started, various settings have to be made. The available options are explained below.



Impedance: Defines the system impedance, 150 Ω or 50 Ω are selectable. The system impedance is only relevant for voltage measurement, since the measuring voltage is U0/6 in 150 Ω systems and U0/2 in 50 Ω systems (U0 is the open loop voltage).

Type: Here you can select voltage mode or current mode. Depending on your choice, you can set voltage or current values in the fields below.

Voltage / Current: Set the target value for the test level determination either in open circuit voltage of 1 ... 40 V or in loop current of 1 ... 1000 mA.

Level: Alternatively, enter the target value of the test level determination as logarithmic in dBµV or dBmA, respectively. If you change the level value, the (absolute) value in field voltage or current adapts automatically.

Level file Import / Delete: Level file allows you to import or delete certain previously saved voltages or frequencies. The uploaded file will be displayed with its name.

Form: Defines the frequency steps in linear or logarithmic units

Start / Stop frequency: Specification of the start frequency or stop frequency between 0.01 ... 400 MHz.

Step increase: Specification of the increment between 0.1 ... 100% or 0.01 ... 100 MHz. This setting determines the gradual increase of the frequency.

Transducer table / Import: Selection of the conversion table for current measurement with "RF_in" input (only available for type: Current and necessary).

3.1.2 Starting / stopping test level determination:

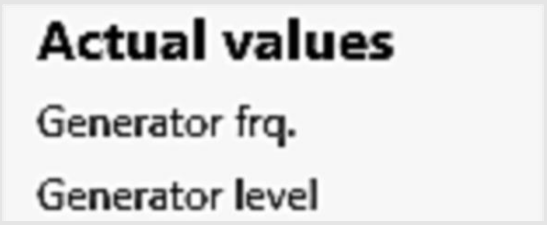
In addition, the idle mode is displayed.

3.1.3 Actual values

Actual values

Frequency: actual generator frequency

Level: actual generator level



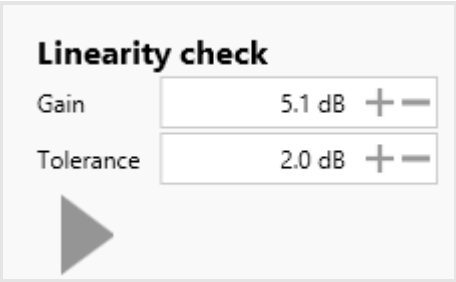
3.1.4 Linearity check

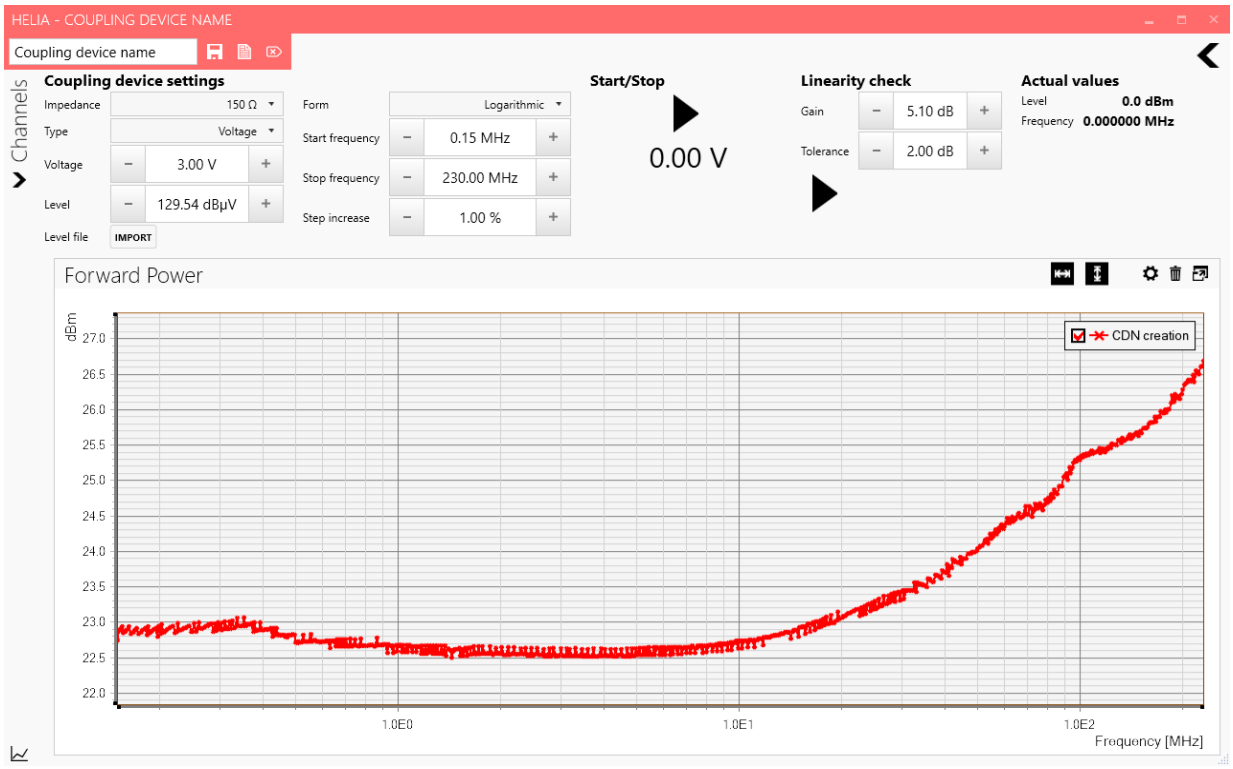
After determining the performance data, a **linearity check** (saturation check) of the amplifier can be performed. The difference of the forward power with gain (signal gain) is determined. Gain = 5.1 dB (equivalent to 80%) is

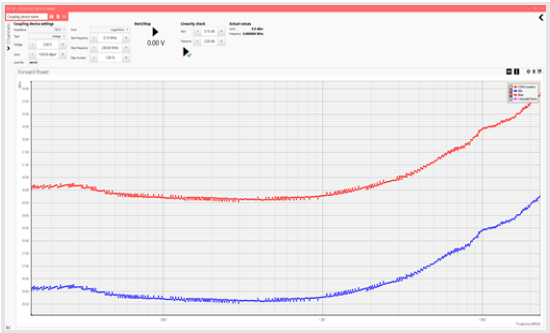
necessary to verify that the amplifier is still linear enough for sufficient output in amplitude modulation mode. The test results are evaluated according to the tolerance factor of EN/IEC 61000-4-6 (± 2 dB).

The linearity check can be started by clicking the triangle.

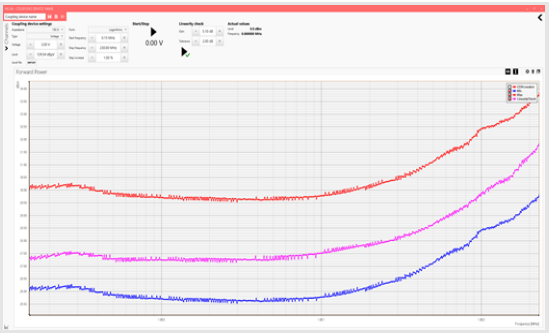
Gain can be used to specify the power addition for the saturation check. Possible values are between 0.0 to 6.0 dB, which corresponds to 0 to 100% amplitude modulation.







Without linearity check



With linearity check

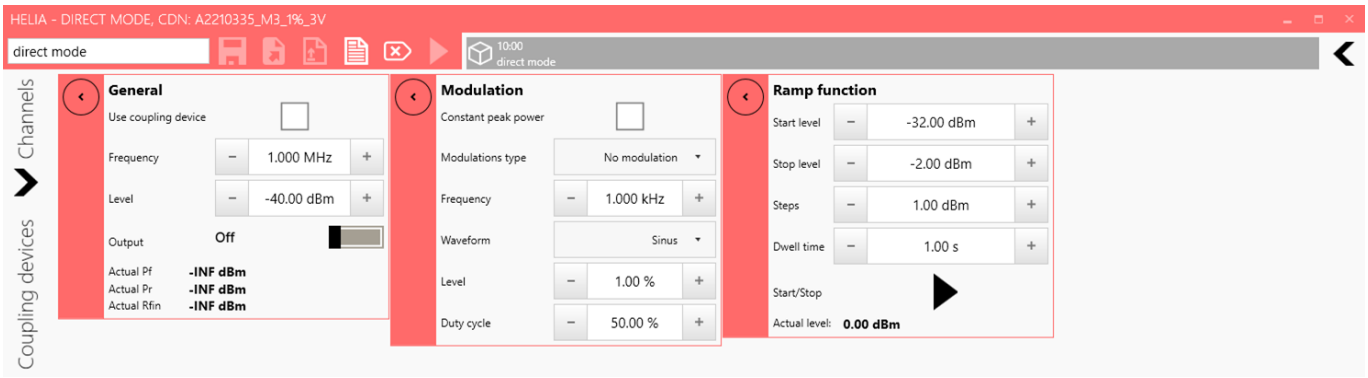
3.1.5 Name / Save / Delete

Once you have completed the determination of the performance data, you can save the test level determination under a name of your choice, protocol or delete the displayed graph.

In the text field on the left, enter the file name for the test level determination data. The icons to the right of the text box are save / protocol / delete.

CDN / EMCL data is best stored under a reasonable name and are available for the following test from then on.

4 Direct Mode



In direct mode, the parameters of the generator are set directly without control and modifications. The output level can be controlled directly. However, option "Use coupling device" can also be used to set an open-circuit voltage or a loop current. The direct mode is intended to analyse individual critical frequencies, such as finding limits of influence or observing response to different modulations.

Similar to the test level determination, several settings have to be defined. First, "general" and "modulation" are explained, then the "ramp function".

Use coupling device:

disabled: The generator level is set directly

enabled: Test level data of a coupling device are used and the test level is set. The level for open circuit voltage or loop current depends on the selected coupling device.

Frequency: The generator frequency of 0.004 ... 1200 MHz can be set. If 'Use coupling device enabled' is chosen, the coupling device limits the frequency range.

Level:

If "Use coupling device" is disabled, the generator level can be set from-63 ... 0.0 dBm.

If "Use coupling device" is enabled and the coupling device is a voltage type device, the open-circuit voltage can be set from 1 ... 40 V. There is no control of forward power!

If "Use coupling device" is enabled and the coupling device is a current type device, a loop current between 1 ... 1000 mA can be set. There is no control on forward power or actual current!

Output: Turns the generator on or off.

Modulation / Constant peak power: If this option is enabled, the output level is lowered by the AM increase before switching on the amplitude modulation, in order to adopt the peak power output to the determined test level (e.g., 80% AM =-5.1 dB).

Modulations type: determines the type of modulation: no modulation, internal AM (amplitude modulation), external AM, pulse modulation.

Modulation Frequency: Set the modulation frequency for internal AM and pulse modulation.

Modulation Waveform: If internal AM is set, you can select the waveform "Sine / Triangular / Rectangular".

Modulation Level: Modulation depth to be set for internal AM of 1 ... 100%.

Duty Cycle: The duty cycle with pulse modulation can be set from 5 ... 95%.

Actual Pf: Display of the current forward power

Actual Pr: Display of the current reverse power

Actual RFin: Display of the current power at the RF-in input

Ramp function:

Defines the parameters of a ramp function. The unit depends on options set in "Use coupling device" and the selected coupling device. The output is switched on at the start of the function and switched off at the end of the ramp.

Start level: Start value of the ramp function (unit as for Level).

Stop level: Stop value of the ramp function (unit as for Level).

Steps: Step size of the ramp function (unit as for Level).

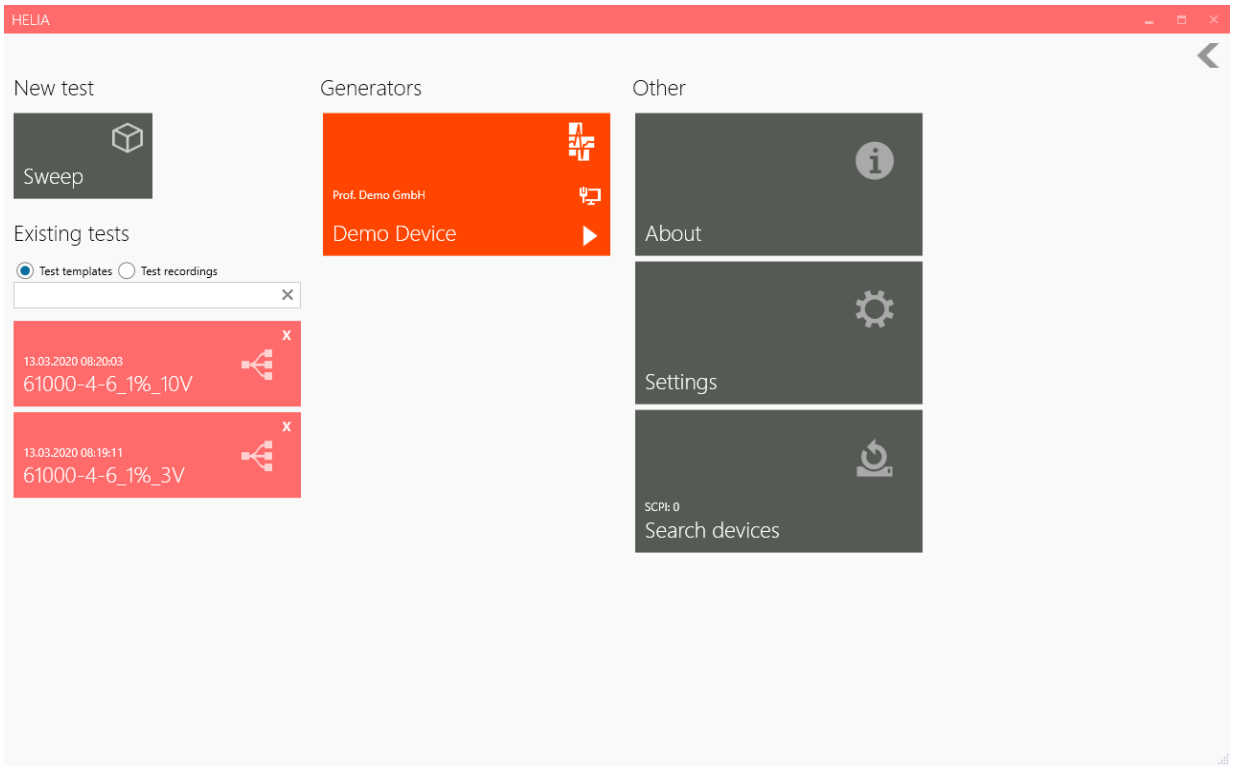
Dwell time: Defines the dwell time at each set level.

Start/Stop: Start and stop the ramp function.

Actual value: actual output level (step) of the ramp function

5 Create a Test

For setting a new test run, always use the tile "Sweep" under "New test" in the start window!



Already created "test templates" can be changed and saved as a copy under new names. Defined test runs can be selected immediately from the start window.

If you have clicked on the tile "Sweep", you have several options available to pre-set your test. At the left edge of the test window, you will see three choices. Clicking on an arrow below opens the menu to the right.

Different measuring channels can be displayed via the bar that opens to the right. To do this, drag and drop a channel into the control window. The following channels of the test generator are available:

- RF Generator Frequency / MHz
- RF Generator Level / dBm
- AF Generator Frequency / Hz
- RF in Power / dBm
- Forward Power / dBm
- Reverse Power / dBm
- EUT Monitor / V
- EUT Failed / 0 or 1
- Target Level / V or dB(mA)

In addition to these channels, all connected devices which can be addressed via VISA are listed. All SCPI-compatible multimeters which support the remote command “read?” can be used during a test.

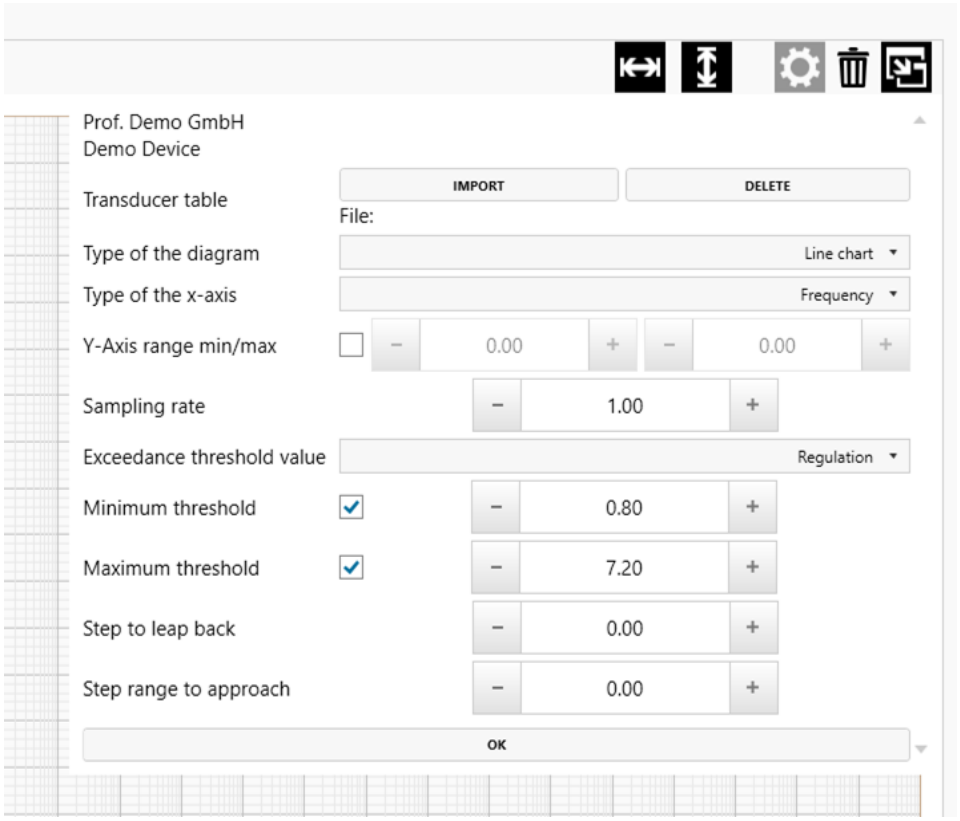
Note when using Keithley Multimeters

To query the measured value, the software uses the SCPI command "READ?". By default, Keithley's multimeters ignore the additional trigger provided by the Read command, producing an error message and a beep. To prevent this, the multimeter must be put in a "one-shot" mode. This can be achieved e.g. with the command "INITate: CONTiuous OFF " or an adequate setting via the front panel.

Attention: When starting, HELIA queries all available interfaces. A "preset" command is sent, which automatically puts the Keithley multimeter into continuous measuring mode. This causes an interface error and HELIA does not recognize the multimeter as a measuring channel. After setting the Keithley to "single-shot" mode and querying the interfaces again, this multimeter is also recognized and be-comes available as a measurement channel.

The channel view is identical for each subprogram (test level determination, direct mode and frequency sweep). There are differences in the query time of the channels. In direct mode, each value is continuously queried after a defined time (default: 1 s). In test level determination and frequency sweep, the query is triggered with each frequency change to obtain an influence curve over the frequency. The internal channels of the test generator are measured after regulation and the internal and external EUT monitor channels are queried after the dwell time at each frequency. Therefore, the X-axis with setting "Frequency" should be used! In direct mode, however, both the frequency representation and the time representation can be useful. Any number of channels can be placed in the window. Even the same channel can be placed several times, e.g. on the one hand to display the power at the RF_in channel directly in dBm and in the other hand as current in dBmA.

5.1.1 Channel settings:



Icons (from left to right):

switching auto scaling for x-axis on / off

switching auto scaling for y-axis on / off

edit graph settings

delete graph from display (Data is also deleted!)

Bring graph to the foreground

5.2 Coupling devices

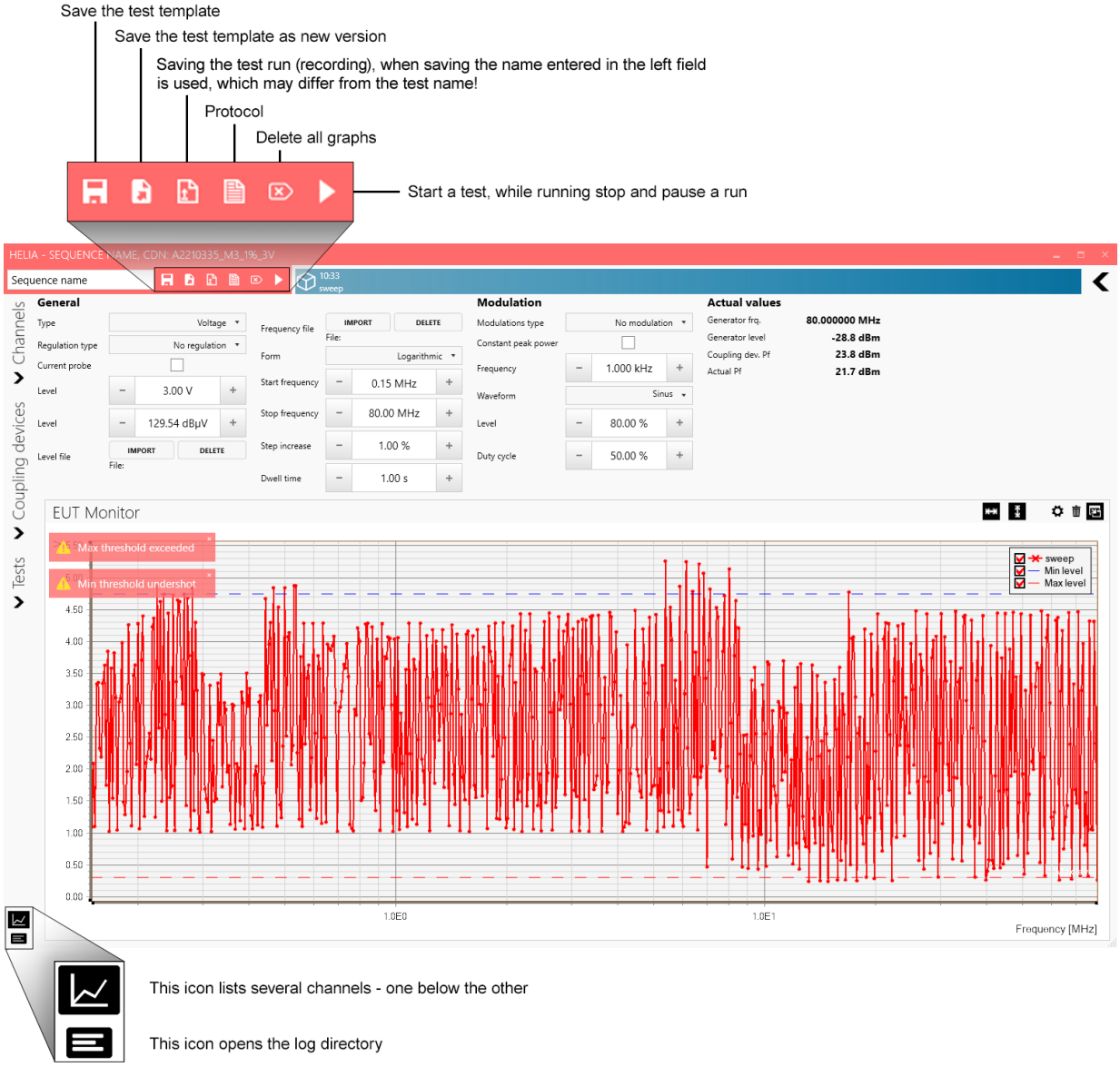
Predefined CDNs or EMCLs are selected from the list that opens to the right. The selected field is highlighted in blue. Delete the coupling device by clicking on the white cross in the upper right corner. Double-clicking on the name allows editing. If the values of frequencies and levels of the determined test levels match the actually measured values during immunity test, the CDN symbol is displayed in white and "full" appears above the CDN name. If extrapolation is required due to deviating test frequencies or test levels, the CDN symbol is drawn in yellow and "partial" appears. If there is an incompatibility between test level determination and test, e.g. because a current device has been selected for a voltage test, the CDN icon is red and "incompatible" appears. In this case, the test cannot be started!

5.2.1 Tests

You can merge a complete test from several individual tests. Open the list to the right and drag the single test into the progress bar of the overall test. You can place the individual test before, after or even between already existing individual tests of the overall test. The number of individual tests is not limited. Only individual tests of the same kind, i.e. voltage or current type can be merged to an overall test. A single test can be merged either as a link (sequence as a hole) or as a copy (sequence individual). When linking, each change to the individual test automatically affects all merged overall tests. Changing only the linked individual test in the specific overall test is not possible! For the copy, the overall test is handled like a new individual test consisting of several parts. It can be changed freely without taking other (merged) tests into account.

5.3 Frequency Sweep

The test window offers further options for editing the settings.



Name field: Name of the test (also used for test records)

Type: Defines the test level as open-circuit voltage or loop current. Only coupling devices of the same type can be used for test level determination and test.

Current Mode

HELIA BCI Edition is required to activate the current mode during sweeps (see chapter 2.3).

Regulation type: Here you can specify if and how control should take place. Select between No regulation, Forward power and Closed loop (the closed loop is only available in current mode).

Current probe: The use of a Current Probe to measure the actual current can be activated here. In IEC/EN 61000-4-6 the permissible interference current is limited to the value U0/150 Ω. This is automatically fulfilled with CDNs due to their design. When using the EMCL, the current can be higher than this limit, depending on the DUT

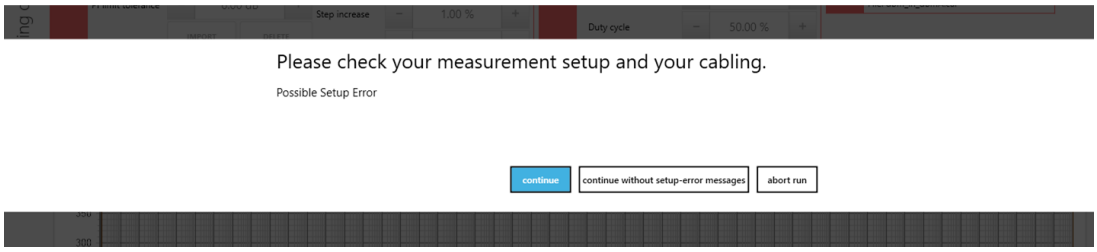
impedance. The actual current is now measured at the forward power and the generator level is reduced by the corresponding amount if necessary. The reduction can be seen, for example, in the graph for forward power measurement.

Forward power: The determined test levels are set. Subsequently, the power output is regulated to the stored forward power. If the forward power is adjusted, the modulation is switched on for the dwell time.

No regulation: The determined test levels were set without further check-ups. The modulation runs continuously during the frequency change. This setting is only available in voltage mode.

Closed-loop: The determined test levels are set and then controlled to the actual measured current. However, the forward power must exceed the determined forward power + "Pf limit tolerance". If the test current or forward power is adjusted, the modulation is switched on for the dwell time. Only available in current mode.

Setup-checking:



If this message appears during a sweep, the test current measured was too low for control. This condition may indicate faulty wiring, especially if it appears directly at the start of the sweep or occurs normally during a sweep. You can cancel the run or continue running normally. To prevent this message from being displayed again and again at each following frequency, the run can be continued without any further message (middle selection). The selection then also applies to all subsequent sweeps of this sweep.

Level: With Level, the voltage or decibel microvolts can be set. Make sure that the set voltage / decibel microvolts correspond to those in the test level determination. If the setting does not correspond to any of the tested and stored CDNs, no final test can be carried out.

Pf limit tolerance: Limitation of the forward power 0 ... 6 dB. In the case of a closed-loop current control, the forward power is raised at a maximum by the value measured during test value determination. (0 dB corresponds to no increase, 6 dB results in a maximum of 4 times the power)

Level file Import / Delete: Select or remove a file with frequency-dependent test level definition.

Frequency file Import / Delete: Select or remove a file with frequency-dependent test level definition.

Form: Defines the frequency steps in linear or logarithmic units

Start/Stop frequency: Specification of the start frequency / stop frequency. The frequency range is determined by the selected coupling device.

Step increase: Specification of the frequency steps from 0.1 ... 100% or 0.001 ... 100 MHz

Dwell time: Can be set from 0.5 ... 3600 s. Duration of every frequency step. This value is also used to calculate the test time in the progress bar. The actual test time may be significantly higher due to possible control processes. After the dwell time, the EUT measurements are also recorded and evaluated.

Transducer table / Import: Selection of the conversion table for the current measurement with the "RF_in" input. This entry is only displayed and required if a current measurement is actually to be made, e.g. in current mode or when using the current clamp for current limitation in voltage mode.

Modulations type: Modulation selection: no modulation / internal AM / external AM / pulse modulation. Where necessary, the modulation is activated only after level control.

Constant peak power: If this option is enabled, the output level is lowered by the AM increase before switching on the amplitude modulation, in order to adopt the peak power output to the determined test level (e.g., 80% AM =-5.1 dB).

Modulation Frequency: Modulation frequency with internal AM and pulse modulation from 1 Hz ... 100 kHz.

Modulation Waveform: Waveform for internal AM "Sine / Triangular / Rectangular".

Modulation Level: Modulation with internal AM 1 ... 100%.

Duty Cycle: Duty cycle with pulse modulation 5 ... 95%

Actual values / Generator frq.: The actual generator frequency

Actual values / Generator level: The actual generator level

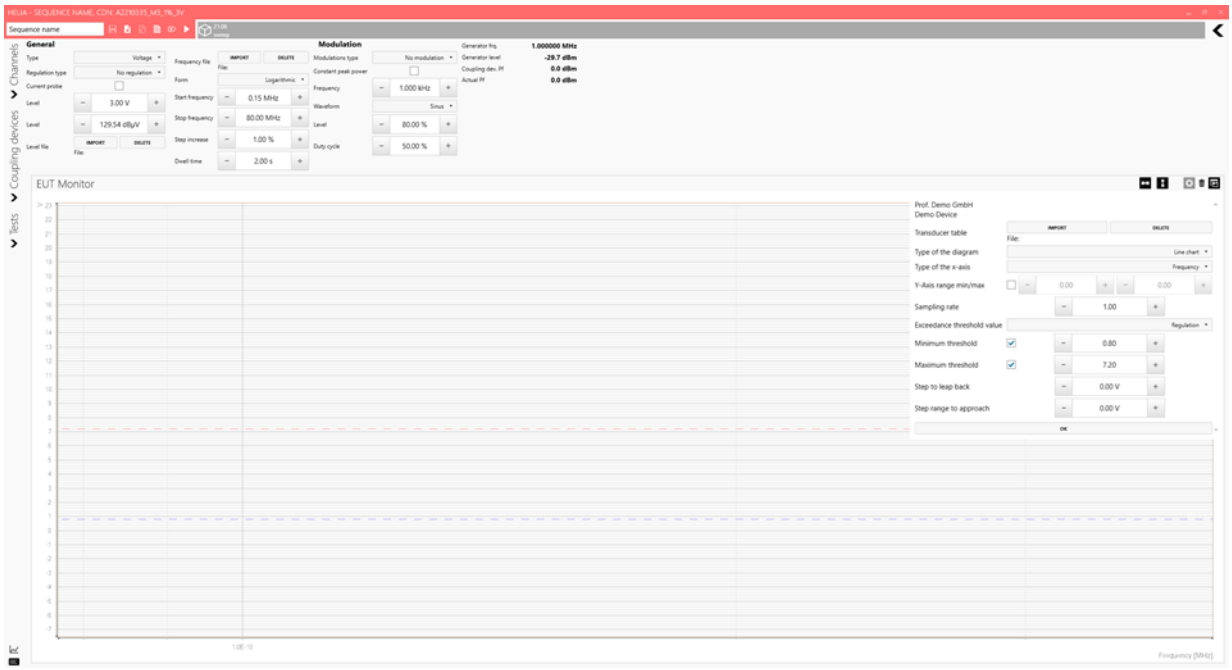
Actual values / Coupling dev. Pf: The stored forward power at test level determination

Actual values / Actual Pf: The actual forward power

Actual values / Actual current: The actually measured current (current / closed-loop only)

5.3.1 Graph Settings

Below, more display options for the graph are listed.



Transducer table / Import / Delete: Loading a conversion table, for example a current probe.

Type of the diagram: Select "Line chart / Bar chart“

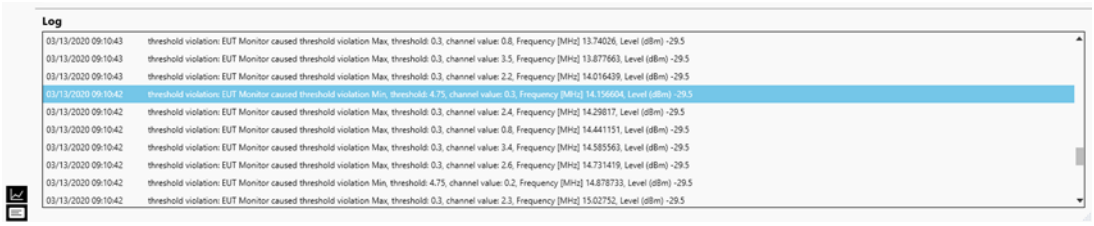
Type of the x-axis: Select "Time / Frequency“: The Frequency setting is recommended for all frequency sweeps; the Time setting may be useful for direct mode.

Y-Axis range min/max: Setting fixed values of the Y axis

Sampling rate: Sample rate of the measured values at time setting (X-axis)

Exceedance threshold value: Behaviour when exceeding the limit value: No reaction

Logging: An entry will be stored for only in case of undershoot / overflow. Entries can be deleted.



Regulation: A threshold value is determined if the limit is exceeded. If a limit value is exceeded, the generator level is lowered by the value in "Step to leap back" and then increased step by step by the value in "Step range to approach" until a limit value is exceeded again. Each level step takes the dwell time. The threshold power is displayed in the forward power graph. A log entry is saved.

Abort: The frequency sweep is canceled. A log entry is saved.

Limit regulation: If the limit value is exceeded, the generator level is lowered until the limit value is no longer exceeded. A log entry is saved.

Minimum threshold: Lower limit

Maximum threshold: Upper limit

Step to leap back: Lowering the level if the limit is exceeded

Step range to approach: Level steps for determining the limit value violation

5.4 Saving a Test

If the test is finished, you can save the whole data including all graphs as a "test recording" and restore it at a later date from the start window. We recommend naming each test to identify the recordings.

5.5 Immunity tests according to IEC/EN 61000-4-6 with CDNs and EMCL

For complete tests, it is recommended to create sweeps accordingly. EN/IEC 61000-4-6 Ed.4 favors test setup with controlling for forward power. If the test is performed without interrupting AM, it must be carried out without control, since level control can only be carried out without modulation. Nevertheless, if the test uses the same setup (attenuator, cable, etc.) the error lies in the range of a few tenths of dB.

For tests with the EMCL a current clamp must usually also be used, since the EUT impedance is generally not known and the actual interference current can be higher than when using coupling networks. This may lead to tests with negative results although the DUT would have passed a test setup with CDNs.

Avoid RF short-circuits, e.g. by placing functional earth terminals directly on the reference ground plane. In case of doubt, a CDN-M1 must be used to avoid direct RF current paths to ground.

6 Document History

Revision	Date	Changelog
2.0	01.04.2020	First publication in new layout
2.1	15.04.2020	Note for Keithley Multimeter added
2.2	05.06.2020	UI changes; Setup Check added

052006