HMExplorer
Software
User Manual

HMExplorer

ROHDE & SCHWARZ

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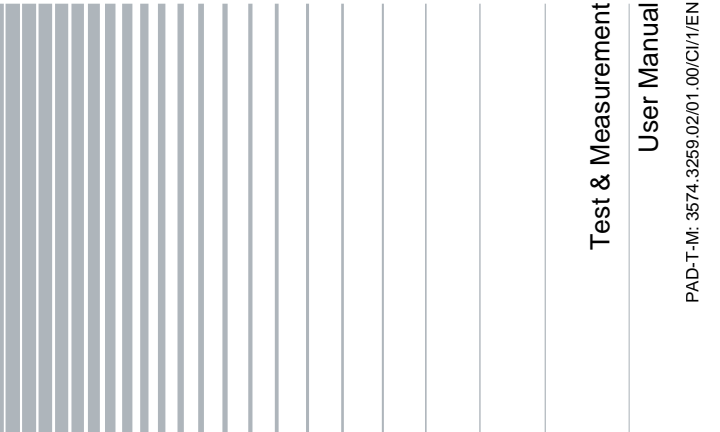
This manual describes the HMExplorer software for the products listed in the overview in chapter 1.

Contents

1 HMExplorer Software

1.1 Overview

The HMExplorer software supports the following instruments:

1. **Digital Oscilloscopes**:

   a) HM1008-2 (for digital mode only)

   b) HM1508-2 (for digital mode only)

   c) HM2008 (for digital mode only)

   d) R&S®HMO Compact Series

   e) R&S®HMO3000 Series

   f) R&S®HMO1002 / 1202

2. **Function Generators**:

   a) R&S®HMF Series

3. **Spectrum Analyzers**:

   a) R&S®HMS10x0…30x0

   b) R&S®HMS-X

4. **Power Supply Units**:

   a) R&S®HMP Series

   b) R&S®HMC804x

5. **Digital Multimeter**:

   a) R&S®HMC8012

6. **Power Analyzer**:

   a) R&S®HMC8015

> **The programmable measurement instruments HM8100 series cannot be used with the HMExplorer software because they do not include a remote control that conform to the SCPI standard.**

1.2 Main Menu

The HMExplorer main menu is arranged as follows:

1. <u>**File**</u>:

    a) <u>Close</u>: Exits the HMExplorer software and closes the module selection
        window
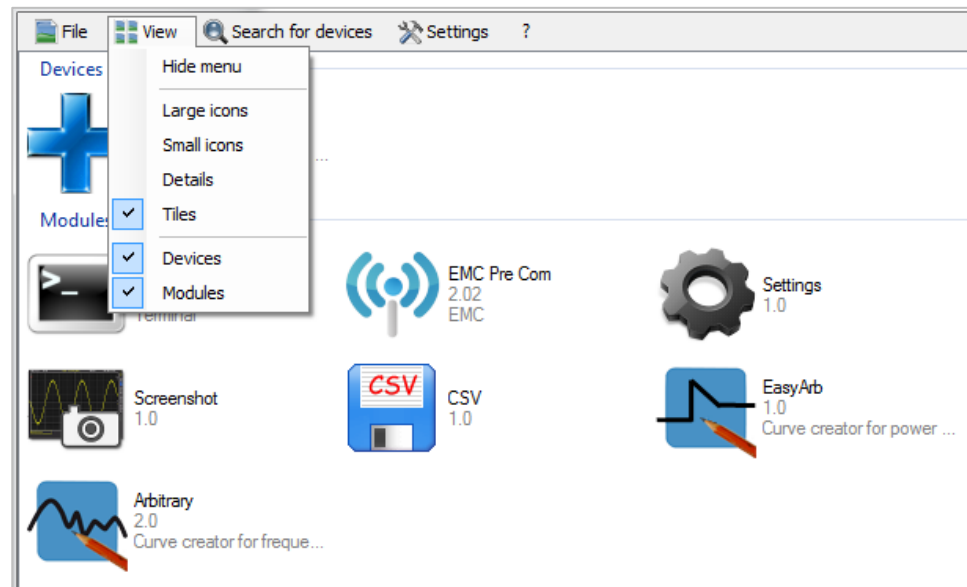
2. <u>**View**</u>:

    a) <u>Hide menu</u>: Hides the upper menu bar; right click on + (or already inserted
        instrument) ➔ "Show menu" to show the upper menu bar again
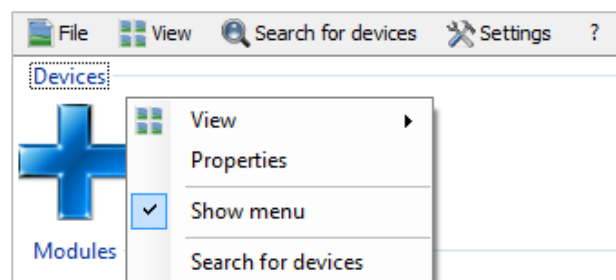
    b) <u>Large icons</u>: Displays modules and instruments as large icons

    c) <u>Small icons</u>: Displays modules and instruments as small icons

    d) <u>Details</u>: Displays details of modules and instruments with detailed description

    e) <u>Tiles</u>: Displays modules and instruments in tile format; you can choose
        between tile format or detailed display, not both functions simultaneously

       f)   <u>Devices</u>: Shows or hides the connected measurement instrument

       g)   <u>Modules</u>: Shows or hides the available software modules

3.   **<u>Search for devices</u>**:

       a)   Manually searches for connected measurement instruments

4.   **<u>Settings</u>**:

       a)   <u>General</u>:

           i. <u>Language</u>: Determines the language for the software and the modules

          ii. <u>Startup</u>: Determines if an automatic search for instruments is to be performed at every startup

         iii. <u>Interfaces</u>: Selects the interface that will automatically be verified for a connected measurement instrument after each restart; the connection via Ethernet (LAN) is exclusively established manually

         iv. <u>Tray</u>: If the "Use tray icon" function is activated (check box is selected) and if the HMExplorer main window is minimized, the software window will be hidden and can be reselected via Windows task bar.
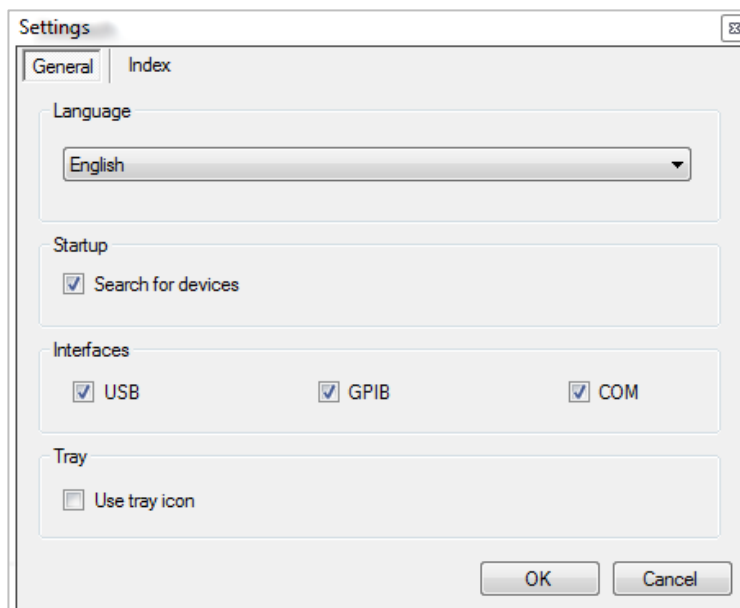
       b)   <u>Index</u>: Displays the default index to save data or modify the file path; the "Default" function resets the folder structure to the default settings
Directories are intended for the following file types:
    i.)   Screenshots of all formats
    ii.)   Device settings file type (*.HDS)
    iii.)   Curves in CSV format
    iv.)   Directory for EMV PreCom software module for the file types (*.mes, *.hlim, *.htr, *.hlga)
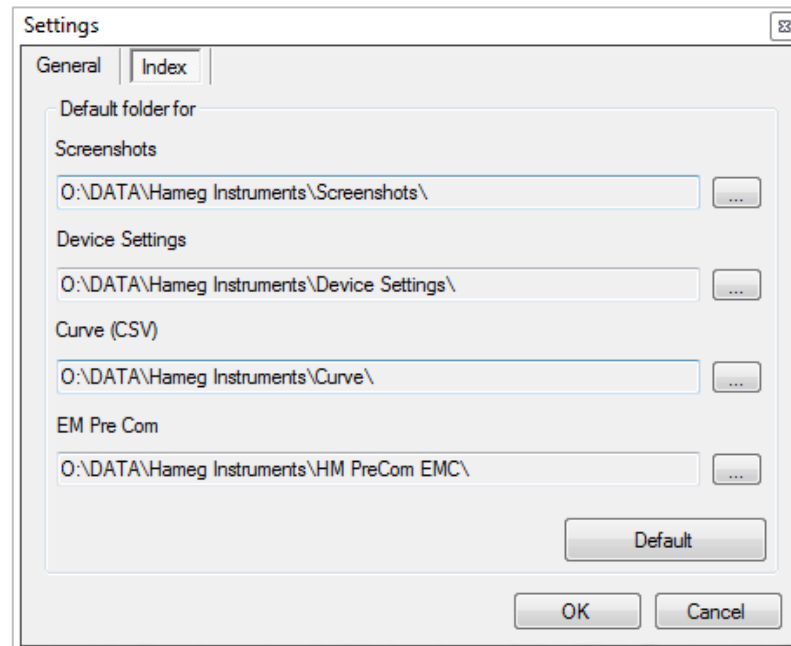
5. **?:**

    a)   <u>Error report</u>: Error report for HMExplorer software

    b)   <u>About</u>: General information about software status for the HMExplorer
           software

2 Getting Started

2.1 Search for devices / Add device

If a device has not been found automatically (e.g. via Ethernet), or if a new device was connected to the PC after starting the HMExplorer software, it is possible to search for it manually by using the option "Search for devices". By default, the following interfaces are automatically searched after starting the HMExplorer software:

1. **USB / VCP** (driver installation required)

2. **COM** (<u>default settings</u> = Baudrate: 115200, Handshake: None, Parity: None, Stopbits: 1;

3. the interface parameters can be adjusted / modified

4. **GPIB**

> **A device is only manually integrated via Ethernet (LAN). IP address and port have to be manual integrated into the HMExplorer software.**

If a new device is connected to the PC after starting the HMExplorer software, the device can be automatically inserted either by double clicking ➕ or by using the option "Search for devices". If the device is manually inserted by using ➕ , a window will be opened to select the respective interface. After clicking the "OK", the interface parameters will be adopted. After completing the search, the detected device will be inserted in the group "Devices".
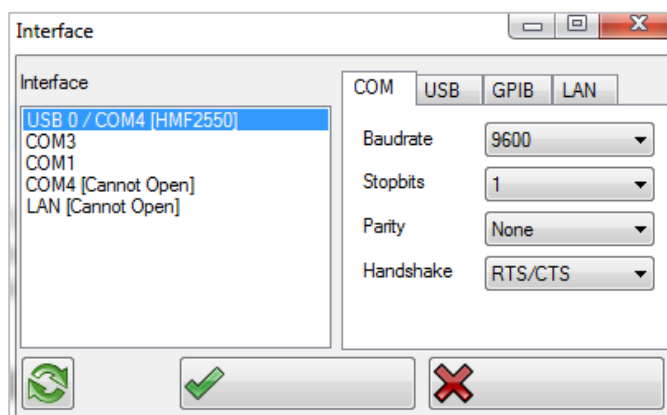
2.2 Device / Module Properties
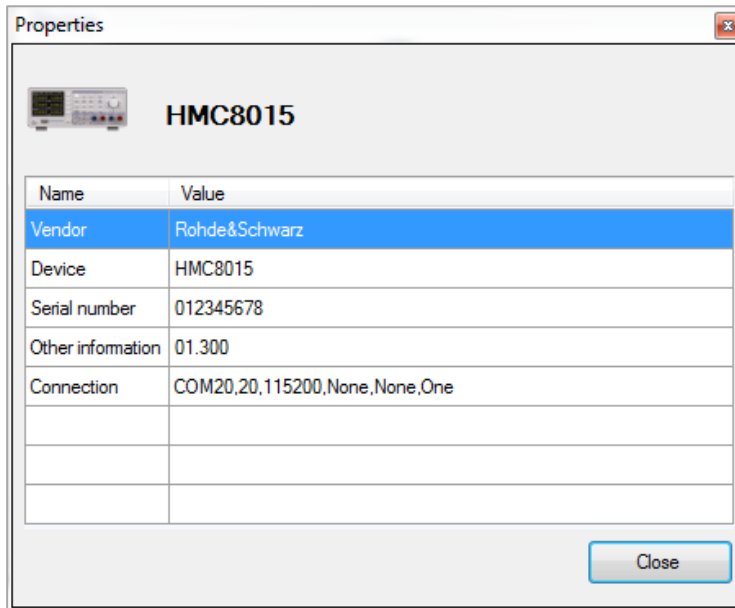
Right click the inserted device or a software module to open a "Properties" window which shows the properties of the device (e.g. device type, serial number, etc.) or of the selected software module (e.g. module type, supported devices etc.). Use "Close" to close the properties window.
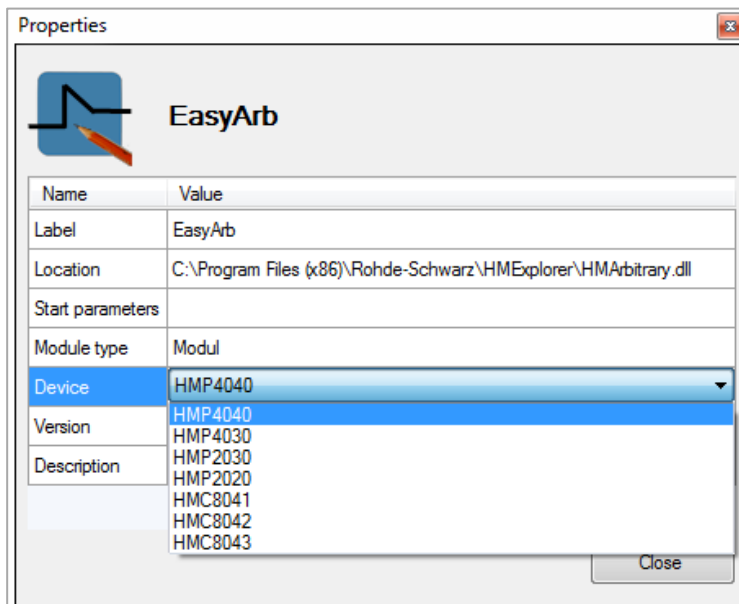
3 Starting a Software Module

Starting a software module does not necessarily require a connected instrument. However, to execute the software functions, is necessary to integrate the main window of the HMExplorer software with an instrument. Multiple options are available to connect a connected instrument with a software module.

> **If the selected software module is not starting, it is recommended to delete the .set file via "…\User\AppData\Roaming\Rohde-Schwarz\HMExplorer\Folder of the software module". Please notice that all saved data settings of the software module will be lost.**

3.1 Double Clicking the Instrument
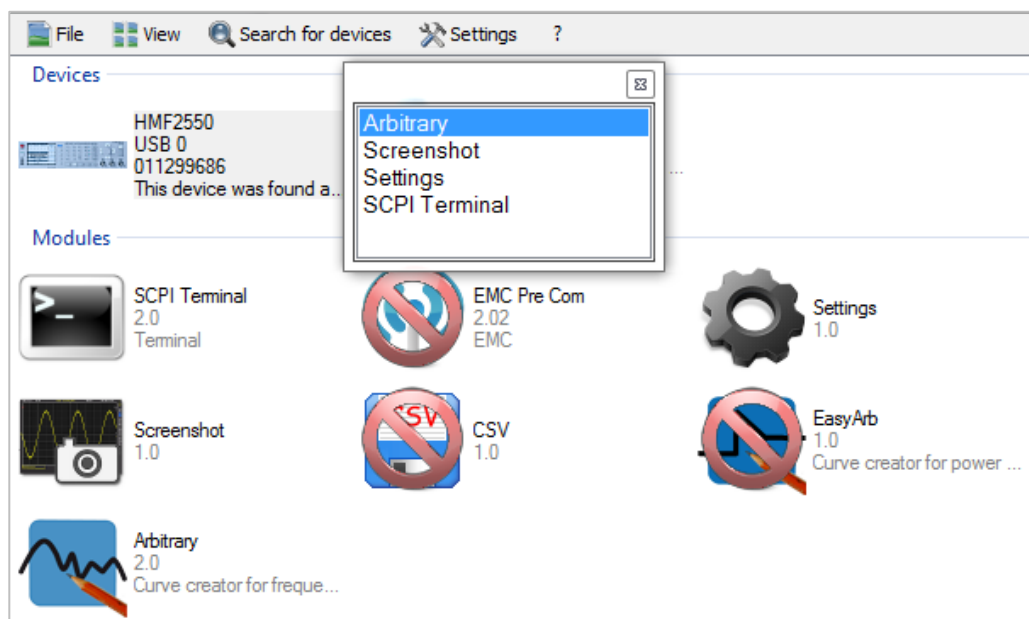
Double clicking the already integrated instrument opens a dialog box which shows the supported software modules. Double click the desired software module to start the module. It is also possible to start the software module via ENTER button if the module has previously marked by using the mouse (highlighted in blue).

3.2 Drag & Drop

After selecting the integrated instrument (highlighted in blue), unavailable software modules will be displayed as crossed out in red. Press and hold the left mouse button and drag and drop the instrument icon to the supported software module. This will start the module.
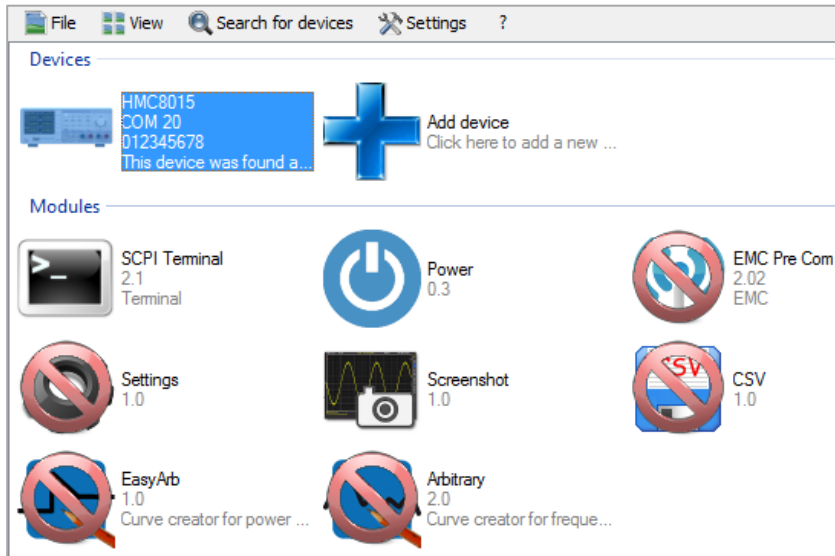
3.3 Selecting via Instrument Menu

Right clicking the already integrated instrument opens a dialog box with the option "Run with" to show the supported software modules. Click the respective software module to start the module.
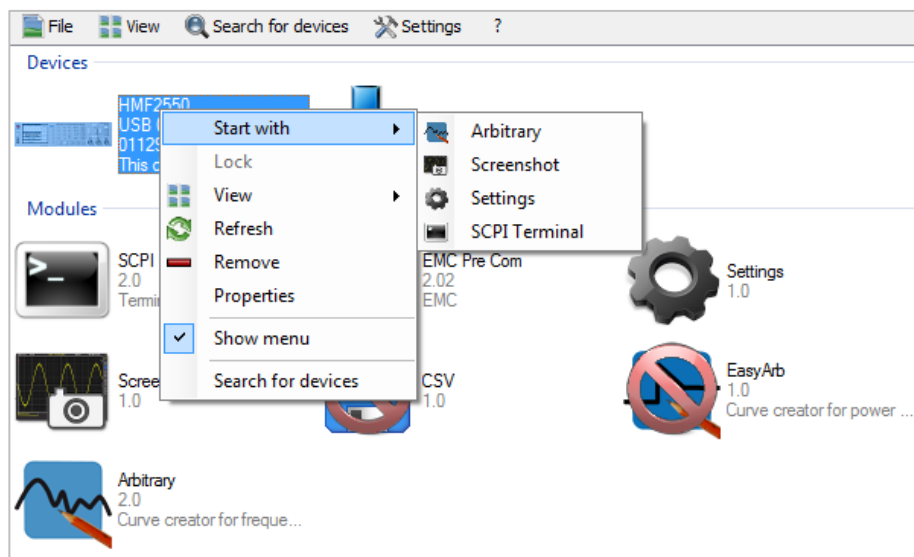
3.4 Selecting via Module Menu

After selecting a software module and right clicking the module, a dialog box opens. The option "Start with" allows you to select the integrated instrument. If you select the instrument via left mouse button, the software module opens.

If multiple measurement instruments are integrated with the HMExplorer software, you can only select one instrument to use with the respective software module. If you briefly hold the mouse cursor over the instrument type in the list (by selecting the option "Start with"), a small field with serial number and interface will appear. This enables you to distinguish the instruments or interfaces.
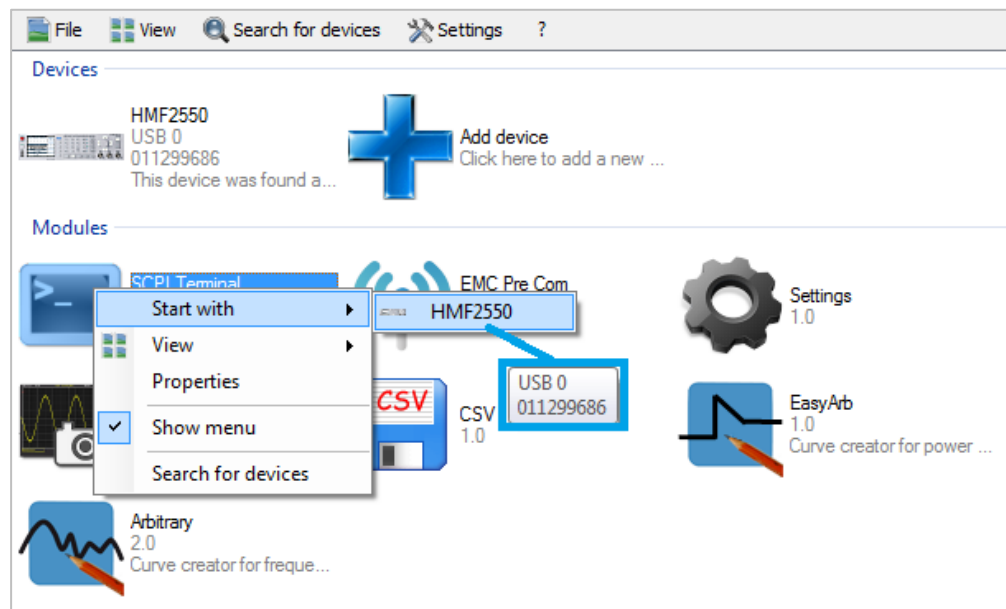
4 SCPI Terminal Program with Script Function

4.1 Overview

The Terminal menu is arranged as follows:

1. **File**

    a. <u>Close</u>: Closes the terminal function

2. **Terminal**

    a. <u>Save</u>: Saves all output of the terminal function

    b. <u>Save with options</u>: Saves only the filtered output of the terminal function

    c. <u>Clear</u>: Deletes all output of the terminal function

3. **Script**

    a. <u>New</u>: Creates new script

    b. <u>Open</u>: Opens / loads a previously created script

    c. <u>Save</u>: Saves script

    d. <u>Close</u>: Closes and exits script

4. **SCPI**

    a. <u>Autoselect SCPI</u>: If this function is activated (check box is selected), the appropriate SCPI remote command list is automatically opened for the connected / selected instrument if this is deposited in the terminal program.

    b. <u>Close</u>: Closes the displayed SCPI remote command list

    c. <u>Measuring instrument group</u>:

        i. <u>Measuring instrument</u>: Displays the SCPI remote command list for the selected measurement instrument

5. **Device**

    a. Selects and displays the measurement instrument which currently is connected with the HMExplorer software and supported by the Terminal software module

4.2 Terminal Menu
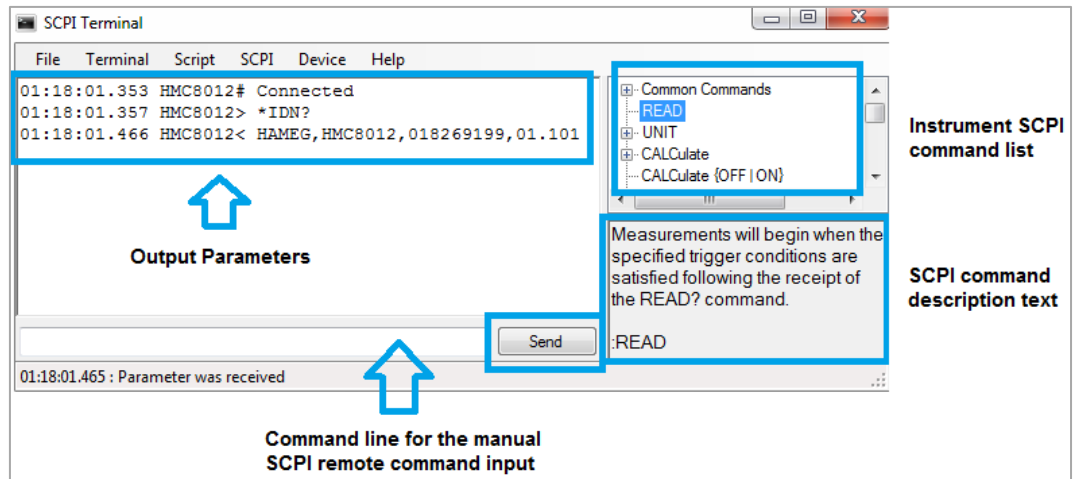
Send button:

The remote commands can be manually entered into the command line or inserted by double-clicking on the respective command in the SCPI command list. Use the Send button of the terminal program or the Enter button to transfer the remote command to the instrument.

Receiving commands:

Commands are automatically received. There are two different format types:

a) **ASCII** characters, separated by comma, without <"> at the beginning and end

Format: <parameter 1>,<parameter 2>,..,

Example: `Rohde&Schwarz,HMC8015,012345678,01.300`

b) **Binary data**

Format: #<N><Length><Data>

<N> = Number of digits in the field

<Length> = Data length

Example: Image transfer

Images are always transferred in binary format. The terminal program saves all binary data in a file and provides a link to access the screenshot. Depending on the instrument type, the image formats, such as GIF, PNG or BMP, will be recognized automatically.

Save with options:
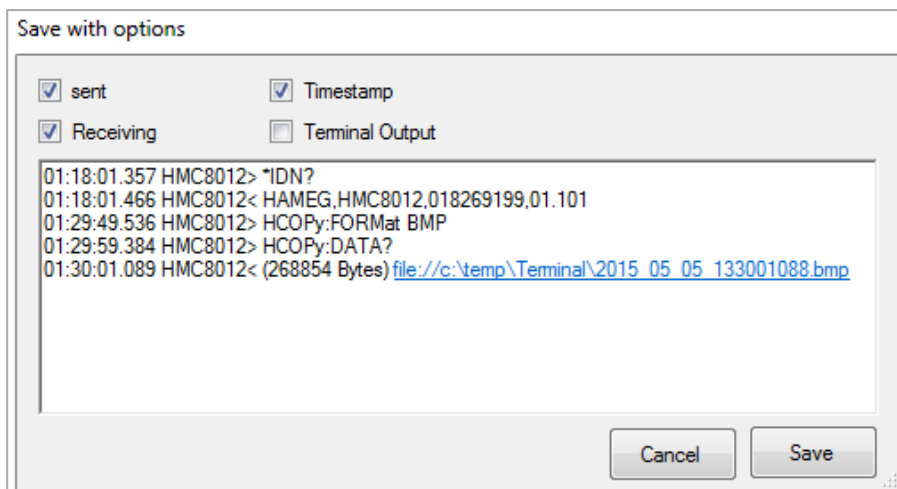
This function allows the output parameters to be filtered and saved. The following options can be activated or deactivated:
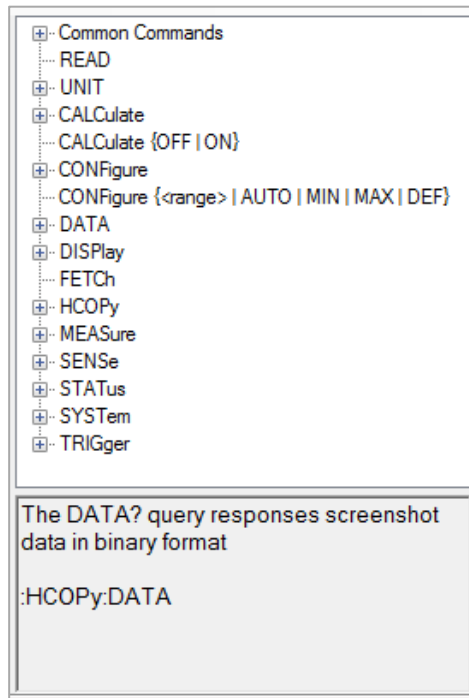
1. **Sent**: Saves the sent commands

2. **Receiving**: Saves the received output data

3. **Timestamp**: Indicates if the timestamp is to be included when saving

4. **Terminal Output**: Saves the terminal output (e.g. `HMC8012# Connected`)

Use the "Save" button to save the selected options in a .txt file.

4.3 SCPI Menu

After selecting the respective measurement instrument, the SCPI remote command list will automatically be opened for this instrument. All available SCPI remote commands will be listed in a tree structure in the upper display area.

The respective commands are briefly described in the lower display area. Double click on the respective command to copy it into the command line.

```
⊞·· Common Commands
 ··· READ
⊞·· UNIT
⊞·· CALCulate
 ··· CALCulate {OFF | ON}
⊞·· CONFigure
 ··· CONFigure {<range> | AUTO | MIN | MAX | DEF}
⊞·· DATA
⊞·· DISPlay
 ··· FETCh
⊞·· HCOPy
⊞·· MEASure
⊞·· SENSe
⊞·· STATus
⊞·· SYSTem
⊞·· TRIGger
```

```
The DATA? query responses screenshot
data in binary format

:HCOPy:DATA
```

4.4 Script Menu

The SCPI terminal program includes an internal script function. The following commands are supported:

a) **Loop**:

<n> = Number of repetitions

Format: Loop <n>

              End

b) **Wait**:

<t> = Time in milliseconds
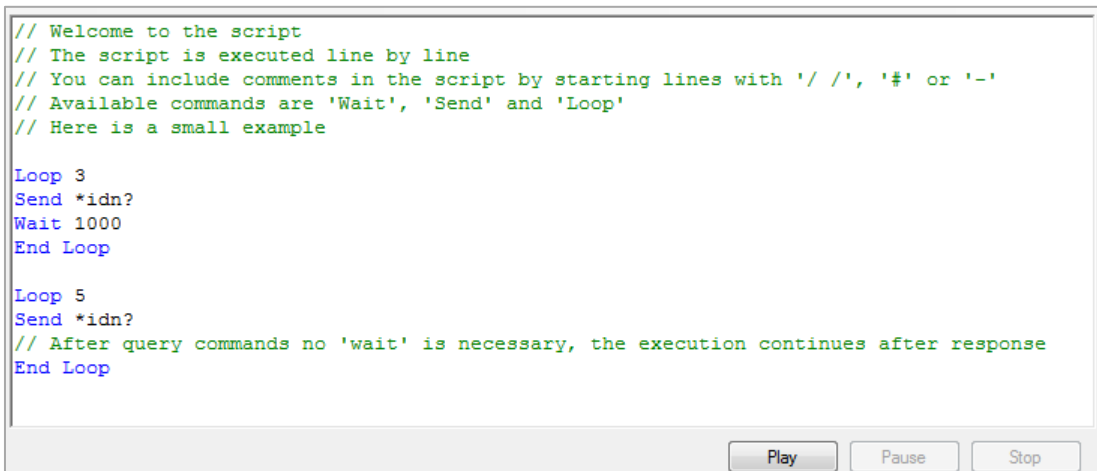
Format: Wait <t>

c) **Send**:

<s> = Command as ASCI string

 If the command ends with "?", the instrument will wait until a response is returned

Format: Send <s>

```
// Welcome to the script
// The script is executed line by line
// You can include comments in the script by starting lines with '/ /', '#' or '-'
// Available commands are 'Wait', 'Send' and 'Loop'
// Here is a small example

Loop 3
Send *idn?
Wait 1000
End Loop

Loop 5
Send *idn?
// After query commands no 'wait' is necessary, the execution continues after response
End Loop
```

                                                                     [Play] [Pause] [Stop]

Use the "Play" button to run the script. Use "Pause" to pause the script. Use "Stop" to stop the script.

Create script:

Use "Script" ➜ "New" to create a new script.

Open script:

Use "Script" ➜ "Open" to load / open a previously created script.

Save script:

Use "Script" ➜ "Save" to save the generated script.

5 EMC Precompliance Software

The use of a R&S®HMS spectrum analyzer and the EMC precompliance software allows you to perform EMC precompliance measurements. Precompliance measurements indicate that the measurement is based on a measurement standard but is not identical to it.

The R&S®HMS measuring instruments are able to deliver very precise measurement results. The measured values display an obvious tendency toward the measured value. However, the results are not as accurate as is required for a standard-compliant test result. Therefore, it continues to be necessary to verify a certified test laboratory as a standard-compliant measurement is only approved with the respective measurement receivers and measurement setups. Substantiated information regarding disturbances can occur exclusively within an adequate test environment (shielded measurement environment). The specifications for measurement time, increments, etc. as detailed in the respective EMC standards are entered manually during setup for every new measurement. A diagram is generated during the incremental measurement to record all individually results in a graph.

In conclusion, the following use of the EMC precompliance software is possible:

1.   Perform measurements based on **<u>but not</u>** identical to CISPR EMC standards

2.   Use user-defined limit lines / definition of user-defined measurement environment

3.   Generate test reports (plots for comparison)
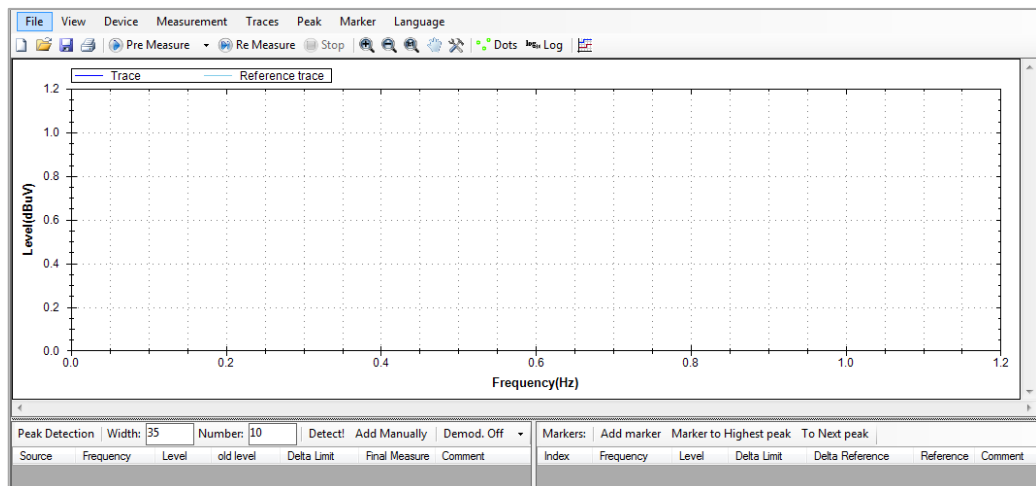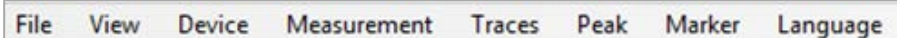
The EMC software can be used with the spectrum analyzers R&S®HMS10x0, R&S®HMS30x0 and the R&S®HMS-X (**only with installed option R&S®HMS-EMC or R&S®HV213 voucher**). The EMC software module supports the communication via the HO720 standard interface (USB/RS-232) or the optional HO732 Ethernet/USB interface.

The HO730 interface (Ethernet/USB) is not supported with the EMC Precompliance software.

5.1 Menu Bar

The EMC software menu is arranged as follows:

1. **File**:

    a. New measurement: Generates a new test set configuration (setup)

    b. Load: Loads a measurement, curve or reference curve

    c. Save: Saves a measurement, curve or reference curve

    d. Print: Prints a EMC precompliance report including settings

    e. Wizard: Wizard that automatically guides through all necessary measurement settings of the EMC software

    f. Demo Mode: EMC software demo mode if no R&S®HMS instrument is available

    g. Exit: Exits the module and closes the editing window

2. **View**:

    a. Peak detector / Marker: If the functions are activated (check box is selected), the peak and marker list will be shown below the measurement window

3. **Device**: Selects and displays the measurement instrument which currently is connected with the EMC software

4. **Measurement**:

   a. <u>New</u>: Generates a new test set configuration (setup)

   b. <u>Load</u>: Loads a measurement

   c. <u>Save</u>: Saves a measurement

   d. <u>Start Pre Measure</u>: Starts a pre-measurement with previously selected settings for the measuring position and the selected detector; a pre-measurement can also be started via "▷Pre Measure"

   e. <u>Start Final Measure</u>: Starts a re-measurement with QPEAK detector. After the pre-measurement, a re-measurement can also be started via "▷Re Measure".

   f. <u>Stop</u>: Stops a measurement

   g. <u>Restart</u>: Restarts a measurement

   h. <u>Setup</u>: Adjusts the test set configuration (setup)

   i. <u>Comment</u>: Inserts a comment which will be added to the test report

5. **Traces**:

   a. <u>Swap</u>: A saved reference curve in the background (light blue) can be interchanged for the current curve in the front (dark blue)

6. **Peak**:

   a. <u>Add</u>: Adds a peak, the frequency value is manually adjusted via peak list

   b. <u>Start peak search</u>: Starts a peak detection after a successful pre-measurement

   c. <u>Add to marker list</u>: Adds a selected peak to the marker list

   d. <u>Remove</u>: Removes a selected peak from the peak list

   e. <u>Remove all</u>: Removes all peaks from the peak list

   f. <u>Copy</u>: Copies peak

7. **Marker**:

   a. <u>Add</u>: Adds a marker; the frequency value is manually adjusted via marker list

   b. <u>To Highest</u>: Selects the highest marker value (marked in green)

   c. <u>To Next</u>: Selects the next higher marker value (marked in green)

d. <u>Add to peak list</u>: Adds a selected marker to the peak list

e. <u>Remove</u>: Removes selected marker from the marker list

f. <u>Remove all</u>: Removes all markers from the marker list

g. <u>Copy</u>: Copies marker

8. **Language**: Toggles the menu language (DE <> EN)
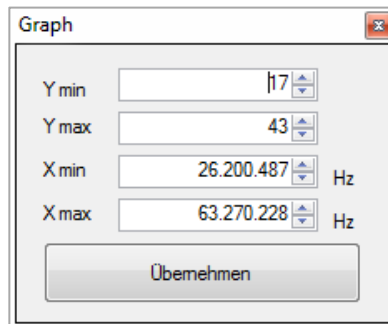
5.2 Toolbar (Quick Menu)
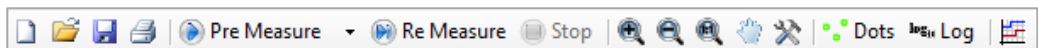
The EMC quick menu (toolbar) is arranged as follows:

1. **Create New Measurement**: Generates a new test set configuration (setup)

2. **Open measurement**: Loads a measurement (.mes file)

3. **Save current measurement**: Saves a measurement

4. **Print measurement results**: Prints EMC precompliance reports including settings

5. **Pre measure**: Selects a detector and starts the pre-measurement

6. **Re measure**: Starts a re-measurement with QPEAK detector

7. **Stop current measurement**

8. **Zoom in, zoom out, display complete curve**: Zooms into the signal, zooms out of the signal or fits the measurement curve in the display window. Additionally, you can use the scroll wheel to zoom in or out of the measurement window. Press and hold the left mouse button to enlarge a cutout of the measurement window.

9.   **Hand tools**: Toggles between magnifying and hand tools. If the hand tools are active, you can also press and hold the left mouse button to move the entire measurement curve within the measurement window.

10.   **Scaling**: Scales the level and frequency axis. The frequency axis can only be scaled in Hz (e.g. MHz is shown as 10^6Hz; the potencies are automatically adjusted).

Graph

Y min	17	
Y max	43	
X min	26.200.487	Hz
X max	63.270.228	Hz

Übernehmen

11.   **Interpolation**: Displays the measurement curve as dots (dots on) or as interpolated curve (dots off)

12.   **Logarithmic display:** Toggles between logarithmic (Log on) or linear (Log off) level or frequency display

13.   **CSV Editor**: Generates file to adjust to measurement position

5.3 Entering Values

Entering Frequency Values

The following options are available to enter frequencies within the software:

- Data in Hz (Hertz); e.g. 1000000Hz for 1MHz
- Data with SI – prefixes (e.g. 1MHz)
- Data in exponential notation (e.g. 1e6 or 1E6 Hz for 1MHz)

Adding the unit is optional.

Entering Time Values

The following options are available to enter time information:

- Data in s (second); e.g. 0.02s = 20ms
- Data with SI – prefixes (e.g. 20ms)
- Data in exponential notation (e.g. 2e-2s or 2E-2s = 20ms)

Adding the unit is optional.

5.4　Setup Window

Use the Setup window to enter the necessary measurement configurations that are required by the respective EMC standard.

In general, correction factors (transducer, amplifier, attenuators) can be subtracted or added by the EMC software automatically. Therefore, positive and negative values are possible depending on the value sign. If you fill in positive values, the correction factor will be subtracted (attenuation). If you fill in negative values, the correction factor will be added (gain).

Transducer
A transducer is an antenna (depending on the antenna factor unit), for instance. During an EMC measurement, the electrical field strength issued by the instrument to be tested is captured by an antenna. Depending on the field strength, the antenna generates an electrical

voltage. The voltage level is captured by the measurement receiver and transmitted to the EMC software. To calculate a field strength value from the voltage value, the EMC software requires a conversion factor assigned to the antenna (antenna factor / compensation value). This varies depending on the viewed frequency. Generally, a list of compensation factors for a frequency range is included with an antenna. These compensation values are saved to a file and are included in the test set configuration. The file name appears in the selection list "Transducer" once the file has been saved.

Amplifier / Attenuator

An antenna (antenna factor unit dB) or V-network (e.g. HM6050-2) is connected to the measurement receiver with a cable. Depending on the frequency, this cable has a certain attenuation. This attenuation is compensated to ensure a correct measurement. Similar to the process with a transducer, a file with compensation data is generated. The same applies to components that are installed between transducer and measurement receiver during a measurement. These compensation values are saved to a file and are included in the software. The file name appears in the selection list "Amplifier/Attenuator" once the file has been saved. If the respective file has been selected, use the option "Add" to insert it to the test set configuration. Double click the file to remove it from the list.
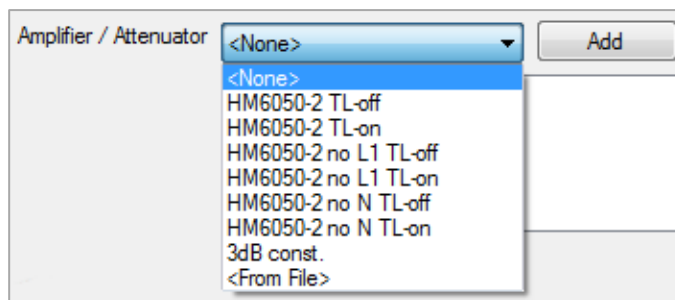
The following correction factors for the HM6050-2 are integrated in the software (please refer to the HM6050-2 data sheet „Insertion Loss"):

1. **HM6050-2 TL-off** = Transient Limiter disabled
2. **HM6050-2 TL-on** = Transient Limiter activated
3. **HM6050-2 no L1 TL-off** = N-Phase Measurement without Transient Limiter
4. **HM6050-2 no L1 TL-on** = N- Phase Measurement with Transient Limiter
5. **HM6050-2 no N TL-off** = L1- Phase Measurement without Transient Limiter
6. **HM6050-2 no N TL-on** = L1- Phase Measurement with Transient Limiter

Depending on the HM6050-2 setting you have to use the respective correction factor file.

Limits

Limit lines can be integrated into the EMC software. These limits will be displayed in the measurement signal window. For each peak or marker value, the distance (delta) to the limit will be displayed. You can select two limits which will both be displayed in the signal window. All the distance values (deltas) that are displayed in the user interface always refer to the limit 1. Limits are selected in the same manner as the transducer.

Measurement Setup

The following settings can be selected in the menu "Measurement Setup":

1. **Start frequency**: The lowest frequency in the spectrum to be measured

2. **Stop frequency**: The highest frequency in the spectrum to be measured

3. **Stepsize**: Size of the frequency intervals during the measurement

4. **Meas. Time**: Duration of how long the measurement receiver pauses at a frequency during the pre-measurement to capture level peaks. The measurement time is not identical to the software transfer time between measurement instrument and PC.

5. **Reference Level**: The highest expected level that is applied to the receiver

6. **Resolution bandwidth**: Selects the RBW filter for pre and re measurement

7. **Preamplifier**: Activates (On) / deactivates (Off) preamplifier

5.5 File Formats for Test Set Configuration

The EMC software enables you to load files to configure the test set and to integrate limits. Frequency spectrums can be loaded and saved in CSV format. You can use the internal file editor or Microsoft Excel to generate transducer or limit files.
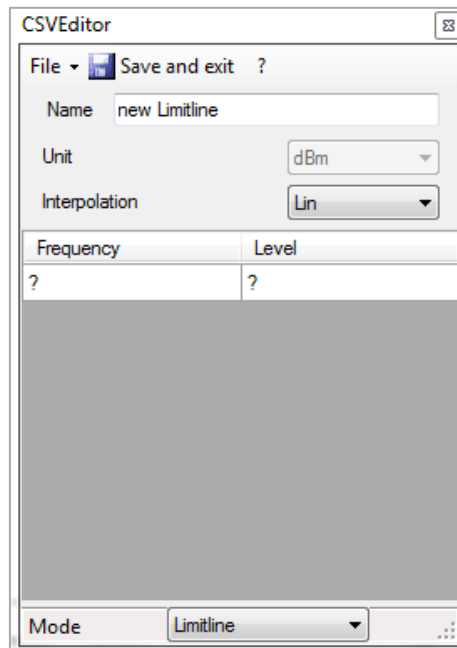
CSV Editor

Use the [icon] icon in the menu bar to open the CSV Editor. When using the internal CSV Editor, you enter the frequency and level values manually. These values are specified by an EMC standard which determines how the measurement is to be performed. Under "Transducer", select the frequency response for the used transducer. This includes a professional EMC antenna, for instance. Professional EMC antennae include so-called compensation values which can be transferred manually to the CSV Editor.

Under "Amplifier / Attenuator", a so-called "Compensation Table" is created that is required for the HM6050-2 V-network, for instance (display of the compensation values in the certificate in dB). The compensation values can either be manually entered to the CSV Editor or loaded as a completed file via software.

Use "File" ➔ "Open" to load a Loss/Gain, transducer or limit line file that was previously created in Excel.

If a foreground curve is loaded, the software applies all frequencies that already exist in the file as points to be measured. This means that a CSV file (e.g. from a previous measurement) can be loaded, and the included frequency range can then be re-measured in the current configuration. The parameters Start frequency, Stop frequency and step size are determined from the CSV file and will be applied to the measurement. If a background curve is loaded, it will be shown as background curve (whether or not the included frequency range corresponds to the current measurement).

Creating a File with Microsoft Excel

For instance, to integrate the antenna factor of an antenna with the software, a file with the respective file ending is generated and saved as "...\My Files\ Rohde-Schwarz\ HMExplorer \HM PreCom EMC\Datasets" (the location may vary depending on the Windows version). All files in this folder are loaded when a new measurement is created, and you can select them during the measurement configuration (setup).

Please note the following when you create transducer or limit files with Microsoft Excel:

- When creating parameter names (Name, Unit, ...), it does not distinguish between upper and lower case letters
- Frequency values can be displayed in detail (1 MHz = 1000000 Hz) or as exponentials (1 MHz = 1e6 Hz)
- Values (frequency, level) will be displayed without unit in general
- For values, the separator is the semicolon ';'
- For level values, the separator is the point '.'
- Is is recommended to complete all files with a row including the word "end"
- The sequence of the rows may not be changed
- The frequency must be listed in ascending order
- You may not use empty characters up to the end of the file

The following file formats are used within the software to align the test set and to integrate limits:

Transducer Files (file extension .htrs)

The file content is defined as follows:

Row 1: Name = <Transducer name>

Row 2: Unit = <unit to be used to issue the measurement results>

Row 3: <frequency>;<level>

…

Row N: <frequency>;<level>

Row N+1: end

The parameter "Unit" determines which unit is to be used to issue the measurement results. This parameter also determines which unit is used for the measurement receiver. If you select "dBm", the receiver will measure in dBm. If you select "dBuV", the receiver will measure in in dBμV.

Example of a transducer file

Name=Transducer_dBuA_Lin_sample

Unit=dBm

Interpolation=lin

100000;50.5

300000;60.3

1000000;70.2

end

Format	Description
Name=Transducer_dBuA_Lin_sample	Transducer name
Unit=dBm	Unit used to display the measurement results; this unit does not impact the conversion
Interpolation=lin	Interpolation type; "lin" for linear or "log" for logarithmic
100000;50.5	Parameter
300000;60.3	…
1000000;70.2	…
end	File end

Amplifier / Attenuator Files (file extension .hlga)

The file content is defined as follows:

Row 1: Name = <element name>

Row 2: <frequency>;<level>

…

Row N: <frequency>;<level>

Row N+1: end

Example of an amplifier /attenuator file

Name=LossGain_sample

100000;50.3

200000;50.3

200000;20.3

1000000;20.3

end

Format	Description
Name=LossGain_sample	Amplifier / attenuator name
100000;50.3	Frequency; only integral and associated values
200000;50.3	…
200000;20.3	…
1000000;20.3	…
end	File end

The interpolation for the amplifier / attenuator is always linear. Therefore, it is not required to indicate the interpolation in this context.

An amplification or attenuation can be indicated as negative or positive. Generally, the attenuation is indicated in the data sheet for antennae. Therefore, the EMC software interprets the values as attenuation and subtracts these. In the case of an amplifier, the values are also indicated as attenuation but with a negative sign (negative attenuation = amplification).

Limit Files (file extension .hlim)

The file content is defined as follows:

Row 1: Name = <element name>

Row 2: Interpolation = <interpolation type>

Row 3: <frequency>;<level>

…

Row N: <frequency>;<level>

Row N+1: end

Example of a limit file

Name=Limitline_log_sample

Interpolation=log

100000;20.2

500000;20.2

500000;50.5

1000000;60.5

1000000;30.3

10000000;10.3

end

| Format	Description
Name=Limitline_log_sample	Limit name
Interpolation=log	Interpolation type; "lin" for linear or "log" for logarithmic
100000;20.2	Frequency; only integral and associated values
500000;20.2	…
500000;50.5	…
1000000;60.5	…
1000000;30.3	…
10000000;10.3	…
end	File end

5.6 Correction Values HZ530 / HZ540 / HZ550

The probe sets HZ530, HZ540 and HZ550 are only suitable for relative measurements. In other words, a measurement is performed, change is made to the test sample and then a measurement is performed again. The impact of the change is now directly apparent within the measurement result. This does not require the frequency response nor a correction factor or a similar object. This also explains why no file with correction values is available.

There are some cases where a relative measurement does not meet the requirements. For these cases, premium manufacturers offer probes for compliance measurements. The offer for these probes includes correction factors and frequency response curves. The probes are able to simulate the results of an EMC test laboratory, provided that a corresponding measurement environment is available.

5.7 Measurement Configuration Using Software Wizard
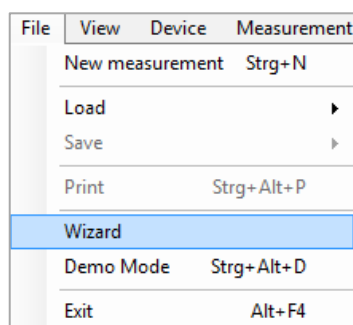

Use "File" ➔ "Wizard" to start the internal software wizard which guides you through all required steps of the measurement setup. You can either select the settings for amplifier/attenuator, transducer and limit lines from the list or use the option "New" to enter them with the CSV Editor. The measurement settings are entered manually.
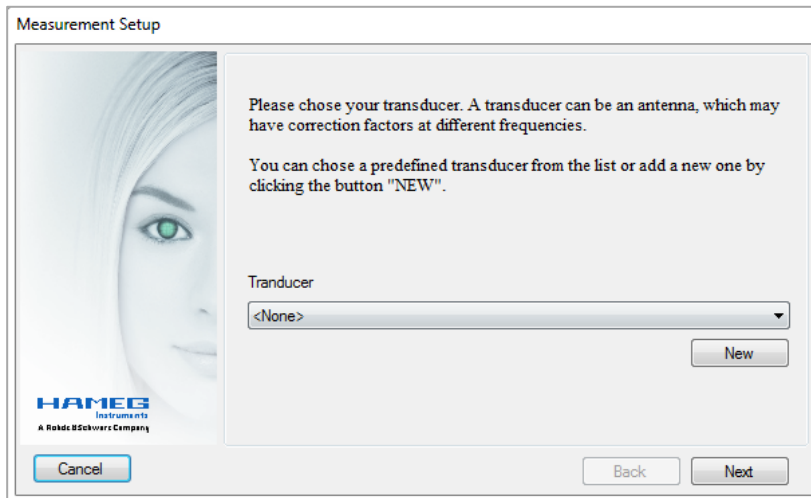
5.8 Performing a Measurement

Step 1: Creating a new measurement
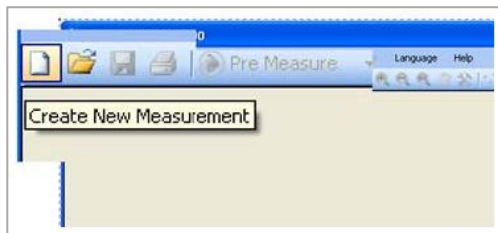
Use "Create new measurement", Wizard ("File" ➔ "Wizard" or "File" ➔ "New measurement" to create a new test set configuration. This opens the Setup window where you can select all necessary settings. Settings for transducer, amplifier/attenuator and limit lines are defined in advance based on the previously described procedure.

Click "Ok" to confirm the configurations and to close the Setup window.
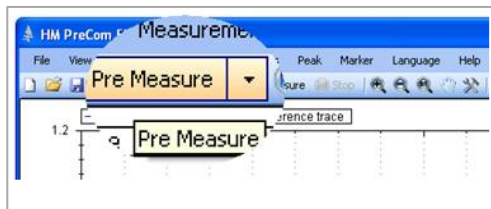
Step 2: Performing a pre-measurement

Use " ▷Pre measure" or "Measurement" ➔ "Start pre measure" to start the pre-measurement. The pre-measurement determines the level values in the selected frequency band. The measurement receiver measures the peak values of the amplitudes.

Use the arrow on the function button "▷Pre measure" to select the desired detector. The following detectors are available:
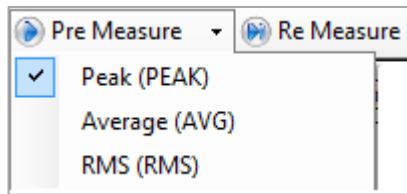
PEAK: The peak value detector shows the highest level during the selected measurement time

AVG: The mean value detector (Average) shows the linear average of the measurement signal within the selected measurement time

RMS: The RMS detector generates the effective value of the measurement signal within the selected measurement time

To start the pre-measurement, click on the function button "▷Pre measure" or "Measurement" ➔ "Start pre-measure". the R&S®HMS instrument automatically switches to the receiver mode. Step by step, the software determines the individual amplitudes (or field strength values) in the selected frequency range.

These will be shown as a graph in the measurement window. The results are displayed in realtime so that the measurement can be tracked at any time in the software or directly at the R&S®HMS instrument. The status and the remaining duration of the measurement are displayed at the bottom of the measurement window. The selected measurement time corresponds to the duration of how long the measurement receiver pauses at a frequency during the pre-measurement to capture level peaks. The measurement time is not identical to the transfer time between measurement instrument and PC. Therefore, a pre-measurement may take a considerable amount of time, depending on the selected measurement settings.
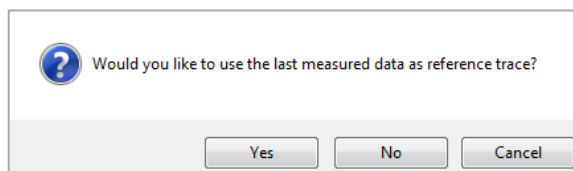
After performing a pre-measurement with a desired detector, you can perform an additional pre-measurement with another detector (if required). You can include the previous measurement as reference curve.

To use the previous measurement as reference, confirm the message by clicking "Yes". The previous measurement curve (e.g with PEAK) will not be deleted and is moved to the background (light blue). The current measurement curve (e.g AVG) is displayed in the foreground (dark blue).
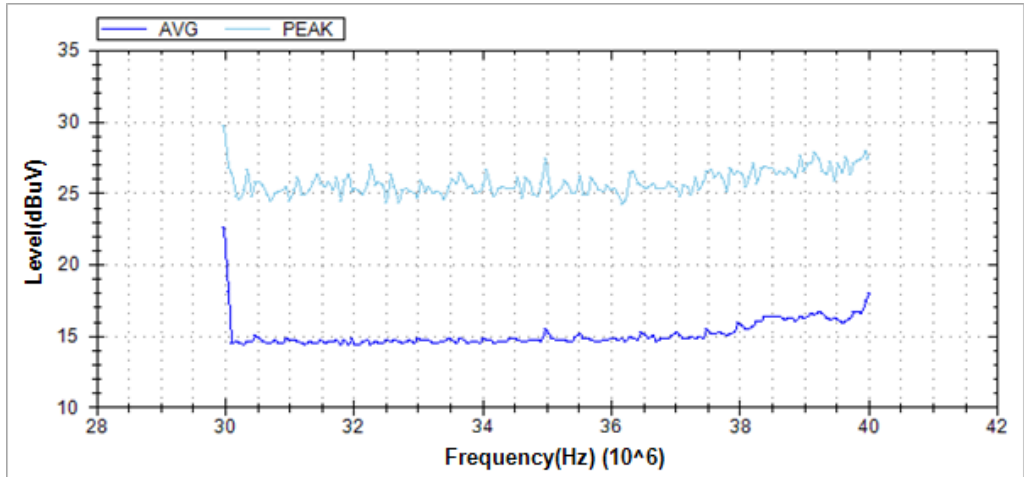
Step 3: Detecting the peak value

After successfully completing the pre-measurement, you can begin with the peak value detection. The peak value detection enables you to detect critical peak values in the frequency spectrum to perform a measurement following the guidelines of the EMC norm at a later point at exactly these positions (re-measurement). Frequencies that lead to high amplitudes during the pre-measurement are quickly identified. A black triangle icon represents each entry.
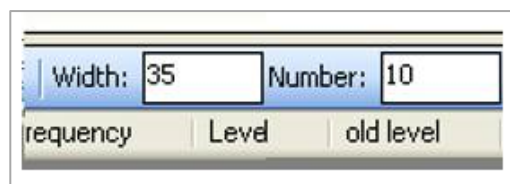
You can determine the values for "Width" and "Number" of the peak value detection in the lower left of the measurement window ("peak detector") . "Number" indicates the amount of the peaks to be detected and "Width" indicates the sensitivity of the peak detector. "Width" always refers to the peak and indicates the number of measurement values that are not included to the left and the right of the peak (points in the measurement window). A high value is more likely to detect broadband interferences in the frequency band where a low value is more likely to detect narrowband interferences.

Example applied to the frequency range:

For instance, if the increment is 60kHz and the width is set to 10 points, the increment equals 10*60kHz = ± 600kHz. Consequently, the peak value detection is performed in 600kHz increments (to the left and right of the peak).

Once you have selected these parameters, click on "Detect!" or select the menu "Peak" ➔ "Start peak search" to start the peak value detection. The peak value detection refers only to the most recently measured curve, not the reference curve. The detected peak values are displayed in the lower left of the measurement window. Additionally, the peak values will be marked on the graph. The peak value detection can be performed multiple times with different settings for "Width" and/or "Number" until the desired peak values were detected.
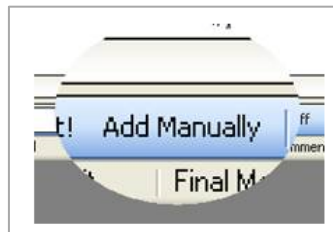
If you wish to include a frequency in the re-measurement that was not detected in the peak value detection, you can click on "Add Manually" to generate an entry in the list. In this case, the value is entered manually. The entry is shown in the peak list with the comment "Manual". Therefore, any number of locations in the spectrum can be marked and measured.
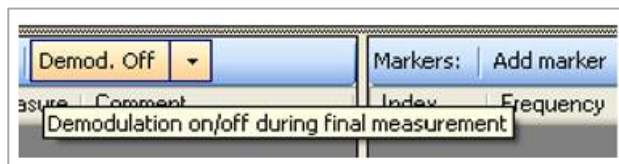
In addition, it is possible to activate the demodulator during the re-measurement for each frequency of the measurement receiver for a specific amount of time

("Duration"). The demodulation allows you to determine if the interference in the frequency band is caused by an external interference (e.g. radio station). If the demodulation is activated (On) and you can hear the signal of a radio station during the re-measurement, it is safe to assume that the interference for the respective frequency is not caused by the tested instrument. You can select the settings for the "demodulation" via arrow buttons and demodulation function button. You can adjust the modulation type (FM/AM), duration and volume of the signal.

The function "Source" describes the entry origin. The following entries are possible:

- **Peak Detector**: The entry is determined by means of peak detection after the re-measurement. If you perform an additional peak detection, the peak detector entries will be deleted and recalculated.
- **Re measure**: The level was determined during the re-measurement by means of quasi peak detector.
- **Manual**: The entry was added manually.

Peak Detection	Width: 35		Number: 10		Detect! Add Manually	Demod. Off ▾
Source	Frequency	Level	old level	Delta Limit	Final Measure	Comment
Finalmeasure	49,68 MHz	22.40 dBuV	28.26 dBuV	No Limit	☑	
Finalmeasure	36,48 MHz	22.37 dBuV	27.90 dBuV	No Limit	☑	
Finalmeasure	43,38 MHz	22.39 dBuV	27.84 dBuV	No Limit	☑	
Finalmeasure	41,22 MHz	22.35 dBuV	27.61 dBuV	No Limit	☑	
Finalmeasure	39,00 MHz	22.36 dBuV	27.59 dBuV	No Limit	☑	

The frequency value can be adjusted for manually inserted peak values. Depending on the entry origin, the level values will be determined in different ways:

- **Peak Detector**: The level corresponds to the level of the current foreground curve (at the corresponding location).
- **Re measure**: The level was determined during the re-measurement by means of quasi peak detector.
- **Manual**: The level here also corresponds to the foreground curve.

The function "Delta Limit" shows the distance of the detected level to the selected limit. A negative value indicates that the level is below the limit. If the level is above the limit, the value is positive and will be displayed in a red font.

If the check box has been selected for "Re measure", this entry will be included in the re-measurement.

You can use right click ➔ "Remove" or the Peak menu to delete a selected peak value from the list. Use right click ➔ "Remove all" or the Peak menu to remove all marker values from the marker list. Use right click ➔ "Add to marker list" or the Peak menu to copy the selected peak value to the marker list.

Step 4: Setting markers

In addition to the peak value detection, you can also select additional markers. You can insert any number of marker values by double-clicking the measurement curve or by clicking "Add marker". For each entry in the marker list, an identifier with a corresponding number is added to the signal section. Use the function "Marker to Highest peak" to set the selected marker to the highest amplitude value, or use the function "To Next peak" to set the selected marker to the nearest smaller amplitude value.

Markers:	Add marker	Marker to Highest peak	To Next peak		
Index	Frequency	Level	Delta Limit	Delta Reference	Reference
1	49,6800 MHz	28.26 dBuV	No Limit	0.00 dBuV	☑
2	30,0000 MHz	25.31 dBuV	No Limit	-2.95 dBuV	☐

"Index" describes the consecutive numbering of the markers. The value in this column is highlighted in color for identification in the signal section.

The frequency value can be adjusted manually in the marker list. The level difference between the markers can be determined in the marker list ("Delta Reference"). "Delta Reference" describes the level difference to the customized reference marker (here: Marker 1) which is highlighted in green. Additional markers are highlighted in red. In case of multiple marker values, use the menu item "Reference" to set the reference marker. If the check box for "Reference" is selected, the selected marker value is set as reference marker and is highlighted in green in the measurement window.
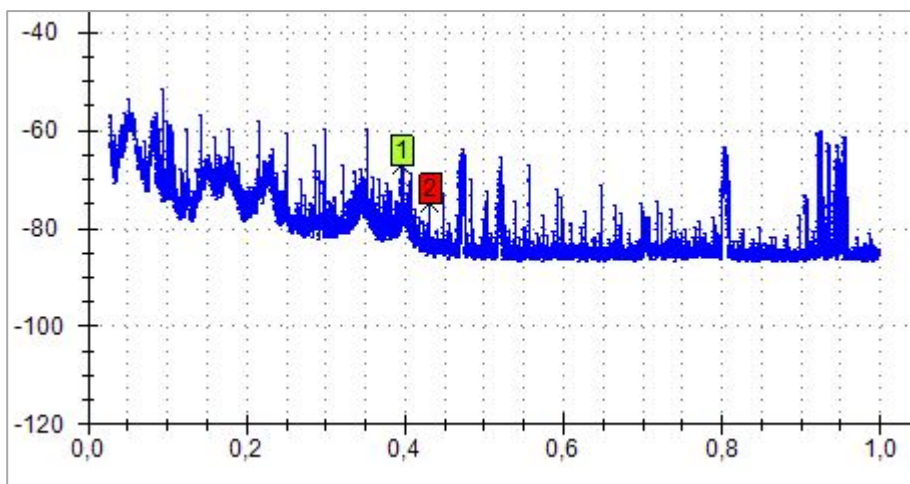
The "Delta Limit" is the distance of the level (at the corresponding location in the spectrum) to the set limit. A negative value indicates that the level is below the limit. Is the level above the limit, the value is positive and will be displayed in a red font.

You can use right click ➔ "Remove marker" or the Marker menu to delete a selected marker value from the list. Use right click ➔ "Remove all" or the Marker menu to remove all marker values from the marker list.. Use right click ➔ "Add to peak list" or the Marker menu to copy the selected marker to the peak list.

Step 5: Performing re-measurement

In a re-measurement, a second measurement is performed for each frequency with an entry in the peak list. This measurement is performed with a special standardized evaluation process (quasi peak). The re-measurement is always performed with the quasi peak detector and cannot be adjusted. The results of this measurement are relevant for the adherence to the EMC standards.

Start the re-measurement via " ▷ Re Measure" button on the top tool bar or via "Measurement" --> "Start Final Measure". During the re-measurement, the peak list entries are overwritten by the results of the re-measurement and the highlights in the graph are moved. The entries show the final level. The current status of the re-measurement is indicated by the blue peak highlights. Depending on which peak value is currently re-measured, the entry in the peak list will be highlighted in blue.

Peak Detection	Width: 35		Number: 10		Detect! Add Manually	Demod. Off ▾	
Source	Frequency	Level	old level	Delta Limit	Final Measure	Comment	
Finalmeasure	49,68 MHz	22.40 dBuV	28.26 dBuV	No Limit	☑		
Finalmeasure	36,48 MHz	22.37 dBuV	27.90 dBuV	No Limit	☑		
Peakdetector	49,68 MHz	28.26 dBuV	28.26 dBuV	No Limit	☑		
Peakdetector	36,48 MHz	27.90 dBuV	27.90 dBuV	No Limit	☑		

You can use right click ➔ "Remove marker" or the Marker menu to delete a selected marker value from the list. Use right click ➔ "Remove all" or the Marker menu to remove all marker values from the marker list.. Use right click ➔ "Add to peak list" or the Marker menu to copy the selected marker to the peak list.
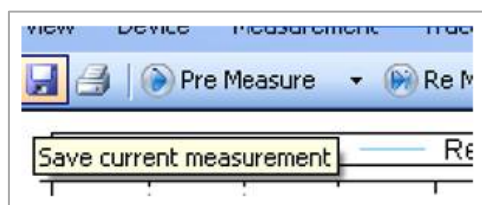
Step 6: Saving and printing measurement results
Once the measurement has successfully completed, the measurement results can be saved and printed. Use the 💾 button or the menu "Measurement" ➔ "Save" to save the EMC measurement results as a .mes file. You can manually select the location and the file name. By default, the software automatically saves the results in the HMExplorer default folder.

You can also use the menu option "File" ➔ "Save" ➔ "Measurement" to save the measurement results as a .mes file. In addition, it is possible to save the curve data (dark blue curve) or the curve data of the reference curve (light blue curve) as a CSV file.
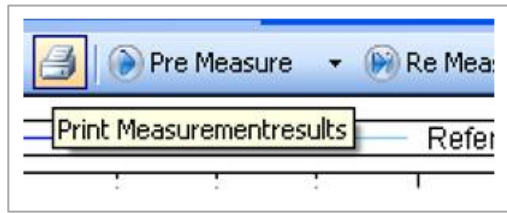
Use the 🖨 button or the menu item "File" ➔ "Print" to print the measurement results as an EMC report or to save as a PDF file (pdf Creator).

EMV Pre Compliance Report
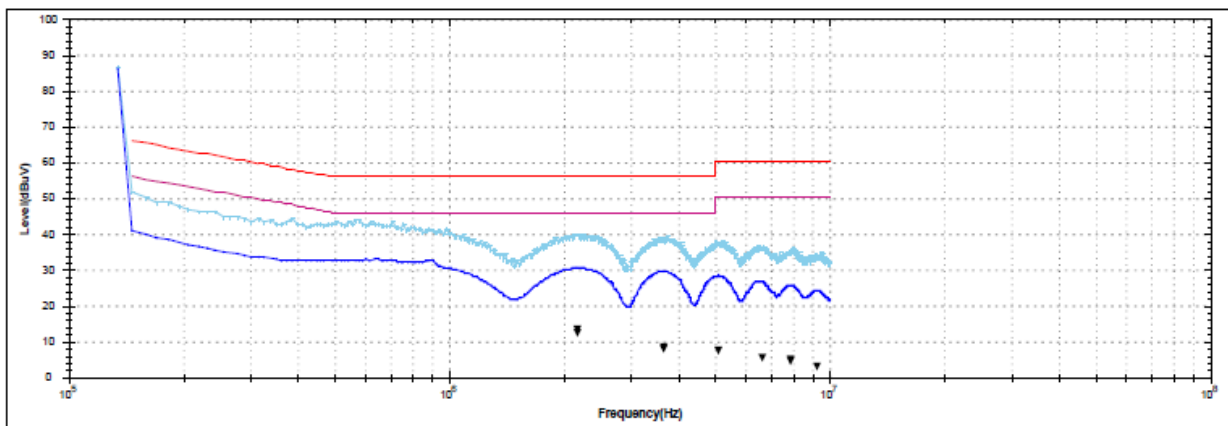
Device		Measurement Settings	
Vendor	HAMEG	Tranducer	
Device	HMS3010	Amplifier/Attenuator	
SW		Limit 1:	EN 55022 Klasse B Stromvers. QPEAK
HW	20000000	Limit 2:	EN 55022 Klasse B Stromvers. AVG
SN		Startfrequency	135,00 kHz
		Stopfrequency	10,00 MHz
Time		Stepsize	12,00 kHz
		Meas. Time	0,1s
		Reference Level	0dB
File		Resolution Bandwidth	30,00 kHz
		Preamplifier	False

| Frequency	Level	old level	Fin...	Delta Limit	Comment
2,17 MHz	12,26 dBuV	30,49 dBuV	*	-43,74 dBuV	
3,67 MHz	7,89 dBuV	29,56 dBuV	*	-48,11 dBuV	
5,11 MHz	7,66 dBuV	28,34 dBuV	*	-52,34 dBuV	
6,62 MHz	5,60 dBuV	26,82 dBuV	*	-54,40 dBuV	

5.9 Error Message

If an error message displays during the EMC measurement, an error file will be saved in the Hameg Instruments folder on the PC (Global Settings). This file contains all the important information about the error that occurred.
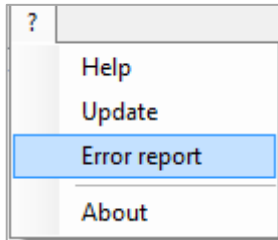
Use the main module window in the HMExplorer software to access the saved error files via "?" ➜ "Error report". All HMExplorer software error occurrences will be listed in this browser. Use right click ➜ "Open Folder" to open the folder containing all error files and to select the respective file. You can email this .hmex file to the technical support at Rohde & Schwarz (**customersupport@rohde-schwarz.com**) to find a solution to the problem.

Use right click ➜ "Send" to automatically send the selected error file and to allow the technical support to edit the file as necessary.
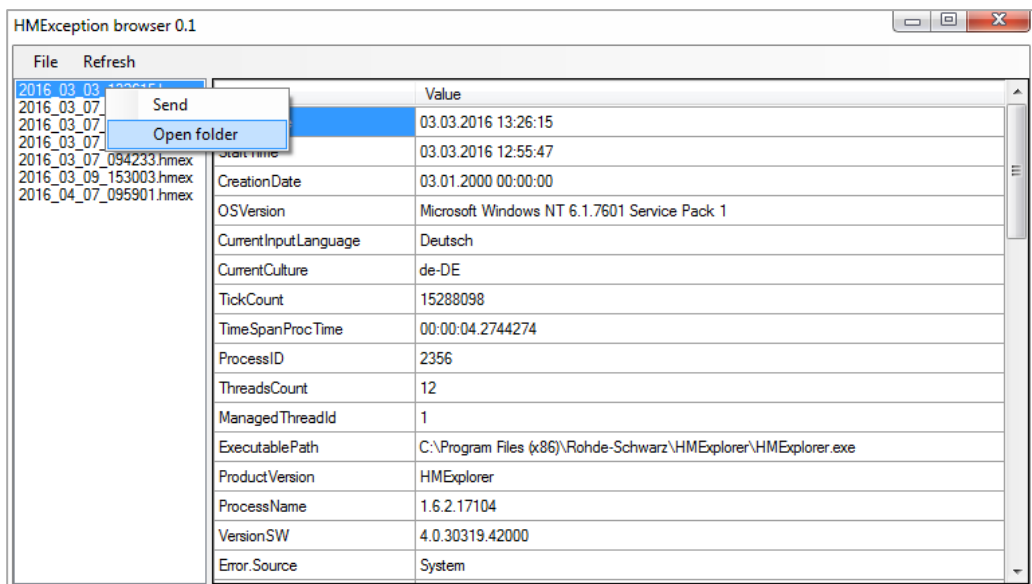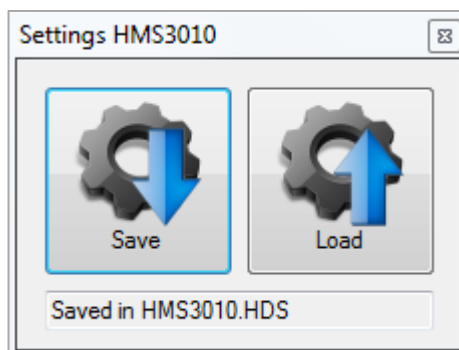
6 Software for Storing Instrument Settings

The settings software module can be used with the following measurement instruments:

- **R&S®HMS10x0…30x0**

- **R&S®HMS-X**

- **R&S®HMO Series**

- **R&S®HMF Series**

6.1 Saving Instrument Settings

The function "Save" allows you to transfer and store measurement instrument settings to a PC.

Click the "Save" button to open a dialog box which allows you to select the respective location (folder) and a file name. Click the "Save" button again to save the selected settings. If the instrument settings have been successfully saved on the PC, this will be displayed in the module window.

6.2 Loading Instrument Settings
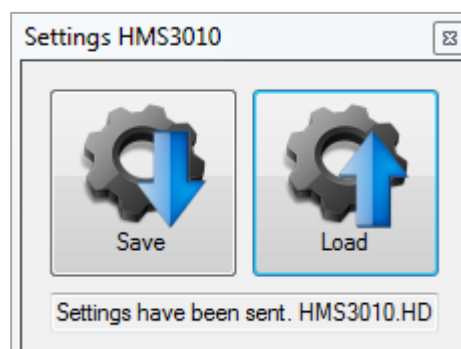
The function "Load" allows you to load instrument settings from a PC back into the measurement instrument. Click the "Load" button to open a dialog box which allows you to select the respective settings file. Click the "Open" button to transfer the instrument settings. If the instrument settings have been successfully loaded and transferred to the measurement instrument, this will be displayed in the module window.

However, it will not be verified if the settings were transferred correctly or if they were accepted correctly by the measurement instrument.

7 Software To Create Screenshots

The screenshot software module can be used with the following measurement instruments:

- **R&S®HMS10x0…30x0**
- **R&S®HMS-X**
- **R&S®HMO Series**
- **R&S®HMF Series**
- **R&S®HMP Series**
- **R&S®HMC8012**
- **R&S®HMC8015**
- **R&S®HMC804x**
- **R&S®HMO1002 / 1202**

Depending on the instrument type, the following image formats are supported:

- **BMP**
- **GIF**
- **PNG**

Depending on the image format, different transfer times can be expected. To keep these times to a minimum, it is recommended (if supported) to select the transfer in GIF or PNG format.

7.1 Operation

The screenshot module includes an image browser and a screenshot function window. The image browser enables the navigation between already transferred (existing) images. Right-clicking on an already transferred screenshot opens a dialog box with various function options. The following functions for the navigation and file administration are available:

1. **Copy as image (Ctrl+C)**: Copies screenshot as image object to the clipboard
2. **Copy as file (Ctrl+F)**: Copies screenshot as file to the clipboard
3. **Delete (Del)**: Deletes the selected file
4. **Rename (F2)**: Changes the file name
5. **View**: Displays the screenshot in the browser as small or large thumbnails

All functions are accessible via shortcut menu or hotbuttons.
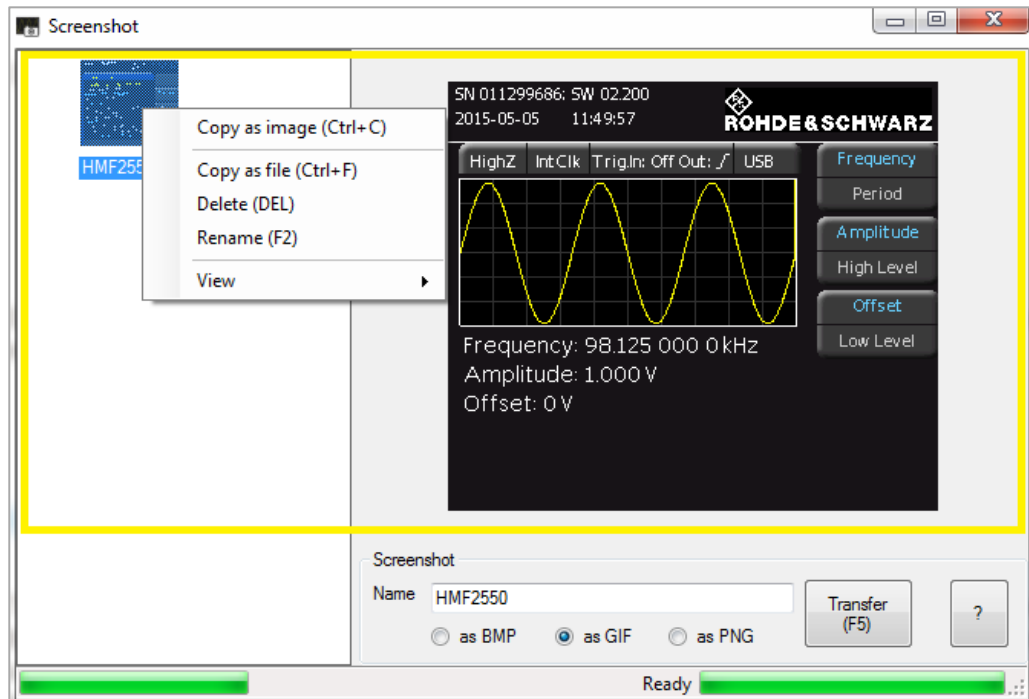
Use the screenshot function window in the bottom section of the software module and the function "Transfer (F5)" to transfer screenshots from a connected measurement instrument to the software. The current status of the screenshot transfer will be displayed as a progress bar. The screenshot will automatically be displayed in the image browser and will be saved simultaneously in the HMExplorer default folder for screenshots on the PC. Prior to starting the screenshot transfer, you can enter a file name ("Name").
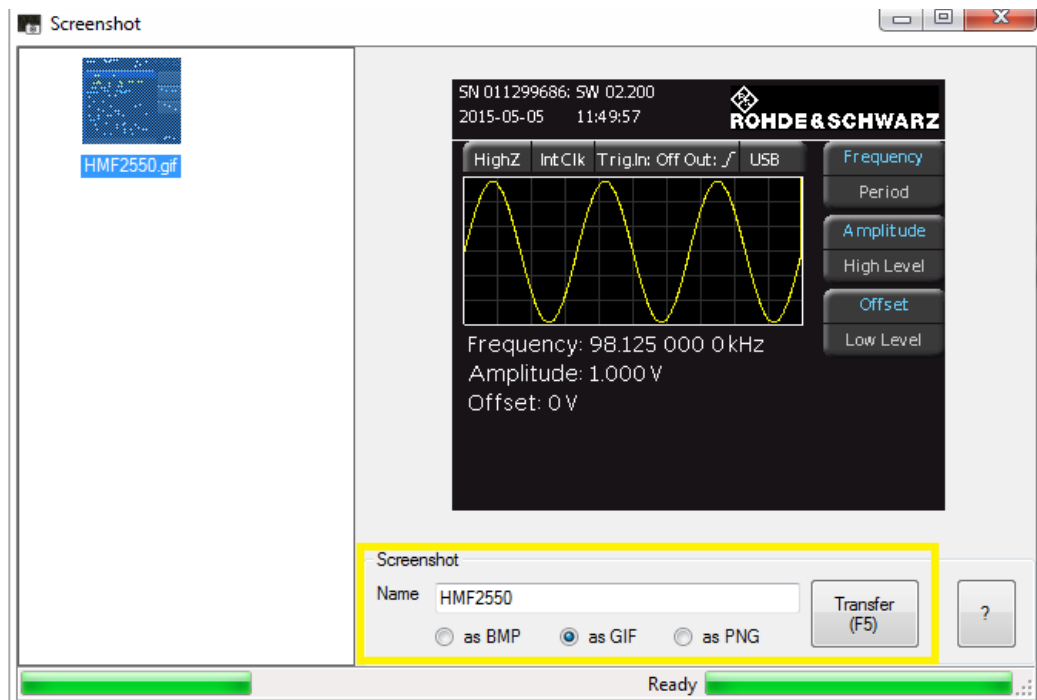
If a screenshot file with the identical name already exists, it will not automatically be overwritten as the date and current time will always be added to the file name.

File Path Settings:
Settings for the file path can be adjusted in the main window of the HMExplorer software at "Settings" ➔ "Directory". Otherwise, the screenshots will automatically be saved to the default folder.

Shortcut buttons:

| Shortcut buttons	Description
F5	Transfers screenshot to the computer
F2	Renames the file
Del	Deletes the files
Ctrl+C	Copies the file as an image to the clipboard
Ctrl+F	Copies the file to the clipboard

8 CSV Software

The CSV software module can be used with the following measurement instruments:

- **R&S®HMO Compact Series**

- **R&S®HMO3000 Series**

- **R&S®HMC8012**

- **R&S®HMC804x**

- **R&S®HMO1002 / 1202**

8.1 Operating R&S®HMO Oscilloscopes

The CSV module includes a display window with buttons which allow you to select the respective channels and the source of the file storage. As source, the display data ("Display") or the entire memory ("Full Memory") can be read and saved in a CSV file on the PC. It is possible to select multiple channels when reading the data. It is also possible to read the digital channels (POD1). If POD1 is activated on the instrument, CH3 (channel 3) will be replaced by the digital channels.
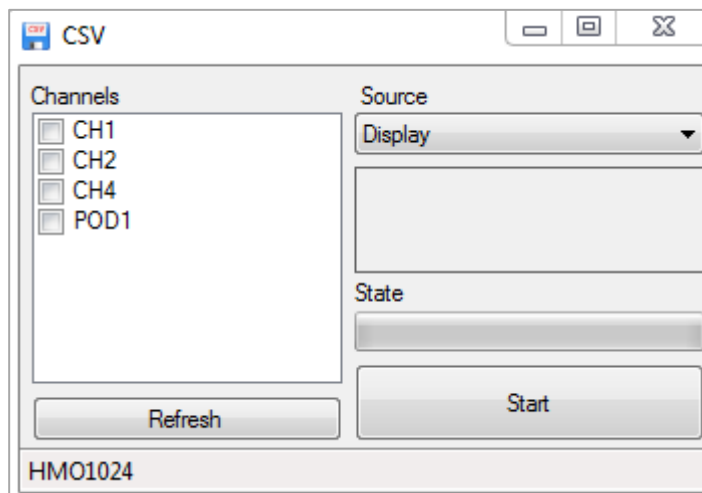
8.2 Reading and Saving R&S®HMO Waveform Data

Select the respective channels (checkbox is selected) to read and save the waveform data. Depending on the instrument type, the waveform data for up to 4 channels (or analog channel + POD) can be read and saved simultaneously. Select the channels and source, then click the "Start" button to open a dialog window. This dialog window enables you to select the location and a file name. Use the "Save" button to automatically set the instrument into STOP mode and to read the waveform data.
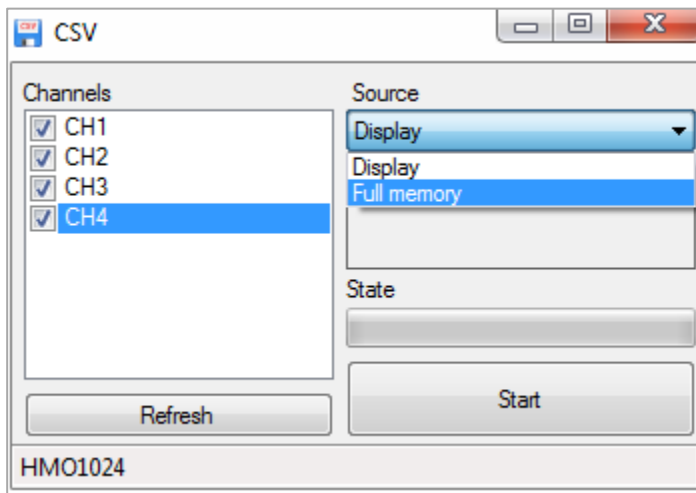
Depending on the selected source and channel, reading the waveform data may require a lot of time. Storage requirements will increase by 8, as well as the transferable data stream, if the waveform data is converted from an internally used number format to an ASCII format for a CSV file, for instance. These large amounts of data will require extended waiting periods since the R&S®HMO oscilloscopes do not have data logging capacities.
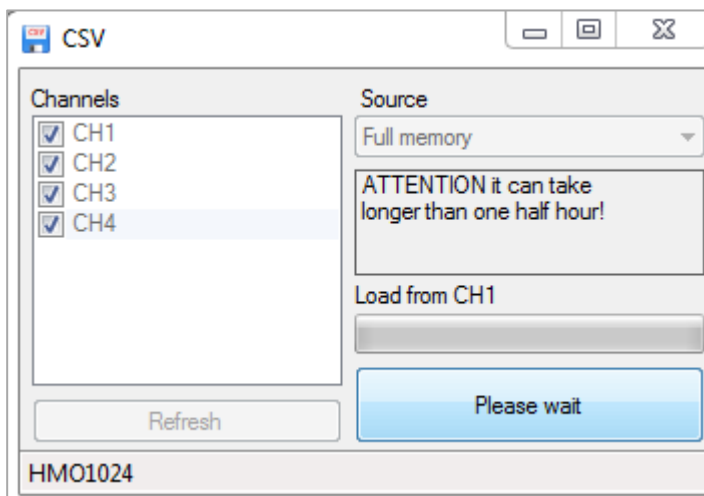
CSV example R&S®HMO1024:

[s],CH1[V]	[s],CH2[V]	[s],CH3[V]	[s],CH4[V]	
-1.048576E-0	-1.048576E-0	-1.048576E-0	-1.048576E-03,-5.147E-04	
-1.048574E-0	-1.048574E-0	-1.048574E-0	-1.048574E-03,-5.147E-04	
-1.048572E-0	-1.048572E-0	-1.048572E-0	-1.048572E-03,-3.147E-04	
-1.048570E-0	-1.048570E-0	-1.048570E-0	-1.048570E-03,-5.147E-04	
-1.048568E-0	-1.048568E-0	-1.048568E-0	-1.048568E-03,-3.147E-04	
-1.048566E-0	-1.048566E-0	-1.048566E-0	-1.048566E-03,-3.147E-04	
-1.048564E-0	-1.048564E-0	-1.048564E-0	-1.048564E-03,-5.147E-04	
-1.048562E-0	-1.048562E-0	-1.048562E-0	-1.048562E-03,-5.147E-04	
-1.048560E-0	-1.048560E-0	-1.048560E-0	-1.048560E-03,-3.147E-04	
-1.048558E-0	-1.048558E-0	-1.048558E-0	-1.048558E-03,-3.147E-04	
-1.048556E-0	-1.048556E-0	-1.048556E-0	-1.048556E-03,-3.147E-04	
-1.048554E-0	-1.048554E-0	-1.048554E-0	-1.048554E-03,-3.147E-04	
-1.048552E-0	-1.048552E-0	-1.048552E-0	-1.048552E-03,-3.147E-04	
-1.048550E-0	-1.048550E-0	-1.048550E-0	-1.048550E-03,-5.147E-04	

8.3 Operating R&S®HMC8012 / R&S®HMC804x

Please note that the CSV module for the R&S®HMC8012 and R&S®HMC804x only allows for the display of the internally and externally saved log or arbitrary files. A real time record of measurement values via HMExplorer software is not available. The logging function is directly controlled by the measurement instrument (manual activation via instrument menu).
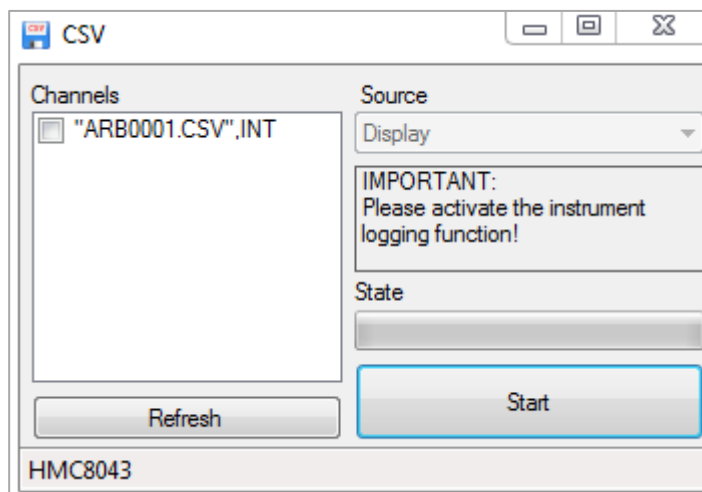
The logging function can only be activated via front panel, not via software.

9 EasyArb Software

The EasyArb software module can be used with power supply units of the R&S®HMP and R&S®HMC804x series.

9.1 EasyArb Software Menu

The EasyArb menu is arranged as follows:

1. <u>File</u>:

    a)   <u>Exit</u>: Exits the module and closes the editing window

2. **<u>Curve</u>:**

    b)   <u>New</u>: Opens an editing window to generate a new arbitrary waveform; it is also possible to generate a new arbitrary waveform using **+**

    c)   <u>Remove</u>: Deletes a selected waveform from the list; an arbitrary waveform can also be deleted by using **—**

    d)   <u>Import</u>: Imports a waveform from a text (.txt) or CSV file (.csv)

    e)   <u>Export</u>: Exports a selected waveform into a CSV file

    f)   <u>Transfer</u>: Transfers the selected waveform to the measurement instrument; an arbitrary waveform can also be transferred via ↑

    g)   <u>Add point</u>: Inserts a point in the selected waveform

    h)   <u>Delete point</u>: Removes a point from the selected waveform

3. **<u>Device</u>:**

    a)   Selects and displays the measurement instrument which currently is connected with the HMExplorer software and supported by the EasyArb software module

9.2 Generating and Editing a Curve

Use the menu "Curve" ➔ "New" (or the button combination CTRL+EINFG) to generate a new curve and to open an editing window. In the upper left corner of the editing window, you can select the respective curve. The setup parameters can be edited in the fields below. Use ✚ , "Curve" ➔ "Add point" or the EINFG buttonboard button to insert arbitrary points. Use ━ , "Curve" ➔ "Remove point" or the DELETE buttonboard button to remove arbitrary points. You can manually adjust the duration as well as voltage and current values for each individual arbitrary points in the table.

Duration (s)	Voltage (V)	Current (A)	Interpolation
1,00	1,000	1,0000	☐
1,00	1,000	1,0000	☐

For the input of numeric values, only numbers, point and comma are accepted (SI units).

| Duration (s)	Voltage (V)	Current (A)	Interpolation
1,00	12,01	1,0000	☐
1,00	1,000	1,0000	☐

Depending on the instrument type, the interpolation of arbitrary points is supported. The "Interpolation" can be activated separately for each row (check box is selected). You can use the left mouse button or confirm the space bar to activate the interpolation. If the connected power supply does not support the interpolation function (e.g. R&S®HMP series), this column will be marked in red. In this case, the instrument would not process this item.

Duration (s)	Voltage (V)	Current (A)	Interpolation
1,00	12,010	1,0000	☑
1,00	1,000	1,0000	☐

InterpolationNotSupported (1/1)

9.3 Transferring the Curve

To transfer a created arbitrary curve, is is recommended to previously connect the corresponding power supply unit which should have been recognized under "Device". If this is not the case, the power supply unit should be connected to the PC via interface cable and manually integrated using the main window of the HMExplorer software ("Search for devices").
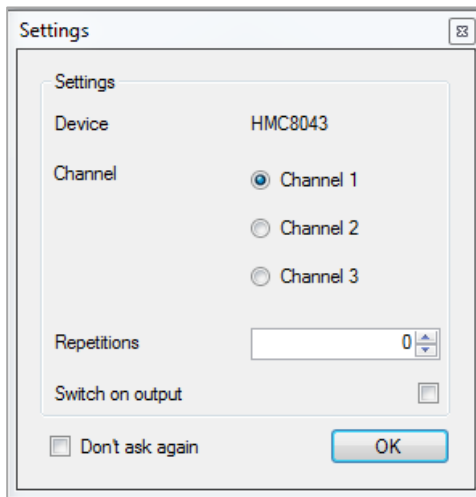
If the instrument was recognized, the arbitrary curve can be transferred to the measurement instrument by using "Curve" ➔ "Transfer" or ⬆. It is also possible to transfer the curve via F5 button on the buttonboard. In the settings window which now opens, you can select the respective channel and the number of repetitions (0 = infinite). You can also determine if the signal output is to be activated after the arbitrary transfer (check box is selected). If you wish to retain the selected settings for the next transfer, select the check box "Don't ask again".

9.4 Export

Use the menu option "Curve" ➔ "Export" to export a generated arbitrary waveform in CSV format or to store it on the PC. You can select a file name and location. Click the "Save" button to store the arbitrary waveform with the selected file name and location to the PC.

File Format:

Format	Description
;	Column separator (semicolon)
.	Decimal separator (period)
d	Column for duration
v	Column for voltage values
a	Column for current values
i	Interpolation

```
d;           v;           a;           i
<duration>;  <voltage>;   <current>;   <interpolation {1 or 0}>
```

9.5 Import

Use the menu option "Curve" ➔ "Import" to import a previously generated arbitrary waveform into the software. Select the file to be imported and use the "Open" option to open it. The option "Save" allows you to store the settings.
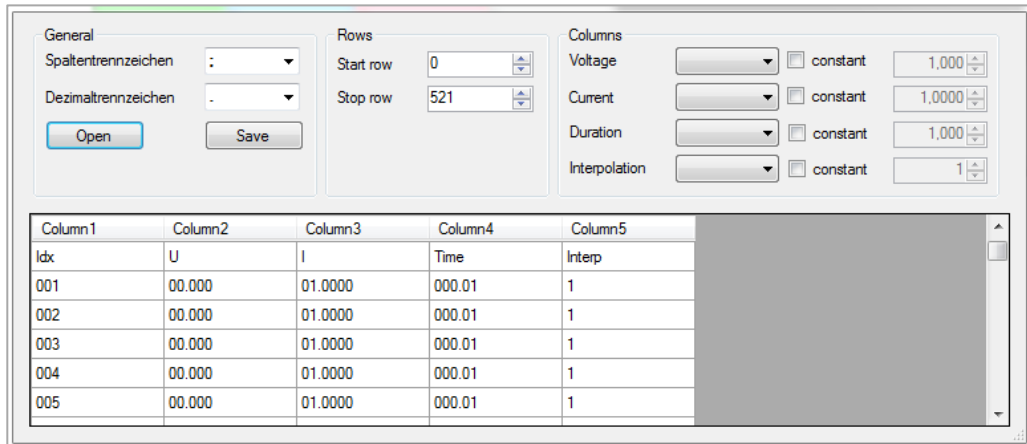
Column separator:
As column separator, you can select a " ; " (semicolon), a " ;, " (semicolon + comma) or a " . " (point).

Decimal separator:
As decimal separator, you can select a " . " (point) or a " , " (comma). Only one character is accepted as decimal separator.

Rows:
The settings for a start and a stop row are <u>not</u> absolutely required. All rows with the successful conversion of numbers in all columns will be imported. The start row defines the row number at which reading the file begins. The stop row defines the row number at which the reading continues.

Row	Result
Hello;2;0.3	Will not be imported, row 1 cannot be converted into a number
3;2;0.3	Ok
3;2;0-3	Will not be imported, row 3 cannot be converted into a number

Columns:

The "Voltage" function allows you to assign a file column to the voltage values.
The "Current" function allows you to assign a file column to the current values.
The "Duration" function allows you to assign a file column to the delay times.
The "Interpolation" function allows you to assign a file column to the interpolation values.

If the "Constant" function is activated for a column (selection box is selected), the selected column will be filled with a constant default value.

The option "Save" allows you to store the settings.

10 Arbitrary Software

The Arbitrary software module can be used with the function generators of the R&S®HMF series.

10.1 Arbitrary Software Menu

The Arbitrary software menu is arranged as follows:

1. <u>**File**</u>**:**

    a) <u>Exit</u>: Exits the module and closes the editing window

2. <u>**Curve**</u>:

    a) <u>New</u>: Opens an editing window to generate a new arbitrary waveform; it is also possible to generate a new arbitrary waveform using ✚

    b) <u>Remove</u>: Deletes a selected waveform from the list; an arbitrary waveform can also be deleted by using ▬

    c) <u>Import</u>: Imports a waveform from a text (.txt) or CSV file (.csv)

    d) <u>Export</u>: Exports a selected waveform into a CSV file

    e) <u>Sum</u>: Generates a new arbitrary waveform from the sum of the selected waveforms

    f) <u>Product</u>: Generates a new arbitrary waveform from the product of the selected waveforms

    g) <u>Edit</u>: Allows the arbitrary waveform to be edited

    h) <u>Transfer</u>: Transfers the selected waveform to the measurement instrument and starts the arbitrary function

3. <u>**Device**</u>:

    a) Selects and displays the measurement instrument which currently is connected with the HMExplorer software and supported by the Arbitrary software module

10.2 Generating a Waveform

Use the menu option "Curve" ➜ "New" to generate a new waveform and to open an editing window. In the upper left corner of the editing window, you can select various waveforms. The setup parameters can be edited in the fields below. The maximum adjustable frequency is displayed above the signal display. The frequency can be used to determine the time sequence of the arbitrary waveform (entire processing time 1 period). This frequency value defines the maximum frequency at which the R&S®HMF measurement instrument can issue frequency values without interpolating points. The number of arbitrary points (points) to be used may be modified. Depending on the number of used arbitrary points, the maximum frequency changes.
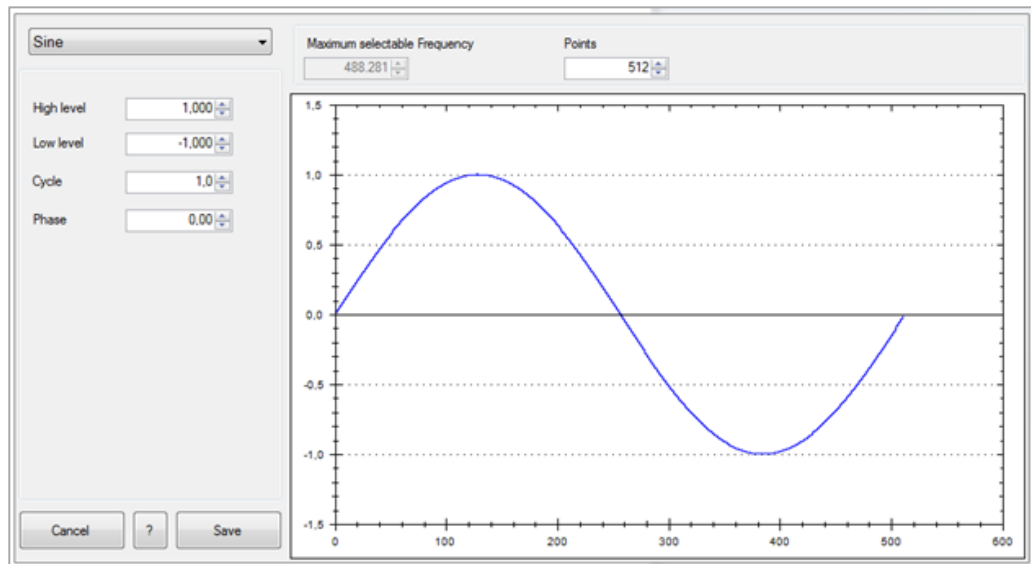
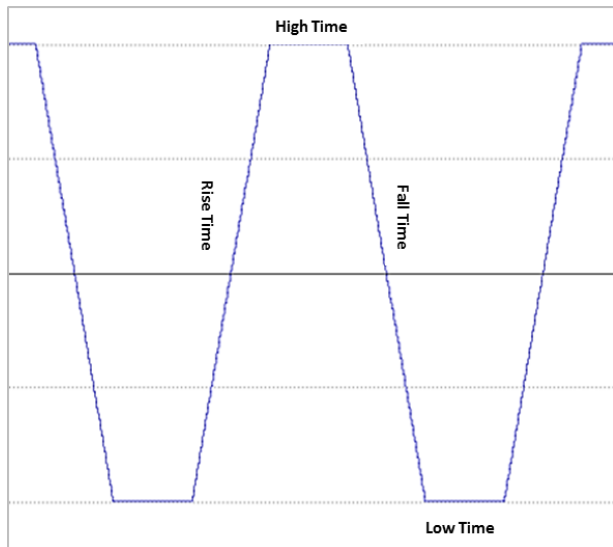The following waveforms are available:
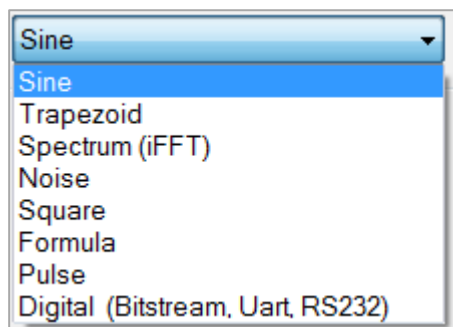
Sine:

For the waveform "Sine", you can use the high and low levels to select the amplitude and the offset. The "cycles" describe the number of periods (in relation to the selected number of points). The "phase" moves the sine signal along the X axis.

High level	1,000
Low level	-1,000
Cycle	1,0
Phase	0,00

Trapezoid:

Similar to the waveform "Sine", for the waveform "Trapezoid" you can also use the high and low levels to select the amplitude and the offset. The "cycles" describe the number of periods (in relation to the selected number of points). The "phase" moves the signal along the X axis. If the "Logarithm" function is activated (check box selected), the linear rise or fall changes logarithmically. If the "Invert" function is activated in addition, the display of the logarithmic rise or fall will be inverted.

|		
High level	1 V	
Low level	-1 V	
Cycle	1	
Phase	0 °	
Rise time	25 %	☐ Logarithm
High time	25 %	☐ Invert
Fall time	25 %	☐ Logarithm
Low time	25 %	☐ Invert

Spectrum (inverse FFT):

The waveform "Spectrum" allows you to enter harmonics to the order of 1…n. From the harmonics, the curve will be calculated back based on an inverted FFT.
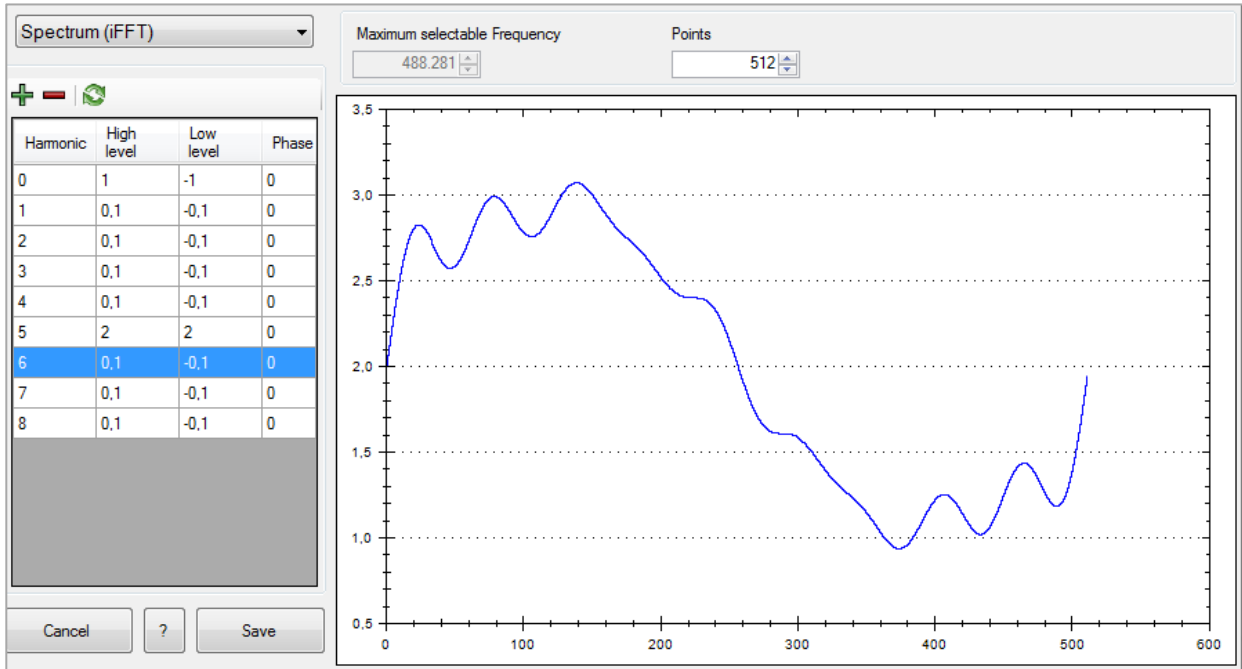

Noise:

For the waveform "Noise", you can also use the high and low levels to select the amplitude and the offset.
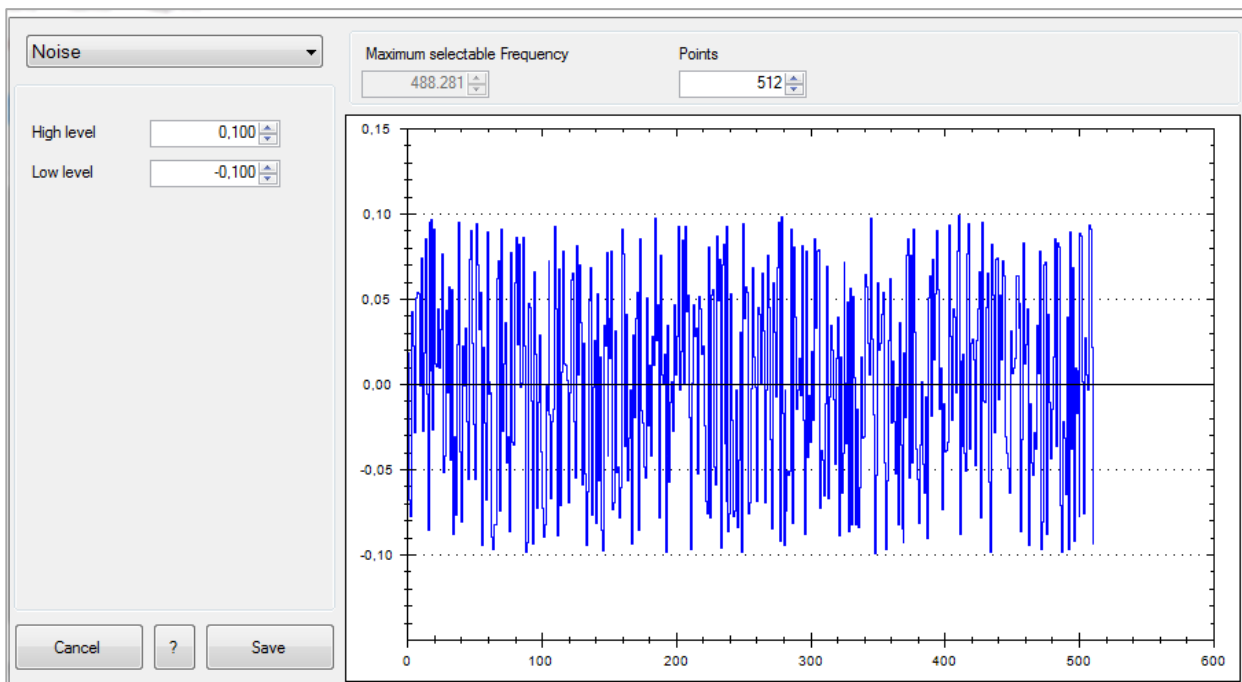
Square:

For the waveform "Square", you can also use the high and low levels to select the amplitude and the offset. The "cycles" describe the number of periods (in relation to the selected number of points). The "phase" moves the signal along the X axis from 0° to 360°. Use High and Low level to select the duty cycle of the square waveform.
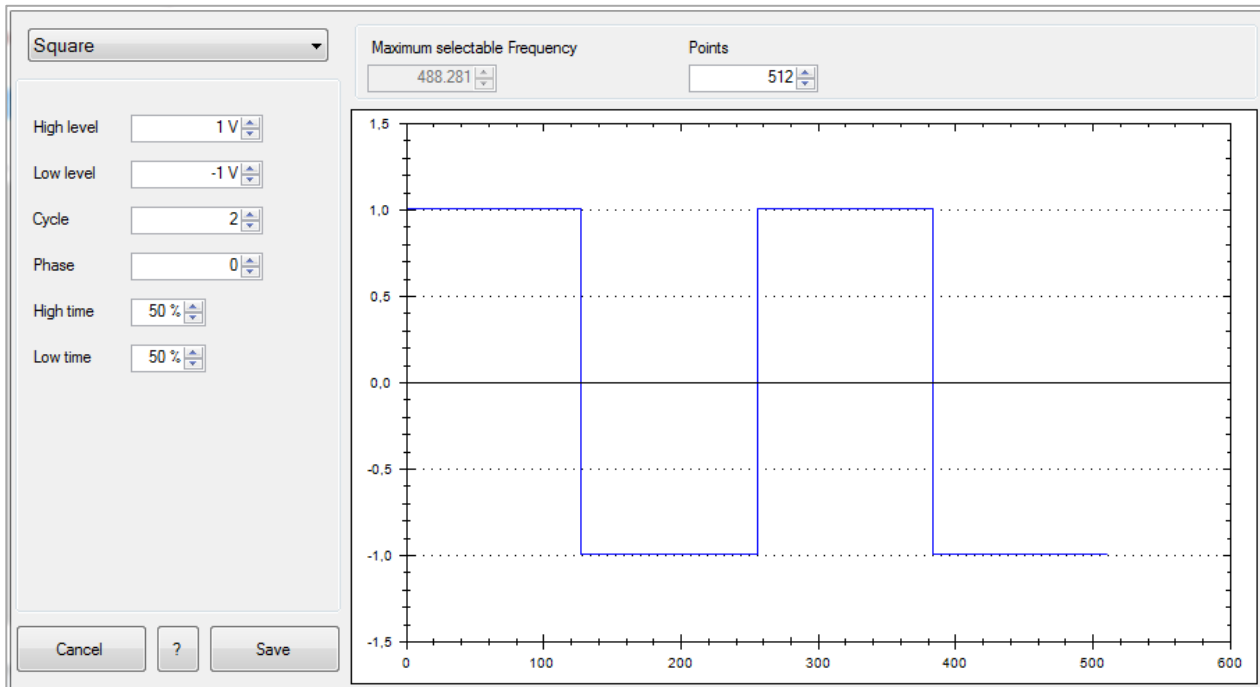
Formula:

You can use the "Formula" function to enter a formula in the text field on the left of the editing window. The signal display will be updated once you have clicked the "Calculate" button.

You can choose from the following formula parameters:

Parameter	Description
X,x	Variable
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Power
( )	Parentheses
Sqrt	Square root

| Parameter	Description
Sin	Sine (radians)
Cos	Cosine (radians)
Tg	Tangent
Ctg	Cotangent
Log	Logarithm including the base
Ln	natural logarithm (logarithm to the base e)
Exp	Exponent to base 10
Abs	Amount
PI	Constant = 3.14159…
E	Constant = 2.71828…
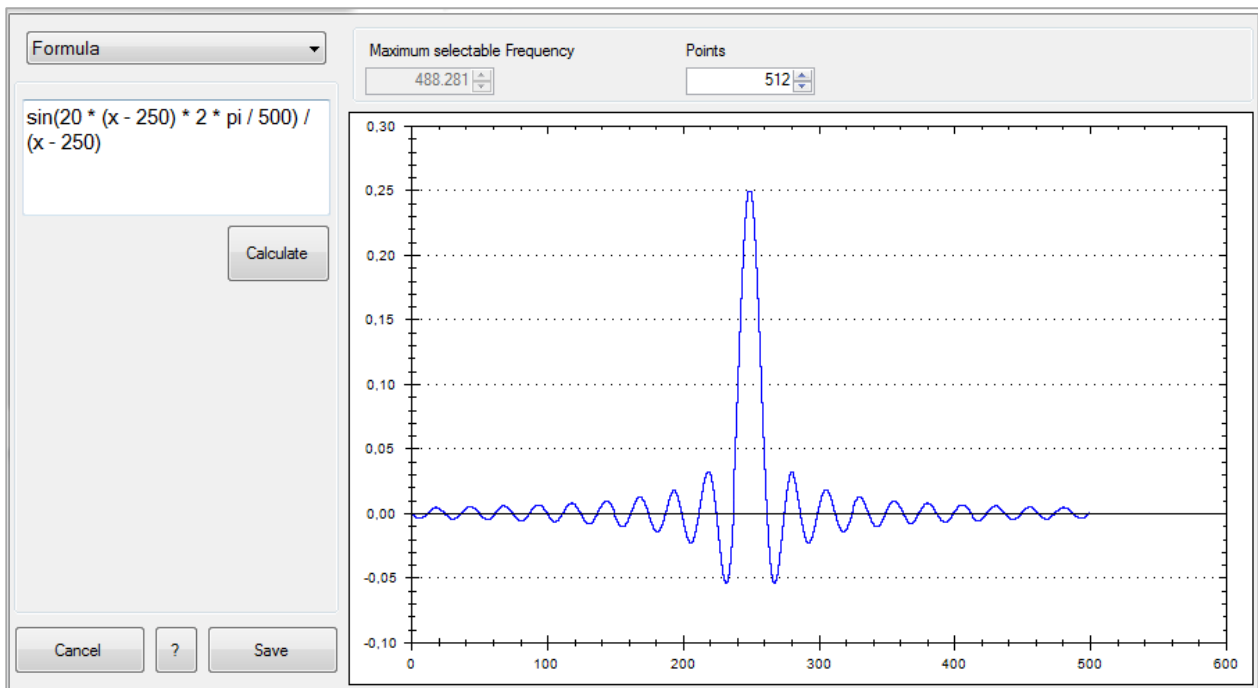
Pulse:

For the waveform "Pulse", you can select the amplitude and the offset. "Phase" moves the signal along the X axis. The option "Width" allows you to define the pulse width in points.
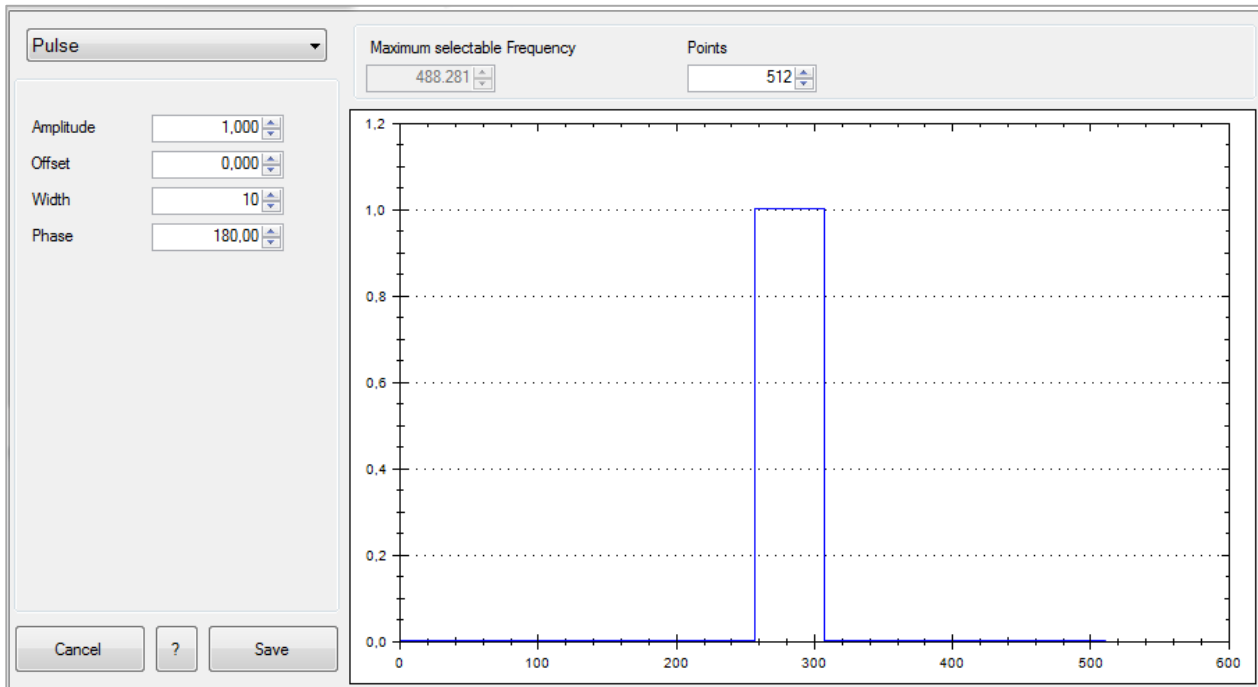
Digital:

The settings for the waveform "Digital" are divided into two tabs. The first tab allows you to enter the data stream in ASCII, hexadecimal (Hex), decimal (Dec) or binary (Bin). For Hex, Dec or Bin, bytes or words are separated by comma or space. For Hex, the prefix "0x" is allowed. The signal display will be updated once you have clicked the "Show" button.
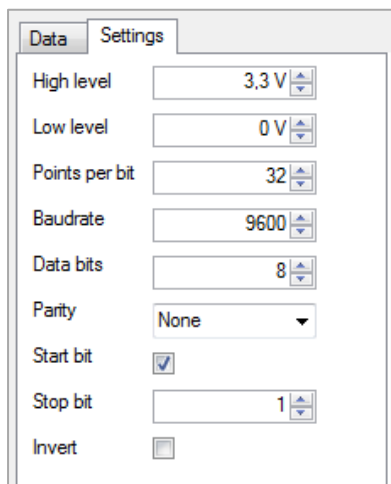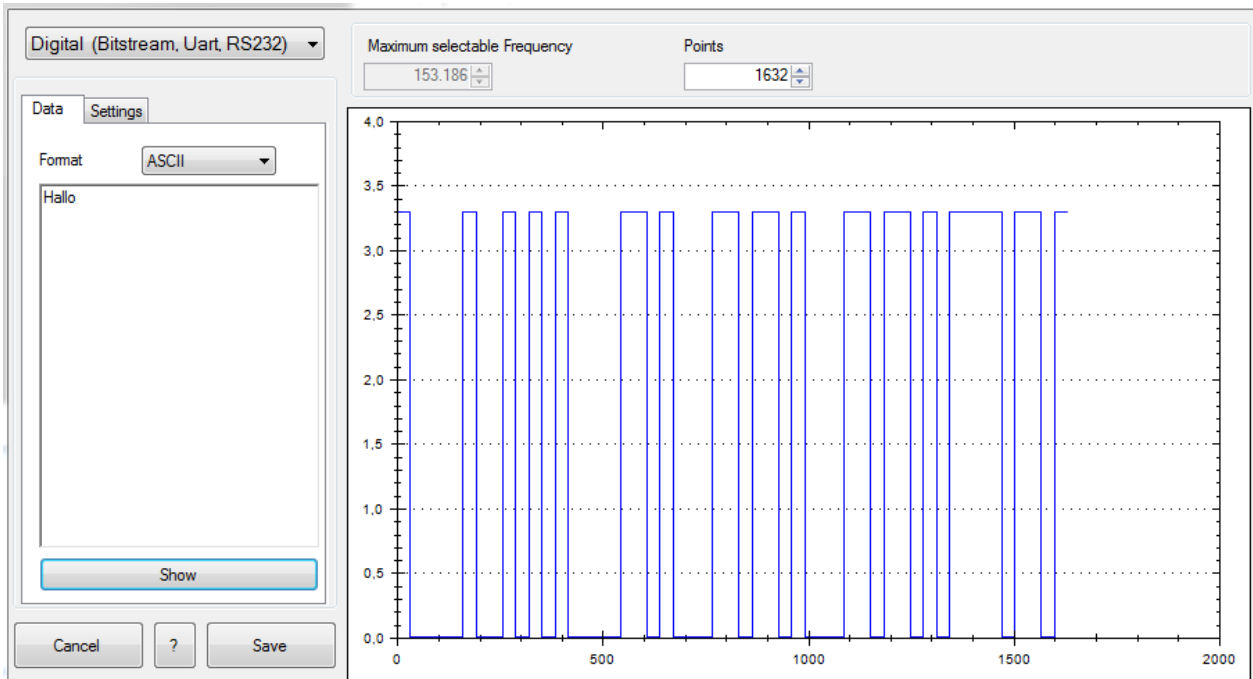
The second tab allows you to select the RS-232 settings. You can use the high and low levels to select the amplitude and the offset here. The options "Points per bit" and "Baudrate" define the number of points for the period. In this case, the option "Points" on the upper right margin of the screen cannot be adjusted.

The function "Data bits" describes the number of bits after which a separator is required in the data stream. For "ASCII", it is recommended to set the number of data bits to "8". If a parity is "selected", the parity bit will be attached. A "start bit" can be selected (check box selected) or unselected. For RS-232/UART, the start bit is required.

The number of "stop bits" can be set to any number. Stop bits can be used to generate a pause between data bytes/words, for instance. The "Invert" function mirrors the signal.

10.3 Remove Curve

A curve must first be marked before it can be removed. Once the curve is marked, you can use "Curve" ➔ "Remove", ▬ or the ENTF button on the buttonboard to remove or delete the curve. Once you confirm in the confirmation window to definitely remove the curve, the selected curve will be irrevocably deleted.

10.4 Export

Use the menu option "Curve" ➔ "Export" to export a generated arbitrary waveform in CSV format or to store it on the PC. You can select a file name and location. Click the "Save" button to store the arbitrary waveform with the selected file name and location to the PC.

File Format:

Format	Description
;	Column separator (semicolon)
.	Decimal separator (period)
#Frequency	Frequency that is to be transferred as setting
#Pointscount	Number of arbitrary points
v	Column for voltage values

Example of a CSV file:

#Frequency;1000
#Pointscount;512
v
0.0100000000123445
…
0.0122715382857199

10.5 Import

Use the menu option "Curve" --> "Import" to import a previously generated arbitrary waveform into the software. Select the file to be imported and use the "Open" option to open it. The option "Save" allows you to store the settings.
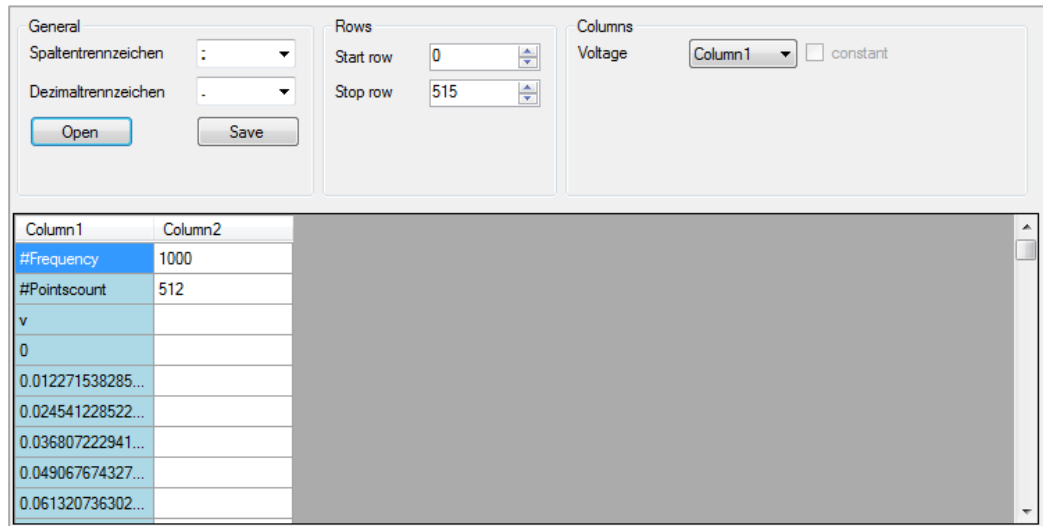
Column separator:
As column separator, you can select a " ; " (semicolon), a " ;, " (semicolon + comma) or a " . " (point).

Decimal separator:
As decimal separator, you can select a " . " (period) or a " , " (comma). Only one character is accepted as decimal separator.

Rows:
The settings for a start and a stop row are <u>not</u> absolutely required. All rows with the successful conversion of numbers in all columns will be imported. The start row defines the row number at which reading the file begins. The stop row defines the row number at which the reading continues.

Row	Result
Hello;2;0.3	Will not be imported, row 1 cannot be converted into a number
3;2;0.3	Ok
3;2;0-3	Will not be imported, row 3 cannot be converted into a number
Hello	Will not be imported, row 1 cannot be converted into a number

Columns:

The "Voltage" function allows you to assign a file column to the voltage values.

10.6 Sum (∑)

Use the ∑ function (Sum) to generate the sum of two previously generated arbitrary waveforms. You can either use the ∑ symbol or the option "Curve" --> "Sum" to activate the sum function. Click the ∑ symbol again to deactivate the sum function and to store the resulting waveform.
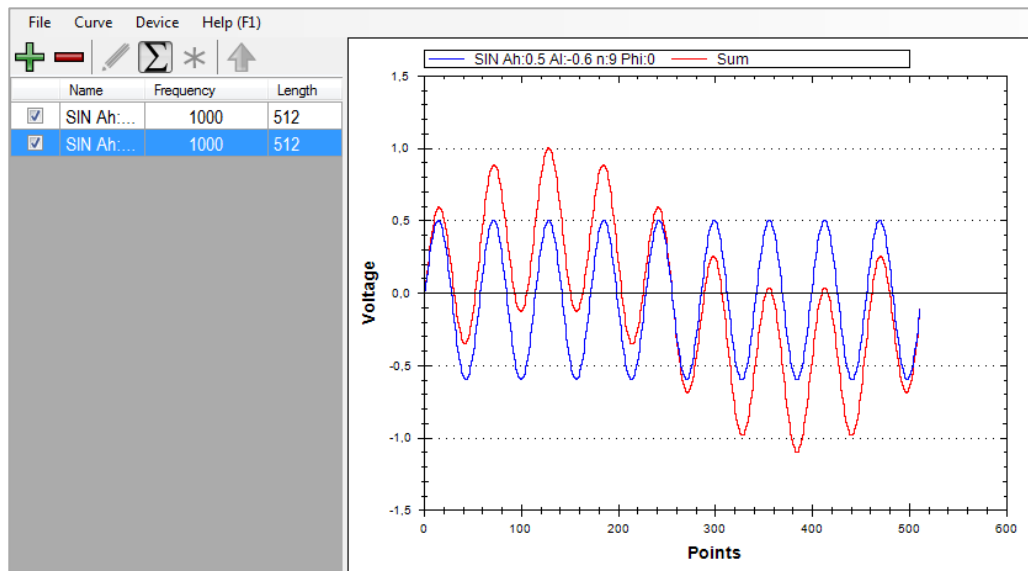
If one waveform is shorter than the other, the missing points will be filled with the value **0**.

10.7   Product (*)

Use the * function (Product) to generate the product of two previously generated arbitrary waveforms. You can either use the * symbol or the option "Curve" ➔ "Product" to activate the product function. Press the * symbol again to deactivate the product function and to store the resulting waveform.
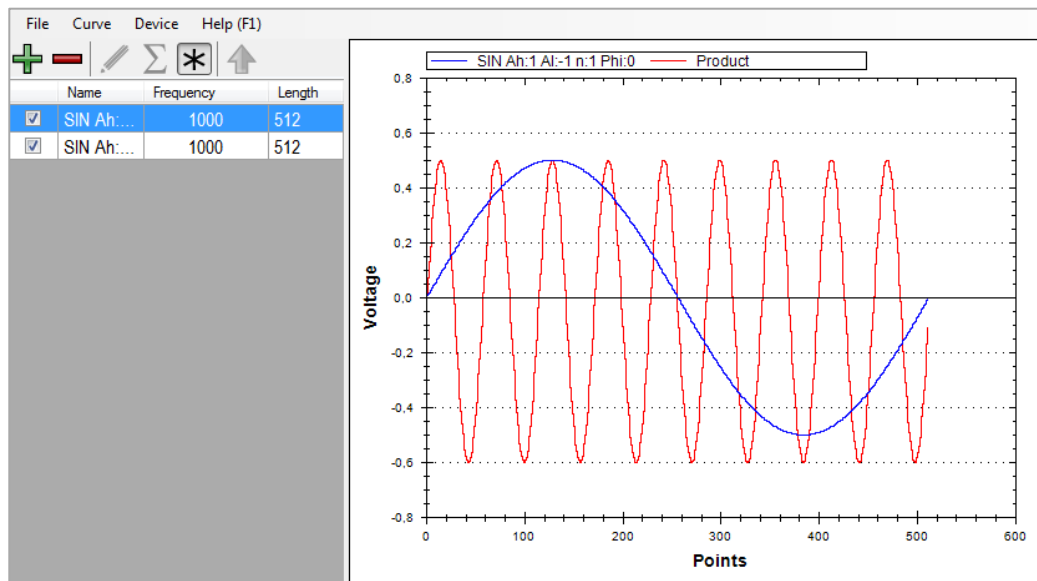

If one waveform is shorter than the other, the missing points will be filled with the value **1**.

10.8 Edit

Use the menu option "Curve" ➜ "Edit" to select and edit a waveform from the list.

1. **Save**: Saves the selected waveform with all changes

2. **Save as new curve**: Saves the displayed curve as a new curve

3. **Cursor**: Editing using the mouse will be activated

4. **Line**: Editing will be performed using lines

5. **Line**: Editing will be performed in "freehand mode"

6. **Amplitude**: Curve is adapted to the desired amplitude

7. **Offset**: Waveform is edited with the desired offset
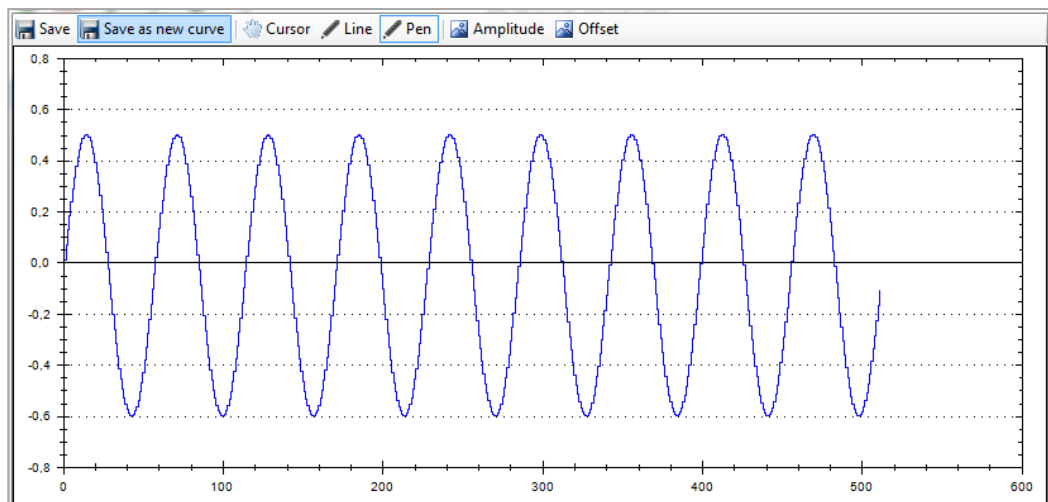
10.9 Transfer

After generating the desired waveform, you can transfer it to the R&S®HMF instrument. Select the respective waveform in the list and use the menu option "Curve" ➜ "Transfer" to transfer it to the R&S®HMF instrument. After the arbitrary waveform has been successfully transferred to the measurement instrument, the status bar displays the message "Transfer completed", and the function will start.

11 Power Analyzer Software

The power analyzer software can be used with the Power Analyzer R&S®HMC8015. The R&S®HMC8015 power analyzer includes different display modes for the display of measurement results. These can be enabled by activating options/upgrade vouchers. The display modes "Harmonics" and "Waveform" are only available in conjunction with the HOC151 option (ex factory) or the HVC151 upgrade voucher. If the option resp. the upgrade voucher is not installed, an info box appears.
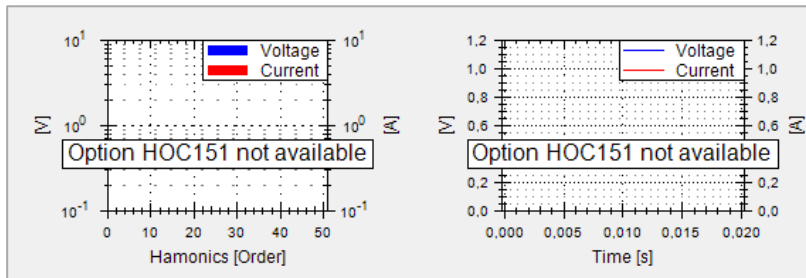

11.1 Software Menu
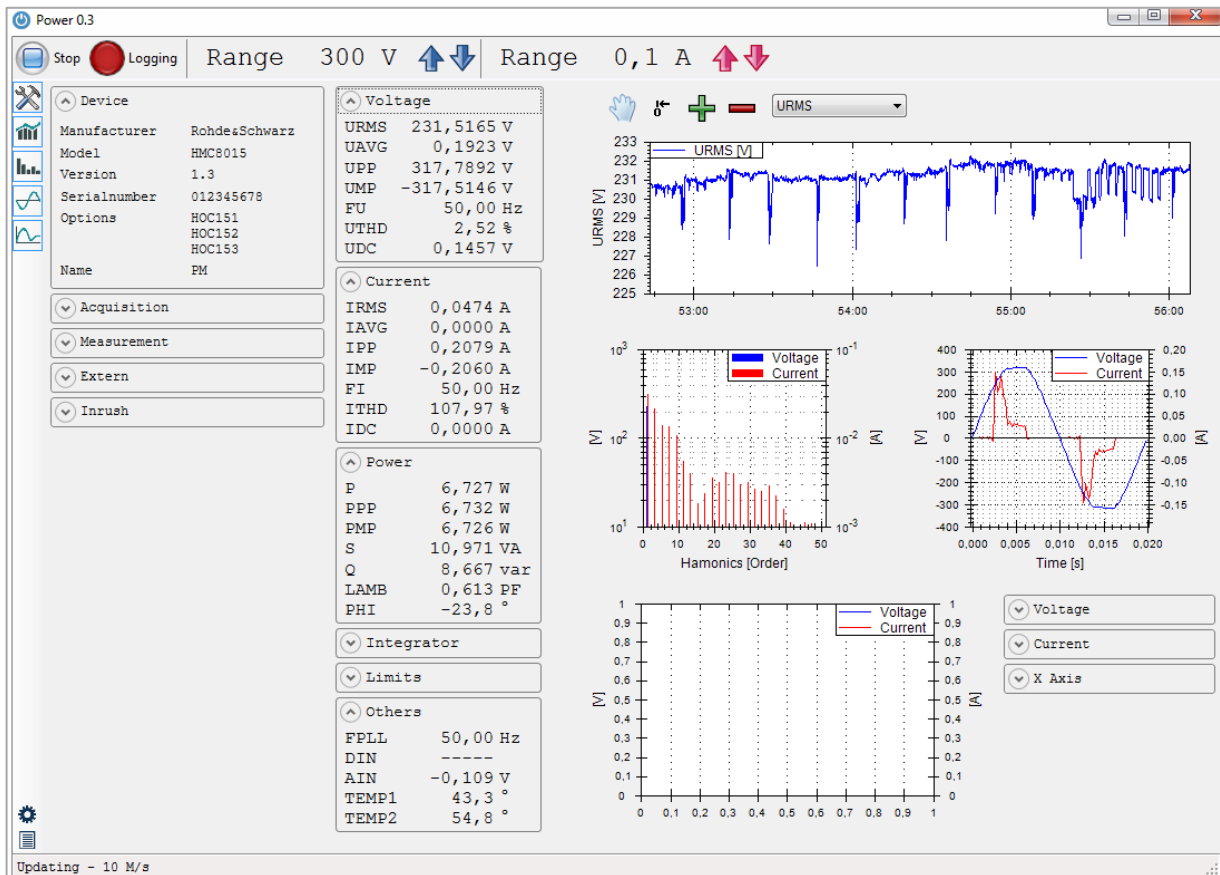
The power software menu is arranged as follows:

1. **Upper status bar**:

   a)   **Start / Stop**:

   Use the "Start" button to activate the power measurement.
   Use the „Stop" button to deactivate the power measurement .
   If no instrument was selected earlier, a check box to choose a
   R&S®HMC8015 power analyzer will be displayed.

   b)   **Logging**:

   With the „Logging" button the logging function can be started. Pressing the
   "Logging" button once more will stop the data logging and the Windows
   Explorer will be opened. The measurement values will be saved in the
   directory "…Rohde-Schwarz ➜ HMExplorer ➜ Curve" automatically. The
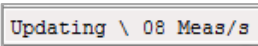   logging file name includes the date and the measurement time.

   c)   **Measurement range**:

   This bar shows the range settings for voltage and current. These settings can
   be changed only, if the power software measurement was started via „Start"
   button before.
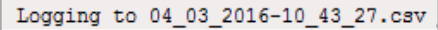
2. **Sidebar**:

   a) Device Settings: Enables / Disables the device settings window

   b) Show Trendchart: Enables / Disables the Trendchart trace

   c) Show Harmonics: Enables / Disables the Harmonics trace

   d) Show Waveform: Enables / Disables the Waveform trace

   e) Show Inrush: Enables / Disables the Inrush trace

3. **Lower status bar**:

   a) Updating \ 08 Meas/s **Updating**:

   Shows the number of measurements per second. By changing the
   measurement settings a progress bar will be displayed. While the progress
   bar is displayed, the measurement values will be not updated.

b)   `Logging to 04_03_2016-10_43_27.csv`   **Logging File Name**:

If the logging function is activated, the logging file name will be displayed in the lower status bar automatically.

4.   **Measured Value Display:**

In the middle section of the power analyzer software different measurement values can be displayed and will be updated automatically.
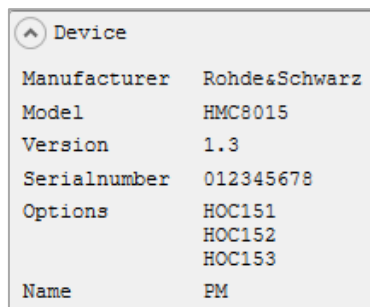
11.2 Software Functions
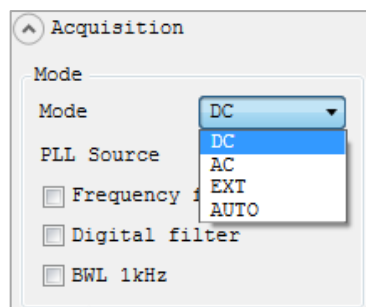
The following software functions are available:

Device Settings

Using the „Device Settings" function enables / disables the device info window or adjusts device settings.

```
Device
Manufacturer    Rohde&Schwarz
Model           HMC8015
Version         1.3
Serialnumber    012345678
Options         HOC151
                HOC152
                HOC153
Name            PM
```

In the „Device" menu the device serial number, the installed options and the device firmware are displayed.

In the „Acquisition" menu the following settings can be used:

```
Acquisition
 Mode
 Mode          DC        ▼
                DC
 PLL Source     AC
                EXT
  Frequency     AUTO
  Digital filter
  BWL 1kHz
```

1.   **Mode**: Acquisition mode selection

     a)   <u>Auto</u>: Automatic selection of the data acquisition mode / automatic detection of an incoming signal.

     b)   <u>DC</u>: For measuring pure DC loads in contrast to the AC mode, there is no synchronization with the signal period, instead synchronization is over a certain period of time (error is displayed if AC signal is applied).

     c)   <u>AC</u>: Average value of a voltage / current period (synchronization with the signal period).

     d)   <u>EXTERN</u>: Specifying a signal period via the external BNC connector DIGITAL IN (only available in conjunction with option HOC152 / upgrade voucher HVC152); e.g. used with a fuzzy signal which must be filtered externally.
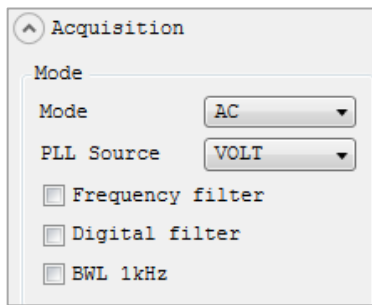
2. **PLL Source** (frequency synchronization): Set the reference variable for the fundamental frequency; the fundamental frequency of each period is the reference for the measured harmonics of the reading

3. **Frequency Filter**: Reliable acquisition of the zero crossings for the precise determination of the signal period.

4. **Digital Filter**: Automatic, adaptive averaging of the filter setting for several periods to increase accuracy; ideal for highly fluctuating values

5. **BWL**: Classic low-pass filter (1kHz) as bandwidth limit (BWL), in order to produce a clean, HF-adjusted signal.
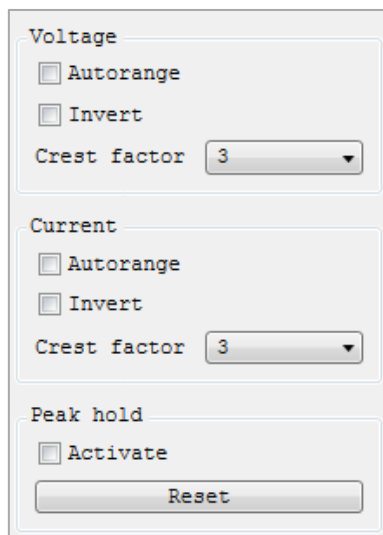
6. **Voltage / Current**:

   In the „Voltage" resp. „Current" menu, the „Autorange" function can be activated (check box selected) resp. disabled. In order to record and display the current correctly (depending on the wiring type), the current direction can be inverted by using the "Invert" function.

   The crest factor can be varied between 3 and 6 by using the function "Crest Factor". When changing the crest factor, the measuring range is adjusted automatically. A crest factor of 5 or higher is used e.g. for sinusoidal waveforms with spikes and is also required for standby measurements according to IEC 62018.

7. **Peak hold**:

   The "Peak Hold" displays maximum peak values ("Activate" checkbox selected), ensuring a stable readout display for loads. The sampling frequency is 500kSa/s.

If "OL" (Overload) appears on the instrument display, the peak values must be reset on the display using function "Reset".

In the "Measurement" menu an energy counter can be activated. The recorded integrator values will be displayed in the middle section of the power analyzer software ("Integrator" menu). WHP / AHP represent the power / current in the positive direction and WHM / AHM in the negative direction. WH / AH correspond to the sum of the watt-hour/ ampere-hour positive and negative portions, respectively.

The following integrator modes can be used:
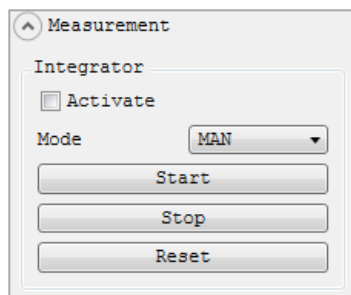
1. **Manual Integrator Mode (MAN)**:

    Using the "Start" button, the energy counter can be started as soon as it has been activated using the "Activate" button (checkbox selected). Pressing the button "Stop" will stop the energy counter. The "Reset" button will reset the integrator values in the "Integrator" menu.
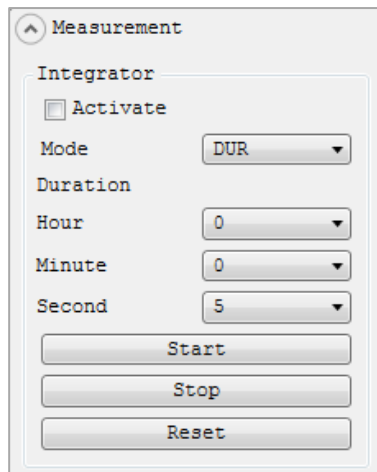
2. **Duration Integrator Mode (DUR)**:

    The integrator mode "DUR" defines how long the energy counter is active. Using the "Start" button, the energy counter can be started as soon as it has been activated using the "Activate" button (checkbox selected). After the integration time ("Duration") has elapsed, the energy counter is automatically stopped. If the integration time is expired, a new integrator measurement can only be started via "Start" button, if the integrator values ("Integrator" menu) were reset with "Reset" button.

The maximum duration for running the energy counter is 96 hours.
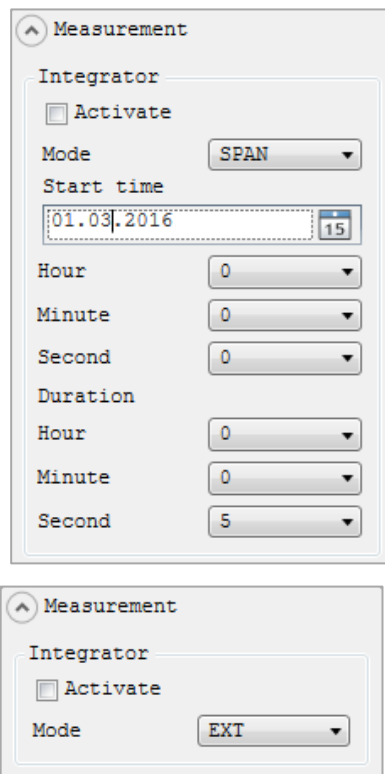
3. **Span Integrator Mode (SPAN)**:

   A "Start Time" and an integration time span ("Duration") can be set using the "Span" integrator mode. Once the energy counter has been activated via the "Activate" button (checkbox selected), the counter will automatically start at the preset start time and then automatically stop after the integration time span ("Duration") has elapsed.

4. **External Integrator Mode (EXT)**:

   Using the external integrator mode "EXT", the energy counter can be started and stopped by an external pulse at the digital inputs on the instrument rear panel. Once activated using the "Activate" button (checkbox selected), the energy counter is automatically started by a "high" signal and automatically stopped by a "low" signal.

> **The integrator mode „EXT" and the limit function are only available in conjunction with the HOC152 option (ex factory) resp. the HVC152 voucher.**
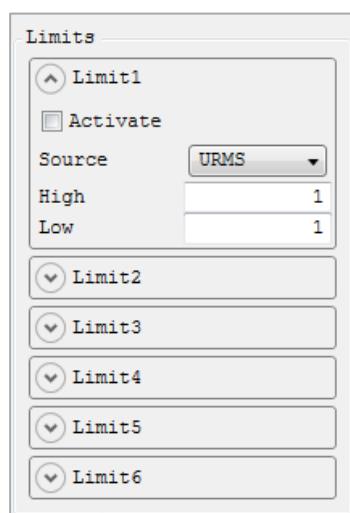
5. **Limits**:

   Up to six limit values (Limit1 to Limit6) can be defined in the "Limits" menu. Once up to six limit values are selected, they can be activated using the button "Activate" (checkbox selected). The button "Source" can be used to select the measurement function for the source.

   The buttons "High" and "Low" are used to define maximum and minimum limit values. The limit values will be displayed in the "Limits" menu.

The following measurement functions can be selected as "Source":

Function	Description
P	Active Power [W]
S	Apparent Power [VA]
Q	Reactive Power [Var]
LAMB	Power Factor λ [PF]
PHI	Phase difference U-I Φ [°]
FU	Frequency Value of the Voltage [Hz]
FI	Frequency Value of the Current [Hz]
URMS	True RMS Voltage
UAVG	Average Voltage [V]
IRMS	True RMS Current
IAVG	Average Current [A]
UTHD	Total Harmonic Distortion U [THD %]
ITHD	Total Harmonic Distortion I [THD %]
FPLL	Frequency and Phase locked Loop recording Frequency [Hz]

In the „Extern" menu the settings for sensor and the digital / analog I/Os can be defined. The following functions are available:
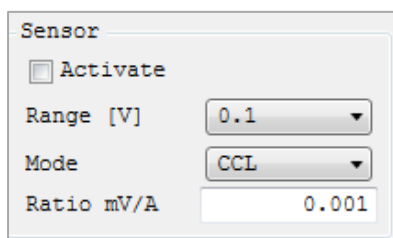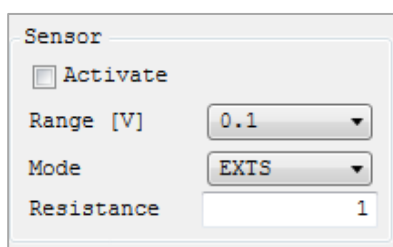
1. **Sensor**:

    Using "Activate" the sensor measurement function can be activated (checkbox selected) or deactivated. When the sensor measurement function is activated, the automatic current measurement range selection is deactivated (if it was activated previously). With the function "Range" the maximum measuring range for the measured voltage can be selected. The available settings are 100mV, 1V and 4V. As a rule, the 100mV range is appropriate for measurements on shunts, while 1V and 4V are used for measurements with a current probe. This setting is referenced to the peak value.

Using "Mode" function the sensor mode can be selected. The available modes are "EXTS" (to connect an external shunt) and "CCL" (to connect a current probe, e.g. R&S®HZC50 / R&S®HZC51). The Sensor menu changes dynamically to match the selected sensor mode. In sensor mode "EXTS", "Resistance" is used to enter the value of the externally connected shunt in ohms. Once the shunt value is entered, all measured values (current, power and values derived from these) can be calculated correctly and displayed. Manual calculations are no longer necessary. The data from the external shunt is converted to the correct measured values internally.

In sensor mode "CCL", "Ratio" is used to define a conversion factor. This factor defines how many millivolts the sensor transmits when a current of 1A is applied. Once the factor is entered, all measured values (current, power and values derived from these) can be calculated correctly and displayed. Manual calculations are no longer necessary.
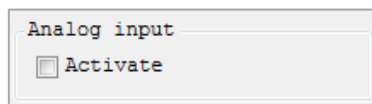
2. **Analog Input**:

   The analog input on the R&S®HMC8015 rear panel can be activated (checkbox selected) or deactivated using "Activate".
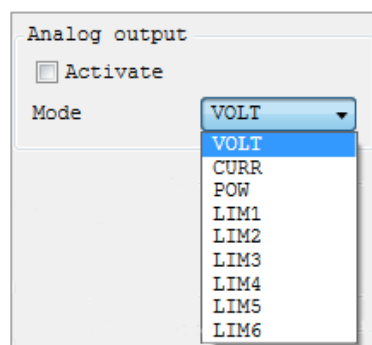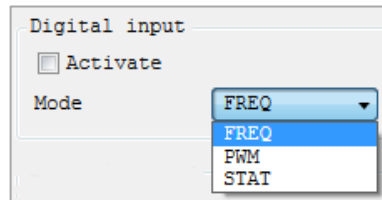
3. **Analog Output**:

   The analog output on the R&S®HMC8015 rear panel can be activated (checkbox selected) or deactivated using "Activate". The minimum voltage modulation of the output is -5V, the maximum voltage modulation is +5V.

   The following modes ("Mode" function) can be selected:

a) **VOLT**:
   Minimum modulation at the output corresponds to 0V and maximum modulation corresponds to the measuring range.

b) **CURR**:
   Minimum modulation at the output corresponds to 0V and maximum modulation corresponds to the measuring range.

c) **POW**:
   Minimum modulation at the output corresponds to 0 W and maximum modulation corresponds to the maximum current and voltage measuring ranges.

d) **LIM\<n\>**:
The limit module is connected to the analog output. The output modulation is represented as a percentage %. −100% corresponds to minimum modulation at the output (≙ −5V) and +100% corresponds to maximum modulation (≙ +5V).

4. **Digital Input**:

The digital input on the R&S®HMC8015 rear panel can be activated (checkbox selected) or deactivated using "Activate".

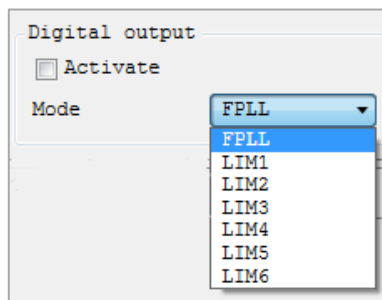The different   modes can be selected using "Mode":

a) **FREQ**:
The power analyzer measures the frequency at the DIGITAL IN.

b) **PWM**:
The power analyzer measures the relationship between High and Low.

c) **STAT**:
The power analyzer measures the High and Low levels.

5. **Digital Output**:

The digital output on the R&S®HMC8015 rear panel can be activated (checkbox selected) or deactivated.

The following modes can be selected using "Mode":

a) **LIM\<n\>**:
The limit module is connected to the digital output. The High level at the output corresponds to logical True and the Low level corresponds to False.
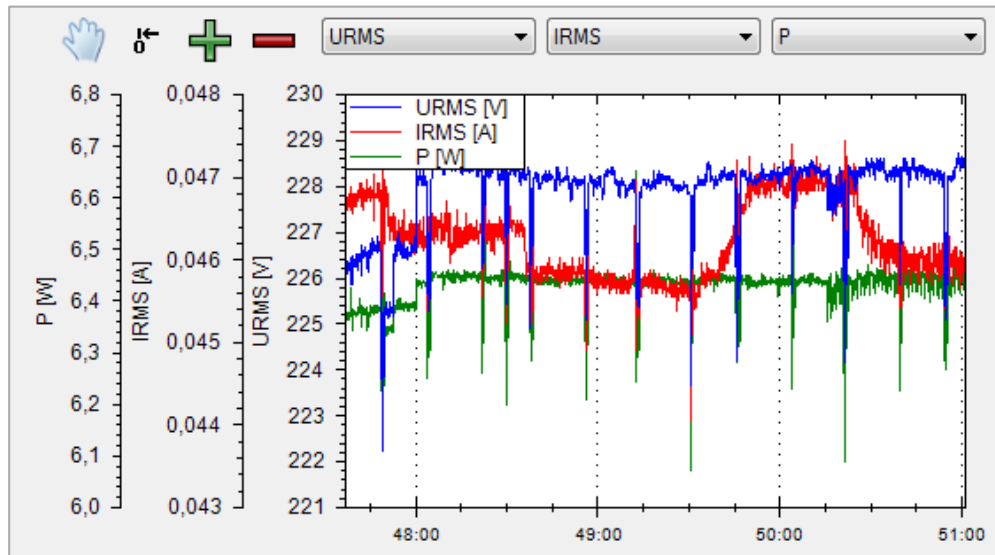
b) **FPLL**:
The output is controlled by an FPGA and always outputs the frequency of the selected source.

11.3 Display Modes

The following display modes are available:

Trendchart Mode

Using display mode "Trendchart" current or voltage values can be displayed as a signal profile (similar to the roll mode in an oscilloscope). Compared to the "trendchart" display mode on the instrument the "Trendchart" display mode via power analyzer software is used to show up to three selected values over time simultaneously.

Disables the automatic trace scaling; manual setting of axis and position.

All traces are scaled to a common Y axis.

Inserts (**+**) or removes (**-**) a trace.

Up to three traces can be displayed simultaneously. The 1st trace will be displayed in **Blue**, the 2nd in **Red** and the 3rd trace in **Green**. The source selection can be made via drop down menus.


The following measurement functions are available as sources:

Function	Description
P	Active power [W]
S	Apparent power [VA]
Q	Reactive power [Var]
LAMB	Power factor lambda λ [PF]
PHI	Phase difference U-I Φ [°]
FU	Frequency value for the voltage [Hz]
FI	Frequency value for the current [Hz]
UPPeak	Maximum voltage [V]
UMPeak	Minimum voltage [V]
IPPeak	Maximum current [A]
IMPeak	Minimum current [A]
PPPeak	Maximum power [W]
PMPeak	Minimum power [W]
URMS	True RMS Voltage
UAVG	Average Voltage [V]
URAN	Voltage measurement range
IRAN	Current measurement range
IRMS	True RMS Current
IAVG	Average Current [A]
UDC	DC component of voltage [V]
IDC	DC component of current [A]
UK (UK1…UK50)	RMS voltage of harmonic order k U(k)
IK (IK1…IK50)	RMS current of harmonic order k I(k)
UTHD	Total Harmonic Distortion U [THD %]
ITHD	Total Harmonic Distortion I [THD %]
FPLL	Frequency and phase locked loop recording frequency [Hz]
DIN	Digital input value [%] [Hz]
AIN	Analog input value [V]
WH / AH	Sum of watt-hour / ampere-hour positive + negative portions [Wh/ Ah]
WHP / WHM	Power in positive (WP+) / negative direction [Wh]
AHP / AHM	Current in positive / negative direction [Ah]

Harmonics Mode

> The display mode „Harmonics" is only available in conjunction with the HOC151 option (ex factory) resp. the HVC151 voucher.
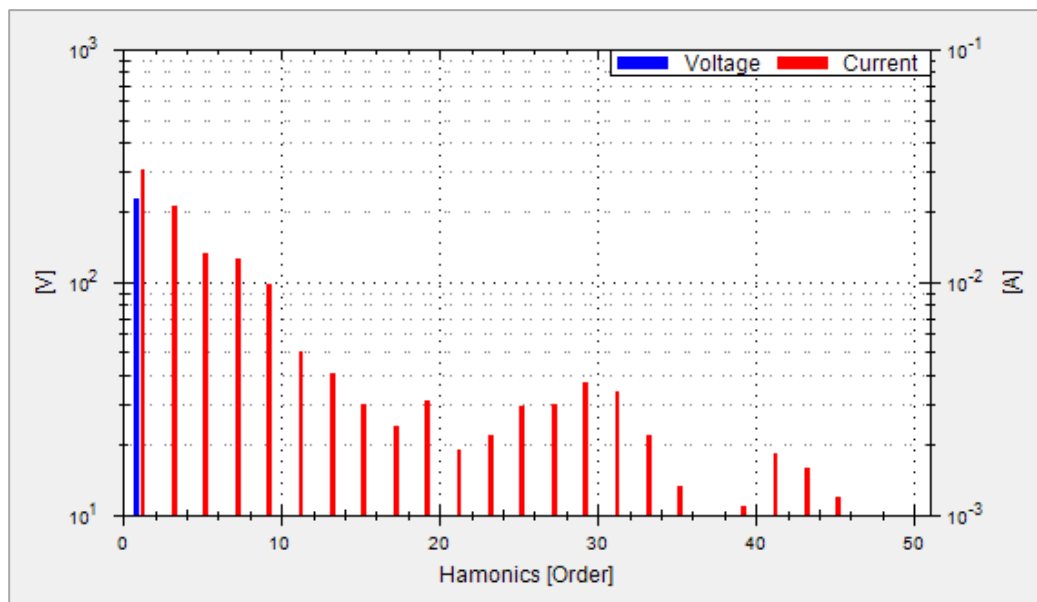
In the display mode „Harmonics", FFT is used to calculate the RMS value and phase angle of the harmonics. This includes a calculation of the first 50 harmonics (100kHz max.). Instead of the total RMS value, the bar graph display shows the voltage level (**Blue**) and the current level (**Red**) of the individual harmonics.
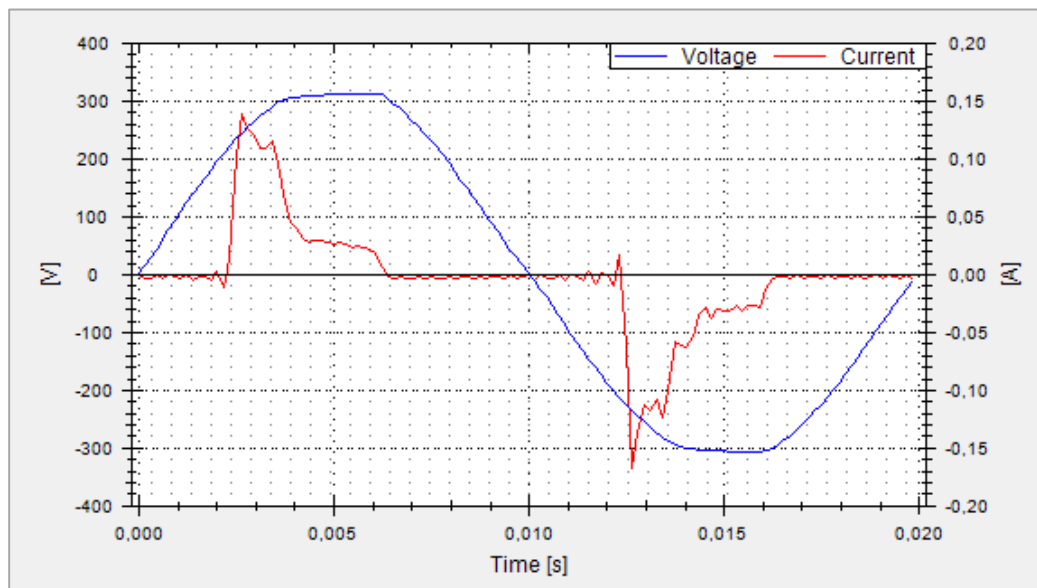
The graphical view is structured as follows:

- Y axis left = Voltage

- Y axis right = Current

- X axis = Display of the Harmonics

Waveform Mode

> ⓘ **The display mode „Waveform" is only available in conjunction with the HOC151 option (ex factory) resp. the HVC151 voucher.**

The "Waveform" display mode can be used to display the voltage (**blue**) and current (**red**) simultaneously as a trace on the screen (hardware-based triggering). Exactly one signal period is displayed in the measurement diagram and automatically scaled to the measuring range final value (100kHz max.).
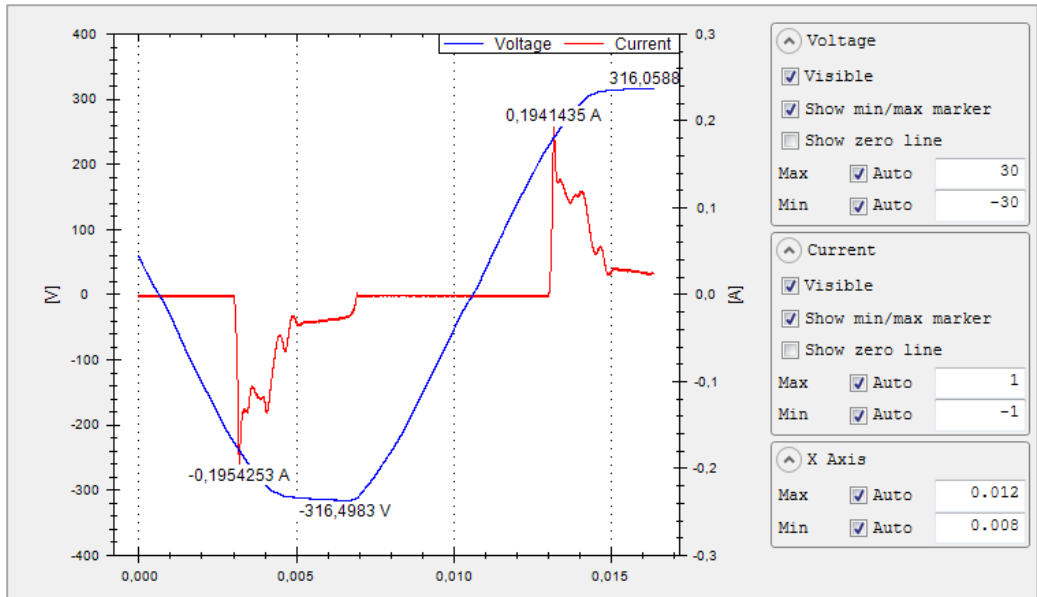
The graphical view is structured as follows:

- Y axis left = Voltage

- Y axis right = Current

- X axis = Time
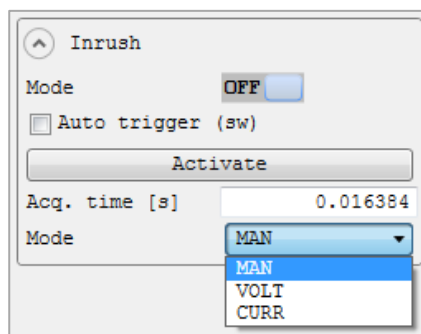
Inrush Mode

The display mode „Inrush" is only available in conjunction with the HOC151 option (ex factory) resp. the HVC151 voucher.

"Inrush" display mode uses an internal hardware buffer to trigger acquisition of a rare event and to output it to the display (similar to the single shot function found on oscilloscopes). This might be used to acquire inrush currents on loads, for example. After an event occurs, the current and voltage trends are acquired.

The graphical view is structured as follows:

- Y axis left = Voltage

- Y axis right = Current

- X axis = Time

The „Inrush" mode will be activated (scroll bar ON) resp. deactivated (scroll bar OFF) via "Inrush" menu and function "Mode". The trace display does not update dynamically. Instead, it must be updated manually by pressing button "Activate". The trace is updated each time the button is pressed (single shot).

> **(i)** If the display mode „Inrush" is activated via „Mode" (ON), the display modes „Waveform" and "Harmonics" will be disabled automatically.

If the function „Auto Trigger" is activated (checkbox selected), the trace display will be updated with the selected acquisition time („Acq. Time") automatically.

The sampling rate can also be varied to permit acquisition of signal sequences of over a minute. The following acquisition rates („Acq. Time") are available:

Sampling Rate	Acquisition Rate
500,00 kSa	16ms
250,00 kSa	32ms
125,00 kSa	65ms
62,50 kSa	130ms
31,25 kSa	260ms
15,63 kSa	520ms
7,81 kSa	1s
3,91 kSa	2s
1,95 kSa	4s
976,56 Sa	8s
488,28 Sa	16s
244,14 Sa	33s
122,07 Sa	67s
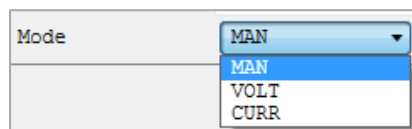
Via the drop-down menu „Mode" in the left menu section the trigger can be set to „VOLT" (voltage trace), „CURR" (current trace) or "MAN" (manual trigger selection).

Mode	VOLT
Slope	RIS
Level [V]	3.3

Mode	CURR
Slope	RIS
Level [A]	0.1

A threshold (function „Level") can also be set, as well as the offset between the rising (RIS) and falling edges (FALL) via drop-down menu „Slope".

(⌃) Voltage
☑ Visible
☑ Show min/max marker
☐ Show zero line

Max	☑ Auto	30
Min	☑ Auto	-30

(⌃) Current
☑ Visible
☑ Show min/max marker
☐ Show zero line

Max	☑ Auto	1
Min	☑ Auto	-1

(⌃) X Axis

Max	☑ Auto	0.012
Min	☑ Auto	0.008

Additional settings can be set in the menus on the right side of the Inrush trace display.

The function "Visible" is used to activate (checkbox selected) or disable the voltage (voltage menu) or current trace (current menu).

If the checkbox „Show Min/Max Marker" is selected in the voltage or current menu, the maximum values of the voltage or current trace can be displayed

If the checkbox „Show Zero Line" is selected in the voltage or current menu, the zero line (Y = 0) can be displayed.

Additionally, instead of the automatic X and Y axis scaling manual Min/Max values can be defined.