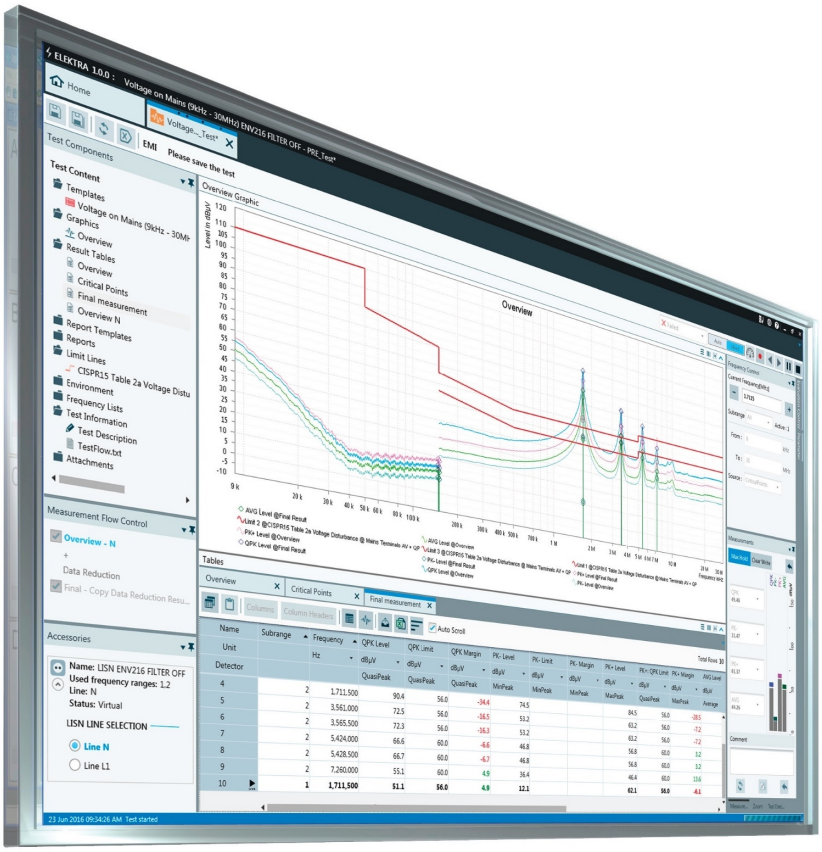
R&S®ELEKTRA
EMI Test Software
User Manual



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Test & Measurement

User Manual

ROHDE&SCHWARZ

This user manual describes the R&S®ELEKTRA EMI Test Software, order no. 5601.0030.02, for electromagnetic interference (EMI) tests.
Software version V1.30 and later

The software contained in this product uses several valuable open source software packages. For information, see the "Open Source Acknowledgment" document, which is available for download from the R&S ELEKTRA product page at "www.rohde-schwarz.com/product/elektra" > "Software".
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, for example R&S®ELEKTRA is indicated as R&S ELEKTRA.

Contents

1 Preface

R&S ELEKTRA is the Rohde & Schwarz system software for **e**lectro**m**agnetic **i**nterference measurements (**EMI** or "*emission*" tests).

This chapter introduces key features of the EMI Test Software, refers to the applicable test standards and provides an overview of the available documentation.

1.1 Key Features

R&S ELEKTRA is optimized for 64-bit Microsoft Windows operating systems, especially Windows 10 or later versions, but also works with Windows 7 or Windows 8.

It is designed to act as a virtual instrument.

The software combines the convenience of an intuitive graphical user interface with maximum flexibility. It includes touchscreen and remote operation, both for controlling test instrumentation and for running EMI tests.

R&S ELEKTRA provides high measurement speeds by using multi-threading technology. Enhanced data transfer with next generation EMI receivers enables handling the extended data volume of those receivers.

Among others, R&S ELEKTRA provides the following key features:

- Graphical user interface (GUI) with optional Touch Operation
- Template-based test preparation, measurement and report generation
- Storage of test results
- Simple selection of test templates, tables and devices, supported by an advanced search functionality
- Remote access to devices via LAN or GPIB
- Dynamic application extensions and device drivers
- Automated device search dialog
- Compatible with international harmonized EMI standards, guidelines & directives
- Enhanced usability for beginners and customer-specific solutions

1.2 EMI Standards

R&S ELEKTRA enables measuring electromagnetic interference in compliance with all relevant EMI standards worldwide.

It is not within the scope of this manual to reproduce those standards. Instead, obtain original information on the various standards, directives, rules, regulations, proceedings and associated publications, for example at the following websites:

- CISPR / IEC / ISO (international)
- EN / CENELEC / ETSI (Europe), FCC / CFR (USA), CCC (China), ...
- MIL-STD / EDSTAR / VG / DEF STAN / GAM (military)
- RTCA (aviation / airborne), BSI (wind turbines), DIN (special interest), ...

Among the standards listed above, CISPR (or the equivalent EN standards in Europe, see Table 1-1) are especially relevant for commercial applications. The US standard MIL-STD-461 is pivotal for military and aerospace applications (see Table 1-2).

Table 1-1: Overview of CISPR / EN standards

Publication	Description
CISPR 10	CISPR organization, rules and procedures
CISPR 11, EN 55011	Industrial, scientific and medical (ISM) equipment containing a radio-frequency generator: *Emission*
CISPR 12, EN 55012	Vehicles, motor boats and internal combustion engines: *Emission* - protection of **off**-board receivers
CISPR 13, EN 55013	Sound / television broadcast receivers and associated equipment: *Emission* (see CISPR 32)
CISPR 14-1, EN 55014-1	Household appliances, portable electrical tools and similar apparatus, part 1: *Emission*
CISPR 14-2, EN 55014-2	Household appliances, portable electrical tools and similar apparatus, part 2: *Immunity*
CISPR 15, EN 55015	Electrical lighting and similar equipment, for example fluorescent lamps: *Emission*
CISPR 16-1, EN 55016-1	*Specification* for EMI/EMS measurement apparatus and methods, part 1: *Apparatus*
CISPR 16-2, EN 55016-2	*Specification* for EMI/EMS measurement apparatus and methods, part 2: *Methods*
CISPR 16-3, EN 55016-3	*Specification* for EMI/EMS measurement apparatus and methods, part 3: *Reports*
CISPR 16-4, EN 55016-4	*Specification* for EMI/EMS measurement apparatus and methods, part 4: *Uncertainties*
CISPR 17, EN 55017	Measurement methods for the characteristics of suppression components, for example passive radio interference filters
CISPR 18, EN 55018	Overhead power lines and high-voltage equipment: *Emission*
CISPR 20, EN 55020	Sound / television broadcast receivers and associated equipment: *Immunity*
CISPR 22, EN 55022	Information technology equipment (ITE): *Emission* (see CISPR 32)
CISPR 24, EN 55024	Information technology equipment (ITE): *Immunity*

Publication	Description
CISPR 25, EN 55025	Vehicles, motor boats and internal combustion engines: *Emission* - protection of **on**-board receivers
CISPR 28	Industrial, scientific and medical (ISM) equipment containing a radio-frequency generator: *Emission within ITU bands*
CISPR 29	Electronic control gear for fluorescent lamps and discharge lamps
CISPR 32, EN 55032	Multimedia equipment: *Emission* (replaces CISPR 13 and CISPR 22 from the year 2017 on)
CISPR 35, EN 55035	Multimedia equipment: *Immunity* (replaces CISPR 20 and CISPR 24 from the year 2016 on, transition period until 2021)

Detailed guidance for users of the CISPR standards can be found on the Internet.

In contrast with civilian applications, testing to MIL-STD-461 is more expensive due to wider frequency ranges, higher EMS power levels, lower limits and the required higher sensitivity. It is typically also used for aerospace applications.

The following table shows an excerpt of MIL-STD-461 regarding EMI (emission) tests.

Table 1-2: Overview of MIL-STD-461

Test type	Requirement	Description
Conducted emission	CE101	Power leads, 30 Hz to 10 kHz
	CE102	Power leads, 10 kHz to 10 MHz
	CE106	Antenna terminal, 10 kHz to 40 GHz
Radiated emission	RE101	Magnetic field, 30 Hz to 100 kHz
	RE102	Electric field, 10 kHz to 18 GHz
	RE103	Antenna spurious and harmonic outputs, 10 kHz to 40 GHz

The requirements (CE101 through RE103) specified in Table 1-2 are assigned to the various areas of application as shown in Table 1-3.

Table 1-3: Application areas of MIL-STD-461 requirements

Equipment installed in, on, or launched from the following platforms	Requirement applicability					
	CE			RE		
	101	102	106	101	102	103
Surface ships	A	A	L	A	A	L
Submarines	A	A	L	A	A	L
Aircraft, army & flight line	A	A	L	A	A	L
Aircraft, navy	L	A	L	L	A	L
Aircraft, air force		A	L		A	L
Space systems & launch vehicles		A	L		A	L
Ground, army		A	L		A	L

Equipment installed in, on, or launched from the following platforms	Requirement applicability					
	CE			RE		
	101	102	106	101	102	103
Ground, navy		A	L		A	L
Ground, air force		A	L		A	L
A = Applicable, **L** = Limited as specified in the individual sections of this standard, **S** = Procuring activity must be specified in procurement documentation						

Table 1-4: History of MIL-STD-461 revisions

Publication	Year issued	Description
MIL-STD-461C	1986	Specific description of measurements and limits, as well as measurement equipment and methods. Note that using the most recent revision of MIL-STD-461 is not necessarily mandatory. The applicable revision is typically agreed upon in a commercial contract between producer and procuring authority.
MIL-STD-461D	1993	
MIL-STD-461E	1999	
MIL-STD-461F	2007	
MIL-STD-461G	2015	
The former MIL-STD-46**2**D (measurement equipment and methods, issued 1993) was canceled in 1999. From then on, MIL-STD-46**1** is referenced, as specified above.		

Besides MIL-STD-461, other US military standards exist that can be relevant for special applications, such as MIL-STD-449D, -464, -469A, -1310G, -1512, -1541A, -1542B, -1605, -1795A and -1857.

1.3 Documentation Overview

The documentation of R&S ELEKTRA comprises of:

- This user manual, which is available both in pdf format and in the context-sensitive help system embedded in the software. It provides explanations, step-by-step procedures, figures and examples to support users during their first experience with the software, from installation and configuration to the various EMI measurements.
- The website www.rohde-schwarz.com/product/elektra that provides
  - Key facts, features and options of R&S ELEKTRA
  - Rohde & Schwarz contacts for information, quotes and demos
  - Brochures and data sheets
  - Technical documentation (manuals and embedded help)
  - Application sheets, tips and tricks for R&S ELEKTRA
  - The current software version and release notes
  - News and information on software updates
  - Answers for frequently asked questions (FAQ)
  - Related products

Screenshots

Sample screenshots in this documentation are used to illustrate as much as possible of the functions provided by R&S ELEKTRA and of potential interdependencies between parameters. Note that:

- The values in these screenshots do **not** necessarily represent realistic test situations.
- The values must not at all be considered as recommended by Rohde & Schwarz.
- The screenshots shown can differ, depending on your particular equipment and configuration.

2 Software Installation

This chapter contains information on how to install R&S ELEKTRA, downloaded from **www.rohde-schwarz.com/software/elektra**. The installation of several different versions of R&S ELEKTRA on one local computer is possible.

Existing data sets of other software packages are not affected by R&S ELEKTRA. If any version of R&S ES-SCAN has previously been installed, it is not required to uninstall it before installing R&S ELEKTRA.

When the System Requirements are provided, R&S ELEKTRA can be installed: Follow the procedure described in Chapter 2.2, "Software Installation Procedure", on page 13. A wizard in the setup file `ELEKTRASetup_Vx.xx.exe` guides the installation.

2.1 System Requirements

Before installing R&S ELEKTRA, make sure that the computer meets the following minimum system requirements:

- Microsoft-Windows-based PC with Intel Core i5 processor
  or
  Laptop / tablet PC with Intel Core i7 processor
- Clock rate: at least 2 GHz (recommended)
- Memory: >8 GByte RAM recommended
- Storage: 250 GByte hard drive, solid-state disk (SSD) recommended
  Free storage: >50 GByte free drive space recommended
- One of the following 64-bit operating systems:
  - Windows 7
  - Windows 8
  - Windows 10 (recommended)
- Administrator access rights
- Super VGA monitor, display resolution of at least 1280 x 720 pixels, 65536 colors
- USB 2.0 interface
- 100 Mbit LAN interface

If your computer does not meet these requirements, the performance of the software can be impaired.

R&S VISA (virtual instrument software architecture) for control of the local area network (LAN) is included in the installation, but any VISA version already available on your computer can be used (optionally supporting GPIB, too).

If you install the software on a tablet computer and you need more USB ports than it provides, you can connect an external USB hub that offers more USB ports.

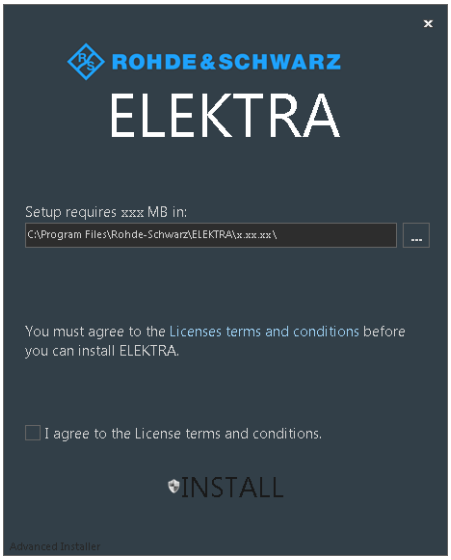
For connecting your tablet computer to the Ethernet, consider using a wireless LAN connection (Wi-Fi).

2.2 Software Installation Procedure

To install the software on a local computer or within a computer network:

1. Terminate other active programs (recommended).
   If any other instances of R&S ELEKTRA are active, be sure to terminate them.
2. In your browser, navigate to www.rohde-schwarz.com/de/produkt/elektra.
3. Download the R&S ELEKTRA setup file.
4. Navigate to your download directory.
5. Double-click `ELEKTRASetup_Vx.xx.exe`
6. Wait for the R&S ELEKTRA installation wizard to launch.
7. The wizard automatically checks the installation prerequisites:
   - Microsoft .NET Framework 4.6.2
   - Visual C++ 2010 SP1 Redistributable x64
   - Visual C++ 2012 Redistributable x64
   - Firebird Server 3.0 (64-bit)
   - R&S License Key Manager
   - R&S License Server
   - R&S Smart Card Minidriver
   - R&S VISA
   - VISA Shared Components

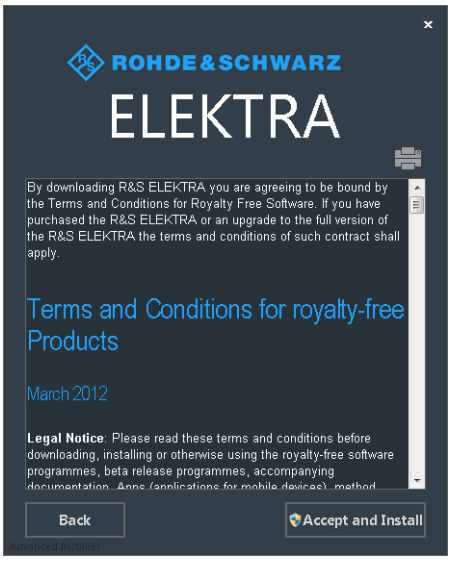
   If any of these programs in the required versions are missing on the computer, the wizard installs them in a background process.
   Depending on the installation environment, the wizard can bring up additional messages. In this case, proceed as indicated.
8. The installation wizard brings up the following dialog:



To continue the installation, the software expects you to agree to the license terms and conditions.
If you know the content and agree with it, activate the checkbox, click "INSTALL" and proceed with step 11.

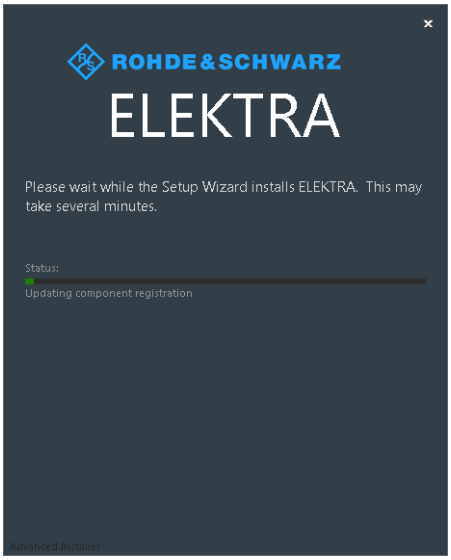
9. Otherwise click the link for "Licenses terms and conditions" to read them.

   The following "End User License Agreement" (EULA) comes up:



   If you wish to print the license text, click the printer icon on top of the text.

10. To continue the installation, select "Accept and Install".
11. Wait while the wizard executes the installation of R&S ELEKTRA:



12. If the wizard finds one or more **previous** installations of R&S ELEKTRA, it prompts you with a dialog for either installing a clean new database or copying existing data into the database of your new installation:

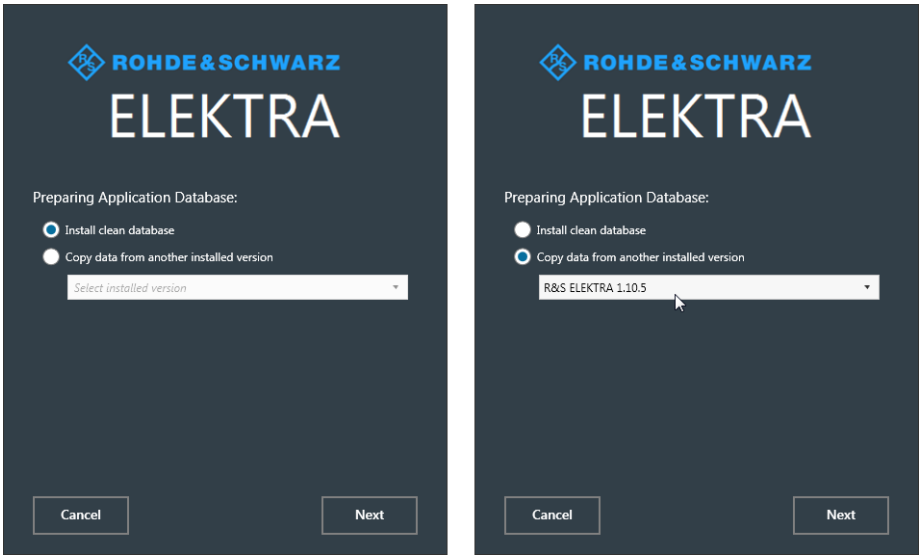
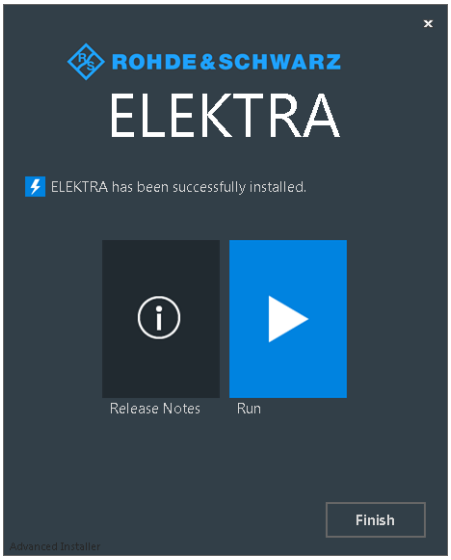


Figure 2-1: Dialog for installing a clean database (left) or copying an older database (right)

Select your preference as in the figure above.

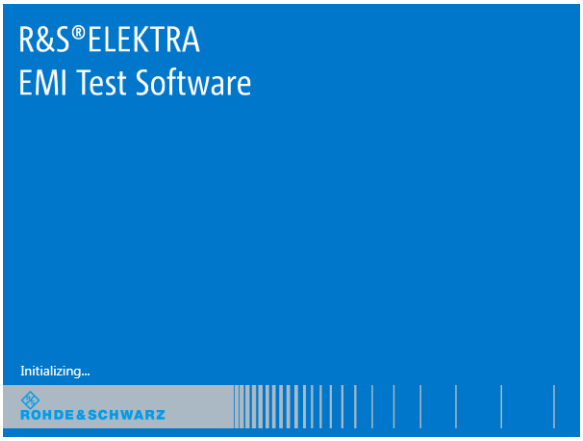
13. Click "Next" to proceed without or with copying data from a previous database, according to your selection.
14. In the final setup dialog, select how to complete the installation:



Select one of the following actions:

- Open the "Release Notes" document.
- "Run" the software.
- "Finish" the installation.

Once the Software Installation is completed, double-click the new desktop icon to start R&S ELEKTRA:



2.3 License Dongle

R&S ELEKTRA is protected by encryption. The software can only be started with licenses installed, if the **R&S EMCPC license dongle** is connected to the computer. This dongle is a mini smart card reader within a USB flash drive that contains a license smart card. It unlocks the license that has been activated for your R&S ELEKTRA serial number.

If your computer has a smart card reader slot, you can directly insert the license smart card into this slot, without using the dongle, as described in Chapter 2.3.1, "Using the Smart Card Reader", on page 17.

To start R&S ELEKTRA with your set of licenses, connect the license dongle to a USB port of your computer.

If you start R&S ELEKTRA without the license dongle connected, the software can only run in demo mode. The following dialog comes up:

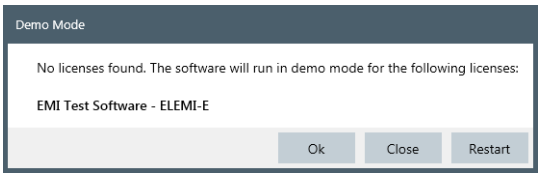


Figure 2-2: Message if there is a missing license dongle

In this dialog, you can select how to proceed:

- **"OK"**: Run R&S ELEKTRA without licenses, hence, in demo mode. No physical measurements can be made, but you can execute tests with simulated data.
- **"Close"**: Shut down the software.
- **"Restart"**: Using this button is the easiest procedure, if you have not yet connected the license dongle, but the dialog just reminded you of doing it now.
  Insert the license dongle to a USB port of your computer, then click "Restart". The software shuts down and automatically restarts.
  With the license dongle connected, the "Demo Mode" dialog does not come up. Instead, the software starts with the licenses available on the dongle, see License Key Manager.

2.3.1 Using the Smart Card Reader

The R&S ELEKTRA software requires a smart card containing the software license to be connected to the PC when you are using the software. The R&S EMCPC license dongle that contains the software license consists of a smart card and a USB dongle. The smart card can be used in the supplied USB dongle or in a smart card reader. The R&S EMCPC license dongle is available as a separate product and *must be ordered in addition to the software*.

You can connect the smart card in two ways.

- Connect the smart card in SIM format.
  To connect the smart card in SIM format, use the USB smart card reader (dongle) provided with the smart card.
- Connect the smart card in its full format.
  To connect the smart card in full format, an interface compatible to the card format is required.

The following devices are able to read the smart card in full format.

– Smart card reader integrated in a keyboard, notebook, or in a desktop PC (e.g. OMNIKEY)
– Smart card reader connected to the computer via serial bus or USB (e.g. OMNIKEY)
– USB reader connected to a LAN-to-USB converter to distribute the license via the network (e.g DIGI AnywhereUSB/2)

Licensing support

If you have any difficulties with the licensing system, support is only assured when you are using the R&S EMCPC license dongle.

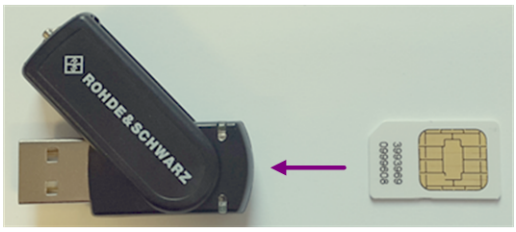
Using the R&S EMCPC USB smart card reader (dongle)

1. The R&S EMCPC license dongle consists of a smart card in full format and a USB smart card reader (dongle).

2. Break out the smart card in SIM format.

3. Twist out the upper part of the smart card reader.

4. Insert the smart card with the chip facing upwards and the angled corner facing the USB dongle, whose "Rohde & Schwarz" label is also facing upwards.



Insert the smart card as far as possible.

5. Twist the smart card reader back into its original state.

The smart card reader is ready for use on any USB interface.

Drivers

When you connect the reader to the computer, MS Windows automatically installs the necessary drivers. If not, you can install the drivers manually from the Internet site of the manufacturer at http://support.identiv.com/utrust-token-standard/.

Problems during login due to smart card reader

When the smart card reader is connected, the operating system may falsely identify the smart card as a medium to perform a login procedure on the PC. In this case, the windows lock screen is displayed instead of a login window.

You can solve this issue by editing the "DisableCAD" ("Disable Ctrl-Alt-Del") registry key in the system registry. This key is located at `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\policies\system`.

Administration rights

Security policies of your network environment might prevent you from editing the system registry or installing drivers. Contact your IT administration in that case.

To change the registry key

1. From the Windows "Start Menu", select the "Run" item.
   (Windows 10: "Start > All applications > Windows System > Run")
2. Enter `regedit` in the dialog box to open the system registry.
3. Look for
   `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\policies\system`.
4. Set the value of `DisableCad` to *0*.

2.4 Configuration Wizard for Creating Basic Data

In the original delivery state of R&S ELEKTRA, the newly installed database is empty. To prepare some basic data for tests, you can run a special wizard tool at any time: The "Configuration Wizard" is designed to generate only dedicated content for your use cases, to avoid overstuffing the database with unnecessary data. Such a customer-specific software setup facilitates the process of getting started with the required EMI tests.

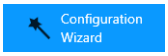
Avoid overstuffing the database

We recommend not to create more data than necessary. One reason for limiting the number of entries that you let the wizard create is this: With more data subsets, deleting device entries from the Device List becomes very complex due to interdependencies between related entries. For example, test templates that have references to specific devices prevent deleting these device entries.

Instead, you can always come back to the wizard and let it additionally create a new individual entry that you may require at a later time.

Depending on your test scenarios, instruct the wizard to load sets of suitable data into the database. This data includes the appropriate limit lines, device drivers, specific test templates for the applicable standards, and the like.

The "Configuration Wizard" is available as follows:

- From any dialog, by going to "Home" > "Tools" > "Configuration Wizard".
  

- In the Welcome screen with configuration wizard for creating sample test data, which is optionally shown on startup of the software:

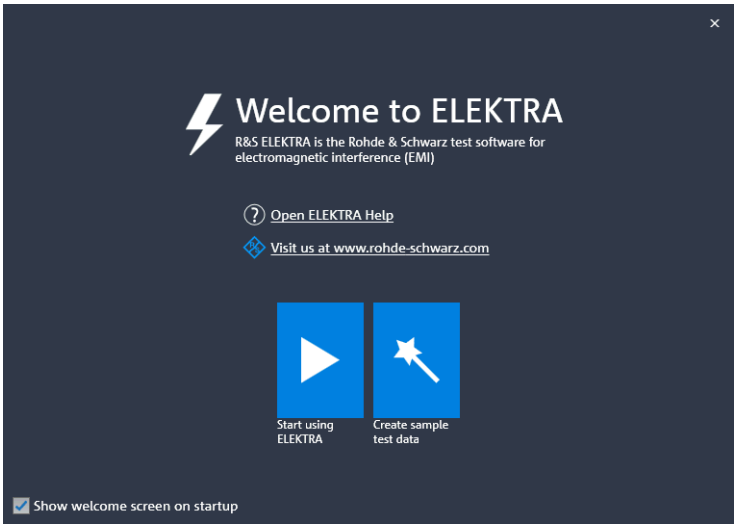
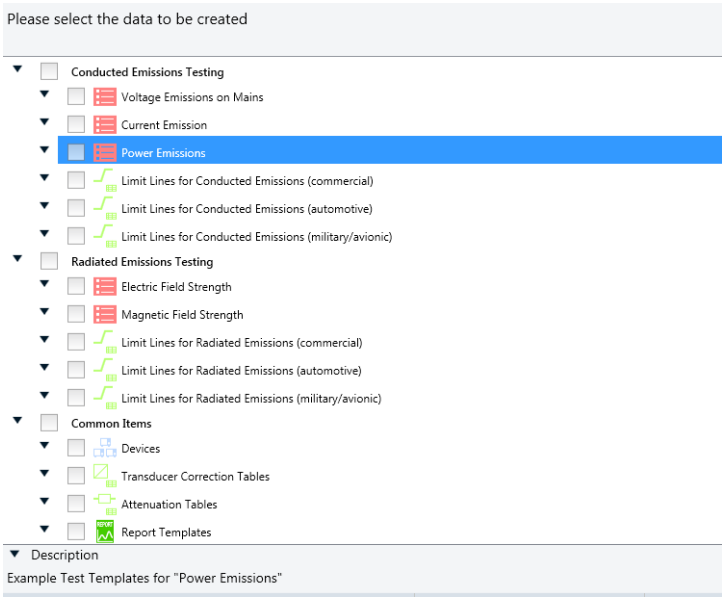


Figure 2-3: Welcome screen with configuration wizard for creating sample test data

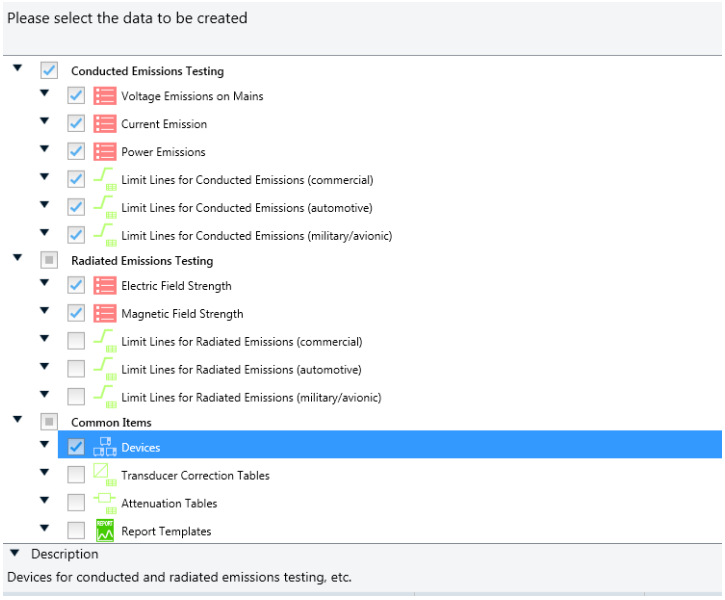
From the welcome screen, you can skip the wizard and run R&S ELEKTRA without creating basic data, by selecting "Start using ELEKTRA". Otherwise, select "Create sample test data".

To execute the "Configuration Wizard", proceed as follows:

1. Start with the following dialog:

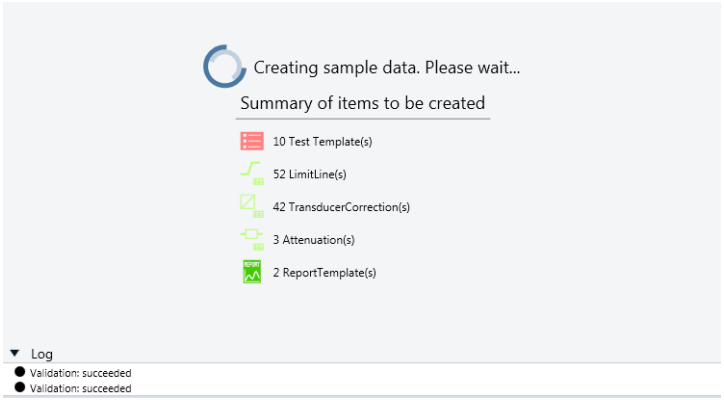


2. Select all data that you want the wizard to create:



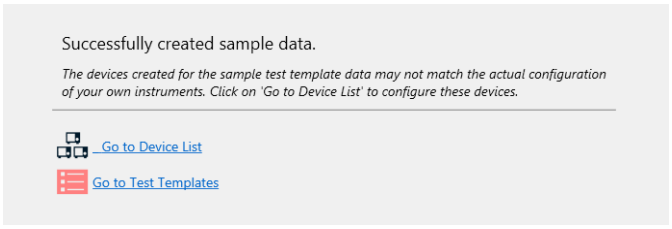
3. Click "Finish & Execute" to complete the procedure.

   The wizard creates sample data:



4. Wait for the wizard to complete the sample data creation.

   When this process is completed, R&S ELEKTRA shows the following dialog:



5. Optionally click "Log" to see information about the creation procedure.
6. Click "Go to ..." or "Done" or "Close" to leave this dialog.

2.4.1 Recovering Data

If R&S ELEKTRA crashes or is shut down unexpectedly during a running test, the software automatically tries to recover data that was not saved. The restarted R&S ELEKTRA brings up a dialog that asks you how to proceed with recovered items:

- "Keep" = Recover the data (hence, save it to the database)
- "View" = Open a dialog to view, edit and save the data
- "Discard" = Delete the data (hence, the data is not recovered)

The recovery feature's auto save function is executed approximately every 5 minutes. Even if data recovery is possible, any data that was created within the last few minutes (up to 5 minutes) before the shut-down can still be lost.

2.5 Language Selection

To adjust the language setting, especially when running R&S ELEKTRA for the first time, click the globe symbol and select your language:

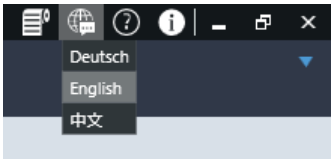


Figure 2-4: Language options are German / English / Chinese

Upon selecting a language that is different from the current setting, a dialog opens to let you decide:

- "No": The dialog closes and the software remains active with the previous language setting.
- "Yes": R&S ELEKTRA immediately shuts down and restarts to activate the new language setting.

The help content (accessible via F1 or) is only available in English, independent of the selected language.

2.6 Migration Tool - XML Data Converter

Access:
`C:\Program Files\Rohde-Schwarz\ELEKTRA\x.xx.xx\ELEKTRAMigrationTool.exe`

Or use the MS Windows "Start" button > All programs > R&S ELEKTRA > x.xx.xx > `ELEKTRA x.xx.xx Migration Tool`

The "ELEKTRA Migration Tool" converts data from R&S ES-SCAN to XML data for R&S ELEKTRA.

To convert data from a previous version of R&S ELEKTRA to a current version, use the "Export" and "Import" functions in R&S ELEKTRA.

Previous EMI Test Software products like R&S ES-SCAN are based on a file system that allows editing data manually. In contrast, R&S ELEKTRA is based on a database that does not permit direct user access to any data or file content. To view or modify data, always use the functions provided by the user interface of R&S ELEKTRA. For more information, see Test Container.

To convert data from R&S ES-SCAN to an XML format that can be interpreted by R&S ELEKTRA, run the program `ELEKTRAMigrationTool.exe`. A two-step dialog comes up: first select the source application, which is R&S ES-SCAN, then select the data folder:

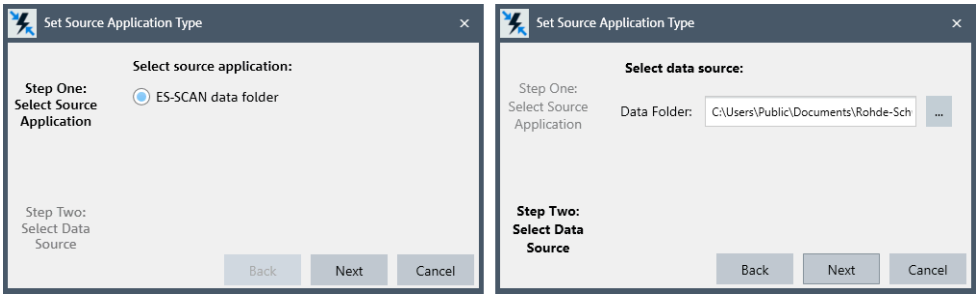


Figure 2-5: Selecting an R&S ES-SCAN data folder as the source for data migration

In Figure 2-5, in the dialog on the left-hand side, click "Next". In the dialog on the right-hand side, select a "Data Folder" that contains files generated by R&S ES-SCAN, then click "Next".

Make sure that the `C:\ProgramData` folder, which contains the data files, is not hidden. To do so, verify the folder properties in Windows Explorer: If the folder has the attribute "hidden", uncheck this attribute.

With your source data selection, R&S ELEKTRA prepares the appropriate settings in the following dialog window:

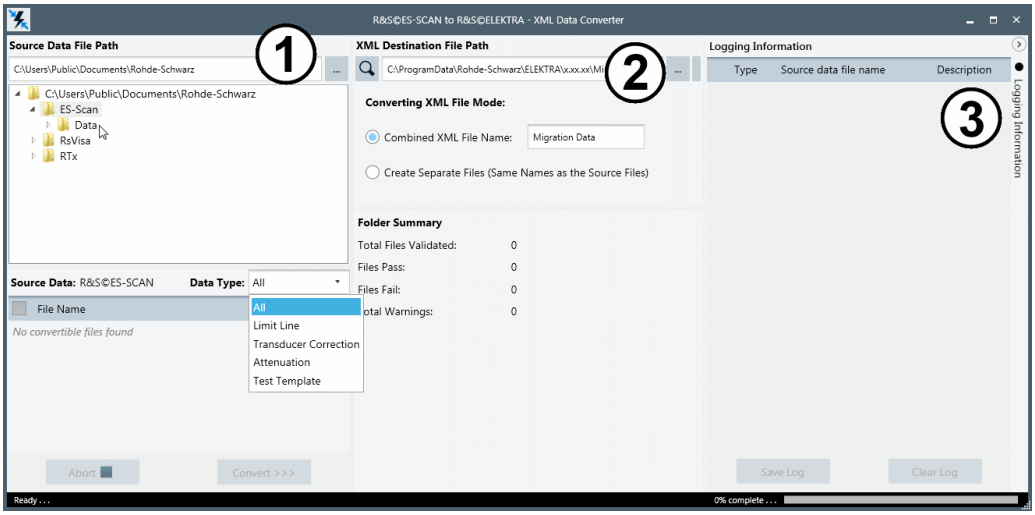


Figure 2-6: Start window of the XML data converter

1 = Selection of the "Source Data File Path"
2 = Selection of the "XML Destination File Path"
3 = Logging information (can be hidden)

You can select the "Source Data File Path" (1) in detail. For example, let the tool only migrate files from specific subdirectories. Additionally, in the "Data Type" drop-down list, you can select to migrate "All" or specific data types, such as "Limit Lines" or "Test Templates", only.

The selections described above determine the list of "Source Data" files that are available for migration:

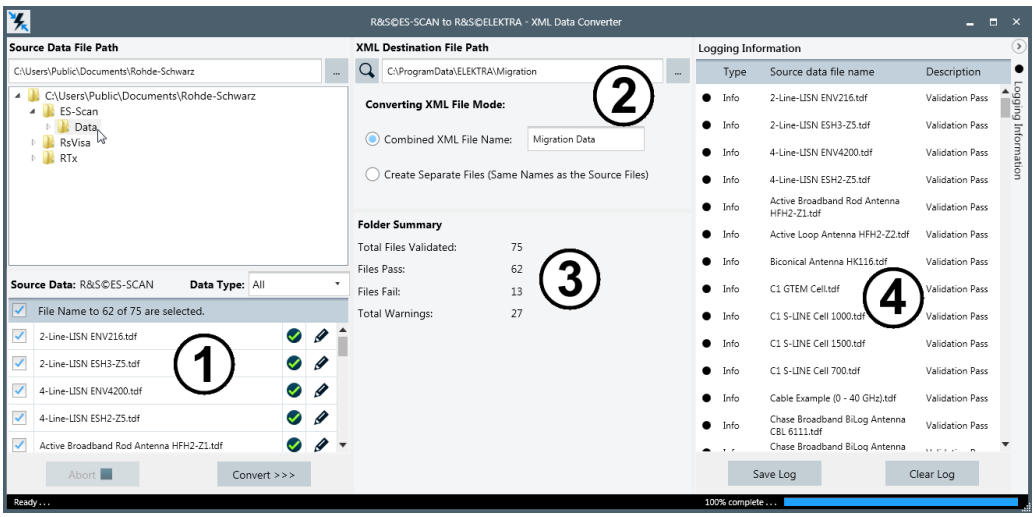


Figure 2-7: Source data selected for conversion to XML data

1 = Selection of "Source Data" files
2 = Selection of the "Converting XML File Mode"
3 = "Folder Summary"
4 = List of "Logging Information"

In the list of "Source Data" files (1), you can select the available files individually. In this dialog section, if you check the checkbox on top of the list, the tool selects all files that have passed validation (see sections (3) and (4) in Figure 2-7).

In section (2), specify a destination path for saving the result of the data migration. Also specify in this dialog, if you want the migration tool to create one combined XML file containing all the converted data or separate XML files.

Section (3) provides a summary of the folder's content. R&S ELEKTRA validates the available files and lists their "Logging Information" (4). It shows either "Validation Pass" or briefly describes any issues.

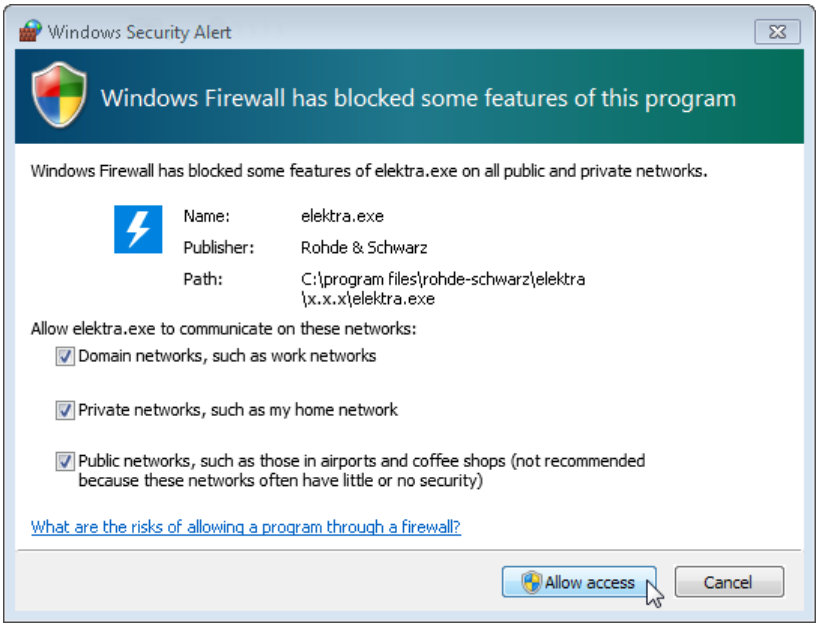
When the data selection, validation and destination are completed, click "Convert > > >".

The migration tool executes the XML data conversion and shows a "Conversion Report".

As a result, XML files that contain the converted data are now available for import, as described in Chapter 4.8.2, "Import", on page 129.

2.7 Network Firewall Settings

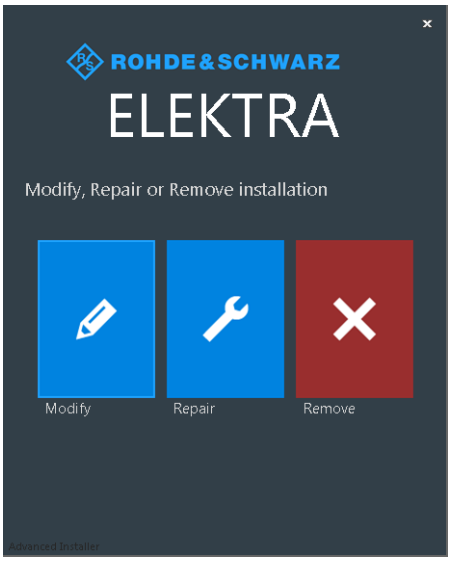
At some point in time, typically while configuring devices or during a first measurement, the Windows firewall system brings up the following security alert:



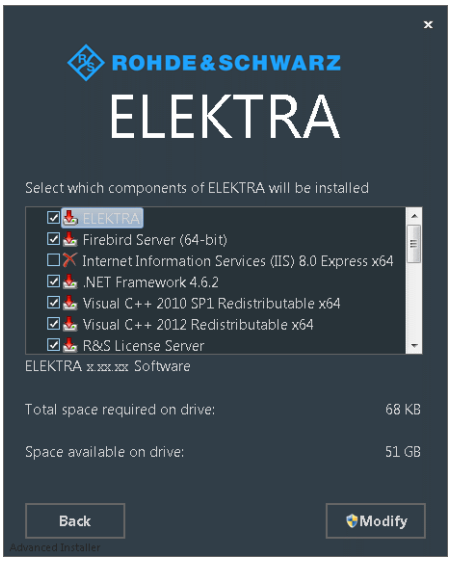
Tick all checkboxes to make sure that R&S ELEKTRA can communicate with devices in any kind of network. Then click "Allow access".

2.8 Modify, Repair or Remove Installation

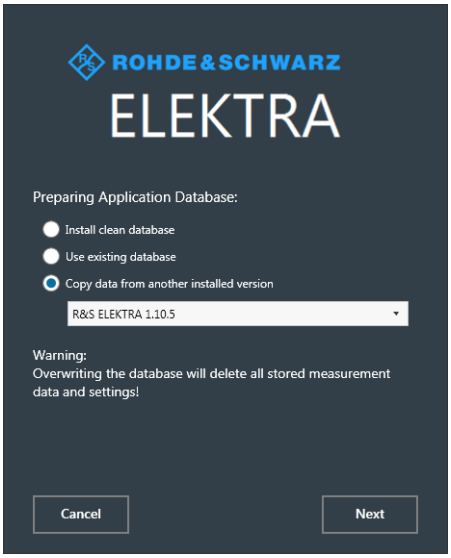
If R&S ELEKTRA is already installed, rerunning `ElektraSetup_Vx.xx.exe` for the same software version does not overwrite the installation, but calls up a wizard to modify, repair or remove it:



- **"Modify"** brings up a dialog for custom selection of desired components to be installed:



  To execute the installation of custom selected components, click "Modify".
  In the next step, if the wizard finds one or more previous installations of R&S ELEKTRA, it prompts you with a dialog for handling the database of this installation:



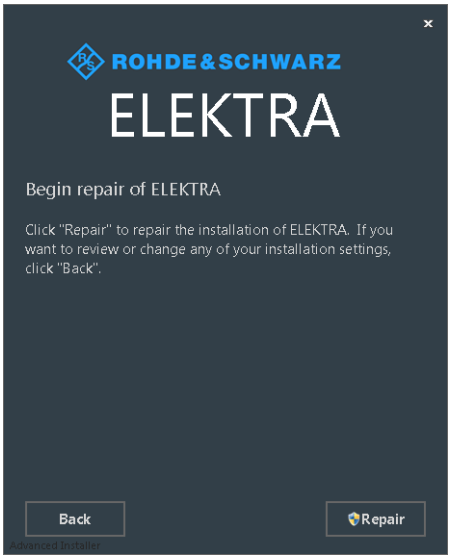
– "Install clean database" resets your database to the clean state of the first installation of this version. If you have generated new data in the meanwhile, it gets lost with this selection.
– "Use existing database" leaves your current database unchanged.
– "Copy data from another installed version" overwrites your current database (which may be empty or not) with a copy of data from the selected older installation.

NOTICE

Loss of settings and measurements

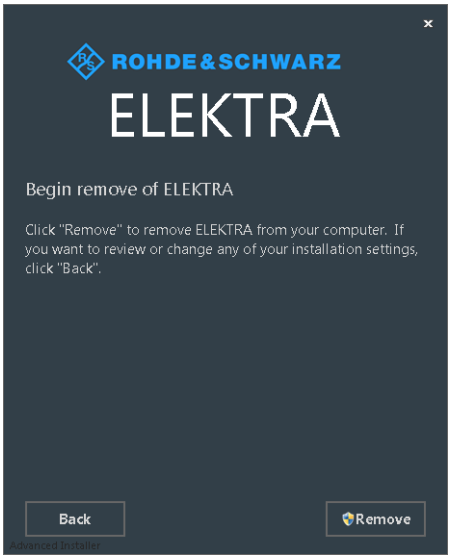
If you have already generated any data in the current database (settings and measurements), this data gets lost, if you select "Install clean database" or "Copy data from another installed version". If you do not wish to overwrite any data, select "Use existing database".

- **"Repair"** brings up a dialog for running an installation repair routine:



To execute the repair procedure, click "Repair". This selection leaves your current database unchanged.

- **"Remove"** brings up a dialog for removing R&S ELEKTRA from the computer:



To execute the removal procedure, click "Remove".

Removing / uninstalling the software does not delete the database.

However, migrating to a different (higher) version of R&S ELEKTRA can require to copy the database of the previous (lower) version of R&S ELEKTRA, as described in step 12 of the installation procedure.

Alternatively, you can Export old data and Import it into the new version of R&S ELEKTRA.

3 Getting Started

This chapter guides through the basic steps of operating the software. Starting with an overview of the software structure and the user interface, it describes the test preparation, test execution, results evaluation and reporting.

Software structure overview

To understand the interaction of the main components for EMI tests in R&S ELEKTRA and their Configuration, it is important to know the specific hierarchy that they follow:

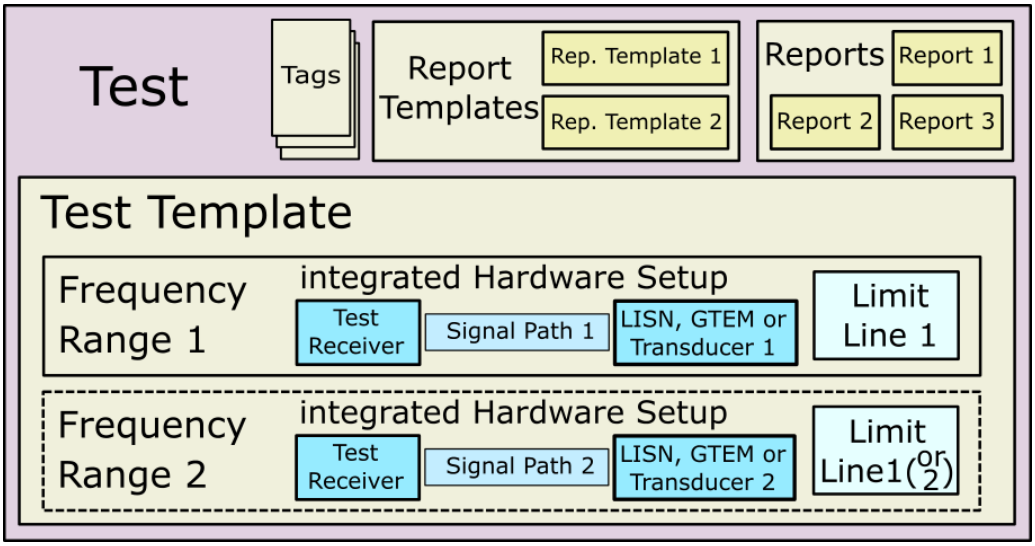


Figure 3-1: Hierarchy of main components within R&S ELEKTRA

What does this figure tell about components in the various hierarchical levels?

For example, the test is on the highest level of hierarchy. It can contain every other component (tags, reports, test templates, devices, etc.), but it cannot be contained in any of those components. The following list gives a complete overview.

A **test** is generated and stored in the database as a unique set of data, which is also called the Test Container. It contains:

- *Exactly one copy* of a **test template**, which can be split into several **frequency ranges**, each containing a **limit line** and a hardware setup with *references* to the following components in the **Device List**:
  - The Test Receiver
  - A Signal Path
  - A LISN, Transducer or TEM Waveguide
- Optionally one or several **report templates** for generating an arbitrary number of **reports**, which are exclusively contained in a test.
- Optionally one or several **user tags**

Where do the *components integrated in a Test Container* come from?

Integrated components are either **newly created**, or **copies**, or **references**.

In detail:

- Those components, which are **newly created** for a test, or which are **copies** of original components in a list of items, include:
  - The test template
  - Report templates
  - Reports (which are, however, never copied, but always newly created out of report templates)
- Those components, which are **references**, include:
  - Limit lines within the test template

  ...and references that link to *items in the Device List*:
  - The receiver
  - The signal path
  - The LISN, transducer or TEM waveguide

From Figure 3-1, you can see how these components are integrated into each other on different hierarchical levels. From the note above, you can see where the components come from. To summarize this structure:

- References for the receiver, the signal path, the transducing device and the limit line are part of the test template and its integrated hardware setups.
- The copy of a test template is integrated into a test, which is stored as a Test Container.
- Reports are created from report templates to compile test results. Reports are exclusively stored in the test container.

For an illustrative example, see Chapter 8, "Measurement Examples", on page 167.

The **configuration** of all components is described in detail in Chapter 4, "Configuration", on page 45.

The following sections explain how to get started with:

3.1 Graphical User Interface

R&S ELEKTRA features a graphical user interface (GUI) in a versatile design. The main dialog is the "Dashboard", which is always available via "Home" > "Dashboard"

from any other dialog. The "Dashboard" dialog provides direct access to all software components.

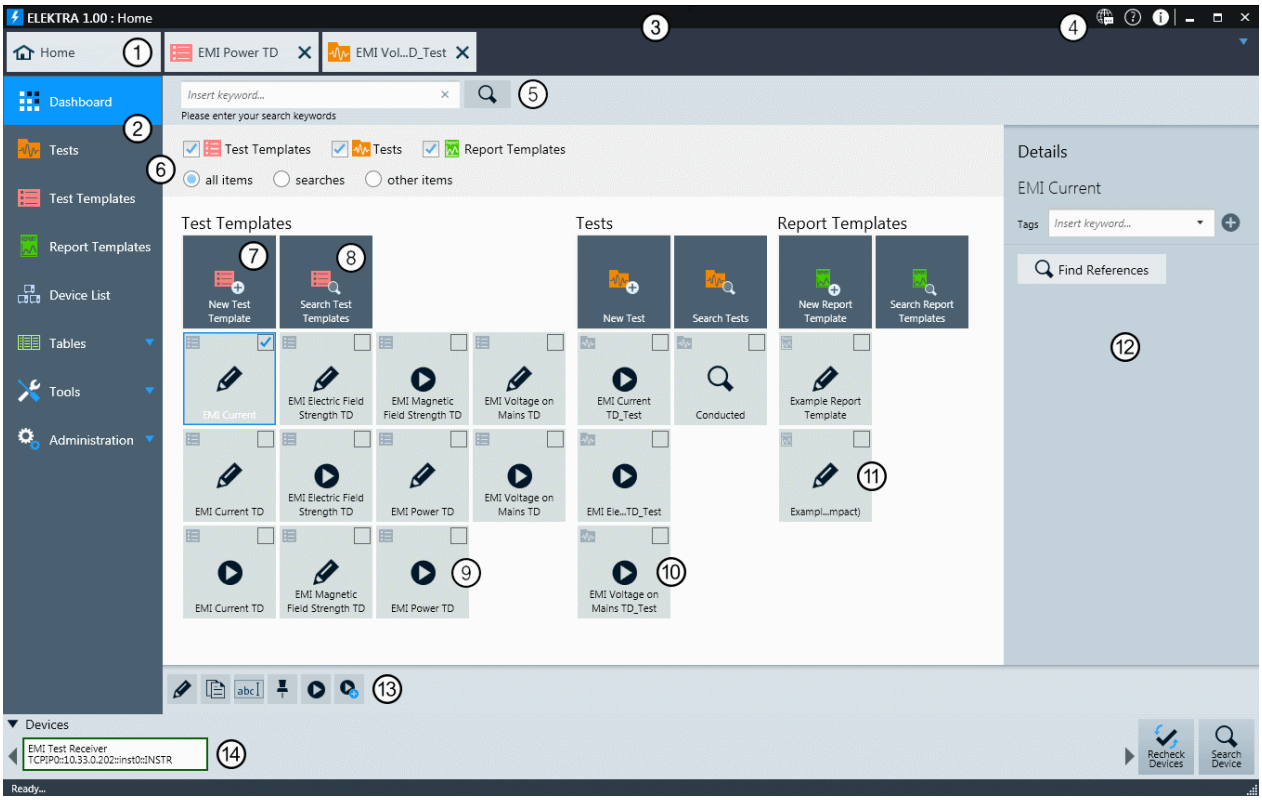


Figure 3-2: The Dashboard dialog

1 = Tab bar area with the "Home" button, which brings up the home menu (2) with the most recently selected dialog (here: the "Dashboard"). Next to the home button, two more tabs are available in the tab bar area in this example: a test template and a test
2 = Home Menu with the "Dashboard" dialog currently selected (highlighted in blue). Buttons for other dialogs are below: "Tests", "Test Templates" etc.
3 = Title bar
4 = Global function buttons in the title bar, see Home Menu
5 = Search field, here for searching among the pinned items in the "Dashboard", see (9), (10) and (11)
6 = Items selector in the "Dashboard" dialog, see Pin to Dashboard
7 = Create button (here for a new test template). To the right: equivalent buttons for creating other items
8 = Search button (here for "Test Templates"). To the right: equivalent buttons for searching other items
9 = Pinned "Test Templates", with the first one being selected (checkbox, blue frame and text in white font) and some others being "Pinned as New Test Direct" (for "Create test from template"), see EMI Tests
10 = Pinned "Tests", with the last one being a search result list for tests with the keyword "Conducted"
11 = Pinned "Report Templates"
12 = Item details, shows details of the selected "Test Template" (9)
13 = Actions bar, contains action buttons for all actions that can be executed for the selected one or more items, here a "Test Template" (9)
14 = Device status bar, shows connectivity status of devices in the Device List and allows checking or searching for connections

The "Dashboard" dialog shown in the figure above summarizes your pinned (favorite) items in the following categories:

- "Test Templates"
- "Tests"

- "Report Templates"

Instead of executing an action in the **individual** dialog of any of these items, most actions can also be executed in the "Home" > **"Dashboard"** dialog: Check an item's checkbox and click the required action button.

As a prerequisite, the item must be pinned to the "Dashboard".

A pinned item can have one of the following functions:

- 

  It can act as a link for **opening this item**.

- 

  It can act as a link for **creating a test** from a test template.

- 

  It can act as a link for **opening a pinned search**.

In the home menu (labeled (2) in Figure 3-2), below the "Dashboard" button, you have access to the following software components:

- Tests
- Test Templates
- Report Templates
- Device List
- Tables
- Tools
- Administration

For details on how to work with these components, see the chapters listed above as well as Chapter 4, "Configuration", on page 45 and Chapter 6, "Special Software Features", on page 143.

3.2 Common Action Buttons

This chapter describes the usage of several common action buttons that are available in many dialog windows of R&S ELEKTRA. The buttons are located in the actions bar

of the Graphical User Interface. Some action buttons are also located directly in each row of the list of items.

The available set of buttons depends on the exact selection and type of items. An example is shown in Figure 3-3:

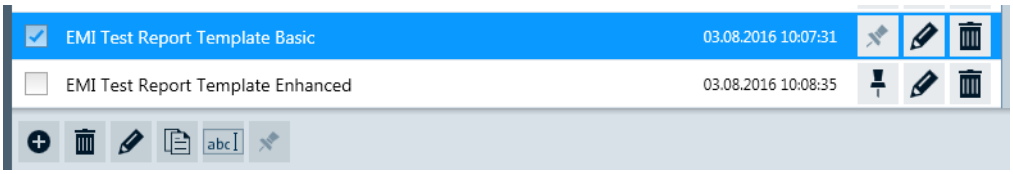


Figure 3-3: Example of some action buttons that are available for a selected report template

For details on how to handle the other, dialog-specific action buttons, see Chapter 4, "Configuration", on page 45 and its subchapters:

- Chapter 4.3, "Tests", on page 47
- Chapter 4.4, "Test Templates ", on page 64, especially section Handling test template items
- Chapter 4.5, "Report Templates", on page 94
- **Chapter 4.6.1, "Action Buttons in the Device List", on page 98** (different from the action buttons described below)

Save (in component configuration dialogs, tables and tests)
Saves the configuration you defined, for example in a new test template, or saves a completed test. If you have changed any settings, you can leave but not close the dialog. To close a changed configuration dialog or an executed test, you must decide if you want to save or discard the changes or measurement results.

R&S ELEKTRA supports the shortcut key "CTRL + S" for the "Save" command.

Save (in Administration settings dialogs)
Saves the changes you made, for example at Administration > "Graphic Settings". If you leave this dialog without saving, the changes in your settings have no effect and are lost upon shutting down R&S ELEKTRA.

The shortcut key "CTRL + S" is not supported.

Save As
Saves a configured component with a name you can specify. Only available, if the component has been saved before.

R&S ELEKTRA supports the shortcut key "F12" for the "Save As" command in component configuration dialogs, tables and tests.

Discard all Changes
Resets your changes in a settings dialog to the previously saved values.

Reset to Default
Overwrites any changes you made in a settings dialog with preset default values.

Select ...
To select any existing item (typically a row in a table), either directly click this item, or click the item's checkbox.

- Clicking checkboxes allows both multiple selections and unselecting items.
- To Rename an item, click the item name.

Depending on the selection and type of items, additional action buttons are displayed.

Note: For a disambiguation of the term "select", see Select / Create New / Edit.

Pin to Dashboard
Adds ("pins") the selected one or more items to the "Dashboard". Multiple selected items can be pinned simultaneously. Once pinned, the icon changes to .

For the special version of this button, called "Pin to Dashboard as New Test Direct" (as opposed to), see Handling test template items.

Note: Instead of pinning individual items to the "Dashboard" dialog, they can also be included there by a pinned Search.

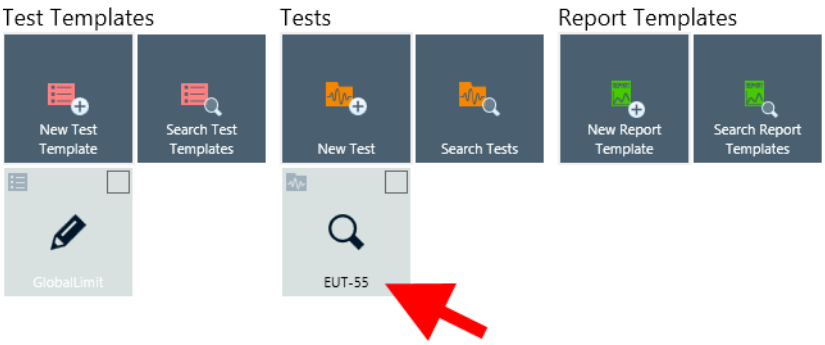


Figure 3-4: A search labeled "EUT-55" is pinned to the "Dashboard"

Clicking such a pinned search brings up a list of search results, see Figure 6-1.

Unpin from Dashboard
Removes ("unpins") the selected one or more items from the "Dashboard". Multiple selected items can be unpinned simultaneously. Once unpinned, the icon changes to .

For the special version of this button, called "Unpin from Dashboard as New Test Direct" (as opposed to), see Handling test template items.

Open
Click "Open" to view, configure, edit or evaluate the selected item or items. Multiple selected items can be opened simultaneously.

Delete
Click "Delete" to delete the selected item or items. Deletion is protected by the following alert: "Are you sure you want to delete the selected item(s)?" Confirm with "OK" or "Cancel" the deletion process. Multiple selected items can be deleted simultaneously.

Create ...
Generates a new item of a type that depends on the current dialog context. In some cases, the type of item must be selected from a list, before the dialog for specifying the new item opens. If any content in such a dialog is entered or changed, this state is marked in the dialog's tab by an asterisk (*), which disappears upon saving.

A new item must be saved to keep the entries, or it can be closed without saving to discard the entries. Closing an item without saving is protected by the following alert: "Would you like to save your changes?" Options are "Save", "Don't Save" or "Cancel" to return to the dialog without saving.

Copy
Generates an identical copy of the selected item or items. The new copy of an item is listed with the addition "- Copy" in its name, or "- Copy (1)" etc., if previous copies exist. Multiple selected items can be copied simultaneously.

Rename
Edit the name of any single selected item. Alternatively, the name can be clicked directly to edit it:

Import ...
Only available for Tables. Imports a table from an external file into the R&S ELEKTRA database as described in "Importing tables" on page 123.

Select / Create New / Edit
In many cases, the ... button brings up a dialog for **selecting** an item. Depending on the context, you can **create** an item of the same type, **add** a device, **edit** or **rename** one of the listed items. To quit from this dialog, click "Cancel".

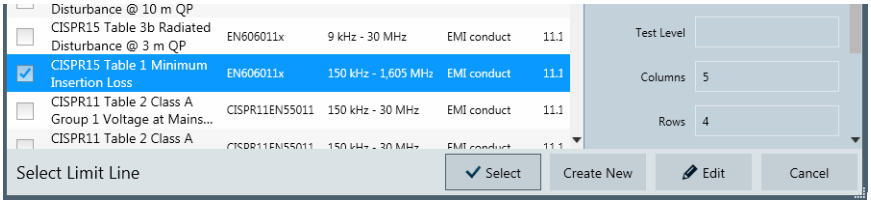


Figure 3-5: Example of selecting a limit line - with additional options "Create New" or "Edit"

Note: The term "to select" has an ambiguous meaning, illustrated in Figure 3-5:
1.) The item highlighted in blue is "selected" (or marked) by clicking the checkbox or the row.

2.) To use this item in a given context, it can be "selected" (or adopted) by the "Select" button:

Most of the Common Action Buttons require to select an item in the first meaning of "marking" it, to decide what to do next with this item.

However, in the remainder of this manual, "selecting" an item typically has the second meaning of "adopting" it for further usage. For example, select a limit line to integrate it into a test template.

Details
To see information details of an item in any components dialog (for example "Home" > "Tests"), select the checkbox at the left end of the item's row. This selection brings up a "Details" list in the right part of the components dialog.

To see information details of a pinned item in the "Dashboard" dialog, select the checkbox in the top right corner of the component's icon. This selection brings up a "Details" list in the right part of the "Dashboard" dialog.

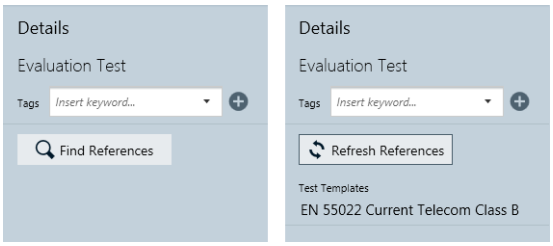


Figure 3-6: Example of a details list (here of a test), left: before searching for references, right: after

The information in the list depends on the type of the selected item and its content.

If you select more than one item, the software displays only information that is common to all selected items.

Tags ← Details
Displays user-defined "Tags" of the selected component or components. Tagging especially facilitates finding groups of components that you have labeled with the same specific tag or tags.

To add a tag to an item, select the item to display the "Details" dialog, enter the tag text and hit RETURN or click the "+" sign next to the input field.

A search cannot be tagged.

Tags are shown for selected items in the "Dashboard" and in the lists of items (for example "Tests"). Note that tags are not visible in opened items, except while using the "Save" dialog. This dialog shows tags and also allows defining new tags.

To delete a tag, click the "X" sign next to it.

Note: If R&S ELEKTRA recovers an item, for example a test or a test template, after an unexpected program shut-down, the tag "Recovered Data" is automatically added to this component.

Find References ← Details
"Find References" searches for references from the selected component to other components, which either use this component or are used by it. For example, a test can have references to a test template.

Once you have executed a search for references, the "Find References" button changes to "Refresh References", which allows repeating the search.

Pinned "Search" items do not have any references.

Note: A test is always based on a **copy** of the test template, that was used to create the test. Upon test creation, this copy is integrated into the Test Container. Therefore, the original test template is not directly referenced in the test.
This relationship becomes obvious, for example, if you modify the original test template: the copy of this test template inside the test container remains unmodified.

Nevertheless, just **for operator orientation**, the displayed reference indicates that the test was created using this test template.

Refresh References ← Details
Repeats the search for references and displays the updated results. Refreshing can be useful, for example, after modifying a referenced item.

Collapse Content
The arrow pointing down indicates that some expanded content below the arrow can be collapsed.

Click to collapse (hence minimize) the content, for example a settings dialog or a list.

Expand Content
The arrow pointing to the right indicates that some collapsed content can be expanded.

Click to expand (hence unfold) the content, for example a settings dialog or a list.

3.3 Touch Operation

R&S ELEKTRA can be installed on a tablet computer (MS Windows) with a touch-sensitive display. In this case, finger-touch operation intuitively replaces conventional mouse operation of the software.

Example:

You can zoom a test chart in conventional mouse operation by drawing a rectangle around the area that you wish to see enlarged. On the contrary, in touch operation, you would enlarge this area by stretching the chart by a two-fingers gesture.

The following touch actions replace mouse actions:

Table 3-1: Correlation of mouse and touch actions

Mouse operation	Touch operation	Gesture icon
Click	Tap	
Double-click	Double-tap	
Click and hold	Touch and hold	
Right-click	Touch, hold for 1 second and release	

Mouse operation	Touch operation	Gesture icon
Drag-&-drop (= click and hold, then drag and release)	Touch and hold, then drag and release	
Zoom by drawing a rectangle	Two-finger zoom ("pinch to zoom")	
Mouse wheel to scroll up or down	Swiping a window area down or up	
Dragging scrollbars to scroll up or down, left or right	Swiping a window area down or up, right or left	

This manual describes all user operations as if executed with a mouse. If instead you use a tablet computer with touch operation, proceed according to the correlations given in Table 3-1. Exceptions apply in those cases that are considerably different from the general correlations. In these cases, both types of operation are described.

On the tablet computer, if you select a field for keyboard input, R&S ELEKTRA automatically brings up an on-screen keyboard. If it overlaps with an input field or covers a relevant display area, undock the on-screen keyboard. Once it floats, you can move it out of the way.

3.4 Performing a Test

Generally, performing EMI tests with R&S ELEKTRA involves the following steps:

1. Determining, **which types of test** to perform, as suggested in the EUT-related Test Matrix.

   This decision leads to the applicable **EMI Standards** (for example CISPR, IEC/EN, or MIL-STD-461).

2. Determining the test concept based on those standards.

3. Planning the hardware setups for the **tests** of EUTs.

   This planning leads to a list of required devices and signal paths. A wizard for preconfiguring entries in the software's database support you in this task.

4. Establishing a useful **data nomenclature** with speaking names for saving, e.g., limit lines and other tables, various templates, devices and the like.

5. Physically **setting up the hardware** for the respective measurement, and **connecting the devices** to the PC. The software requires this setup to perform the following steps:

6. Entering the measurement **devices** in R&S ELEKTRA by creating or editing entries in the device list. A search function for network devices supports you in this task.

If a firewall message comes up, see Network Firewall Settings.

7. Creating or editing **limit lines** in R&S ELEKTRA according to the relevant standards.
8. Configuring EMI test settings (together with configuring the hardware setups) in R&S ELEKTRA **test templates**.
9. **Creating tests** as described in Chapter 4.3.1, "Configuring Tests", on page 48
10. **Running tests** as described in Chapter 7, "Running Tests", on page 149.

Once a test is completed, **save** it and proceed with the following steps:

- **Evaluating** the results as described in Chapter 3.5, "Test Results", on page 40.
- Generating **test reports** as described in Chapter 3.7, "Reporting", on page 43.

These steps may become more clear in Chapter 8, "Measurement Examples", on page 167.

For compliant EMI tests, all details of the measurement procedure must be taken from the applicable EMI Standards. R&S ELEKTRA supports you in this task. However, it is outside of the scope of this software to ensure that all regulations from the relevant standards are properly applied. Therefore, the compliance of testing remains in your responsibility.

3.5 Test Results

Once a test has been run and saved, the whole Test Container with all measurement results is stored in the database. To see the test results, make sure to have the test opened.

Access: "Home" > "Tests" > "Open" > "... test"

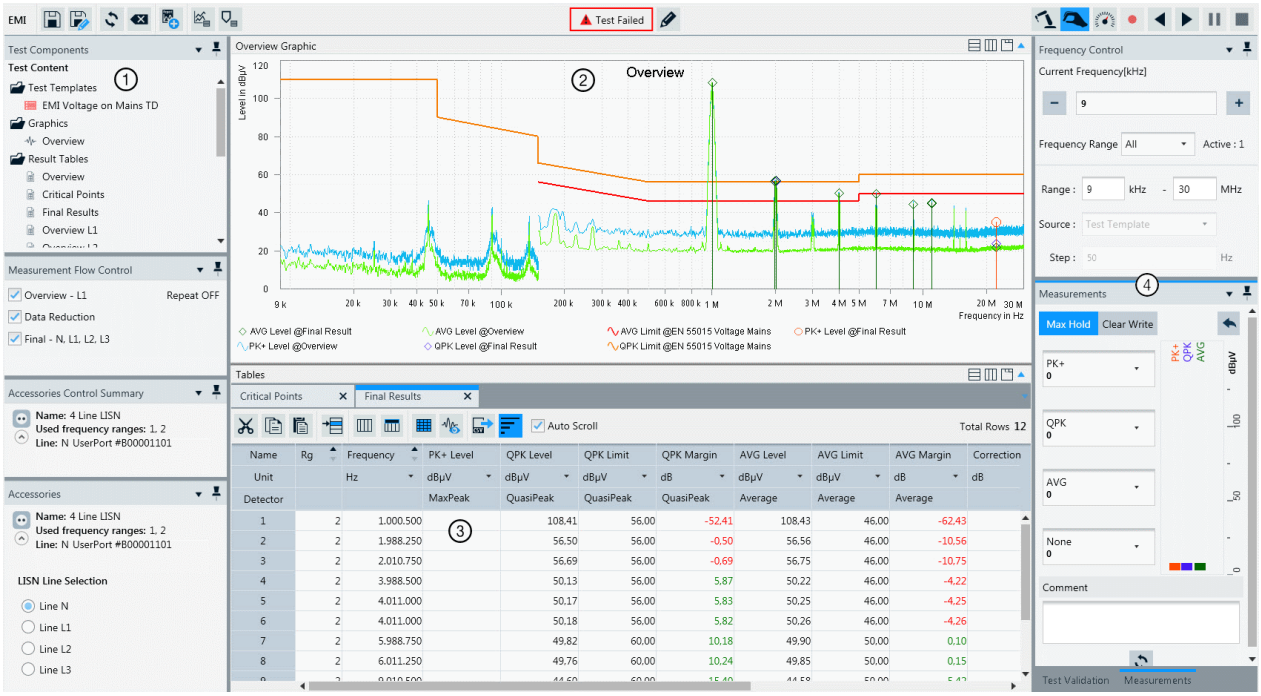


Figure 3-7: Example of a test window

1 = Side panels on left-hand side (see table below and Using the Test Control Elements)
2 = Test charts. For details on how to work with these graphics, see Configuring Test Charts and Test Result Graphics
3 = Test result tables. For details on how to work with these tables, see Configuring Test Tables, and Test Result Tables
4 = Side panels on right-hand side (see table below and Using the Test Control Elements). On the top right, find the Test Control Toolbar

You can use the following side panels on the left-hand and right-hand side:

- Test Components
- Measurement Flow Control
- Accessories Control Summary and Accessories
- Frequency Control
- Measurements
- Test Validation

The chart in the "Overview Graphic" and the values in the "Final Results" table represent a view of these results. However, a complete EUT testing task typically also requires to *evaluate* the measurement results. An example is finding broadband signals or specific frequencies, at which the minimum Margin between measured level and a limit line is violated. Evaluation is intended to provide crucial information (see Verdict) to decide whether an EUT conforms with a given EMI standard.

Overview of LISN results

If the transducer used in the measurement is a LISN, the "Overview Graphic" and the "Overview Table" show merged maximum levels measured on any of the selected lines.

For example, if your test template defines measurements on lines N and L1, the overview results can comprise levels measured on line N in some parts of the frequency range and measured on line L1 in other parts of the frequency range. The "Line" column in the test table indicates, from which line the level result in each row was taken.

To see the results of an individual line, open its "Result Table" from the Test Components dialog and click the Show Graphic Display button ( ).

The software evaluates the Verdict with respect to the limits, further evaluation of the test results is a user task.

After having performed the required evaluation tasks, proceed with Reporting.

3.6 Verdict

The "Verdict" is a label for EMI test results, which is either assigned automatically or edited manually. It can state that a test is "Failed", "Inconclusive" or "Passed":

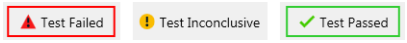


Figure 3-8: Test Verdict: Failed, Inconclusive or Passed

The following rules apply for automatic verdict assignment:

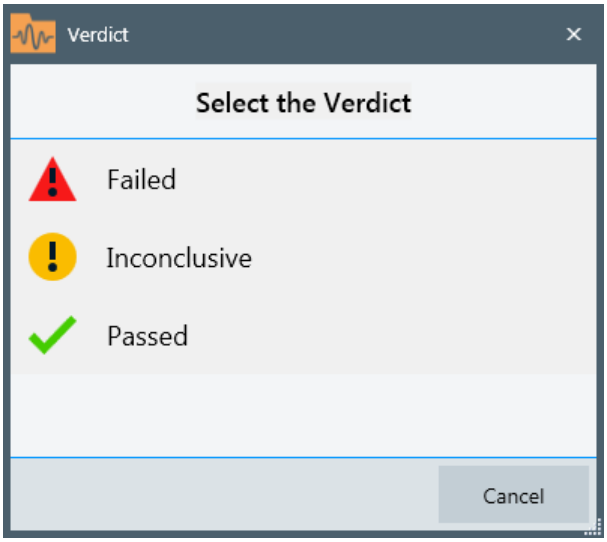
- **Start condition**: A newly created or cleared test (but not a refreshed test) is set to the verdict "Inconclusive".
- **Evaluation**: R&S ELEKTRA calculates the verdict for a test, when the automatic measurement sequence is successfully completed, including the "Final Measurement".
- **Algorithm**: The verdict depends on *all margin values* in the "Final Result" table, except for margin values at frequencies with *empty test level cells*. These margin values are skipped and not considered.
  At each frequency point, the Margin is defined as the limit line's value minus the measured level value. Hence, if the level remains below the limit, the margin is positive.
  The three verdict states are derived as follows:
  - If at least one frequency has a margin value < 0, the verdict is **"Failed"**.
  - Else, if at least one frequency has an *empty margin value cell*, the verdict is **"Inconclusive"**.
  - Else, if all frequencies have margin values ≥ 0, the verdict is **"Passed"**.
- **Revaluation**: If a verdict was calculated for a completed test and you manually change one or several limit lines or measurement values in the "Final Results" table, R&S ELEKTRA immediately recalculates the verdict.

- **Interruption**: If you or R&S ELEKTRA pause or suspend a test or you resume or continue it, after it was stopped by an exception, the verdict is set to **"Inconclusive"**. Note that in this situation, the software does not recalculate the verdict after operator intervention, such as changing limit lines or measurement values.
- **Limitation**: Interactive measurements have no influence on the verdict.

3.6.1 Editing the Verdict

Independent of the automatic verdict assignment, R&S ELEKTRA allows you to select the verdict manually. This feature is in accordance with your option to change measurement values. Editing can be reasonable in various situations, for example if known signals from a nearby radio station must be eliminated from test results in an open area test site (OATS). As an operator, you are responsible for the test results.

To select the verdict manually, click the "Edit" button ( ) next to the verdict in an opened test. The following dialog comes up:



Click the verdict type you wish to select. Your selection is immediately assigned to the test. To keep this change, make sure to save the test.

3.7 Reporting

To generate a report for a completed test or to open an existing test report, first open the test.

Access: "Home" > "Tests" > "Open" "... test"

Click "Add Report" to create a report using a default report template.

For more report configuration options, proceed as follows:

1. In the "Test Components" dialog, select an existing report template.

Alternatively, create one by right-clicking on "Report Templates": either select to create a "New Report Template", or select "Add global Report Template" to choose from a list of existing report templates.
If the "Report Templates" folder in the "Test Components" menu is not yet open, click its icon to see the newly created or selected report template.
Note that via the "Test Components" dialog, you must first select or create a report template before you can generate a report.

2. Double-click the selected report template to create a report.

   R&S ELEKTRA now generates a report as specified in the report template. The result is displayed in a new tab.

To modify a report, proceed as described in Chapter 4.5, "Report Templates", on page 94.

To update the report contents, for example, if report template components or test contents have changed since creating the report, click "Refresh" (🔄) in the *top menu of the report*. Do **not** confuse this button with the taller "Refresh" button 🔄 in the *top menu of the test*.

To save a report in the R&S ELEKTRA database together with the test, select "Attach" (the paper-clip icon 📎). This action opens the "Reports" folder in the "Test Components" menu, where the attached report can now be seen. If the "Reports" folder is not open, click its icon to see attached reports.

Optionally, click the "Export" button 📄 or 📄 to save a report as a `PDF` or `DOCX` file in a selectable folder outside of the R&S ELEKTRA database.

To open a report in a separate window of a `PDF` file viewer program, or in Microsoft Word for `DOCX`, if installed, double-click the attached report in the "Test Components" menu.

4 Configuration

R&S ELEKTRA supports the creation of user-specific test cases for custom application scenarios.

This chapter describes the configuration of the following software components:

- The Home Menu - see page 45
- The Dashboard dialog - see page 46
- Tests - see page 47
- Test Templates - see page 64
  (with included hardware setup and Limit Lines)
- Report Templates - see page 94
- The Device List - see page 96
  (with the receiver, signal paths and various transducing devices)
- Various Tables - see page 123

This chapter also describes the use and configuration of

- Tools - see page 127
- Administrative settings - see page 130

Related subjects:

- The configuration wizard is a tool for the application-specific generation of sample data and templates for tests.
- Measurement devices connected to the computer that runs R&S ELEKTRA can be automatically searched, checked and integrated into the Device List.
- For an **overview** of the "Dashboard" dialog, see Chapter 3.1, "Graphical User Interface", on page 31.
- For the most basic **action buttons**, see Chapter 3.2, "Common Action Buttons", on page 33.

4.1 Home Menu

This chapter describes the configurable items in the "Home" view of the Graphical User Interface. You can configure settings in the dialogs of the home menu (or navigation menu, left) and in the title bar (top right),

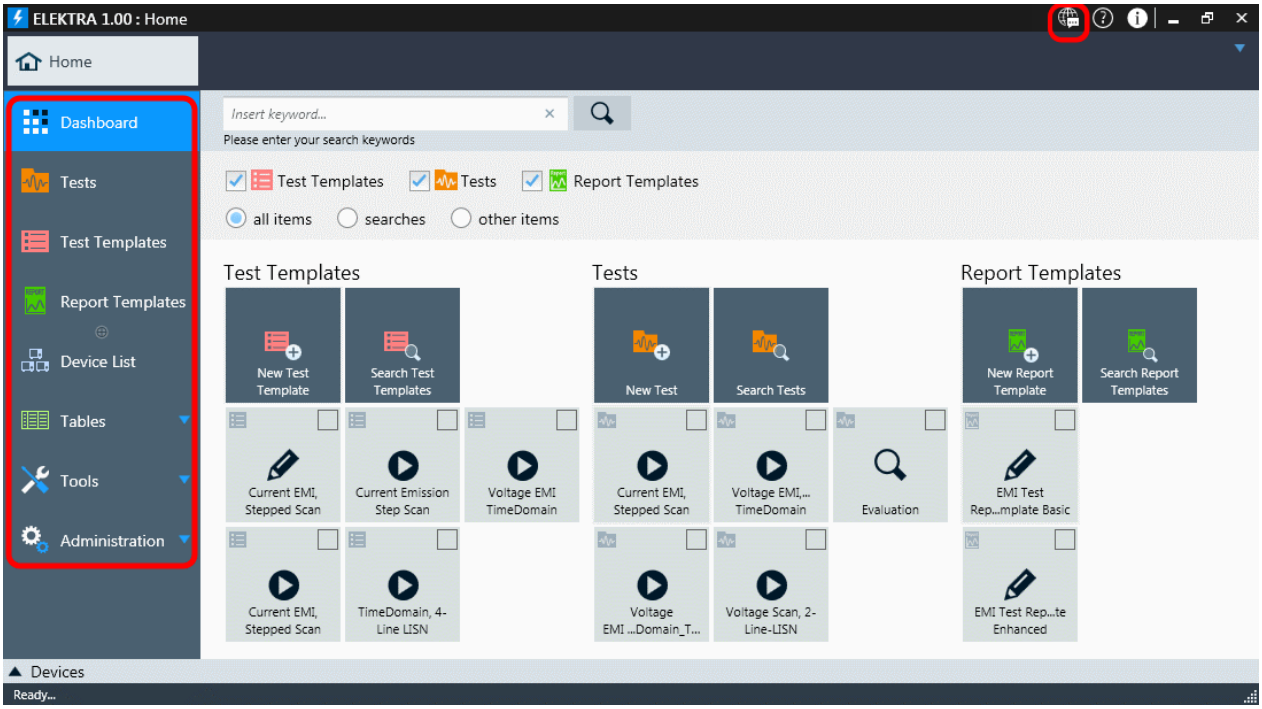


Figure 4-1: Configurable items in the home menu and in the title bar

Red frame at left hand = Configurable items in the home menu
Red frame on top right = Configurable settings in the title bar

For a description of the configurable settings in the **title bar** (top), see below. For the button see Embedded Help, for the button see Product Information.

For a description of the configurable items in the **home menu** (left), refer to the appropriate chapter, which you can select from the overview in Chapter 4, "Configuration", on page 45.

Language Selection
The language selection button in the title bar selects one of the available language options. For description of the language settings, see Chapter 2.5, "Language Selection", on page 23.

4.2 Dashboard

The user-configurable "Dashboard" dialog (see Graphical User Interface) selects the types of pinned items to be displayed by icons. Use these icons for one-click access to your favorite components. The configuration of this dialog is described in the section "Handling pinned items" on page 47.

To pin a component, select "Pin to Dashboard" ( ) for any component that is marked and highlighted.

Access, for example: "Home" > "Tests" **or** "Home" > "Test Templates"

This function is available in many dialogs (such as "Tests" or "Test Templates"), but *not* in the "Home" > "Dashboard" dialog. For an example, see Figure 4-2.

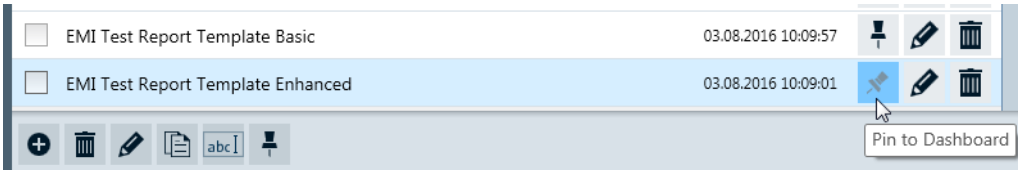


Figure 4-2: Pinning a component (here: a report template) to the "Dashboard" dialog

Once a component is pinned, it can be opened directly from the "Dashboard" dialog by clicking the item there.

Handling pinned items

Access: "Home" > "Dashboard"

The presentation of pinned items in the "Dashboard" dialog can be limited to selected item categories.

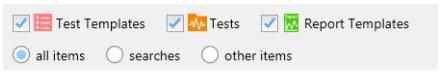


Figure 4-3: Select to display item categories (upper row), select 'normal items' and/or searches (below)

Within all selected categories, you can also limit the displayed items to the following groups:

- "all items"
- "searches" only
- "other items" only (hence, 'normal items', no searches)

The intention is to provide simple access to - and a good overview of - exactly the pinned items and searches that you require. In combination with user-defined Searches, this selection is especially helpful, if you have created many items or searches over time.

To see Details of a pinned item and get access to the Common Action Buttons available for this item, check the checkbox in its top right corner.

Checking more than one item reduces the displayed details and action buttons to those details and buttons, which are commonly valid for the checked items.

4.3 Tests

Tests are used to measure the electromagnetic interference of EUTs. Each test is based on a single Test Template, which must be configured before running the test.

The software structure shows that a test contains one test template.

By creating a test and selecting a test template for it, all settings of this test template are copied into a newly generated Test Container. If the original test template is modified later on, its changes do not influence any previously created tests.

See Chapter 7, "Running Tests", on page 149 for information on how to run tests and how to work with the side panel control elements in an opened test.

Handling test items

Access: "Home" > "Tests"

Depending on the selection of one or several tests, different action buttons are available in the actions bar. These common action buttons are described in Chapter 3.2 on page 33.

For information on how to proceed from **"Create Test"**, see Chapter 4.3.1, "Configuring Tests", on page 48

Use the "Open" button to view or configure selected tests (see Configuring Test Charts and Configuring Test Tables) or to evaluate the Test Results.

The following chapters describe how to configure tests, test charts and test tables.

4.3.1 Configuring Tests

Access: "Home" > "Tests"

Click "Create Test" to generate a new test as described below.

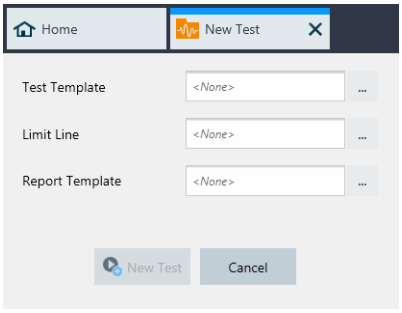


Figure 4-4: New Test configuration dialog for EMI tests

Test Template
Selects a test template from a list of preconfigured items.

The configuration of test templates for EMI tests is described in Chapter 4.4, "Test Templates ", on page 64.

Selecting a test template is a prerequisite for creating a test.

Limit Line
The limit line is *automatically* entered in this field by R&S ELEKTRA, when the test template is selected (which is obligatory), but *only*, if the test template contains exactly one limit line. Afterwards, you can optionally select a different limit line from the list of preconfigured items. But if you do so and then select a test template *after* that, your limit line selection is overwritten by the setting in the test template.

If *no limit line is suggested* by the software upon selecting a test template, this lack of a suggestion can have two different reasons:

- The test template contains no limit line, which is indicated by a placeholder "<none>" in the empty "Limit Line" field
- The test template contains more than one limit line (for various frequency ranges), which is indicated by a placeholder "<Multiple Selection>" in the empty "Limit Line" field

In either case, you can decide:

- Leave this field blank. In this case, R&S ELEKTRA does not overwrite anything.
- Select any limit line. In this case, if different limit lines have been specified in the test template, R&S ELEKTRA *overwrites them all* with the limit line that you have selected.

Therefore, unless you are sure, we recommend leaving a blank limit line field blank in this instance, to avoid overwriting different limit lines in the test template's frequency ranges.

Instead of selecting a limit line in this field, we recommend to first create the test and then open the test template inside the test. This way, you can better decide, if a limit line (or different ones) needs to be selected.

The configuration of limit lines is described in Chapter 4.7.1, "Limit Lines", on page 125.

Selecting a limit line is optional for creating a test.

Report Template
Selects a report template from a list of preconfigured items.

The configuration of report templates is described in Chapter 4.5, "Report Templates", on page 94.

Selecting a report template is optional for creating a test.

4.3.2 Configuring Test Charts

Access: "Home" > "Tests" > "Open" "... test"

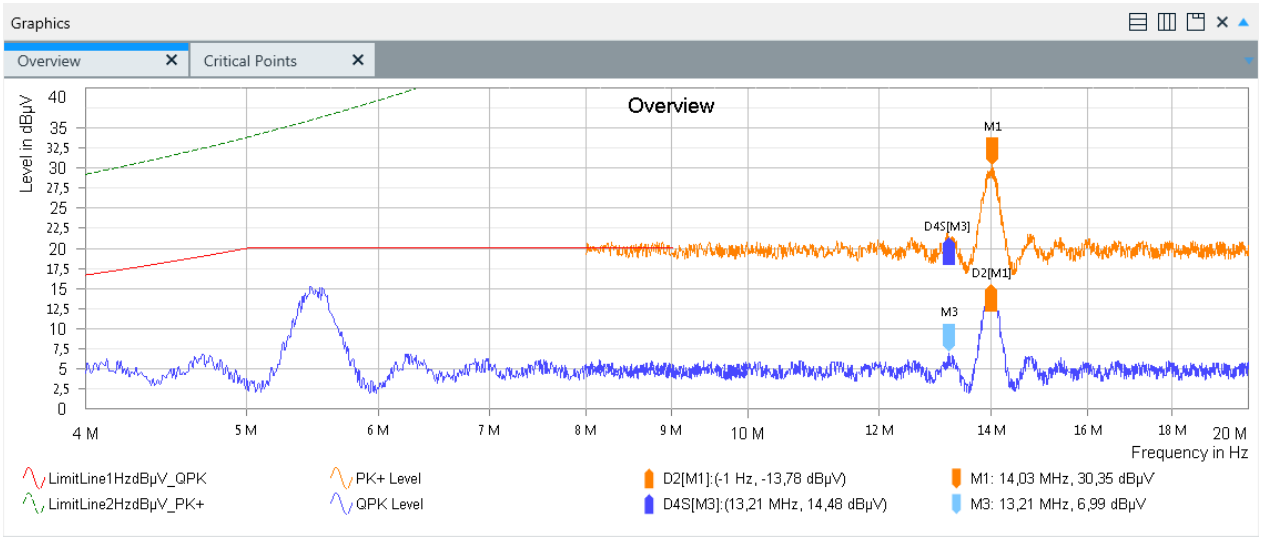


Figure 4-5: Example of an EMI test chart

PK+ Level = Trace of "Max Peak" detector measurements
QPK Level = Trace of "Quasi Peak" detector measurements (here: two frequency ranges, overlapping at 8 MHz to 10 MHz)
M1 = Marker 1 (in color of its own trace), see Marker
D2[M1] = Delta marker 2 (referenced to M1, in color of reference trace), see Set Reference
M3 = Unreferenced marker 3 (light blue = selected)
D4S[M3] = Synchronized delta marker 4 (referenced to M3, in color of reference trace)

In an existing EMI test (which has previously been executed and saved, as described in EMI Tests), you can configure the test results presentation as described in the following chapters.

4.3.2.1 Chart

Access: "Home" > "Tests" > "Open" "... test" > "Chart Menu" button

In the charts configuration, you can determine how one or more charts are displayed and how the axes are scaled. You can determine the graphic properties and make the content of charts available outside of R&S ELEKTRA.

Hide / show charts
The top "Graphics" bar toggles between hiding and showing all charts. If both graphics and tables are visible (half screen, each), hiding the graphics shows the tables in full size. Hiding the tables, too, leaves the two top bars visible, only. Opening the graphics while the tables are hidden shows the charts in full size.

Close / Close all
Closes the selected chart or all charts that are shown. To reopen closed charts, double-click their names in the Test Components side panel.

Arrange charts
To arrange charts horizontally, vertically or cascade them behind each other, use the buttons . Only available, if more than one chart is open.

Chart
Right-clicking the chart and selecting "Chart" (or clicking the "Chart Menu" button) provides access to the chart configuration functions described below. If more than one chart is open, clicking the "Chart Menu" button also requires selecting the chart for which you want to access the chart configuration functions.

Connect Charts ← Chart
Right-clicking a chart and selecting "Chart" > "Connect Charts" allows moving markers jointly in different charts. The connect function is only available, if at least two charts are present and at least one marker is set in one of the charts. Setting or moving a marker in another chart moves the "active" marker (the one that was selected last) in each of the connected charts to the same frequency.

Synchronized markers within the same chart remain synchronized, even when connected to a marker in a different chart. A marker in a connected chart is no longer displayed, if it moves out of the frequency range of "its" trace, while following a marker in a different chart. When it is moved back into that frequency range, it is displayed again.

Note that markers cannot be *referenced* to markers in other charts. Instead, display the trace in question within the same chart by "Add Trace" on page 55.

The joint movement of connected markers can best be seen in charts that are displayed next to each other by "Arrange charts" on page 51.

To terminate the connect function, click "Chart" > "Connect Charts" again. Deleting all markers in one chart also terminates the connect function.

Set Logarithmic x-Axis in all Graphics ← Chart
Right-clicking the chart and selecting "Chart" allows enabling "Set Logarithmic x-Axis in all Graphics".

Set Linear x-Axis in all Graphics ← Chart
Right-clicking the chart and selecting "Chart" allows enabling "Set Linear x-Axis in all Graphics".

Axis X ← Chart
Right-clicking the chart and selecting "Chart" > "Axis X" provides access to the X-axis configuration functions described below.

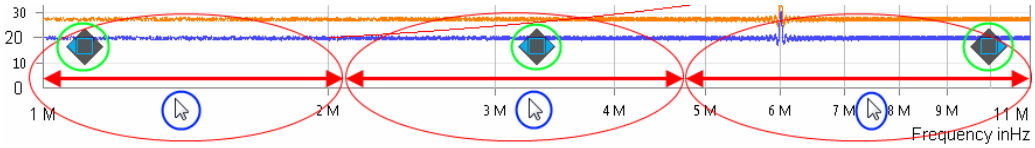
X Axis Logarithmic ← Axis X ← Chart
Toggles between logarithmic and linear X-axis. Alternatively, right-clicking the X-axis allows enabling or disabling the logarithmic scale.

Note: Logarithmic scale is not available, if zero or negative values are shown on the axis.

Change scale ← Axis X ← Chart
Opens a dialog to set the frequency range limits for the X-axis. Alternatively, right-clicking the X-axis and selecting "Change scale" opens the same dialog.

Manual frequency scaling ← Change scale ← Axis X ← Chart
Clicking, holding and horizontally drawing the mouse pointer in the left, center or right third of the X-axis allows a manual frequency scale adjustment:

- In the **left** third, the lower (left) end of the frequency scale is manipulated.
- In the **center** third, the whole frequency scale is shifted up or down.
- In the **right** third, the upper (right) end of the frequency scale is manipulated.



Green circles	= Direction indicators for manual scale adjustment of the frequency axis (only one indicator visible at a time)
Red arrows in red ovals	= Left 1/3, center 1/3 and right 1/3 of the frequency axis
Blue circles	= Mouse pointer positions in the left, center and right third of the axis

Do Autoscale ← Axis X ← Chart
Automatically adjusts the scale of the X-axis to the frequency range used for measurements. Alternatively, right-click the X-axis and select "Do Autoscale" or hit the SHIFT + X keys to do the same.

Autoscale to measurement result ← Axis X ← Chart
Truncates frequencies outside the measured range: R&S ELEKTRA adjusts the boundaries on the X-axis to the values displayed in the chart. Alternatively, right-clicking the X-axis and selecting "Autoscale to measurement result" allows doing the same.

Axis Y ← Chart
Right-clicking the chart and selecting "Chart" > "Axis Y" provides access to the Y-axis configuration functions described below.

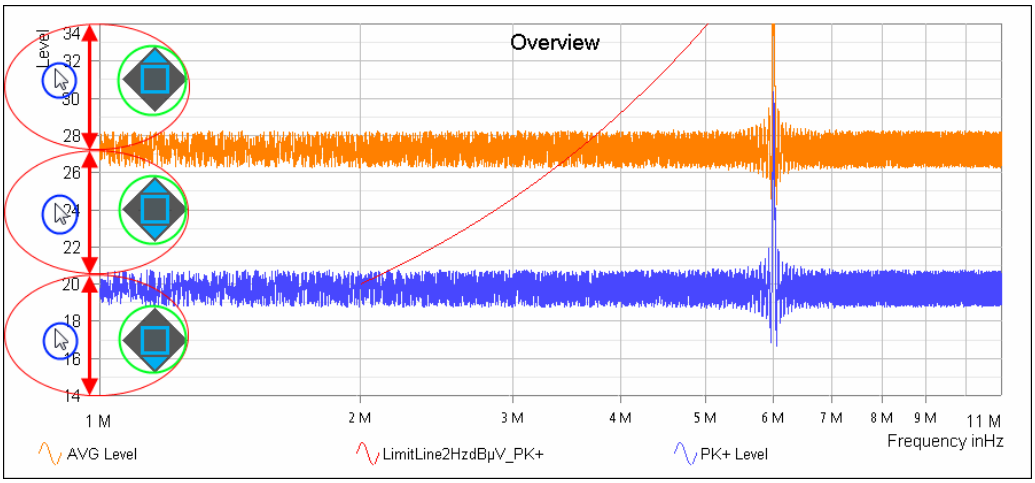
Y Axis Logarithmic ← Axis Y ← Chart
Toggles between logarithmic and linear Y-axis. Alternatively, right-clicking the Y-axis allows enabling or disabling the logarithmic scale.

Note: Logarithmic scale is not available, if zero or negative values are shown on the axis.
Logarithmic Y-axis is not available for dB levels, because dB levels are logarithmic already.

Change scale ← Axis Y ← Chart
Opens a dialog to set the level range limits for the Y-axis. Alternatively, right-clicking the Y-axis and selecting "Change scale" opens the same dialog.

Manual level scaling ← Change scale ← Axis Y ← Chart
Clicking, holding and vertically drawing the mouse pointer in the upper, middle or lower third of the Y-axis allows a manual level scale adjustment:

- In the **upper** third, the upper end of the level scale is manipulated.
- In the **middle** third, the whole level scale is shifted up or down.
- In the **lower** third, the lower end of the level scale is manipulated.



Green circles	= Direction indicators for manual scale adjustment of the level axis (only one indicator visible at a time)
Red arrows in red ovals	= Upper 1/3, middle 1/3 and lower 1/3 of the level axis
Blue circles	= Mouse pointer positions in the upper, middle and lower third of the axis

Do Autoscale ← Axis Y ← Chart
Automatically adjusts the scale of the Y-axis to a range that is a bit wider than the measured levels. Alternatively, right-click the Y-axis and select "Do Autoscale" or hit the SHIFT + Y keys to do the same.

Copy To Clipboard
Right-clicking the chart and selecting "Copy To Clipboard" captures a screenshot bitmap of the active chart and copy it to the clipboard. Outside of R&S ELEKTRA, this bitmap chart can then be entered into any application that allows pasting graphics.

Save to Image File
Right-clicking the chart and selecting "Save to Image File" saves a screenshot bitmap of the active chart outside of R&S ELEKTRA in portable network graphics (PNG) format.

Graphic Properties
Right-clicking the chart and selecting "Graphic Properties" opens the "Chart Options" dialog to define the settings for Graphics, Marker, Grid and Traces.

While these settings are local for the currently opened graphic chart, the same settings can also be defined globally as a default for all new graphics, as described in Chapter 4.9.2, "Graphic Settings", on page 132. However, the global settings do not influence tests that have already been created.

Note:
- The parameter "Show Pixel Mode" in the tab "Marker" > "Pixel Mode" specifies how markers are moved along traces (especially noticeable, if only a few frequency points are visible). If "Show Pixel Mode" is enabled, markers move from pixel to pixel between frequency (measurement) points. If disabled, markers can only jump from one frequency point to the next (see Graphic Settings > Marker > "Pixel Mode").
- The parameter "Peak Excursion" in the tab "Marker" > "Search" specifies the relative level difference between peak and non-peak measurement results. The size of this difference determines whether a marker detects a peak or not (see Graphic Settings > Marker > "Search"). The default "Peak Excursion" is 6 dB.

Print
Opens a dialog for printing the chart.

Zoom
Right-clicking the chart and selecting "Zoom" allows viewing enlarged sections of a chart ("zoom into a chart"). Zooming is done by drawing a rectangle with the left mouse button, to specify the area to be zoomed. In this way, multiple zooming into the same chart is possible. The first zoom can also be done by just drawing a rectangle, as long as the mouse pointer's origin does not collide with any object in the chart. A small copy of the whole chart, superimposed in the upper right corner, provides an overview of the zoomed area (dark rectangle) in relation to the whole chart area.

Using a tablet computer with touch-sensitive display, test charts can be zoomed by stretching or shrinking them with two fingers ("pinch to zoom"): Zooming is done by touching and holding two opposite corners of the rectangular area that you want to zoom, then drawing your fingers apart or bringing them closer together.

Once zoomed, clicking and holding the chart's visible fraction allows dragging it to a different area of the full chart at the same zoom factor. Alternatively, the dark rectangle mentioned above can be dragged by clicking and holding it. However, avoid clicking the chart in a place that is occupied by a trace, line or marker, as this click would call up other functions.

The zoomed view is disabled by double-clicking the chart or by right-clicking the chart and selecting "Undo Zoom".

4.3.2.2 Trace

In the trace configuration, you can add or delete traces, move a trace to the front and set its properties.

Right-clicking the chart and selecting "Trace" provides access to the trace functions described below.

Add Trace
Right-clicking the chart and selecting "Trace" > "Add Trace" allows selecting the kind of trace to be added as described below.

Constant Trace ← Add Trace
Adds a horizontal line in the chart with a user-defined trace name and a constant level (Y) value.

Result Trace from another Test ← Add Trace
Adds a trace from a column selected in a result table of another test.

Global Limit Line ← Add Trace
Adds a trace from a column in "Tables" > "Limit Lines".

Global Attenuation / Transducer Corr. ← Add Trace
Adds a trace from "Tables" > "Attenuation" or from "Tables" > "Transducer Correction".

Delete Trace
Right-clicking the chart and selecting "Trace" > "Delete Trace" allows selecting a trace and deleting it.

Move Trace To Front
Right-clicking the chart and selecting "Trace" > "Move Trace To Front" allows selecting a trace and moving it to the front.

Trace Properties
Right-clicking the chart and selecting "Trace" > "Trace Properties" opens a dialog that defines the following trace settings. Alternatively, this dialog can be accessed by right-clicking a *trace* and selecting "Trace Properties".

Traces ← Trace Properties
Selects the trace, limit line or symbol trace to be configured.

Line ← Trace Properties
Specifies "Color", "Thickness" and "Style" of the selected trace.

Symbol ← Trace Properties
Specifies "Color", "Size" and "Shape" of symbols on the selected trace.

Line To Bottom ← Trace Properties
Specifies "Color", "Thickness" and "Style" of lines that connect symbols on the selected trace to the lower edge of the chart.

4.3.2.3 Marker

Access: "Home" > "Tests" > "Open" "... test" > "Marker Menu" button 

In the marker configuration, you can add or delete markers, reference markers to each other or move them to specific positions. The Pixel Mode determines the step size for moving markers. To specify default marker properties such as flag colors and Peak Excursion, use the "Home" > Administration > Graphic Properties > Marker dialog.

All markers have a name label and, by default, a flag with the same color as "their" trace or as the trace of the referenced Delta marker.

To select a marker, click it directly or click its legend entry. The selected marker (or selected last, if multiple markers are present) is identified by a light blue flag, if color is enabled in the Graphic Properties. This blue "highlighting" color temporarily overrides the original flag color.

Moving markers manually

Click and hold a marker to drag it to any position on the same trace. Alternatively, you can use the left and right arrows on the keyboard or the mouse wheel to move the selected marker. (In Pixel Mode, these steps can be too small to see them without zooming.)

Moving markers automatically

Right-click a marker to select one of the following marker positioning functions:

- "Marker" > To Peak
- "Marker" > To Next Peak
- "Marker" > To Min
- "Marker" > To Next Min
- "Marker" > To Position

- "Marker" > To Trace

Alternatively, right-click the *chart* to select one of these functions for positioning the selected (highlighted) marker.

Be aware of the following:

- Synchronized markers always move jointly.
- Selected markers in other charts also move, if Connect Charts is activated.
- The moving behavior of markers is influenced by the Pixel Mode setting.

Right-clicking the chart and selecting "Marker" (or clicking the "Marker Menu" button) provides access to the marker functions described below. If more than one chart is open, clicking the "Marker Menu" button also requires selecting the chart for which you want to access the marker configuration functions.

Add To Trace
Allows selecting the trace, to which a new marker is to be set, and adds the marker to this trace.

- If the marker that you set is the first one in this chart, it is immediately set to the peak of the selected trace.
- If one or more other markers are already present in the chart, R&S ELEKTRA opens a context dialog that offers three selections:
  – "Trace" - allows changing the trace that you have selected for the marker
  – "Reference Mode" - specifies if and how the marker is referenced to another marker, see Set Reference
  – "Reference Marker" - specifies to which other marker the new marker is referenced (not available for "Reference Mode" = "None")

If the Reference Mode is set to "None",R&S ELEKTRA places the new marker at the trace's peak.

Alternatively, directly double-clicking a *trace* and confirming the defaults in the "Add New Marker" dialog allows placing a new marker on the trace. Unless you have selected to synchronize the marker, it is placed at or near the mouse click position.

Note: If you double-click a trace to add a new marker, but the chart is zoomed, your double-click first disables the zoom. To add the new marker, double-click the trace again.

Set Reference
Opens a dialog for specifying a "Reference Mode" for any two markers.

Alternatively, directly right-clicking a *marker* and selecting "Set Reference" opens the same dialog, with this marker preselected.

To set a reference, first select a "Marker" (or keep the preselected marker), then select one of the following options for the "Reference Mode":

- **"Delta"** shows the level difference value of the two referenced markers in the legend
- **"Synchronized"** locks the two markers to the same frequency (only available for markers on different traces)
- **"SynchronizedDelta"** locks two markers on different traces to the same frequency *and* calculates their delta
- **"None"** leaves the selected marker unreferenced with any other marker

Finally, select the "Reference Marker" from a list of markers that are available for referencing (not available for "Reference Mode" = "None").

Pixel Mode
Opens a dialog for activating or deactivating the "Pixel Mode" function.

- If enabled, a marker can move from pixel to pixel on the display between the frequency (measurement) points.
- If disabled, the marker can only jump from one frequency point to the next.
  The effect of this setting becomes especially noticeable, if only a few frequency points are visible, for example when zooming deeply into a trace.

Alternatively, the setting can be accessed by right-clicking a *marker* and selecting "Pixel Mode", or by right-clicking the chart and selecting Graphic Properties > "Marker" > "Pixel Mode" > "Show Pixel Mode".

The global setting for "Show Pixel Mode" can be altered at "Home" > "Administration" > "Graphic Settings" > Marker > "Pixel Mode". However, **this setting does not influence any test** that has already been created.

To Peak
Automatically moves a marker to the peak value of a trace.

To Next Peak ← To Peak
Automatically moves a marker to the next peak value of a trace, if it has previously been set to the overall peak ("To Peak"). Moving a marker to the next peak can be repeated until the limit is reached that is specified by the parameter "Peak Excursion". This parameter is defined by clicking the chart and selecting "Graphic Properties" > "Marker". Defaults are defined at "Home" > Administration > Graphic Properties > Marker.

Note: Specifying the "Peak Excursion" in the Graphic Properties menu does not influence a test that has already been created.

To Min
Automatically moves a marker to the minimum value of a trace.

To Next Min ← To Min
Automatically moves a marker to the next minimum value of a trace, if it has previously been set to the overall minimum ("To Min").

Moving a marker to the next minimum can be repeated until the limit is reached that is specified by the parameter "Peak Excursion". This parameter is defined by clicking the chart and selecting "Graphic Properties" > "Marker". Defaults are defined at "Home" > Administration > Graphic Properties > Marker.

Note: Specifying the "Peak Excursion" in the Graphic Properties menu does not influence a test that has already been created.

To Position
Automatically moves a marker to a user-defined frequency. If this marker is synchronized with another marker, both are moved jointly to the new frequency position.

To Trace
Automatically transfers a marker to another trace or limit line. Note that a marker cannot be transferred to a trace or limit line where the same frequency position is already occupied by a synchronized marker. R&S ELEKTRA only offers the appropriate choice of targets.

Delete Marker
Allows selecting one specific marker or "All Markers" to be deleted.

Alternatively, right-clicking a marker and selecting "Delete Marker" offers the same choice.

4.3.3 Configuring Test Tables

Access: "Home" > "Tests" > "Open" "... test"

Final Results Table

Auto Scroll Total Rows 11

Name	Rg	Frequency	QPK Level	QPK Limit	QPK Margin	CAV Level	CAV: AVG Limit	CAV Margin	Correction	Meas BW	Meas Time	Meas. Date/Time	Source	Comment
Unit		Hz	dBµA	dBµA	dB	dBµA	dBµA	dB	dB	Hz	ms			
Detector			Quasi Peak	Quasi Peak	Quasi Peak	CISPR Average	Average	CISPR Average						
1	2	159.000	54,44	37,00	-17,44	52,49	-3,98	-56,47	5,12	9.000	100,000	24.03.2017 10:59:01	Critical Points	
2	2	163.500	55,45	37,00	-18,45	51,93	-3,98	-55,91	4,85	9.000	100,000	24.03.2017 10:59:02	Critical Points	
3	2	15.063.000	40,07	0,43	-39,64	39,07	-40,55	-79,62	-9,85	9.000	100,000	24.03.2017 10:59:02	Critical Points	
4	2	15.072.000	39,73	0,42	-39,31	38,96	-40,56	-79,52	-9,85	9.000	100,000	24.03.2017 10:59:03	Critical Points	
5	2	150.000	55,28	37,00	-18,28	54,27	-3,98	-58,24	5,65	9.000	100,000	24.03.2017 11:01:22	Interactive	
6	2	154.500	56,12	37,00	-19,12	52,67	-3,98	-56,65	5,38	9.000	100,000	24.03.2017 11:01:29	Interactive	
7	2	15.081.000	39,66	0,42	-39,24	38,92	-40,56	-79,48	-9,85	9.000	100,000	24.03.2017 11:01:34	Interactive	

Figure 4-6: Example of a final results table in an EMI test

EMI test tables contain the following columns:

- "Rg" - the frequency range number
- "Frequency" - the frequency points
- The "Level", "Limit" and "Margin" values for each detector selected in the test template (with Margin = "Limit" minus "Level")
- "Correction" - the accumulated amount of "Attenuation" and "Measurement Correction" specified for the signal path and LISN or transducer used in this measurement

- "Line" - only available in tests that use a LISN: label of the LISN line, for example "N" or "L1". See also Chapter 7.4, "Test Result Graphics", on page 166.
- Meas BW - only available in "Final Results" tables
- Final Measurement Time Per Point - only available in "Final Results" tables
- "Meas. Date/Time" - only available in "Final Results" tables: R&S ELEKTRA automatically enters the date and time of the measurement. To toggle between a display of time only, or date and time, use the Show / Hide Column Headers button to activate the "Accuracy" header. This header lets you select either "Date/Time" or just "Time".
- "Source" - only available in "Final Results" and "Critical Points" tables: Provides information on the origin of the frequency points for the critical points table or for the final measurement, for example Critical Points from data reduction or Interactive measurements. You can edit this information.
- "Comment" - content (which you can edit) depends on the kind of table:
  - In the "Overview" table: You can enter arbitrary comments in any cell of the "Comment" column.
  - In the "Critical Points" table: R&S ELEKTRA automatically enters the names of detectors, with which a critical level value was detected in the overview measurement at this frequency point.
  - In the "Final Results" table: During an Interactive Measurement, your comments from the Measurements dialog are automatically entered in the new rows that are generated in this table.

To sort the table rows by any of the columns, click the column's name header. Click the name header again for reverse order.

For the default and optional headers of test tables, see Table Headers.

For information on how to work with tables, see Test Result Tables.

You can configure tables by the following functions:

Hide / show tables
The top "Graphics" bar toggles between hide and show all tables. If both graphics and tables are visible (half screen, each), hiding the tables shows the graphics in full size. Hiding the graphics, too, leaves the two top bars visible, only. Opening the tables while the graphics are hidden shows the tables in full size.

Close / Close all
Closes the selected table or all tables that are shown. To reopen closed tables, double-click their names in the Test Components side panel.

Arrange tables
To arrange multiple tables horizontally, vertically or cascade them behind each other, use the buttons .

Select cells
A single cell is selected by clicking it directly. Selected cells are marked by bold content.

Multiple individual cells (not necessarily adjacent) are selected by pressing CTRL while clicking the cells to be selected. You can also unselect previously selected cells by this combination of pressing CTRL and clicking the cells. In tablet operation, selecting multiple cells requires to bring up the on-screen keyboard, tap CTRL and then tap the cells to be selected.

A single row of cells is selected by clicking the row header. Selecting all cells in a row is equivalent with selecting the whole row. Selected rows are highlighted by a blue background color together with bold cell content.

Multiple adjacent rows of cells are selected by clicking the first row header, then pressing SHIFT and clicking the last row header. In tablet operation, bring up the on-screen keyboard, tap the first row header, then tap SHIFT and tap the last row header.

A rectangular range of cells is selected by clicking a cell in one corner of the rectangle, then pressing SHIFT and clicking the cell in the opposite corner of the rectangle. This procedure is also used to select one single or multiple columns. Note that the scrollbars can be used between clicking the two corner cells. In tablet operation, selecting multiple rows requires the following steps: Bring up the on-screen keyboard, tap a cell in one corner of the rectangle, tap SHIFT and tap the cell in the opposite corner of the rectangle. If you want to use the scrollbars between tapping the two corner cells, proceed as follows: First tap one corner cell, then scroll to the opposite corner cell, tap SHIFT and tap the opposite corner cell. If a relevant part of the table is hidden by the on-screen keyboard, undock it. Once the on-screen keyboard floats, it can be moved out of the way.

An alternative for selecting a rectangular range of cells is clicking a cell and using the SHIFT + ARROW keys to define the selection. The CTRL key can be used in combination with the ARROW keys to jump to the first or last row or column.

You can also select the whole table.

Cut
Cutting is only available in tables that are not controlled by a test template, for example the "Critical Points" table. Thus, it is not permitted in the "Overview" and "Final Result" table.

To cut values of selected cells from a table and copy them into the clipboard, right-click any selected cells and select "Cut", or click the "Cut" button, or press CTRL + X. When the cut cells are inserted in a new position by Paste, they disappear from their original position.

Copy
To copy values from selected cells into the clipboard, right-click the cells and select "Copy", or click the "Copy" button, or press CTRL + C. The copied values can be inserted in a new position by Paste.

Paste
To paste cut or copied values from the clipboard into a table, right-click the new (first) cell position and select "Paste", or click the "Paste" button, or press CTRL + V.

Add new row
Adding rows is only available in tables that are not controlled by a test template, for example the "Critical Points" table. It is not permitted in the "Overview" and "Final Result" table.

To insert a new row, right-click a row header or a cell and select "Insert new row before". The new row is then inserted above the row that has been clicked.

To add a new row at the end of the table, click the button and select "Add new row".

To delete selected rows, click the button while the rows are highlighted and select "Delete rows".

Show / hide columns
To show or hide columns selectively, right-click any column header and select "Show / hide columns". In the list of available columns, tick the columns to be shown and untick the columns to be hidden. Alternatively, click the "Show / hide columns" button and activate or deactivate the individual columns in the list accordingly. You cannot hide the columns "Rg" (frequency range number) and "Frequency" (frequency points).

Show / Hide Column Headers
To show or hide individual column headers described below, right-click any column header and activate or deactivate either of them. Alternatively, click the "Show / Hide Column Headers" button.

- Detector shows the selected Detector types in level, limit and margin columns, but does not allow modifying the selection.
- Accuracy adjusts the decimal fraction of the values in the selected column.
- Base Unit shows the selected base units, but does not allow modifying them.

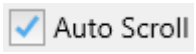
Select Table
Selects all cells of a table. Alternatively, click any header of the first column or press CTRL + A or right-click any cell in the table and select "Select Table".

Show Graphic Display
Generates a graphic representation of selected table contents. Alternatively, right-click any cell and select "Graphic Display". A dialog opens up to select the columns to be displayed, and to select either the generation of a new chart or the integration of the selected column's data into an existing chart.

Export to CSV file format
Exports a table's contents to a file in `.csv` format. A dialog opens up to specify the target folder and filename.

For importing such files, see "Importing tables" on page 123. For exporting table contents to an Excel file, use copy and paste.

Set default sorting
Re-establishes a table's original order. Typically, a table is sorted per deault by rising frequency values.



Auto Scroll
Facilitates reading the "Final Results" or "Critical Points" table during a measurement:

Enabling the checkbox keeps the row that shows the currently measured frequency point within the display area.

Sort table
To sort the table's rows by the values in the "Rg" (frequency range number) or "Frequency" column, click this "Name" header. Click this header again for reverse order.

Table Headers
The Name and Unit headers are always visible, the optional Detector header is enabled per default. You can also enable Accuracy and Base Unit.

Name ← Table Headers
Shows the name of the column, as in Figure 4-6. You can change the order of rows by clicking the "Rg" or "Frequency" header. In detector columns, the name consists of an abbreviation for the Detector name and the type of trace, which can be "Level", "Limit" or Margin.

Unit ← Table Headers
To select one of the optional units for an individual column, click its "Unit" header. The software automatically converts the displayed values.

Example:

If the unit is "kHz" and the displayed value is "2,000", changing the unit to "MHz" changes the displayed value to "2".

If the unit is "dBV" and the displayed value is "-137", changing the unit to "dBµV" changes the displayed value to "-17".

Accuracy ← Table Headers
Specifies the number of decimal places of the values displayed in the selected column. You can set this parameter from 0 to 8 decimal places.

"Accuracy" is only available, if it is enabled at Show / Hide Column Headers.

Detector ← Table Headers
Displays the full name of the measurement detector, which is abbreviated in the "Name" header. The detector cannot be changed in this column, which is only available, if it is enabled at Show / Hide Column Headers.

Base Unit ← Table Headers
Displays the base unit of the column. The base unit cannot be edited in this column, which is only available, if it is enabled at Show / Hide Column Headers.

4.4 Test Templates

Test templates are used to **configure EMI Tests**. The software structure shows that a test contains one test template, which contains hardware setups along with Limit Lines and user-definable configuration settings.

Types of test templates

1) A test template that you create and save with your settings can be considered as a **"global" test template**.

2) As soon as you create a test based on a test template, a **copy** of this test template is **integrated** into the Test Container.

The differences between these two types of test templates are:

- **Global** test template
  - Is available at "Home" > "Test Templates"
  - Allows creating tests
  - Allows modifying device properties from within the test template dialog
  - Changing settings in a global test template has no influence on existing tests
- **Copy** of a test template in a test container
  - Is only available within the test, into which it is integrated
  - Exclusively controls the test, into which it is integrated and cannot be used for creating other tests
  - Does not allow modifying device properties from within the test template dialog
  - Changing settings in this copy (while the test is stopped) makes R&S ELEKTRA clear (discard) all existing results of the test, into which the copy is integrated.
    (Discarding is required to always keep settings and results consistent with each other. A saved test reflects the entirety of settings and measurement results at the time of testing.)

Handling test template items

Access: "Home" > "Test Templates"

Depending on the selection of one or several test templates, different action buttons are available in the actions bar. Most of them are common action buttons, described in Chapter 3.2, "Common Action Buttons", on page 33. (For information on how to proceed with **"Create Test Template"**, see "Configuring test templates" on page 65.)
The dialog-specific action buttons for test templates are:

"Pin to Dashboard as New Test Direct" adds the selected test templates to the "Dashboard" with the function of directly creating a test (see "Create test from template").

"Unpin from Dashboard as New Test Direct" removes the selected test templates from the "Dashboard" with the function "Pin to Dashboard as New Test Direct" (for directly creating a test).

"Create test from template" applies the selected test template for directly creating a test. From here, you can continue with step 2 of the procedure Creating and running tests. Note that this action button is only available, if one single test template is selected in the "Test Templates" dialog.

"New Test" creates a test based on the selected test template. Hence, using "New Test" in the "Test Templates" dialog is an abbreviation of the procedure described in Chapter 4.3.1, "Configuring Tests", on page 48: Now, you do not have to first select a test type. Instead, the test type of the selected test template is used. Therefore, the new test configuration dialog (for example Figure 4-4) is preconfigured. Note that the "Create Test" action button is only available in the "Test Templates" dialog, if one single test template is selected.

Configuring test templates

Access: "Home" > "Test Templates"

Click "Create Test Template" to generate a new EMI test template. The following chapter explains how to configure a test template.

A default EMI test template is partly preconfigured by R&S ELEKTRA as in Figure 4-7.

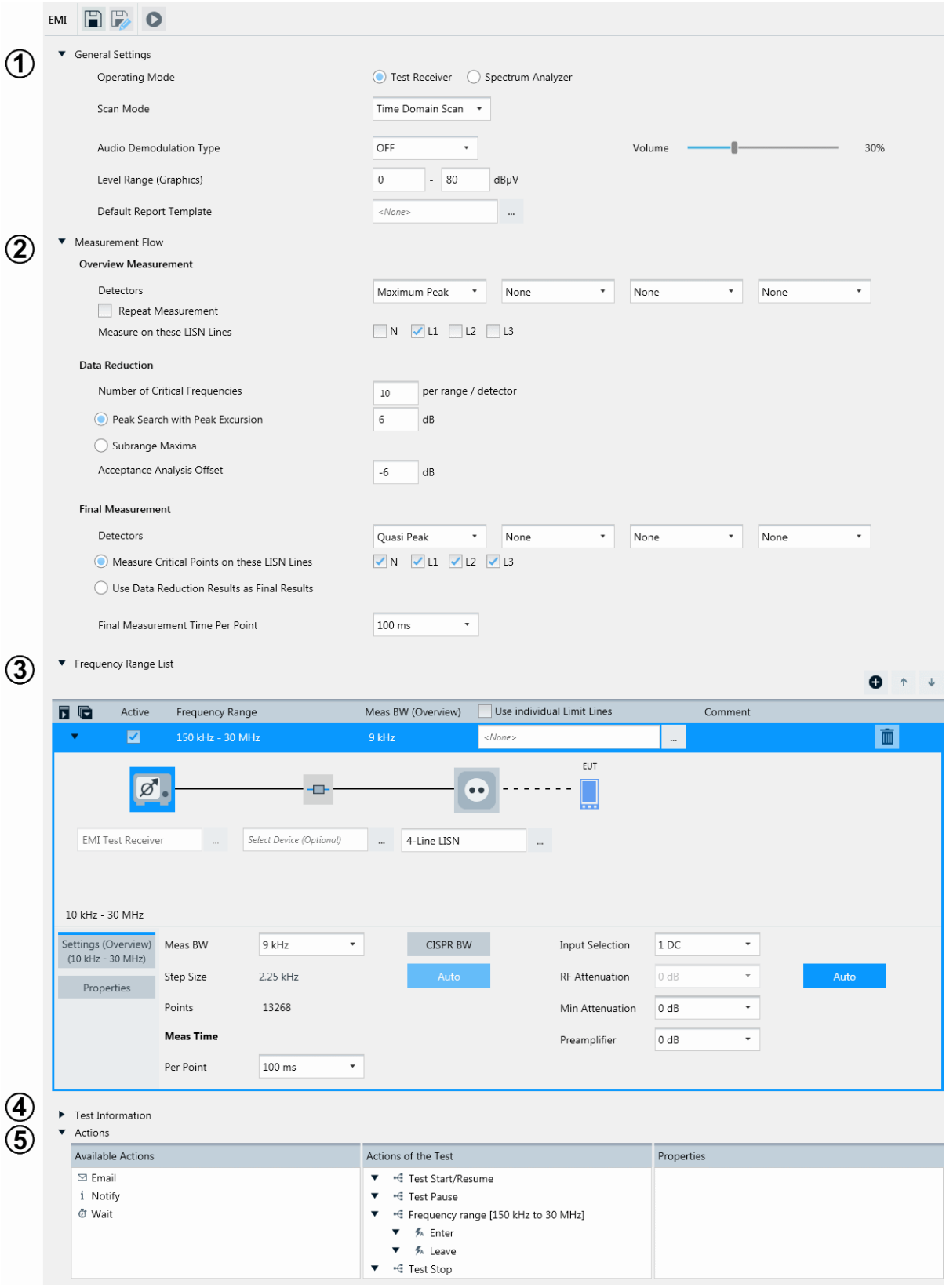


Figure 4-7: Default test template for EMI tests

1 = General Settings globally relevant for the test execution
2 = Measurement Flow settings for overview measurement, data reduction and final measurement
3 = Frequency Range List (here: one frequency range, only)
4 = Test Information (can be edited also in a test components dialog)
5 = Actions with settings relevant for user interaction during tests

For a configuration example, see Figure 4-8.

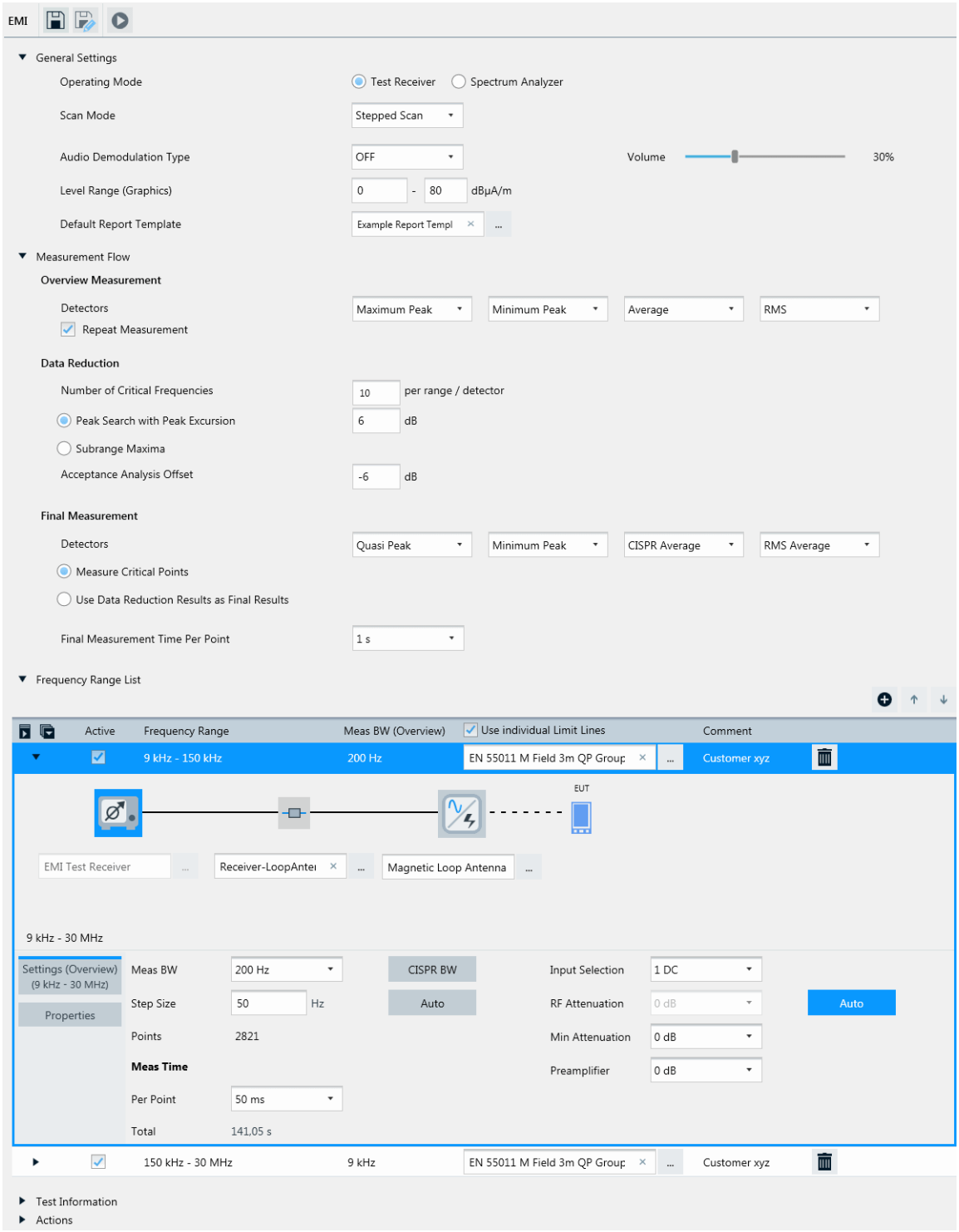


Figure 4-8: Example of a fully configured EMI test template with radiative transducer

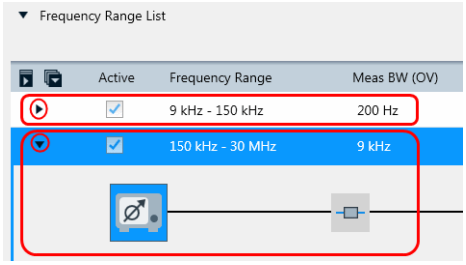
In Figure 4-8, the EMI test template example is configured with the following settings:

- General Settings
  - "Operating Mode" on page 71 = "Test Receiver"
  - Scan Mode = "Stepped Scan"

  - Audio Demodulation Type = "OFF" (which leaves the Volume setting idle)
  - Level Range (Graphics) from 0 dBµA/m to 80 dBµA/m
  - An existing Default Report Template is selected
- Measurement Flow
  - Four Detectors for the overview measurement, here "Maximum Peak", "Minimum Peak", "Average" and "RMS"
  - The checkbox for Repeat Measurement is activated
  - Various Data Reduction settings
  - Various Final Measurement settings, especially four Detectors, here "Quasi Peak", "Minimum Peak", "CISPR Average" and "RMS Average"
- Frequency Range List
  - A first Frequency Range, here 9 kHz to 150 kHz. See section The various frequency range statements shown in the dialog are explained below for more details
  - A Limit Line with the name "`EN 55011 M Field 3m QP Group 2 Class B`" is selected from the list of limit lines
  - The checkbox for individual limit lines is activated, enabling different limit lines for the frequency ranges
  - Some arbitrary Comment text is entered, here "*Customer xyz*"
  - The Signal Path "Receiver-LoopAntenna" and the Transducing Device "Magnetic Loop Antenna" are selected. (Instead of an antenna, you can select other types of transducers, including LISNs.)
  - For the highlighted receiver device icon, the settings for the overview measurement are configured, including, for example, the Step Size = *50 Hz*, "Auto" ranging for the RF Attenuation and the Preamplifier = *0 dB*.
    Note that there is a "Select Device" field and a ··· button available below each device icon for selecting this device.
  - The receiver's, signal path's or transducer's Properties as specified in the Device List are not shown in this figure.
  - An additional second frequency range, here 150 kHz to 30 MHz (not expanded in this figure), with the same limit line.
- The Test Information dialog is not shown in this figure.
- The Actions settings dialog is not shown in this figure (see Figure 4-20).

Minimize frequency ranges

For best access to all frequency ranges within a limited display area, each of the frequency ranges can be minimized like the first frequency range in this example:



Or use the scrollbar, to shift the frequency range that you want to edit into the display area.

The following chapters explain how to configure an EMI test template.

For information on how to execute a test, see Chapter 7, "Running Tests", on page 149.

4.4.1 General Settings

General Settings

This dialog provides access to several settings that are relevant independent of the type of measurement.

The software automatically configures several settings in the background, for example the Filter Type.

Filter Type

The "Filter Type" defines the bandwidth of the measuring filter (IF filter). R&S ELEKTRA automatically sets the IF filter bandwidth to 6 dB, if the Receiver supports this filter type. If it does not support 6 dB filters, R&S ELEKTRA automatically sets the IF filter bandwidth to 3 dB.

- A normal Gaussian filter with a 3 dB filter bandwidth approximately matches the noise bandwidth.
- EMI filters with a 6 dB filter bandwidth comply with CISPR and MIL standards. In the context of EMI tests, the 6 dB definition is more common, since it approximately matches the *equivalent pulse bandwidth* of broadband signals.

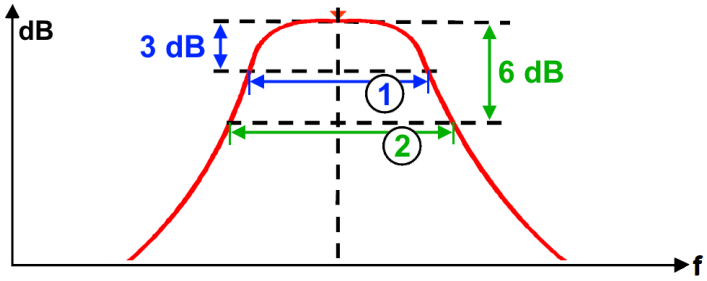


Figure 4-9: Definition of filter bandwidths

dB = Level in decibels
f = Frequency
3 dB = Signal level 3 dB down from peak
6 dB = Signal level 6 dB down from peak
1 = Bandwidth at a level 3 dB down from peak
2 = Bandwidth at a level 6 dB down from peak

The selected filter type is shown in the test report, if you configure the Report Template to include the "EMI Test Template" and to "Show Details" of this template.

Operating Mode

Specifies the type of Receiver:

"Test Receiver"	Operate your measuring device in test receiver mode to perform scan measurements. This mode also enables selecting a Scan Mode, if the receiver offers both "Stepped Scan" and "Time Domain Scan".
"Spectrum Analyzer"	Operate your measuring device in spectrum analyzer mode to perform sweep measurements. During final measurements, the device performs sweeps in zero span mode.

Scan Mode

Only available, if the Operating Mode is "Test Receiver" (not "Spectrum Analyzer"), and if the test receiver is capable of both "Stepped Scan" and "Time Domain Scan". For a Rohde & Schwarz test receiver, make sure that software option "Time Domain Scan" is available, for example `R&S ESR-K53`, and that "K53" is enabled in the Receiver properties. See "Options" in Chapter 4.6.3, "General Properties", on page 109.

"Stepped Scan"	With this selection, R&S ELEKTRA performs conventional scans.

"Time Domain Scan" — With this selection, R&S ELEKTRA enables fast scans with support of fast Fourier transform (FFT) algorithms. As this scanning mode is much faster than stepped scans, "Time Domain Scan" is typically the preferred selection, if available.

Audio Demodulation Type
Only available, if the receiver supports audio demodulation (option `R&S FSV-B3`) and if "FSV-B3" is enabled at "Home" > "Device List" > "Receiver" > General > "Options".

Audio demodulation can improve the identification of signals in the Interactive Measurement mode. For example, if an FM broadcasting radio signal acts as interferer, FM demodulation can make the original audio signal audible.

Available audio demodulation types are:

"OFF" — Disables audio signal demodulation.

"AM" — Enables audio demodulation of amplitude modulated RF signals.

"FM" — Enables audio demodulation of frequency modulated RF signals.

Volume ← Audio Demodulation Type
Sets the audio volume level, if Audio Demodulation Type is available. Use this feature for a receiver that is suited for controlling the audio demodulation volume (option "B3").

Level Range (Graphics)
Specifies the lower and upper level range limits to be displayed on the Y-axis of the test chart.

The software automatically assigns the unit of the level values, when the Transducing Device is selected.

Default Report Template
If you wish to specify that an existing (pre-defined) report template is used as a default for each test based on this test template, select this report template here.

Site Correction Factors (C2) for the GTEM Correlation
Only available, if you have selected a TEM Waveguide as the Transducing Device.

Specifies two Attenuation Tables with dB values for the correlation between measurements in an open area test site (OATS) and in the GTEM waveguide.

R&S ELEKTRA uses these tables for a correlation algorithm. It converts the results of a measurement in a GTEM cell into equivalent results that would be measured in a true OATS with an antenna that is polarized horizontally or vertically.

You can either select existing attenuation tables or let the software compute correction factors to create tables automatically.

"Horizontal" — Name of the attenuation table that represents horizontal antenna polarization in the OATS. Use the ··· button to select a table.

"Vertical" — Name of the attenuation table that represents vertical antenna polarization in the OATS. Use the ··· button to select a table.

Create new factors ← Site Correction Factors (C2) for the GTEM Correlation
Uses a set of input parameters to let R&S ELEKTRA calculate attenuation tables for GTEM correlation. The software automatically creates these tables for the frequency range 10 MHz to 30 GHz.

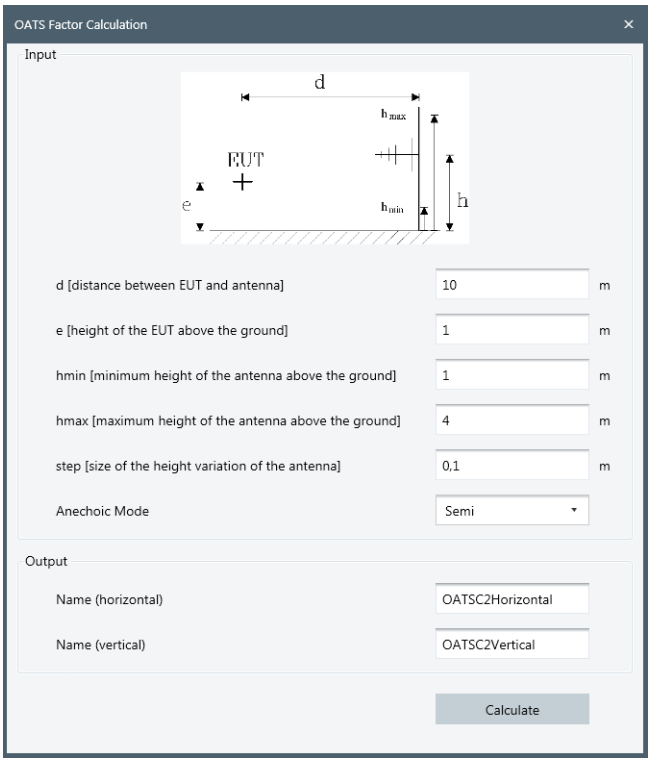


Figure 4-10: OATS (open area test site) factor calculation

Use the following "Input" parameters:

- "d" = horizontal distance between EUT and antenna
- "e" = vertical height of the EUT above the ground
- "hmin" = minimum vertical height of the antenna above the ground
- "hmax" = maximum vertical height of the antenna above the ground
- "step" = step size of the vertical height variation of the antenna
- "Anechoic Mode" = either "Semi" anechoic or "Fully" anechoic

Note: Do not consider the default values suggested in the dialog as recommended by Rohde & Schwarz.

For the "Output", specify names for the attenuation tables for horizontal and vertical polarization, respectively.

Click "Calculate" to let R&S ELEKTRA automatically create and save these tables.

Note: For the GTEM conversion factor C1, see "GTEM Correction" on page 119.

4.4.2 Measurement Flow

▼ Measurement Flow

This dialog provides access to various settings for the overview measurement, for the data reduction and for the final measurement. These settings are valid across all frequency ranges specified in the test template.

Overview Measurement
The intention of the overview measurement is finding signals and frequencies that deserve being examined in more detail. This measurement is a scan or sweep, according to the Operating Mode, the Scan Mode and the Settings (Overview). The overview measurement is executed across the full spectral range defined in the test template.

The overview measurement could be more coarse than the Final Measurement, and if there is a LISN, it typically ignores some of the LISN lines. However, it must be fine enough to find all interference signals. Therefore, in the Settings (Overview), select a good balance of Meas BW and Step Size.

If the Transducing Device is a TEM Waveguide, R&S ELEKTRA automatically enables "Evaluate on all 3 othogonal EUT axes (X/Y/Z)". This evaluation means that you must perform three overview measurement scans with the EUT in three different orthogonal orientations. During the test, the software prompts you to switch (or rotate) the EUT axis to the X, Y or Z orientation. The three measurements are stored in separate result tables.

Detectors ← Overview Measurement
Selects the detector types for up to four detectors used in the overview measurement of a test.

At least, the first detector must be selected. For the optional 2nd, 3rd and 4th detector, you cannot select a detector type that is already selected otherwise (exclusiveness).

Typically, a single fast detector is used, for example "MaxPeak". More and other detectors are permitted and can be a good choice, too, depending on the test situation. For a list of all available detector types, see Chapter 5.3, "Detectors", on page 142.

The selection of detectors for the overview measurement also influences the default settings for the final measurement detectors.

Repeat Measurement ← Detectors ← Overview Measurement
Specifies that the overview measurement is cyclically repeated in a test, until you manually terminate the repetition. This mode is useful for observing changes in the measurement results, if you modify any test conditions during test execution.

Note: During repeated measurements, R&S ELEKTRA compares the currently measured level values with the previously measured level values and keeps the maximum. Lower values in the still varying level measurements are thus ignored. Over time, this algorithm leads to a trace that approaches the maximum of the measured level values at each frequency point, with a continuously reduced variation along the trace.

To terminate the continuously repeating overview measurement while the test is running, click "End Repetition" in the test's Measurement Flow Control side panel.

If "Repeat Measurement" is disabled, the overview measurement is executed in a single scan or sweep, only.

Measure on these LISN Lines ← Overview Measurement
Only available, if you have selected a LISN (not a different transducer) in the Hardware Setup.

The dialog selects the LISN lines to be measured in the overview measurement. The following settings apply:

- In a hardware setup with a 2-line LISN, you can select or deselect "N" or "L1".

- In a hardware setup with a 4-line LISN, you can select or deselect "N", "L1", "L2" or "L3".

Select at least one line for the overview measurement. The default is "N" and "L1".

Data Reduction
Specifies various parameters for algorithms that reduce the number of measurement results from the overview measurement. To identify the most critical results, either a peak search or a subrange maxima evaluation can be performed.

If a LISN is used, the data reduction algorithms include all LISN lines that have been selected for the overview measurement. The reduced number of frequencies and levels are stored in the result table together with the information, which individual line delivered which individual critical result.

Number of Critical Frequencies ← Data Reduction
Specifies the number of frequency points (default = 10) to be collected among those frequencies that have the most critical level values. This selection is in the sense of coming closest to the limit line, or even violating it.

Peak Search with Peak Excursion ← Data Reduction
Activates a peak search evaluation and disables the Subrange Maxima evaluation. This data reduction mode finds the highest narrowband signals in the measured frequency range. The dialog specifies the Decision Level (as explained in the section Marker > "Search"), which defines the relative level difference between peak and non-peak measurement results. The size of this difference determines whether a peak is detected or not. The default Decision Level is 6 dB.

Subrange Maxima ← Data Reduction
Activates a subrange maxima evaluation and disables the Peak Search evaluation. This data reduction mode finds critical broadband signals in the measured frequency range. The number of subranges is defined by the Number of Critical Frequencies.

Acceptance Analysis Offset ← Data Reduction
The number of frequency points for each detector, obtained from the Number of Critical Frequencies, can often be further reduced by specifying an acceptance offset (default = -6 dB). The limit lines of each frequency range are shifted by the specified offset (lowered by adding a negative dB value). Frequency points with level values that fall below the shifted limit line are then discarded.

Final Measurement
Selects the Detectors and the measurement mode for the final measurement.

There are measurement mode options available that depend on the Transducing Device, which you have selected in the Hardware Setup.

These interdependent options are:
- Measure Critical Points on these LISN Lines (only available with a LISN measurement)
- Measure Critical Points (only available with a transducer measurement)
- Evaluate Critical Points on all 3 othogonal EUT axes (X/Y/Z) (only available with a TEM waveguide measurement)
- Use Data Reduction Results as Final Results (independent of LISN or transducer)

An overview of all options for the "Final Measurement" is given below:

Detectors ← Final Measurement
Selects the detector types for up to four detectors used in the final measurement of a test.

At least, the 1st detector must be selected. For the optional 2nd, 3rd and 4th detector, no detector type can be selected that is already selected otherwise (exclusiveness).

The default selection of the final measurement detectors is influenced by the settings for the overview measurement detectors.

Table 4-1: Mapping of overview and final detectors

Selected detector in overview measurement	Suggested default detector in final measurement
Maximum Peak (PK+)	Quasi Peak (QPK)
Minimum Peak (PK-)	Minimum Peak (PK-)
Average (AVG)	CISPR Average (CAV)
RMS	RMS Average (RMSAV)
Quasi Peak (QPK)	Quasi Peak (QPK)
CISPR Average (CAV)	CISPR Average (CAV)
RMS Average (RMSAV)	RMS Average (RMSAV)

For a list of all available detector types, see Chapter 5.3, "Detectors", on page 142.

Measure Critical Points on these LISN Lines ← Final Measurement
Only available, if you have selected a LISN (not a different transducer) in the Hardware Setup.

This dialog selects the LISN lines, across which the measurements are to be repeated at the critical frequencies that were identified in the Data Reduction.

The following settings apply:
- In a hardware setup with a 2-line LISN, you can select or deselect "N" and "L1".
- In a hardware setup with a 4-line LISN, you can select or deselect "N", "L1", "L2" or "L3".

Select at least one LISN line for the final measurement. The default is all available LISN lines. The selection is independent from the selection in the Overview Measurement.

Measure Critical Points ← Final Measurement
Only available, if you have selected a Transducer as the Transducing Device in the Hardware Setup.

Repeats measurements at the critical frequencies, which were identified in the Data Reduction.

Evaluate Critical Points on all 3 othogonal EUT axes (X/Y/Z) ← Final Measurement
Only available, if the Transducing Device is a TEM Waveguide. Select this option to let R&S ELEKTRA perform the final measurements for the three orthogonal orientations of the EUT.

Note: TEM waveguides such as GTEM cells are not suited for interactive measurements.

Use Data Reduction Results as Final Results ← Final Measurement
Does not repeat any measurement, but:

- Takes the critical frequency points found with the Data Reduction evaluation and
- Copies the originally measured levels at these critical frequency points as the final results.

If you use a LISN, the software copies the measured levels from the same LISN lines that were found to have critical points.

If you use a TEM waveguide, the software copies the measured levels from the same EUT orientations that were found to have critical points.

We recommend using this option for the final measurement, if the overview measurement data is sufficient for a standard-compliant characterization of the RF emission. This option is typically reasonable, if you operate the receiver in Scan Mode "Time Domain Scan" with a compliant detector, for example QuasiPeak. Even with such a slow detector, a "Time Domain Scan" is often faster than a "Stepped Scan", especially within the relatively small frequency ranges of conducted measurements. As the detector is standard-compliant, you can skip the final measurement and use the levels at the critical points of the overview measurement as the final results.

However, in some special cases of a "Time Domain Scan", it can be an advantage to run the overview measurement with a fast non-compliant detector, for example "MaxPeak". An example is a broad frequency range that requires measurements in many frequency segments. In this case, using the "MaxPeak" detector for the overview measurement and the compliant "QuasiPeak" detector for the final measurement on critical points, only, can be faster. For this mode, disable the option "Use Data Reduction Results as Final Results".

Final Measurement Time Per Point ← Final Measurement
Only available, if the Operating Mode is "Test Receiver" (not "Spectrum Analyzer").

Selects from a list of predefined measurement time values per point between 100 µs and 100 s for the final measurement. The selection is independent of the Meas Time in the Settings (Overview).

Measurement Time ← Final Measurement
Only available, if the Operating Mode is "Spectrum Analyzer" (not "Test Receiver").

Selects from a list of predefined total measurement time values between 1 ms and 16.000 s for the final measurement. The selection is independent of the Meas Time in the Settings (Overview).

4.4.3 Frequency Range List

Frequency Range List

This dialog provides access to settings for all frequency ranges.

Add Frequency Range
Creates an additional frequency range in the same test template and with the following default settings:

- The lower limit of the new frequency range is automatically set equal to the upper limit of the highest existing frequency range in this test template.
- The upper limit of the new frequency range is automatically set 10 MHz above its lower limit.
- The following settings and selections are copied, if available, from the frequency range that was previously selected (highlighted in blue).
  - All selected devices in the hardware setup
  - The limit line
  - All measurement settings

Shift Frequency Range Up / Down
Only available, if at least one other frequency range is displayed above / below the selected frequency range. The buttons swap the position of the selected frequency range with the one above / below it.

Frequency ranges are typically arranged in an order of increasing frequency, but different arrangements are permitted, too.

Active
Activates or deactivates measurements in a frequency range.

Frequency Range
Specifies the lower and upper frequency limit of the frequency range. To edit the values, click them. You can also edit the units. Permissible units are *Hz*, *kHz*, *MHz* and *GHz*.

If the test template is new, the frequency values of the first frequency range can change, depending on the Transducing Device that you select.

Note: The various frequency range statements shown in the dialog are explained below.

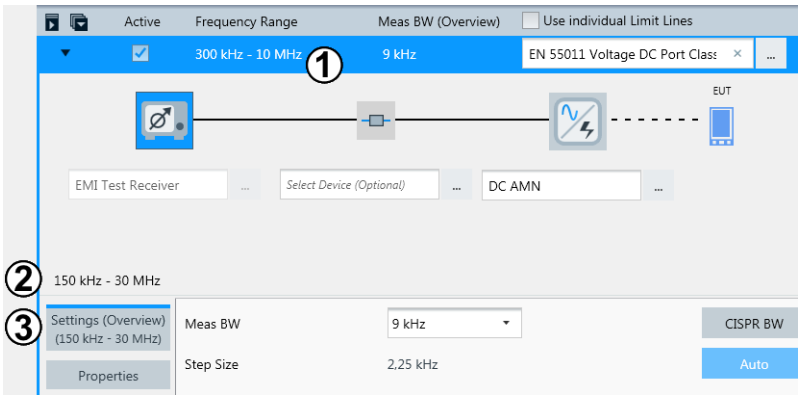


Figure 4-11: Example of frequency ranges shown in the settings dialog

- 1 = Specified lower and upper limit of the frequency range (here: 300 kHz to 10 MHz).
  Mouse-over text: "Set Start and Stop Frequency"
- 2 = Frequency range, in which the combined receiver, signal path and transducer (here: an artificial mains network) can be used. This frequency range can be limited, for example, by the transducing device's correction table.
  Mouse-over text: "The Frequency Range of the Hardware Setup"
- 3 = Usable frequency range of the receiver with the current overview measurement settings. This frequency range can be reduced by various properties and settings of your receiver, for example, the selected input. R&S ELEKTRA computes this reduction in a complex algorithm.

The frequency range (1) is an interactive setting, while the other frequency range statements are for your information, only.

The settings and their frequency range statements are only shown, if the receiver icon is selected (highlighted).

Meas BW (Overview)
Displays the measurement bandwidth (or intermediate frequency filter bandwidth, IF filter BW) as specified in the Settings (Overview).

...

Limit Line
Selects a limit line table.

Note: In each frequency range, you can select **one limit line table**, only. However, each limit line table can be defined with up to **four limit line columns**, each for an individual detector.

If no limit line is defined for the current detector, but there is a limit line for an alternative detector according to Table 4-2, R&S ELEKTRA automatically replaces the missing limit line. R&S ELEKTRA uses the alternative limit line for calculating the Margin values in the result table and the Verdict.

Table 4-2: Alternative limit line detectors

Test template detector	Limit line detector alternative
Average (AVG)	CISPR Average (CAV)
Maximum Peak (PK+)	Quasi Peak (QPK)
Minimum Peak (PK-)	none (no detector alternative)
Quasi Peak (QPK)	none (no detector alternative)
CISPR Average (CAV)	none (no detector alternative)
RMS	RMS Average (RMSAV)
RMS Average (RMSAV)	none (no detector alternative)

If the selected limit line table does not contain a limit line specification for the alternative detector, either, a "Validation Warning" comes up when you save the test template: "Selected limit line does not match the configured detector in this frequency range" (or several warnings, one for each frequency range). Saving is still possible, but as the test misses a required limit line, R&S ELEKTRA cannot calculate the margin values and the verdict. To solve this issue, we recommend using the detectors as specified in a limit line table that conforms with the applicable standard.

Use individual Limit Lines ← Limit Line
To allow different limit lines for different frequency ranges, activate the checkbox. Otherwise, if this checkbox is not activated, the same (global) limit line is used for all frequency ranges.

If different limit lines are specified for different frequency ranges, deactivating this checkbox copies the limit line selection of the currently highlighted frequency range (blue) to all other frequency ranges. This copying of settings is protected by a warning: "Individual Limit Line settings of frequency range(s) will be lost by disabling "Use individual Limit Lines"." The "OK" button confirms this, "Cancel" returns to the dialog without de-activating the checkbox.

Comment
Per frequency range, arbitrary text can optionally be entered below the headline "Comment", as shown in Figure 4-8.

Delete Frequency Range
Only available, if at least two frequency ranges are present. Deletes the selected frequency range without additional warning and without the possibility to restore a deleted frequency range with its settings.

Hardware Setup
The hardware setup, represented by a diagram as in Figure 4-12, is part of each frequency range in a test template.

Figure 4-12: Hardware setup diagram

1 = Receiver (here selected, hence highlighted in blue)
2 = Signal Path
3 = Transducer, LISN or TEM Waveguide
4 = Representation of the EUT

Note that the EUT is not a device in R&S ELEKTRA.

The hardware setup diagram is displayed, along with the devices and their measurement settings and properties.

To select a device or change the selection in the hardware setup diagram, proceed as follows:

- If the device has not been selected before, click its icon to open the selection dialog.
- If the device has already been selected, click the ··· button to open the selection dialog.

Except for the receiver, which is fixed, you can specify different signal paths and transducing devices for the hardware setups in different frequency ranges, if the devices are compatible with each other. To be compatible, the devices must have the same device type, such as "Transducer" > "Probe". For example, using a current clamp in one frequency range is compatible with using a voltage probe or a power absorbing clamp in another frequency range. On the contrary, LISNs and GTEM cells are not compatible with any other devices.

According to the LISN (selected for all frequency ranges) or the transducer (selected for the first frequency range), R&S ELEKTRA defines the unit for the level range. The definition is valid and binding for all frequency ranges to be created later. Therefore, in additional frequency ranges, R&S ELEKTRA only permits the selection of transducers with the same result unit.

Note: Changing the "Type" can cause a loss of settings. If you assign a different device type to a transducing device in one out of several frequency ranges, R&S ELEKTRA resets the test template. All additional frequency ranges are removed, since a mix of device types is not allowed across the frequency ranges. All settings in these frequency ranges are lost.

R&S ELEKTRA compares the level unit of your selected Limit Line with the level units of the devices in the hardware setup of the same frequency range. If the units do not match, you cannot save the test template.

To edit the **measurement settings**, select (highlight) the receiver icon as in Figure 4-12.

Select (highlight) the icon of any device or signal path to edit their **Properties** as defined in the Device List.

Note: If you modify any device that is used for a test template that is currently open, R&S ELEKTRA validates the test template. If the modification is relevant for the test, the software adjusts the affected settings. R&S ELEKTRA notifies you of this adjustment, when you view the affected test template after a device modification.

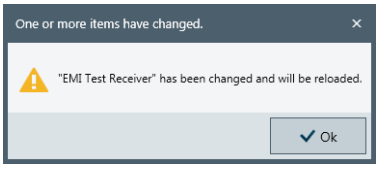


Figure 4-13: Notification of adjusted measurement settings due to a replaced receiver

For example, consider replacing receiver "A" that is capable of *time domain scans* (option "K53") by receiver "B" that does not feature this Scan Mode, but only *stepped scans*. In this case, the scan mode in a test template that uses this receiver for "Time Domain Scan" is changed to "Stepped Scan".

This change requires that in a test, which is based on this template, R&S ELEKTRA automatically deletes all existing test results from the Test Container, when you save or rerun the test. The reason is the requirement to preserve consistency between measurement settings and measurement results.

To keep results that you have saved earlier, close the test without saving it and create a new test based on the test template. Alternatively, you can make a copy of your test and rerun this copy.

Receiver ← Hardware Setup
The measurement instrument is the Receiver (test receiver or spectrum analyzer), which is automatically entered by R&S ELEKTRA as a reference from the Device List.

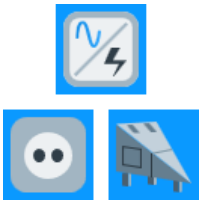
In the device list, you can specify to use a different receiver. However, be aware that this change affects all test templates, as the same receiver is referenced in each test template. Just as well, be careful with changing the Device Properties of the receiver, as these properties settings also affect all test templates.

If the measurement instrument is a test receiver (not a spectrum analyzer), you can select the Operating Mode "Test Receiver" for *scan* measurements or "Spectrum Analyzer" for *sweep* measurements. This setting only affects the test template in which you specify it.

Select (highlight) the receiver icon to access the settings for the overview measurement and the receiver properties.

Signal Path ← Hardware Setup
Selects the Signal Path for this frequency range as a reference from the Device List.

If there is a signal path, select (highlight) its icon to access its device properties. However, be careful with changing these properties, as any change affects all test templates that use this signal path.



Transducing Device ← Hardware Setup
Selects the Transducer (current clamp, antenna etc.), LISN or TEM Waveguide for this frequency range as a reference from the Device List. The type of selected transducing device determines the icon that is displayed in the hardware setup diagram.

For different frequency ranges, you can specify *different transducers* of the same Type ("Probe" or "Transmitter"), but R&S ELEKTRA allows only *one LISN* or *one TEM waveguide* for all frequency ranges.

Note: If the test template is new, your selection of the transducing device can interactively change the frequency range values of the first frequency range.

Select (highlight) the icon of the transducing device to access its device properties. However, be careful with changing these properties, as any change affects all test templates that use this transducing device.

Settings (Overview)
Specifies the receiver settings for the Overview Measurement.

Note: If the hardware setup uses the LISN "ENV 216", this specific LISN is the only one that also has a Settings dialog for its "High Pass" filter.

The receiver settings are only available, if you have selected (highlighted) the Receiver icon in the hardware setup diagram.

Figure 4-14: Prerequisite: select (highlight) the receiver icon

Note: Be aware of the difference: *Settings* define the individual behavior of a device during a test that is controlled by this test template. On the contrary, *Properties* define the global characteristics of a device as specified in the Device List.

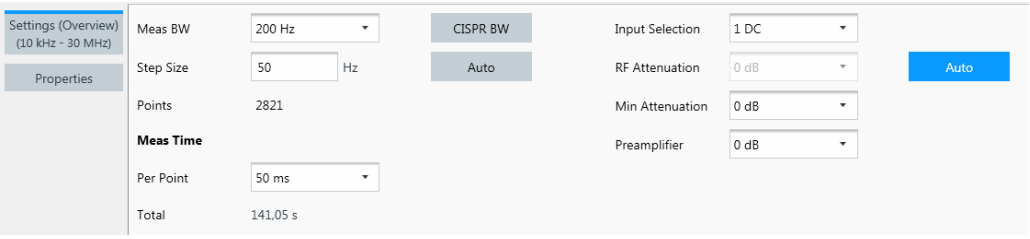


Figure 4-15: Settings dialog for the overview measurement

Note: After an EMI measurement with a test receiver, R&S ELEKTRA programs the scan settings (as specified here in the test template) into the test receiver's internal scan table. You can instantly use these settings at the test receiver.

Note that the availability of some elements in the "Settings (Overview)" dialog varies with several settings in other dialogs. The details are described in the following sections.

Detectors ← Settings (Overview)
Selects (activates or deactivates) the Detectors that you have specified in the Measurement Flow.

One or more detector checkboxes can be disabled (gray), if these detector types are not available for the measurement, for example due to the properties of the receiver that you use.

Meas BW ← Settings (Overview)
Selects from a list of suggested bandwidths for the measuring filter (intermediate frequency filter). The range and content of this list, for example 10 Hz to 1 MHz, depends on your receiver.

If you select a "Meas BW" value that does not comply with CISPR standard specifications, R&S ELEKTRA brings up a warning message, and you cannot save the test template.

The measurement bandwidth that you set here is also displayed in the headline of the Frequency Range.

CISPR BW ← Meas BW ← Settings (Overview)
Automatically sets the measuring filter bandwidth according to CISPR specifications, depending on the width of the selected frequency range.

The button "CISPR BW" is only available, if the following conditions are all met:
- The required CISPR bandwidth of the measuring filter is available in the receiver.
- R&S ELEKTRA can select the Filter Type "6 dB" in the receiver.
- The frequency limits of the user-defined frequency range are **within the boundaries of a CISPR band** as defined in the standard, see Table 4-3.

Table 4-3: CISPR frequency bands

CISPR band	Frequency range	CISPR bandwidth
A	9 kHz to 150 kHz	200 Hz
B	150 kHz to 30 MHz	9 kHz
C/D	30 MHz to 1 GHz	120 kHz
E and above	1 GHz and higher	1 MHz

Step Size ← Settings (Overview)
The input field for entering a measurement frequency step size is only available, if the following conditions are all met:

- The Operating Mode is "Test Receiver"
- The Scan Mode is "Stepped Scan"
- The "Auto" button next to the "Step Size" input field is not enabled

In this constellation, R&S ELEKTRA automatically suggests the half Meas BW (BW/2) as a default value for the frequency step size.

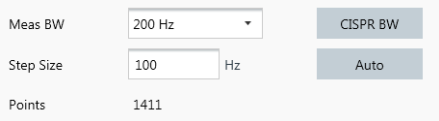


Figure 4-16: Step size in operating mode "Test Receiver"

You can edit this value and specify an arbitrary step size for the test. We recommend using at most the half "Meas BW" value, to avoid erroneous measurements.

If you specify a step size value that is greater than BW/2, a warning comes up next to the "Step Size" input field. You can still save and use the test template, but R&S ELEKTRA shows the same warning next to the Verdict in the test:

The "Auto" button next to the "Step Size" input field resets the step size to half the "Meas BW" and disables editing this field.

The resulting number of Points, which is the frequency range divided by the step size, is automatically calculated and displayed for your information.

Note: A typical setting for an overview measurement is a step size of half the Meas BW ("Auto" button) with a 6 dB Filter Type. However, as the measurement filter is not flat, the accuracy is limited. Narrow bandwidth (CW) signals could be measured up to 1.5 dB lower than their actual level. Manually setting the step size to a third or fourth of the measurement bandwidth (BW/3 or BW/4) improves the accuracy, but at the cost of a longer measurement time.

In the Scan Mode "Time Domain Scan", R&S ELEKTRA automatically fixes the "Step Size" at a quarter of the Meas BW (BW/4). You cannot change this setting, and the "Auto" button is disabled.

As opposed to "Test Receiver" mode, in operating mode "Spectrum Analyzer" the step size is automatically calculated from the frequency range divided by the number of Points. In this case, the step size just serves for your information.

Points ← Settings (Overview)
Only available, if the Operating Mode is "Spectrum Analyzer" and the "Auto" button next to the Step Size input field is disabled.

R&S ELEKTRA automatically suggests a default number of measurement points in such a way that the automatically calculated "Step Size" is equal to or close below the half Meas BW.

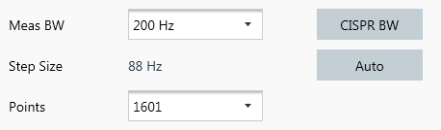


Figure 4-17: Measurement points in operating mode "Spectrum Analyzer"

You can change this value and select from a list of suggested numbers of measurement points for the test. We recommend selecting the number of points in such a way that the resulting "Step Size" is not more than the half "Meas BW" value, to avoid erroneous measurements. Use the "Auto" button to reset the number of points to meet the recommended "Step Size".

The step size is displayed, too, for your information.

Note: For selecting a suitable number of measurement points, see the recommendations at Step Size.

As opposed to "Spectrum Analyzer" mode, in operating mode "Test Receiver" the number of points is automatically calculated from the frequency range divided by the Step Size. In this case, the number of points just serves for your information.

Meas Time ← Settings (Overview)
Specifies the measurement time (total or per point) in the overview measurement, depending on the Operating Mode:

- In operating mode "Test Receiver", you can specify the measurement time Per Point. The total measurement time results from this setting.
- In operating mode "Spectrum Analyzer", you can specify the Total measurement time. The measurement time per frequency point results from this setting.

The shortest required measurement time depends on the type of EUT and on various conditions, including the Scan Mode setting.

To determine the shortest required measurement time, run a continuous measurement directly on the test receiver (or a sweep in spectrum analyzer mode). We recommend observing the measurement results directly on the receiver's display, as this procedure allows the best judgment of short-term instabilities. On the contrary, when you observe the measurement results in R&S ELEKTRA, the delay of data transfer to your computer and of graphics generation can impair the identification of relevant instabilities.

If you use a test receiver that supports Time Domain Scan, this fast scan mode is helpful, as you can better observe a wide frequency range. However, if you set your measurement time too short, you risk missing sporadic disturbances.

Use the "Maximum Peak" detector across the whole frequency range of the limit line. Observe the displayed "Clear Write" and "Max Hold" levels. We recommend considering the time that it takes, until the "Max Hold" spectrum looks "stable", as the minimum measurement time for final measurements at critical frequencies. The measurement time determined by this approach is also recommended for the overview measurement, but the best selection also depends on the type of the disturbance.

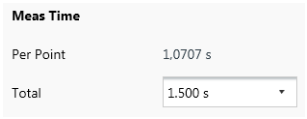
Note: If the disturbances generated by the EUT are occasional short pulses ("clicks"), you must evaluate the characteristics of such a device and the required measurement time by a click rate analysis. For a description of this procedure, refer to the user documentation of your test receiver.

Per Point ← Meas Time ← Settings (Overview)
Only available, if the Operating Mode is "Test Receiver": Selects the measurement time per point from a list of predefined values.

Depending on this setting, the total measurement time is displayed, too, if the Scan Mode is "Stepped Scan". The "Total" is automatically calculated from the measurement time per point multiplied by the number of Points.

If the "Scan Mode" is "Time Domain Scan", the total measurement time (which is typically much shorter than in "Stepped Scan" mode) is not displayed. This time cannot be computed, because it depends on internal parameters and hardware capabilities of your receiver model.

Total ← Meas Time ← Settings (Overview)
Only available, if the Operating Mode is "Spectrum Analyzer": Selects the total measurement time from a list of predefined values.



Depending on this setting, the measurement time per point is displayed, too. It is automatically calculated from the total time divided by the number of Points.

Video BW ← Meas Time ← Settings (Overview)
Only available, if the Operating Mode is "Spectrum Analyzer": Selects from a list of suggested video bandwidths (1 kHz to 10 MHz).

The "Video BW" is the bandwidth of the lowpass filter directly after the envelope detector. This downstream filter is used to remove noise from the signal envelope.

Typically, the "Video BW" must be wider than the Meas BW. Exceptions apply, if standards require that the video bandwidth filter cuts away part of the signal that has passed the measuring filter (IF selection filter). If you select a "Video BW" that is smaller than the "Meas BW", R&S ELEKTRA shows a warning.

Auto ← Video BW ← Meas Time ← Settings (Overview)
Enables an algorithm that automatically selects the widest possible video bandwidth, in any case wider than the Meas BW.

Input Selection ← Settings (Overview)
Selects the test receiver's or spectrum analyzer's port number, hence the physical RF input connector. If more than one port is available, the selected port is used for the measurement.

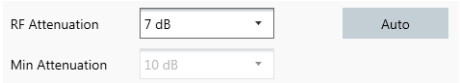
If you use a two-port test receiver that offers the coupling modes "AC" or "DC", you can select as follows:

"1AC"or "2AC" Port 1 or 2 with alternating current coupling mode. AC coupling is typically limited to signals that alternate with a few kHz, at least. Therefore, you cannot use this mode for lower frequency ranges, but the receiver is better protected against signal overload than in DC coupling mode.

"1DC"or "2DC" Port 1 or 2 with direct current coupling mode. You can use this mode to measure signals down to 0 Hz, but it leaves the receiver sensitive to overlaid DC voltage, which can damage the receiver input.

RF Attenuation ← Settings (Overview)
Only available, if Auto is disabled.

Selects a fixed input attenuation (in dB) from a list of predefined attenuation values.



If you use a test receiver in measurements with potentially strong signal pulses, you must protect the receiver input by selecting a sufficiently high "RF Attenuation" value.

Note: Setting the attenuation too high reduces the sensitivity of the measurement.

We recommend protecting the receiver input by using Auto ranging. If the Operating Mode is "Test Receiver", we recommend combining "Auto" with a Min Attenuation of 10 dB.

Auto ← RF Attenuation ← Settings (Overview)
This "Auto" ranging button has three effects:

- It disables the manual "RF Attenuation" selection.
- It enables an algorithm that automatically selects the appropriate input RF attenuation (higher than the manual selection, if necessary). The algorithm depends on various settings and on the test situation.
- If the Operating Mode is "Test Receiver", it enables the Min Attenuation selection.

Min Attenuation ← RF Attenuation ← Settings (Overview)
Only available in Operating Mode "Test Receiver", if Auto is enabled.

Specifies either no minimum attenuation (0 dB = default) or a minimum attenuation of 10 dB, as described in RF Attenuation.

Preamplifier ← Settings (Overview)
Specifies the receiver's preamplification (in dB) for each frequency range.

We recommend disabling the preamplifier (= 0 dB) and using an RF Attenuation of at least 10 dB, to protect the receiver from damage due to input overload. This protection is especially important, if high disturbance pulses could occur, for example in conducted measurements. Another scenario that imposes an overload risk is the generation of electrostatic discharge pulses, caused by touching the antenna during manual antenna changes.

The following settings are available:

"0 dB"	Selects 0 dB preamplification (= default)
"20 dB"	Selects 20 dB preamplification
"30 dB"	Selects 30 dB preamplification (only available with some receiver types)

Reference Level ← Settings (Overview)
This parameter is only available, if the Operating Mode is "Spectrum Analyzer".

It specifies the value of the upmost line on the analyzer's display, to avoid an input overload.

The unit of the reference level is automatically adjusted to the measurement unit of the transducing device, hence typically *dBµV*. The default value is 80 dBµV.

Settings

Settings
This "Settings" dialog is only available, if the hardware setup uses the LISN **"ENV 216"**, *and* if you have selected (highlighted) the icon of this "ENV 216" LISN.

Figure 4-18: Prerequisite: select (highlight) the icon of the ENV 216 LISN

The "High Pass" checkbox enables or disables remote switching of this LISN's internal 150 kHz highpass filter.

Note: For a description of the receiver settings, refer to Settings (Overview).

Properties

Properties
Shows the properties of the device that you select (highlight) in the hardware setup diagram.

Note the difference: Properties define the global characteristics of a device as specified in the Device List (see Device Properties). On the contrary, the Settings define the individual behavior of a device (the receiver) during a test that is controlled by this test template.

The "Properties" are shown as specified in the Device List.

Note: Access to device properties depends on type of test template.

- You can open a test template that is integrated into a test (as a "copy" of a "global" test template). However, you can only read but not modify any device properties from within this test template dialog.
- If you open a "global" test template outside of a test, you can modify the device properties from within the test template dialog.

However, be careful with modifying any device properties from within the test template dialog. These properties are also changed in the device list and in each other "global" test template that uses the device. (Existing tests are influenced by modified device properties, too, when you rerun these tests.)

4.4.4 Test Information

This dialog allows editing test information that is relevant for all (or most) of the tests that you run from this test template. By entering this information in the test template instead of in the test, you avoid having to enter the same information repeatedly for the same type of tests.

When you open the test information dialog within a test, you can edit your predefined titles and contents.

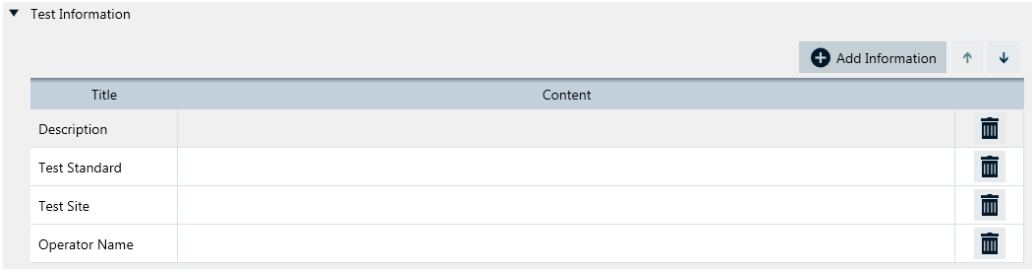
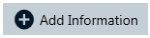


Figure 4-19: Test information dialog



Add Information
Adds a new row in the test information table, below the default lines "Description", "Test Standard", "Test Site" and "Operator Name".

Shift Row Up / Down
The buttons swap the position of the selected row with the one above or below it.

Title
Enter a title for each row of test information.

Click the titles headline to sort the rows alphabetically by their titles.

Content
Enter arbitrary content in each row of test information. You can also leave the content of a row blank and enter only the title, for entering the content later (within the tests).

Click the contents headline to sort the rows alphabetically by their contents.

Delete Row
Deletes the selected row without additional warning and without the possibility to restore the deleted title and content.

4.4.5 Actions

▼ Actions This dialog defines actions that are executed when a particular event occurs during a measurement.

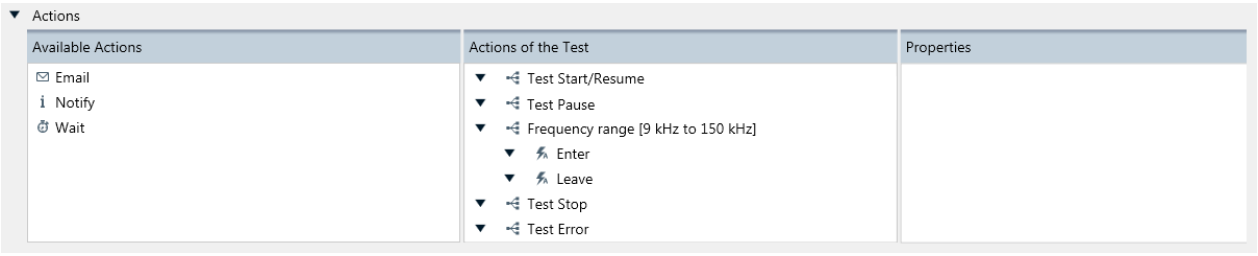


Figure 4-20: Actions dialog

The available actions are:

- Email - sending an email message to alert the user
- Notify - sending a notification to alert the user
- Wait - waiting for a defined time before R&S ELEKTRA continues with the next step of a test. During this time, you can stop the test.

Typical events, for which actions can be assigned, are:

- "Test Start/Resume"
- "Test Pause"
- "Frequency range" according to the Frequency Range List, where the event can be:
  - "Enter" the frequency range
  - "Leave" the frequency range
- "Test Stop" (scan end or user interruption)
- "Test Error"

Assigning an action

To assign an action to an event, drag-&-drop the action icon from "Available Actions" (left tab) to the name of that specific event in "Actions of the Test" (center).

For example, click-and-hold "Notify", drag it to "Test Stop" and drop it there.

Click any assigned action to edit it in the "Properties" tab.

To remove an action from an event, select the icon of that specific action and click DELETE on the keyboard. Alternatively, right-click an action icon to select DELETE from the context menu. In touch operation on a tablet computer, tap and hold the icon of an action and select DELETE in the context menu.

The available actions are:

Email

Sends an email message when the event has occurred, for example, a test is started or stopped.

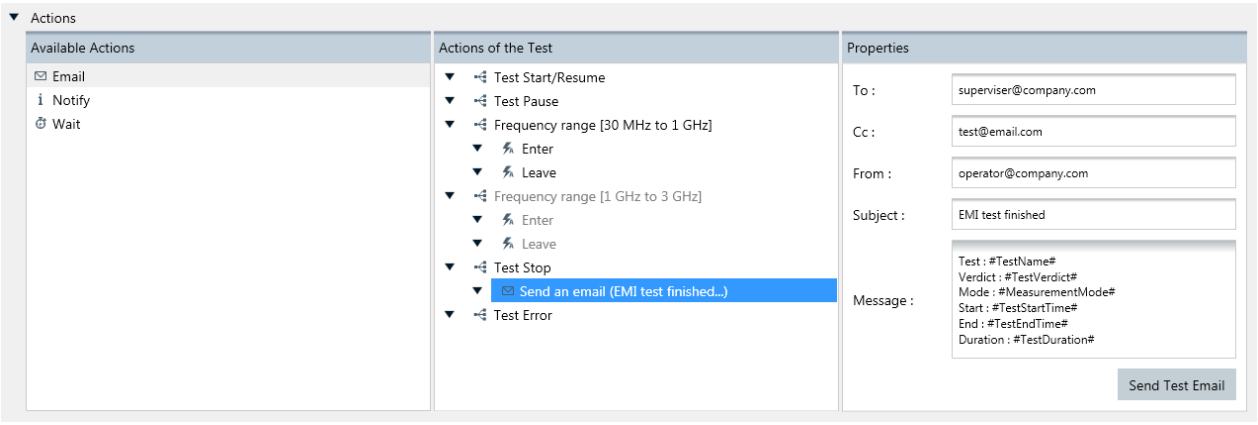


Figure 4-21: Action "Email" assigned to event "Test Stop"

"To"	Enter one or more recipient addresses.
"Cc"	Enter one or more copy addresses.
"From"	Enter the address of an email account that you have access to.
"Subject"	Enter a subject heading. R&S ELEKTRA suggests a default heading. For the hash characters, see the description at "Message".

"Message" Enter any arbitrary message text. R&S ELEKTRA suggests some default entries. The functional text items between two hash characters (for example "#TestName#") are automatically replaced by the content that they represent. This replacement is executed only, if the message is issued out of a real test. The replacement cannot take effect when you use the button "Send Test Email" out of the test template.

The functional text items that the software can replace automatically are:

- #TestName#
  Returns the name that you used to save the test. If the test is not yet saved, R&S ELEKTRA uses the default name of the test based on the name of the test template.
- #TestVerdict#
  Output values are "Inconclusive" or "Failed" or "Passed". Only available after the test is finished.
- #MeasurementMode#
  Output values are "Overview" or "Final" measurement. Only available, if the measurement in the first frequency range has started.
- #CurrentSubrange#
  Returns the start and stop frequencies of the frequency range that is currently used in the measurement.
- #TestStartTime#
  Returns both date and time.
- #TestEndTime#
  Before the test is completed, the output value is "<Test not yet finished>".
- #TestDuration#
  Returns the hours, minutes and seconds from the test start to the moment that the notification is generated.

"Send Test Email" Sends an email to the specified "To" and "Cc" addresses.
Note that in a test message, the text items between hash characters are not replaced by the content that they represent.

Notify
Brings up a user-defined text and audio message on the computer, on which R&S ELEKTRA is running, when the event has occurred.

The audio feature requires that the computer has a sound card and that the computer's loudspeaker is not muted (volume > 0%).

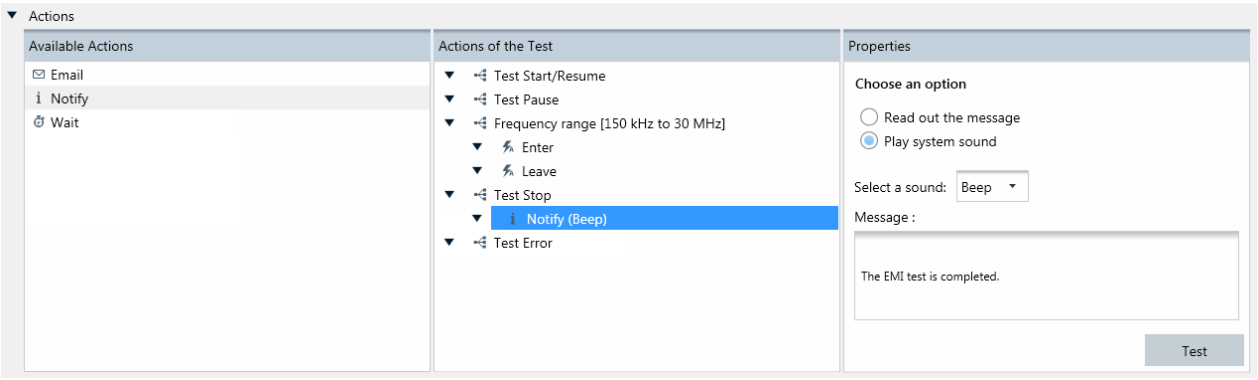


Figure 4-22: Action "Notify" assigned to event "Test Stop"

While the dialog box shows the text message, you can optionally stop the test or select "Continue" to proceed with the test execution.

"Read out the message"
: This function displays the text from the "Message" field in a dialog box and also reads it out loud, when the event has occurred.
Note that acronyms such as "EMI" are better pronounced if written as "E.M.I.".
The audio replay of the message is not stopped even if you continue or stop the test.

"Play system sound"
: Replays a Windows standard sound according to your selection in the field "Select a sound".

The available Windows standard sounds are called:

- "Beep"
- "Exclamation"
- "Asterisk"
- "Hand"

"Message"
: Enter any arbitrary notification text. R&S ELEKTRA suggests a default entry. The functional text items between two hash characters (for example "#TestName#") are automatically replaced by the content that they represent. This replacement is executed, if the notification is generated out of a real test, rather than out of the test template by using the button "Test".
For a list of functional text items that can be used between two hash characters, see Email > "Message".

"Test"
: Serves for testing the audio output of the "Notify" feature.
Note that in this test notification, the text items between hash characters are not replaced by the content that they represent.

Wait
Makes R&S ELEKTRA pause the test for a user-defined time (number of seconds) before the next step of the test is executed.

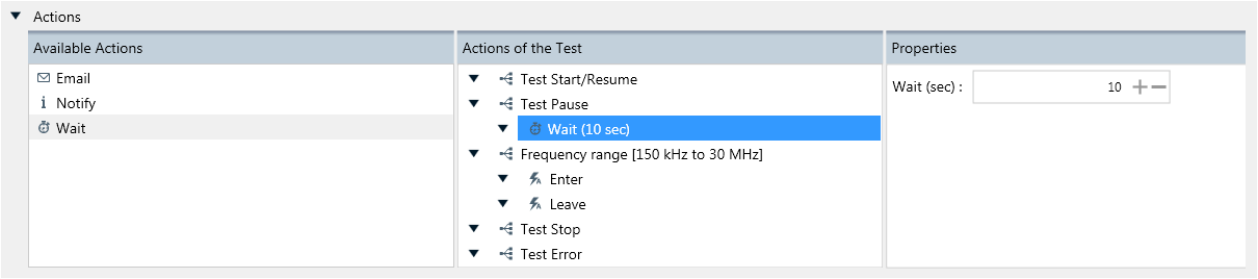
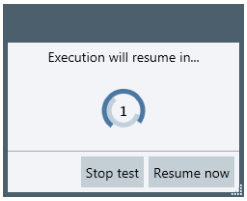


Figure 4-23: Action "Wait" assigned to event "Test Pause"

While the test is paused, a dialog box shows a countdown of the remaining seconds to wait. During this time, you can optionally stop the test or select "Resume now" to skip the remaining waiting time.



4.5 Report Templates

Report templates are used for the configuration of test reports. Report templates contain user-definable settings and are contained in Tests, as shown in the software structure.

Handling report template items

Access: "Home" > "Report Templates"

Depending on the selection of one or several report templates, different action buttons are available in the actions bar. All these buttons are common action buttons, described in Chapter 3.2, "Common Action Buttons", on page 33.

Specify general settings for report templates at "Home" > "Administration" > Report Settings.

With "Open" or "Create Report Template", proceed as described in Chapter 4.5.1, "Configuring Report Templates", on page 94.

4.5.1 Configuring Report Templates

Either start with an existing report template, or create a new one.

- To open an existing report template, use one of the following options:

  - Select it at "Home" > "Report Templates" and click "Open". Opening a report template from this menu allows saving it as a global report template, available for other tests, but you cannot configure all details.
  - Open it from within a test as described in Chapter 3.7, "Reporting", on page 43. Opening a report template inside a test allows configuring all details, but you cannot save it as a global report template, available for other tests.
- To create a report template, use one of the following approaches:
  - Select "Home" > "Report Templates" > "Create Report Template". Creating a report template from this menu allows saving it as a global report template, available for any test, but you cannot configure all details.
  - Create a report template from within a test as described in Chapter 3.7, "Reporting", on page 43. Creating a report template inside a test allows configuring all details, but you cannot save it as a global report template, available for other tests.

Hence, create your report templates from the report templates menu and configure them with all contents that are not test-specific. Then save these report templates as global report templates. Inside a test, select one of your global report templates and refine it by configuring specific details. The detailed report template is saved in the test container as a copy of the original report template. This copy is not globally available.

In the "General" section of the report template, specify the report title as well as the left-hand, center and right-hand content of both the report header and footer.

All items that can be included into the report header or footer are self-explanatory, except for the Verdict.

Below the "General" section, select from a list of "Available Components" in an arbitrary order. Double-click an item, or click the "Selected Component" button ▸ next to it, to add the item to the list of "Selected Components" (dialog next to the "Available Components").

Within this list, you can rearrange the "Selected Component": drag and drop them to the desired position. (If you use a tablet computer, touch and immediately drag the object you want to move, without holding it for long.)

Most of the "Selected Component" offer individual "Component Options", for which you can specify settings when you have highlighted that "Selected Component". In part, you can only specify options once the report template is opened (embedded) inside a real test. Outside of a test, hence in a non-embedded report template, placeholders for all selected components are inserted into the report preview .

The following options are only available for **embedded** report templates, opened inside a test:

- For the component "EMI Tables", select at least one of the "Available Tables" by clicking the "+" sign (⊕) to add it to the list of "Selected Tables". In the selected table, optionally select a subset of rows and optionally disable individual columns.
- For the component "Generic Graphics", select at least one of the "Available Graphics" by clicking the "+" sign (⊕) to add it to the list of "Selected Graphics". For each selected generic graphic, you can enable "Show Zoom Area" and configure this area via the "Configure Zoom Area" dialog. This dialog works similar to Configuring Test Charts.

- For the component "Generic Table", select at least one of the "Available Tables" by clicking the "+" sign ( ) to add it to the list of "Selected Tables".

To put any change into effect, click the "Refresh" button in the *top menu of the report* (but **not** the taller "Refresh" button in the *top menu of the test*).

Since the placeholders shown for selected components in non-embedded report templates provide no details, we recommend creating basic report templates from the report templates menu and refining it within a test, as described above.

Next to the "Refresh" button in the top menu of the report, more report functions are available for displaying, printing, searching, zooming, navigating, exporting (PDF or DOCX) and attaching.

The "Attach" button, which is only available for embedded report templates, saves a report in the R&S ELEKTRA database together with the test, see Chapter 3.7, "Reporting", on page 43.

Note that tables that do not fit on the length of one page are continued on the next page (or pages). Tables that do not fit on the width of one page are split to fit on the width of n pages. They are labeled "(1/n)" on the first page and continued with labels "(2/n)", "(3/n)", ... until "(n/n)". To reduce the width of a table, deselect columns that are dispensable. This deselection can only be done in a report template that is embedded within a test.

Once the configuration of the report template is completed, make sure to save the result by clicking or .

4.6 Device List

The "Device List" comprises all measuring equipment in the test site. Devices from this list are part of Test Templates , as shown in the software structure.

R&S ELEKTRA is compatible with a comprehensive choice of Rohde & Schwarz devices. When you add a device to the "Device List", a device driver is implemented in the background. The software does not provide user access to these drivers, which cover all communication tasks between R&S ELEKTRA and the devices.

Each device entry contains General Properties. You can edit these properties. In case of the receiver, you can let R&S ELEKTRA automatically retrieve the properties by using the functions Search Device and Recheck Devices. This feature requires that the receiver is connected to your computer, either directly via GPIB or remotely via LAN.

Handling device list items

Access: "Home" > "Device List"

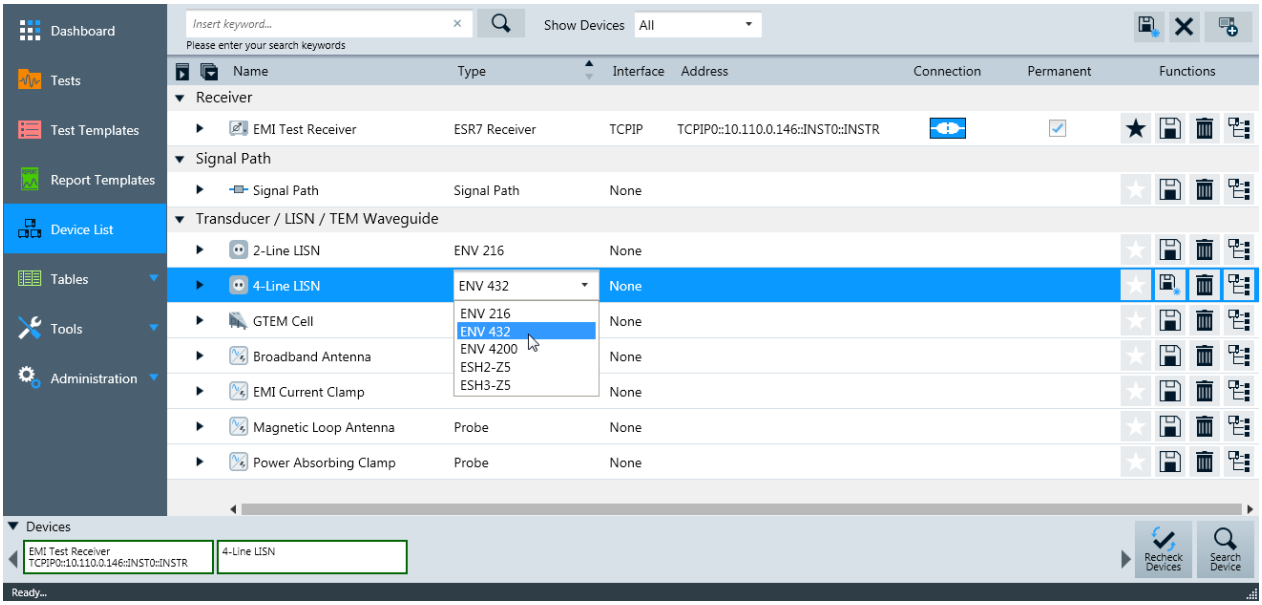


Figure 4-24: Device list dialog with an exemplary list of devices

The "Device List" dialog is largely different from the other "Home" dialogs ("Tests", "Report Templates", etc.). Differences are:

- All items in the "Device List" are grouped in Device classes, for example "Receiver" or "Transducer". (To sort the entries within each device class, click the column header. Click the header again for reverse order.)
- No item in the "Device List" can be selected for an action to be executed with it. Instead, you can set one device per device class to be the Favorite Device in this device class.
- No item in the "Device List" can be pinned to the "Dashboard".
- No search can be saved, but the "Device List" can be filtered (Show Devices) for referenced, unreferenced or modified devices.
- None of the familiar Common Action Buttons is available. Instead, there is a special set of Action Buttons in the Device List.
- The device properties are not edited by opening them in a separate dialog tab. Instead, the device properties unfold in several tabs within the "Device List".
- Besides editing the device properties manually, they can also be automatically retrieved from existing physical equipment. This retrieval is implemented by the functions Search Device and Recheck Devices. To use these functions, the equipment must be connected to the computer, which runs R&S ELEKTRA.
- Changes in the settings or properties of *several* devices can jointly be saved or discarded.

Device classes

The "Device List" includes the following classes of devices, which are described in Chapter 4.6.2, "Device Properties", on page 108:

- **Receiver**
- **Signal Path**

- Various transducing devices are combined in the group **Transducer / LISN / TEM Waveguide**:
  - **LISN**
  - **TEM Waveguide**
  - **Transducer**

Devices are always *integrated into test templates* as **references** that link to the original data sets in the "Device List". They are not integrated as copies of those data sets. Therefore, if device properties are modified in the "Device List", these properties are changed in all instances, too: in each test template that uses this device, in each test that uses this test template, etc.

Signal paths are included in the "Device List". A signal path is not necessarily only a piece of cable but can include multiple cables, connectors, attenuators, etc.

4.6.1 Action Buttons in the Device List

Access: "Home" > "Device List"

In the "Device List", none of the familiar Common Action Buttons are available. Instead, the dialog-specific action buttons for the "Device List" are:

Search

Searching for devices in the "Device List" works as described in Chapter 6, "Special Software Features", on page 143: Enter an arbitrary text string into the search field to *filter the "Device List"* for entries that contain this text.

Note:

- Other than conventional Searches, a search in the "Device List" cannot be saved and pinned to the "Dashboard".
- Do not confuse this function for *searching (filtering) the "Device List"* with the function *Search Device*, which allows finding devices in the network environment (LAN or GPIB).
- If there are unsaved device changes in the device list, the search results are not complete. To get complete search results, save the changed devices before doing a search.
  If yo wish to see exclusively the devices with unsaved changes, select Show Devices > "Modified".

Show Devices

Filters the devices that are displayed in the "Device List" by the following criteria:

"All"	All devices are displayed without being filtered.
"Referenced"	Only those devices are displayed, which are used ("referenced") elsewhere, for example in test templates or tests.
"Unreferenced"	Only those devices are displayed, which are **not** referenced.
"Modified"	Only those devices are displayed, which have been modified, with the changes still being unsaved.

Save All Changes

Saves all changes in all devices that have not yet been saved after modifying them. Saving the changes is not protected by any alert, all changes are immediately saved.

R&S ELEKTRA supports the shortcut key "CTRL + SHIFT + S" for the "Save All Changes" command.

Note: Instead of "Save All Changes", you can save the changes in each individual device: Click Save in the row of the device for which you want to save the changes. Alternatively, use the shortcut key "CTRL + S" to save the selected (highlighted) device entry.

Note: If you make changes in the Receiver that is selected as the Control Device of a LISN, R&S ELEKTRA considers this LISN as changed, too.

Discard All Changes
Discards all changes in all modified devices that have not yet been saved. This loss of settings is protected by the following alert: "Do you really want to discard all changes? Total number of <n> device(s) changed:", followed by a list of the "n" modified devices. To discard the changes, confirm with "Yes", or select "No" to return to the device list without discarding the changes.

Note: To discard the changes in one or several devices, but not all that you have modified, proceed in two steps: First click the "Save" button in the row of each device for which you want to keep the changes. Then click "Discard All Changes" to discard the changes for the remaining modified devices.

Add a new Device
Opens a dropdown menu for selecting a device that you want to add to the "Device List".

The dropdown menu consists of a tree of folders and sub-sub folders that branch out from "Device Class" to the individual "Device Type".

Note: You cannot add a receiver but only exchange the receiver specified in the "Device List" for a different one. To do so, connect the new receiver to your computer or network and select the correct receiver Type for it. Then use the Search Device dialog to assign the new receiver to the "EMI Test Receiver" entry in the "Device List".

For the properties of the various types of devices, see Chapter 4.6.2, "Device Properties", on page 108.

Collapse All
Minimizes the details of all devices:

- The first click collapses any expanded sections of device properties, if available, and shows a minimized list of device names.
- A second click collapses the list of device names, too, and shows a minimized list of device class headlines, only.

Expand All
Fully unfolds all collapsed device classes, device entries and device properties.

Name
Lists the device names, grouped within Device classes.

To sort the device classes and the entries within each device class by the device names, click the "Name" column header. Click the header again for reverse order.

Type

Selects the device type for the receiver and for the one or more LISN entries in the device list.

To sort the device classes and the entries within each device class by the device type, click the "Type" column header. Click the header again for reverse order.

To select the type, highlight an entry and click the "Type" field to show the selection switch. In the pull-down list that opens, select any of the available device types, as in Figure 4-25.

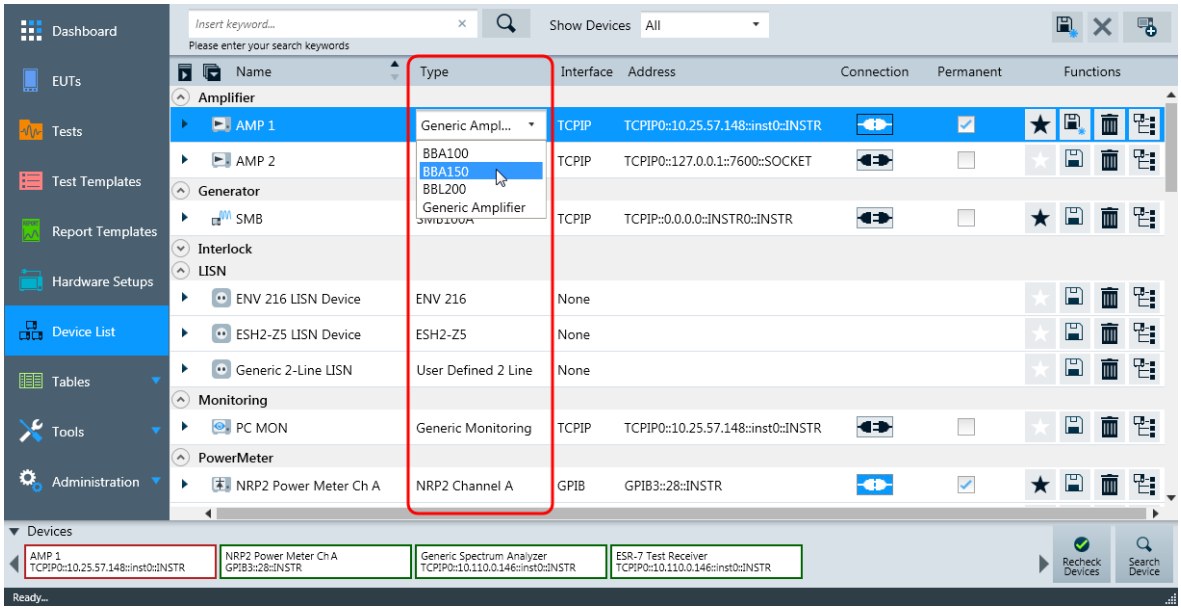


Figure 4-25: The Type selecttion in the Device List dialog

You can use the "Type" selection to exchange a device. If the device, which is replaced by this exchange (for example an ESR7 by an ESR26 Receiver), was referenced in a test, any existing test results data remain unchanged. However, when you rerun the test, the original test result data are discarded. The new device is then used for measurements in the rerun test.

Interface

Shows the Interface Type of the Receiver (the only device that can be connected). All other devices are labled as "None" in the "Interface" column.

Address

Shows the VISA resource string of the Receiver (the only device that can be connected).

Connection

Toggles the connection state of the receiver.

- - receiver not connected
- - receiver connected

To be able to connect the receiver, first make sure to select your correct Type of receiver, for example the "ESR7 Receiver".

Note: Toggling the connection state is no criterion for R&S ELEKTRA to consider the receiver as "changed". Instead, the software checks, if the state of the Permanent switch has changed. Connecting or disconnecting the receiver does not alter the state of the "Permanent" switch.

You cannot edit the device properties of a connected receiver. Instead, the properties are automatically read from the receiver. The various properties tabs of a connected receiver show these properties in deactivated (gray) dialogs.

Permanent
Activating this switch defines a permanent Connection to the receiver. After shutting down R&S ELEKTRA and starting it again, the receiver is automatically reconnected, if the network connection is available. If no connection is available, the receiver status is "red", see Recheck Devices.

Functions
Comprises the following functions described below:

- Set as Favorite Device
- Save
- Delete
- Show Reference

Set as Favorite Device ← Functions
The set-as-favorite button is available in each individual device's row.

Per device class, you can select exactly one item to be "Set as Favorite Device" ★. This device is automatically used as the default, when R&S ELEKTRA requires a device of a specific device class for a test setup. All other devices in the same class are automatically assigned as non-favorite and hence non-default devices (☆).

Note: Clicking the "Set as Favorite Device" button of a newly created device also saves this device entry.

You can also remove the selection of one device as the favorite without assigning the favorite role to another device in the same class. To do so, temporarily add a new device to the same device class, set it as the favorite device and delete it from the "Device List".

Save ← Functions
The save button is available in each individual device's row.

Saves the changes in the selected device. Saving the changes is not protected by any alert, all changes are immediately saved.

Note: Instead of saving the changes in one individual device, you can use the Save All Changes button to save all changes in all devices that have not yet been saved after modifying them.

Delete ← Functions
The delete button is available in each individual device's row.

You can only delete a device that is not used (hence, not "referenced") in test templates and tests. If a device has references, you must first remove these references as described below, to be allowed to delete the device entry.

Note:
Before you plan to delete a device entry, first consider the following use cases:

- If you wish to use a **different receiver model**, while only one receiver device entry is allowed in the device list, we recommend not to delete the receiver device entry. Instead, exchange the device type by a different receiver model, using the Type selection. This exchange preserves existing references, for example from test templates to the receiver device entry.
- If you wish to **replace** an old device by a new one, and you are sure that you will never again use the old device, we recommend to rename the existing entry of the old device and overwrite its properties with the new information. This includes, for example, selecting new correction tables.
- If you **stop using** a certain device without replacing it, we recommend not to delete the existing entry, for example to maintain existing references to this device from test templates.

When you click the "Delete" button, R&S ELEKTRA first checks, if the item that you wish to delete is referenced.

- If the device is **not referenced**, the deletion process is merely protected by the following alert: "Are you sure you want to delete the selected item(s)?" Confirm with "OK" or "Cancel" the deletion process. This function is similar to the common action button Delete, except that no multiple selection of items can be deleted simultaneously.
- If the device **is referenced**, R&S ELEKTRA warns you that deletion is not possible, since the software expects that you clear the references first:

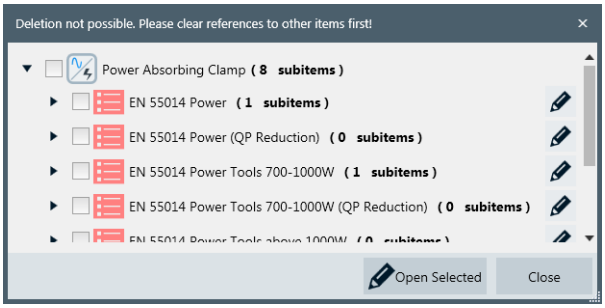


Figure 4-26: Dialog with subitems referenced by a device (here: a transducer)

If you wish to delete the receiver or a referenced LISN, **first consider to use the Type selection, instead**.
For all other devices, or if type selection is not an option for your device, and if you still wish to delete the device despite the recommendations given above, proceed as follows:

– To unfold a tree of all references, in which the device is used, click the triangles in front of all items that have subitems.
– Select the checkboxes of all items in the reference tree:

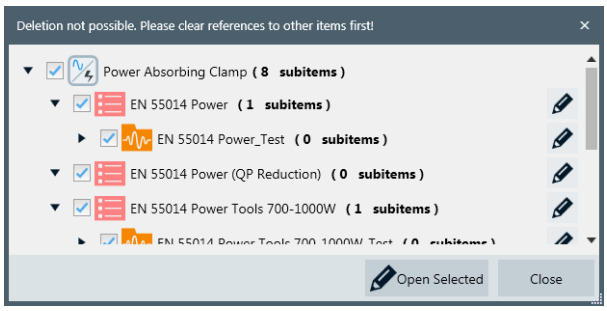


Figure 4-27: A transducer that is referenced in several levels of subitems, down to tests

You can select all referenced items by selecting only the checkbox in front of the device icon itself.

– Click "Open Selected" to open a dialog tab for each selected item. This action closes the reference tree dialog and opens all selected subitems, but not the device itself.
– In each dialog tab (test template or test), replace the referenced device by a different device. Then save this change and close the tab.
  Proceed in the same way with all opened dialog tabs that contain a reference for the device you wish to delete.
  Note that replacing a device can be difficult, since the new device must comply with several property requirements. For example, it must cover the frequency ranges required by the test templates.
  Replacing devices in a test is especially difficult, as you must modify the test template on which the test is based. Any modification of a test template embedded in a test container leads to a deletion of the test results.
– In the "Device List" dialog, you can delete the now unreferenced device (which is still highlighted).

Show Reference ← Functions
This button brings up the same reference tree of a device as the Delete button, but it does not have the delete function. It is also available in each individual device's row.

The reference tree shows, in which test template and test a device is used ("referenced").

Search Device
The button "Search Device" in the lower right corner of the "Device List" window calls up a dialog for searching devices in the network environment, to which the computer is connected. Once the search is executed, the dialog looks as in Figure 4-28:

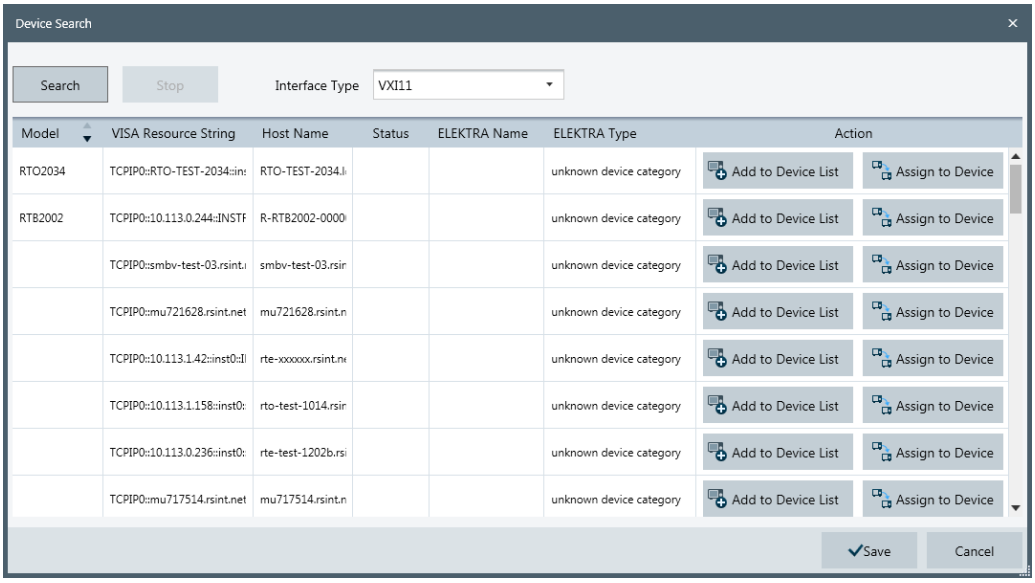


Figure 4-28: Device search dialog with an exemplary list of devices

To sort the search result list alphanumerically by the entries in one of the columns, click the column header. For reverse order, click the header again. Sorting works for all columns except for "Status" and "Action".

Note:

- Do not confuse this function, which *searches devices in the network environment* (LAN or GPIB), with the function *Search*, which allows for filtering the "Device List".

Search ← Search Device
Starts a search for devices by a broadcast command within the network, to which the computer is connected via the selected Interface Type. The search stops automatically after a time that depends on the size of the connected network. (If it takes too long, you can Stop it.)

The dialog then presents a list of available devices, as shown in Device search dialog with an exemplary list of devices. Use this list to select Add to Device List or Assign to Device.

Stop ← Search Device
Stops the Search. Use this function if you wish to terminate the search at some point, or if it does not stop automatically within a reasonable timeframe.

Interface Type ← Search Device
Selects the interface type for searching devices within the network, to which the computer is connected.

Changing the selected interface type immediately starts a search.

"VXI11" VXI-11 is a protocol, specified by the VXIbus Consortium, for remote control of LAN-based test and measurement instruments. Use this "Interface Type" to search for devices connected via Ethernet (LAN).

"GPIB" GPIB (General Purpose Interface Bus) is the common name for the 8-bit parallel communications interface specification IEEE-488. Use this "Interface Type" to search for devices connected over a short range via GPIB bus.

Model ← Search Device
States the model name, if it is contained in the network device's reply to the device search. You cannot edit this field, which remains empty, if the search algorithm cannot read the model name from the device.

VISA Resource String ← Search Device
Displays the VISA Device Identifier as originally found by the automatic device search. You cannot edit this string.

Host Name ← Search Device
Displays the host name of the device within the network. You cannot edit this string.

Status ← Search Device
Only available for the network device that is assigned to your receiver entry in the "Device List".

Shows and sets the connection state of this device, which you can toggle between connected and disconnected.

ELEKTRA Name ← Search Device
Only available for the network device that is assigned to your receiver entry in the "Device List".

Displays the receiver's Name in the "Device List".

You cannot edit the name in this column, but only in the Name field of the "Device List".

ELEKTRA Type ← Search Device
Displays the device class of the network devices. For all network devices that do not match with the "Device List", R&S ELEKTRA displays "unknown device category".

You cannot edit this field.

Action ← Search Device
Allows using results of the network device search for entries in the "Device List". Only available, if the search algorithm finds connectable devices in the network environment.

Add to Device List ← Action ← Search Device
"Add to Device List" is available for each network device that the Search Device function finds in the network environment.

When you click this button for an individual network device, R&S ELEKTRA offers the device types for which you can add the selected network device. If no device type is offered, you can not add this entry to the "Device List".

Assign to Device ← Action ← Search Device
Assigns the connectivity parameters of an individual network device to the receiver device entry in the "Device List". "Assign to Device" is available for each device found by Search Device in your network environment.

To assign a specific network device from the "Search Device" dialog, first execute the Search. If the search delivers results, browse the list of search results to find the network device that you wish to couple with your receiver entry in the "Device List". In this row of the search results list, click the "Assign to Device" button. The dialog opens a dropdown list for selecting the receiver.

When you select it, R&S ELEKTRA assigns the VISA Resource String of the selected network device to your receiver entry in the "Device List" (hence, without adding a new entry).

Close the device search dialog either by "Save" or "Cancel". If you select "Cancel", you can decide later (in the "Device List" dialog) to either save or discard the modification of the receiver entry. Make sure to select the correct receiver type.

Note: Avoid interfering with other people's devices. We recommend that you use "Assign to Device" only for devices, for which a control via R&S ELEKTRA is reasonable and desired. Be aware that this function allows connecting remotely to any available network resource. This connection can interfere with the work of other people, who may use the same network device.

Discard ← Action ← Search Device
Only available for the network device that is assigned to your receiver entry in the "Device List".

Clicking "Discard" brings up a second button to confirm "Remove Device":

- If the device is **not referenced**, clicking "Remove Device" brings up the following warning: "Are you sure you want to delete the selected item(s)?" If you confirm your intention by clicking "OK", the "Device List" entry is deleted immediately.
- If the device is **referenced**, clicking "Remove Device" opens a dialog to inform you that deletion is not possible. As described in the section on the Delete function, you must first clear the references to other devices.
  However, this deletion is often not reasonable. Instead, if you only wish to break the relation between the receiver entry and a network device while keeping the entry in the "Device List", we recommend using the Connection Properties dialog. After disconnecting the receiver, just erase the receiver's address or host name.

Save (Ctrl+S) ← Search Device
Saves the settings of the Search Device dialog in the Device List. Saving the settings within the Search Device dialog has the same effect as first canceling from this dialog and then selecting Save All Changes.

Cancel ← Search Device
Cancels the Search Device dialog without saving the device settings and returns to the Device List. In this dialog, the changed settings are still available. They can be individually or globally saved or globally discarded.

Recheck Devices
Only available, if at least one permanent connection was previously established.

The button "Recheck Devices" in the lower right corner of the "Device List" window launches a special checking algorithm for the permanent receiver connection. The algorithm checks this connection in the network environment, to which the computer has access via the specified Interface Type.

Note: If the receiver's ID response differs from the selected receiver type setting, the checking algorithm is not executed.

The result of rechecking the receiver connection is shown in the device status bar at the lower edge of the "Dashboard" dialog (see Graphical User Interface):

- A **green** box represents a permanently connected receiver that is available.
  If an available receiver - with a setting for permanent connection - is found to be currently disconnected, the algorithm reconnects it.
- A **red** box represents a permanently connected receiver that is not available.
- An **orange** box represents a connected receiver, which is found to be in a physical state that does not correspond with the defined settings.
  Examples of receiver states represented by an orange box:
  – A hardware or software option, which is enabled at "General" > "Option", is not available in the connected receiver.
  – A hardware or software option, which is available in the connected receiver, is not enabled in the "General" > "Option" settings.

  In either of these cases, clicking "Recheck Devices" adjusts the "Option" settings in the "General" tab and brings up a notification regarding this adjustment. Clicking "Recheck Devices" again finds the settings in agreement with the physical state and hence leads to a **green** box.

4.6.2 Device Properties

The "Device List" specifies all device properties that are relevant for your EMI measurements.

Per device class, these properties are organized in sets of tabs, for example:

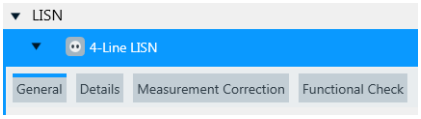


Figure 4-29: The device class "LISN" has the properties tabs "General", "Details", "Measurement Correction" and "Functional Check"

Other device classes have different sets of properties tabs.

Table 4-4 provides an overview of all tabs of all device classes.

- The **"General"** tab is **common** to all devices. It is described in Chapter 4.6.3, "General Properties", on page 109.
- All other tabs are individually **different** for the various device classes. These tabs are described in the chapters that are directly linked from the **X** characters in Table 4-4. The table headline entries are linked to the individual device chapters.

Table 4-4: Properties tabs in the various device classes

Class → / Tab ↴	Receiver	Signal Path	GTEM	LISN	Transducer
General	**X**	**X**	**X**	**X**	**X**
"Connection"	X				
"Details"				X	
"Transducer Type"					X
"Measurement Correction"		X	X	X	X
"Functional Check"				X	

4.6.3 General Properties

This tab contains general properties of the devices. It includes the following parameters:

Description
Arbitrary text to describe the device.

Manufacturer
For LISNs and the receiver, this field displays the Rohde & Schwarz company logo.

For GTEM cells, transducers and signal paths, you can enter arbitrary text to describe the device manufacturer.

Serial Number
For the receiver, this field displays the serial number as read from the device, if the receiver is connected.

For GTEM cells, transducers and signal paths, you can enter arbitrary text to describe the device's serial number.

Valid until
In this field, you can note the expiry date of the device's calibration validity. This note is intended to remind you when the next calibration is due. However, the software does not take any action, if the expiry date is reached or exceeded.

Either directly edit the date field or click the calendar icon for date selection. To select a different month, click the calendar headline. To select a different year, click the calendar headline again.

Options
In case of the receiver, this field shows a predefined checkbox list of the receiver's hardware and software options. For a non-connected receiver, you can enable or disable individual options. This choice is useful, for example, for measurements with device simulation.

If a remote connection to the receiver is established, R&S ELEKTRA automatically adjusts the options list to the actual configuration of the receiver. This adjustment is carried out when you execute one of the following actions:

- Connect the receiver
- Select Recheck Devices.

While connected, the checkboxes are then no longer available for user interaction. Instead, the options list represents the physical receiver configuration.

In case of LISNs and GTEM cells, this field is blank. You can edit it, but it has no effect on any test execution.

For all other devices (signal paths included), this field is blank and cannot be edited.

Model
For the receiver, this field displays the model as read from the device, if the receiver is connected. For a non-connected receiver, this field is blank and cannot be edited.

For LISNs, GTEM cells, transducers and signal paths, you can enter arbitrary text to describe the device model.

Firmware Version
Displays the firmware version as read from the receiver, if it is connected. For a non-connected receiver, this field is blank and cannot be edited.

For devices that have no firmware, this field is not available.

Frequency Range
For the receiver, this field shows the start and stop frequencies according to the specifications of the selected receiver type.

For LISNs, GTEM cells, transducers and signal paths, this field shows the start and stop frequencies as read from attenuation or correction tables, selected in the "Measurement Correction" tab. If you use fixed values instead of tables, the frequency range is from 0 Hz to infinite.

4.6.4 LISN

For a description of the configuration of a **"TEM waveguide"**, see Chapter 4.6.7, "TEM Waveguide", on page 118.

For a description of the configuration of other **"Transducers"** (no LISNs), see Chapter 4.6.8, "Transducer", on page 120.

Line Impedance Stabilization Networks (LISNs, also called Artificial Networks or V-Networks) are used for two purposes in conducted EMI measurements:

- These auxiliary networks extract the conducted RF interference that an EUT injects into the lines of its power supply.
- LISNs suppress any RF interference coming from the power supply, allowing to evaluate exclusively the EUT's interference emissions into the power line.

Protect the receiver against voltage spikes

If you use a LISN without a built-in pulse limiter, consider inserting a separate pulse limiter in front of the receiver's input port.

In this case, enter the pulse limiter's attenuation in the Measurement Correction of the Signal Path.

R&S ELEKTRA distinguishes between **2-line LISNs** for single-phase AC mains systems and **4-line LISNs** for three-phase rotary current mains systems.

The software supports the following Rohde & Schwarz LISN types:

- "ENV 216" (2-line LISN, max. 50 V DC, 16 A, with TTL remote control, switchable 140 dBµV pulse limiter and switchable 150 kHz highpass filter)
- "ENV 432" (4-line LISN, max. 350 V DC, 32 A, with TTL remote control and switchable 140 dBµV pulse limiter)
- "ENV 4200" (4-line LISN, high-current design for max. 4 x 200 A, with TTL remote control)
- "ESH2-Z5" (4-line LISN, max. 400 V, 25 A, with TTL remote control)
- "ESH3-Z5" (2-line LISN, max. 250 V, with TTL remote control)
- "HM6050-2" (2-line LISN, max. 250 V, 16 A, with serial remote control)

A **single-line LISN** must be defined as a Transducer device (Type = "Probe").

Common Mode or Differential Mode

Conducted EMI tests with a LISN are performed either in common mode (unsymmetric test setup) or in differential mode (symmetric test setup):

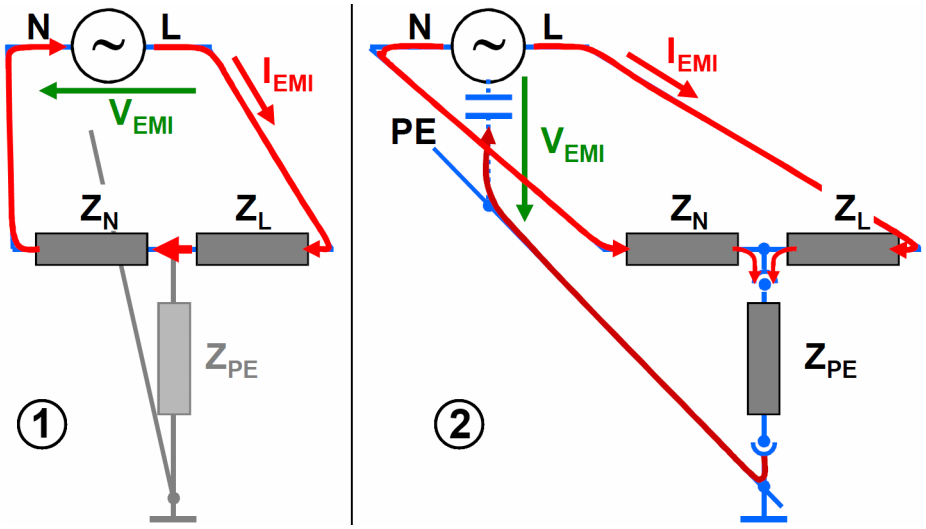


Figure 4-30: 2-line LISN in differential mode (1) and in common mode (2)

1 = Schematic of the differential mode setup
2 = Schematic of the common mode setup
L = Live line
N = Neutral line
PE = Protective earth (ground)
Z_L = Impedance of the L line
Z_N = Impedance of the N line
Z_{PE} = Impedance of the PE line
V_{EMI} = Voltage of the disturbing signal
I_{EMI} = Current of the disturbing signal

The **common mode** setup in Figure 4-30 is also called **unsymmetric** test setup. The 2-line LISN configuration used here is also called a **V**-type artificial network. It does not distinguish between common mode and differential mode signals and is therefore typically used for power lines.

The **differential mode** setup in Figure 4-30 is also called **symmetric** test setup. The 2-line LISN configuration used here is also called a **T**-type or **Y**-type artificial network. It extracts the common mode signals and is therefore typically used for signal lines (with wanted signals in differential mode).

LISN type "HM6050-2"

The LISN type "HM6050-2" has a serial interface for remote control. This LISN is the only one with a "Connection" dialog:

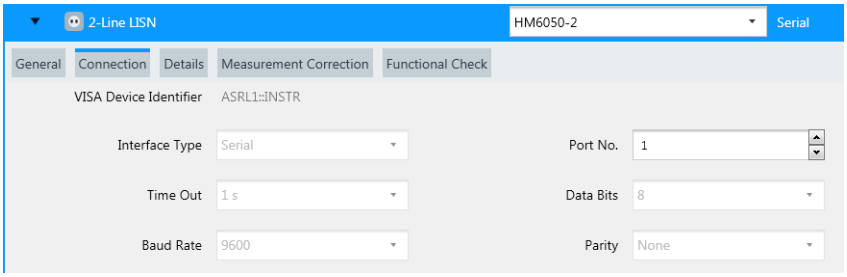


Figure 4-31: Connection dialog for the LISN HM6050-2

In this dialog, all parameters are preselected and fixed at the appropriate settings, except for the "Port No.". You must set this parameter to the port number of your computer's serial port, to which the LISN is connected by a serial cable.

This chapter describes all individual device properties, but not the General properties, which are common to all devices and described separately.

Besides the "General" tab, the LISN properties comprise the following tabs:

4.6.4.1 Details

Specifies the LISN control details.

Control Device

Specifies manual or remote control operation of the LISN:

- If you use "Manual" LISN control, R&S ELEKTRA generates messages during the test with instructions for manual LISN switching.
- "Remote" selects the Receiver as the control device. Rohde & Schwarz test receivers feature TTL remote control for automatic switching of the LISN line to be evaluated during a test.
  To use this feature, make sure that the LISN is connected to the receiver's user port via the appropriate cable.

If you make changes in the receiver that is selected as the Control Device of a LISN, R&S ELEKTRA considers this LISN as changed, too.

4.6.4.2 Measurement Correction

To evaluate the real signal level generated by the EUT, transduced by a LISN and measured by the receiver, you must correct the receiver's readout by suitable correction values or tables. This dialog specifies how to correct the measurements by selecting the appropriate cable attenuation and transducer correction data.

For the measurement correction of **TEM waveguides**, see Chapter 4.6.7.1, "Measurement Correction", on page 119.

For the measurement correction of other **transducers** (no LISNs), see Chapter 4.6.8.2, "Measurement Correction", on page 122.

LISNs are often used in a firm connection with a LISN cable. However, the LISN's data sheet only provides correction data for LISN itself, not for the cable. To handle this situation flexibly, the dialog offers separate parts for specifying values for the LISN cable and for the LISN lines.

You can select a pre-defined table for all LISN line. Hence, the values in the "Correction Level" column of the selected table are valid for the N and L1 line of a two-line LISN and for the N, L1, L2 and L3 lines of a four-line LISN.

Cable Correction
The RF cable, which connects the LISN's RF output with the test receiver, can be described by a simple attenuation in units of dB.

- "Fixed Value"
  Specifies a constant attenuation value in dB for the LISN cable.
- "According to Attenuation Correction Table"
  Selects an attenuation table with one column of frequency-dependent attenuation values in dB for the LISN cable.

LISN Correction
The network part of the LISN converts physical units. Its influence on the RF signal is therefore described by a transducer correction with potentially different units on the input side (measurement) and output side (result). Typically, the correction level values are in dBµV.

- "Fixed Correction"
  Specifies a constant correction value for all N and L lines. You can set the unit for the correction value (typically dBµV).
- "According to Transducer Correction Table"
  Select a Transducer Correction Table that contains one column of frequency-dependent "Correction Level" values for all N and L lines in a result unit (typically "dBµV") that is defined in this table. The result unit is read from the transducer correction table and serves for converting the measured values from the receivers measurement unit, which is in general "dBµV", to the final result unit of the converted values.
  The table allows common correction values for all N and L lines.

4.6.4.3 Functional Check

Tests the remote control switching of LISN lines. The following prerequisites apply:

- The LISN Control Device in the Details tab must be set to "Remote" control via the EMI test receiver
- The Receiver must be in connected state.
- On hardware side, the LISN must be connected to the receiver's user port via an appropriate cable.

To test any one of the available LISN lines, click the button of this LISN line, for example "L1". If the test is successful, the software displays the LISN driver's control bit pattern for this LISN line, for example "L1: #B00001101"

The "Local" button enables manual control at the LISN's front panel, which otherwise displays the state that is set via remote control.

4.6.5 Receiver

Receivers are key instruments for measuring electromagnetic emissions. Without a test receiver or spectrum analyzer, EMI measurements are impossible.

R&S ELEKTRA supports the following Rohde & Schwarz receiver types:

- "ESCI3" / "ESCI7" Receiver
- "ESL3" / "ESL6" Receiver
- "ESPI3" / "ESPI7" Receiver
- "ESR3" / "ESR7" / "ESR26" Receiver
- "ESRP3" / "ESRP7" Receiver
- "ESU8" / "ESU26" / "ESU40" Receiver
- "ESW8" / "ESW26" / "ESW44" Receiver
- "FPC1000 Analyzer"
- "FSL3" / "FSL6" / "FSL18" Analyzer
- "FSV3" / "FSV4" / "FSV7" / "FSV13" / "FSV30" / "FSV40" Analyzer
- "FSW8" / "FSW13" / "FSW26" / "FSW43""FSW50" / "FSW67" / "FSW85" Analyzer

In contrast to other device classes, for which you can specify multiple devices, the device class "Receiver" is limited to one receiver, only. Rather than adding different receivers, you can exchange the receiver by selecting the type.

To verify the selection, enter the new receiver's "IP Address" in the Connection tab, select the correct receiver type and connect the receiver.

For a receiver exchange, the following rules apply:

- If the replaced receiver is referenced in an existing test, the results data of this test remains unchanged. If you rerun the test, the software discards the original test results and uses the new receiver for the measurement.
- If the replaced receiver is referenced in a test template, this test template is synchronized to the new receiver when you open it or use it to create a test. The properties of the new receiver can cause the validation to fail. In this case, either

use a receiver that is compatible with the settings in the test template or adjust these settings.

- You can only connect the receiver, if you have selected the correct Type of receiver.

In addition to the receiving function in EMI measurements, R&S ELEKTRA supports the use of Rohde & Schwarz receivers for remote control of a LISN via the receiver's user port.

If you make changes in the receiver that is selected as the Control Device of a LISN, R&S ELEKTRA considers this LISN as changed, too.

In the General tab, the "Option" field shows a list of options that are available for the receiver, for example "FSV-B29".

You can select a "Receiver" (= test receiver) or an "Analyzer" (= spectrum analyzer) with their specific features. If your test receiver is capable of measurements in spectrum analyzer mode, you can choose between the Operating Mode "Test Receiver" or "Spectrum Analyzer" in a test template.

If a spectrum analyzer is used as the receiver, some constraints apply. For example, spectrum analyzers are not suited for compliant measurements (precompliance, only).

For the selection of the receiver's RF input connector in a test template, see "Input Selection" on page 87.

The availability of "Time Domain Scan" measurements requires a receiver that is capable of this Scan Mode, for example with option "ESR-K53".

Besides the General properties tab, which is common to all devices, the receiver properties comprise the following tab:

4.6.5.1 Connection Properties

This tab contains connection settings for the remote control of your receiver. If the receiver is connected, its connection settings are only displayed but cannot be edited.

The tab includes the following parameters:

VISA Device Identifier
Displays the VISA resource string for the selected interface type.

The following list and table describe this string in more detail.

Examples of the VISA resource string are:

- `TCPIP0::10.113.0.75::inst0::INSTR`
- `GPIB::3::INSTR`

Besides the separator "`::`", the VISA resource strings consists of the following elements:

Table 4-5: Structure of the VISA resource string

Interface	TCP/IP internet protocol		GPIB 8-bit parallel
Header	`TCPIPx`, with "x" = Board No.		`GPIBx`, with "x" = Board No.
Address	IP Address in one of two VXI11 modes:		GPIB Address: integer from 1 to 31
	Hostname:	V4 format:	
	arbitrary alphanumeric string	four blocks, each with one to three numbers, separated by dots: `xxx.xxx.xxx.xxx`	
Delimiter	`inst0::INSTR`	`inst0::INSTR`	`INSTR`

Interface Type
The following interface types are available:

"TCPIP" Transmission Control Protocol / Internet Protocol (TCP/IP)

"GPIB" General Purpose Interface Bus for 8-bit parallel communication according to IEEE-488

Time Out
Defines the time period in seconds applied to detect a timeout in the communication of a single command.

Address
The address field depends on the Interface Type:

- For TCP/IP: **"IP Address"** or **"Host Name"** (depending on the address Mode)
- For GPIB: **"Primary Address"**: numeric value from 1 to 31

Mode
Address mode, depending on the "Interface Type" on page 117"Interface Type":

For TCP/IP:

- "VXI11 Hostname" - LAN instrument protocol using a hostname as address
- "VXI11 V4" - LAN instrument protocol using a 4x3 digit IP address (*xxx.xxx.xxx.xxx*)

For GPIB:

- "Normal" - default GPIB address setting, for example *GPIB::1::INSTR*

Board No.
TCP/IP board number (values from 0 to 9) or GPIB board number (values from 0 to 31).

4.6.6 Signal Path

A signal path describes the physical RF signal connection between two devices in an EMI setup. It typically contains information on the cable loss (conducted attenuation) between these devices.

You can create and edit signal paths in the device list or in a test template.

This chapter describes all individual device properties, but not the General properties, which are common to all devices and described separately.

Besides the "General" tabs, the signal path's properties comprise the following tab:

4.6.6.1 Measurement Correction

Specifies how to correct the measurement values by setting the appropriate cable attenuation value or table for the signal path.

Constant

Specifies a fixed attenuation value in dB for the signal path.

Table

Selects an attenuation table with one column of frequency-dependent attenuation values in dB for the signal path.

4.6.7 TEM Waveguide

A typical TEM waveguide is the Gigahertz Transverse Electromagnetic (or **GTEM**) cell in the shape of an extended rectangular hollow pyramid, which acts as an EMI test chamber. Inside, the bare metal side walls reflect and guide RF radiation, while the base of the pyramid is lined with RF absorber material. With this design, the cell forms an enclosed TEM stripline that can be used as a receiving or transmitting RF antenna. The EUT is placed in the GTEM cell's test volume.

For a description of the configuration of a **"LISN"**, see Chapter 4.6.4, "LISN", on page 110.

For a description of the configuration of other **"Transducers"**, see Chapter 4.6.8, "Transducer", on page 120.

This chapter describes all individual device properties, but not the General properties, which are common to all devices and described separately.

Besides the "General" tab, the GTEM cell's properties comprise the following tab:

- Measurement Correction.....119

4.6.7.1 Measurement Correction

Specifies how to correct the GTEM cell's measurement values by setting the appropriate cable correction value or table and GTEM correction factor C1.

For the measurement correction of **LISNs**, see Chapter 4.6.4.2, "Measurement Correction", on page 114.

For the measurement correction of other **transducers** (no LISNs), see Chapter 4.6.8.2, "Measurement Correction", on page 122.

GTEM cells are often used in a firm connection with "their own" cable. However, the cell's data sheet only provides correction data for the GTEM cell itself, not for the cable. To handle this situation flexibly, the dialog offers separate parts for specifying values for the GTEM cable.

Cable Correction

The cable part of the GTEM cell assembly can be described by a simple attenuation in units of dB.

- "Fixed Value"
  Specifies a constant attenuation value in dB for the GTEM cable.
- "According to Attenuation Correction Table"
  Selects an attenuation table with one column of frequency-dependent attenuation values in dB for the GTEM cable.

GTEM Correction

A GTEM cell is a receiving structure for electromagnetic fields. It's structure can be compared to a coaxial cable that is geometrically expanded extremely wide, making room to place an EUT between the inner and outer conductor. This outer conductor is represented by the outer shell of the GTEM cell, while the inner conductor is represented by the cell's septum.

As the oscillating field directly induces an alternating voltage between septum and outer shell, the GTEM cell does not convert physical units. Therefore, the conversion factors (C1 values), that depend on the cell's characteristics, are described by a simple attenuation table. Such a table contains one column of frequency-dependent "Attenuation Level" values in dB.

You can either select an existing attenuation table or let the software compute correction factors to create a new table automatically.

Use the ··· button to select an existing table.

Alternatively, click "Create new factor" to let R&S ELEKTRA calculate a GTEM correction table based on a set of input parameters. The software automatically creates this table for the frequency range 1 Hz to 30 GHz.

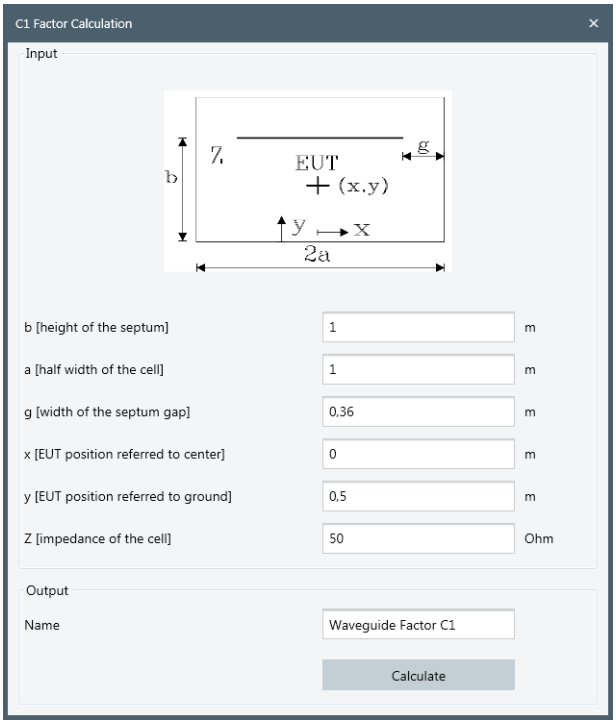


Figure 4-32: C1 factor calculation

Use the following "Input" parameters:

- "b" = vertical position of the septum in relation to the ground plate of the GTEM cell
- "a" = horizontal half width of the GTEM cell
- "g" = vertical width of the gap between septum and side wall
- "x" = horizontal position of the EUT in relation to the center of the GTEM cell
- "y" = vertical position of the EUT in relation to the ground plate of the GTEM cell
- "Z" = impedance of the GTEM cell

Do not consider the default values suggested in the dialog as recommended by Rohde & Schwarz.

For the "Output", specify a name for the attenuation table.

Click "Calculate" to let R&S ELEKTRA automatically create and save this table.

For the site correction factors C2 (GTEM correlation for an open area test site / OATS), see Chapter .

4.6.8 Transducer

The transducer is one general type of transducing device, such as a current clamp, a current probe, a near field probe, an antenna or a calibration adapter. Some other special transducing devices, such LISNs or TEM waveguides, are handled separately.

For a description of the configuration of a **"LISN"**, see Chapter 4.6.4, "LISN", on page 110.

For a description of the configuration of a **"TEM waveguide"**, see Chapter 4.6.7, "TEM Waveguide", on page 118.

A transducer is a device that converts one physical unit into another. For example, an antenna converts an electric field (V/m) into a voltage (V), while a current clamp converts electric current (A) into a voltage (V).

This chapter describes all individual device properties, but not the General properties, which are common to all devices and described separately.

Besides the "General" tab, the transducer's properties comprise the following tabs:

4.6.8.1 Transducer Type

Defines the type of transducer, either conducted or radiated. Do not confuse this property with the device type, which is "Probe" for all transducers.

If you change the type of transducer from conducted to radiated, or vice versa, you must also change the "Transducer Correction Table" (see Measurement Correction) to ensure compatibility of units. The measurement unit of a conducted transducer is typically dBµV, dBµA or dBm, while the measurement unit of a radiated transducer is typically dBµV/m or dBµA/m. You must select a "Transducer Correction Table" with a measurement unit that matches the "Transducer Type".

Conducted

Select this transducer type, if the transducer is characterized by emitting or receiving RF signals via a cable. Common basic measurement units of conducted transducers are V, A or W (typically dBµV, dBµA or dBm).

Examples of conducted probes are:

- Current probe
- Coupling/Decoupling Network (CDN)
- Single-line LISN
- Absorbing clamp
- Calibration adapter (Cal Jig) for a CDN

Radiated

Select this transducer type, if the transducer is characterized by emitting or receiving RF signals via free space. Common basic measurement units of radiated transducers are V/m or A/m (typically dBµV/m or dBµA/m).

Examples of radiated probes are:

- Near-field probe
- Antenna

4.6.8.2 Measurement Correction

Specifies how to correct the transducer's measurement values by setting the appropriate cable attenuation and transducer correction data.

For the measurement correction of **LISNs**, see Chapter 4.6.4.2, "Measurement Correction", on page 114.

For the measurement correction of **TEM waveguides**, see Chapter 4.6.7.1, "Measurement Correction", on page 119.

Transducers such as antennas or current clamps are often used in a firm connection with a cable. However, the transducer's data sheet only provides correction data for the transducer itself, not for the cable. To handle this situation flexibly, the dialog offers separate parts for specifying values for the cable and for the signal-converting part of the transducer.

Cable Correction

The cable part of the transducer can be described by a simple attenuation in units of dB.

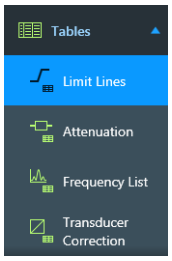
- "Fixed Value"
  Specifies a constant attenuation value in dB for the transducer cable.
- "According to Attenuation Correction Table"
  Selects an attenuation table with one column of frequency-dependent attenuation values in dB for the transducer cable.

Transducer Factor (Measurement Unit -> Result Unit)

The signal-converting part of the transducer converts physical units. Its influence on the RF signal is therefore described by a transducer correction with potentially different units on the input side (measurement) and output side (result). Typically, the correction level values are in dBµV/m, dBµA/m or dBpW.

Select a Transducer Correction Table that contains one column of frequency-dependent "Correction Level" values in a result unit that is also defined in this table. The result unit can be, for example, "dBµV/m" for a dipole antenna, "dBµA/m" for a loop antenna or "dBµA" for a current clamp. The result unit is read from the transducer correction table and serves for converting the measured values from the measurement unit, which is typically "dBµV", to the result unit as defined in the table.

4.7 Tables



Access: "Home" > "Device List"

Tables can be created by measurement or calibration, they can be edited (from scratch, if necessary) or they can be imported. Tables can contain, for example:

- Frequency values
- Power or voltage levels
- Attenuation or gain data
- Correction factors

This chapter does not refer to Test Result Tables, which are implemented only within the Test Container. Chapter 4.3.3, "Configuring Test Tables", on page 59 describes how to handle test result tables.

For all these tables (with the exception of test result tables), the buttons for common actions such as create, delete, open or copy are described in Chapter 3.2, "Common Action Buttons", on page 33. The import and export functions are described below. Other functions for handling the various tables are described in the subsequent chapters.

Table nomenclature

Whenever you create a table, we recommend establishing a comprehensible **nomenclature** for saving tables with speaking names.

For example, "`BB-antenna1_ESR7`" is a speaking name for an attenuation table that describes the frequency-dependent attenuation of the Signal Path from the broadband antenna 1 to the receiver R&S ESR7.

Importing tables

To import tables from files in **`.xlsx`** or **`.csv`** standard file format, do not use the Import tool. Instead, go to "Home" > "Tables" and proceed to the type of table you want to import (for example Limit Lines). Here, you have two options:

- Click to create a new table and paste some copied table content from your external `.xlsx` or `.csv` file into this table. Use CTRL+C to copy the external content and CTRL+V to paste it.
- Click to directly import a table from an external `.csv` file. This option is not available for `.xlsx` files.

If you use the import option, a "Table Import" wizard supports you in transfering your table content:

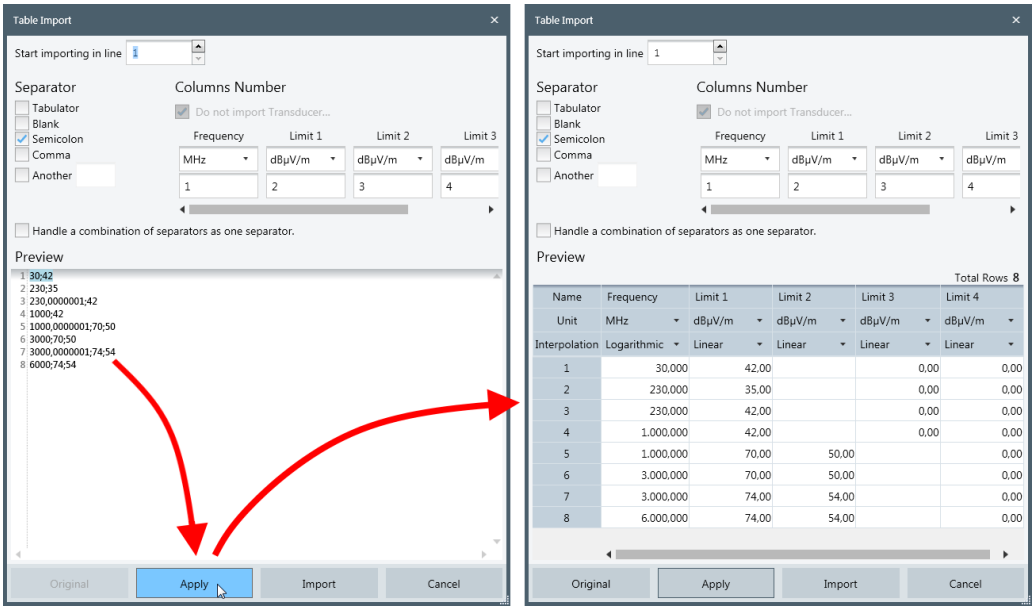


Figure 4-33: Two dialog views of the Table Import wizard for .csv files

Left = You must manually select the separator and the frequency and limit units
Right = "Apply" the settings to create a table in R&S ELEKTRA format, ready for import

Verify or edit the pre-settings in the "Table Import" wizard:

- Select the first line for starting the import of table values
- Specify the correct table cell separator or a combination of separators
- Set the units for the frequency (Hz, kHz, MHz, GHz) and for the data values, for example:
  - Limit in dBµV/m
  - Attenuation in dB
  - Correction level in dBpT

"Apply" converts the data with your settings into a table in R&S ELEKTRA format. "Import" terminates the wizard and opens the imported table in a new tab, where you can still edit it. If you wish to keep the table, make sure to save it.

Exporting tables

To export tables from R&S ELEKTRA to files in **`.xlsx`** or **`.csv`** format, do not use the Export tool. Instead, go to "Home" > "Tables" and proceed to the type of table you want to export (for example Limit Lines). Open the table you want to export. Here, you have two options:

- Select and copy the table content that you want to export and paste it into an external `.xlsx` or `.csv` table file. Use CTRL+C to copy the content and CTRL+V to paste it.
- Click to directly export a table into an external `.csv` file. This option is not available for `.xlsx` files.

R&S ELEKTRA distinguishes the following tables according to their use:

4.7.1 Limit Lines

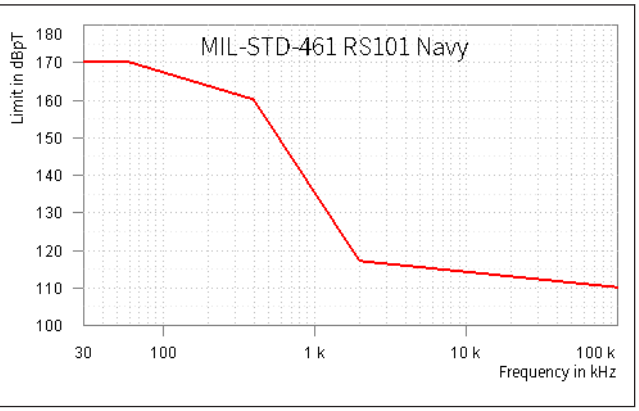
A limit line is typically defined by a standard. Create or import your limit line tables accordingly. By using the Configuration Wizard, you can let R&S ELEKTRA create a basic set of limit lines.

In R&S ELEKTRA, a **limit line table** consists of a list of frequencies in the first column and up to four **limit line columns** with limit level values for up to four individual detectors. Specify the detector types in the table header.

Example:

For the magnetic flux density, the standard MIL-STD-461G specifies the following RS101 limit for all navy applications:

Frequency [Hz]	Limit Level [dBpT]
below 30 Hz	not defined
30	170
60	170
400	160
2000	117
100,000	110
beyond 100 kHz	not defined



The limit levels between the frequency points specified in this table are linearly interpolated in a semi-logarithmic chart (linear levels over logarithmic frequencies).

Unit

You must define physical units in the limit line headers. For example, consider a limit line for tests that use an antenna: The true physical unit of the RF levels is a field strength (dBµV/m), even though the receiver measures a voltage (dBµV). Therefore, enter the result unit as described in Chapter 4.6.8.2, "Measurement Correction", on page 122.

Detector

For each limit line, select from the drop-down list the detector, for which this limit line is defined.

Interpolation

Defines whether to interpolate between the table rows in linear or logarithmic mode. To select "Linear" or "Logarithmic" interpolation for an individual column, click its "Interpolation" header.

4.7.2 Attenuation Tables

In the propagation of RF radiation across real media, there is always some loss of power due to attenuation. A technically especially relevant example is the propagation through an RF cable.

With the simplified assumption of the same amount of attenuation across all frequency bands, no attenuation tables would be required. Instead, a single attenuation value would be sufficient, for example for cable loss.

Attenuation tables serve to represent the frequency dependency of RF radiation across true propagation media. This frequency dependency describes the attenuation characteristics, for example of a piece of cable. A typical application of an attenuation table in R&S ELEKTRA is its use in the definition of a Signal Path.

By using the Configuration Wizard, you can let R&S ELEKTRA create a basic set of attenuation tables.

We recommend that you save your tables according to the suggested nomenclature.

Gain vs. attenuation

Within R&S ELEKTRA, attenuation has a positive sign, gain has a negative sign.

Hence, to specify a gain table (for example for a preamplifier), enter negative attenuation levels.

Unit

This table header defines the frequency unit in Hz, kHz, MHz or GHz, and the attenuation level typically in dB.

Interpolation

Defines whether to interpolate between the table rows in linear or logarithmic mode. To select "Linear" or "Logarithmic" interpolation for an individual column, click its "Interpolation" header.

4.7.3 Frequency List

A frequency list contains a single column with frequencies. It defines discrete frequencies, for example in a test template, to let R&S ELEKTRA measure at these frequencies in addition to - or instead of - the frequencies defined by a given frequency setting.

Frequency lists are typically created by hand. Write the frequencies into the table or paste them there from a different source, for example from a spreadsheet.

For emission measurements, frequency lists can also be created by data reduction. The resulting list can be used in the final measurement.

Unit

Available frequency units are Hz, kHz, MHz and GHz. To select the unit, click the column header.

Comment

You can optionally enter arbitrary comments in each frequency row, for example the name of a frequency band.

4.7.4 Transducer Correction

Transducer correction tables contain a column for frequencies and a column for the "Correction Level".

The tables are used to consider for the transfer function of a LISN or transducer (antenna, current clamp, etc.), as described in LISN Measurement Correction and Transducer Measurement Correction.

Transducer correction tables are typically generated by hand, by copy-paste from the transducer manufacturer's data sheet or through a calibration process. By using the Configuration Wizard, you can let R&S ELEKTRA create a basic set of transducer correction tables.

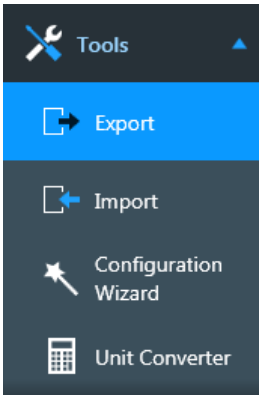
Unit

You must define a physical unit in the "Correction Level" header. This unit is the result unit as described in Chapter 4.6.8.2, "Measurement Correction", on page 122. For example, if there is a transducer correction table for an antenna: The RF levels are measured as some voltage (dBµV) at the receiver's antenna connector. This voltage is converted by the transducer correction table into the field strength (dBµV/m) that was actually received by the antenna. In this way, result tables and charts can display signal levels with their true physical units, rather than measured voltage levels.

Interpolation

Defines whether to interpolate between the table rows in linear or logarithmic mode. To select "Linear" or "Logarithmic" interpolation for an individual column, click its "Interpolation" header.

4.8 Tools



Access: "Home" > "Tools"

Opens the tools described below.

4.8.1 Export

Access: "Home" > "Tools" > "Export"

All data in R&S ELEKTRA is saved in a single database file that can only be interpreted by this software. To make individual sets of data available outside of R&S ELEKTRA, you can export selected items.

"Export" is also an option for exchanging data between different instances of this software. However, if you wish to migrate to a new (higher) version of R&S ELEKTRA, we recommend using the installation wizard and copying an existing database into the new installation. Do so, *before* you start working and creating data with your new version of R&S ELEKTRA.

To export data, first specify a target folder and target filename. The file format is automatically set to XML (extensible markup language).

By default, the checkbox "Archive the output and log files" is disabled. If you want the files to be archived, enable the checkbox.

Select the types of items you wish to export and confirm with "Next".

For each selected type of items, select the individual items you wish to export and confirm with "Next".

If you have previously pinned any searches to the dashboard, you can include these searches into the export file by selecting "Include saved search".

When you have defined your selection for all types of items, complete the export process by clicking "Finish & Execute".

The wizard generates the export file and saves it into the selected folder. At the same time, the dialog shows "Logging Information". Optionally click "Open Log" to see this information.

Exporting tables

To export tables into `.xlsx` or `.csv` files, do not use the export tool described above. Instead, proceed as described in Chapter 4.7, "Tables", on page 123.

4.8.2 Import

Access: "Home" > "Tools" > "Import"

The import feature allows importing data from external XML files into the R&S ELEKTRA database. Use this feature especially for importing data that has previously been exported.

"Import" is also an option for exchanging data between different instances of this software. However, if you wish to migrate to a new (higher) version of R&S ELEKTRA, we recommend using the installation wizard and copying an existing database into the new installation. Do so, *before* you start working and creating data with your new version of R&S ELEKTRA.

To import data, select the XML file you wish to import and click "Open".

If the selection field shows a path and filename from a previous import, you can open this file by *placing the cursor in the selection field* and pressing ENTER.

Alternatively, remove the filename entry and start with a new file selection.

If the selected file is suited for import, the dialog lists all types of items that are contained in the file.

Select all types of items that you wish to import and click "Next".

The import wizard now checks, if any items among the selected types of items are already available in R&S ELEKTRA.

Items that already exist in the database are handled in the following way:

- If an "Already Existing" item is listed, you cannot import this item.
- If an existing item is not referenced, the wizard lets you select one of the following options:
  - "Create New" creates an additional entry with a modified name
  - "Use Existing" skips importing this item
  - "Overwrite" imports this item, which overwrites the existing item

Out of those items with activated checkboxes, select those items that you wish to import. Proceed in the same way with every selected type of items.

Click "Finish & Execute".

The items are now imported and saved into their lists. For example, an imported test template is now available in the list of test templates.

Importing is only possible for XML files that are validated by R&S ELEKTRA as having compatible content. If you try to import an incompatible file, an error message comes up and warns you that the import of this file is not allowed.

If you import tests, you cannot run or rerun them. Upon opening an imported test, it is labeled as "Imported Test (Read Only)".

Importing tables

To import tables from `.xlsx` or `.csv` files, do not use the import tool described above. Instead, proceed as described in Chapter 4.7, "Tables", on page 123.

4.8.3 Configuration Wizard

Access: "Home" > "Tools" > "Configuration Wizard"

Run the wizard as described in Chapter 2.4, "Configuration Wizard for Creating Basic Data", on page 20.

This tool creates application-specific sample data for tests.

It can generate some of the following content:

- Test Templates
- Limit Lines
- Devices
- Transducer Correction Tables
- Attenuation Tables
- Report Templates
- Frequency List

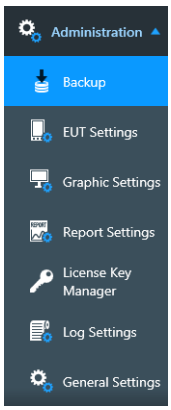
4.8.4 Unit Converter

Access: "Home" > "Tools" > "Unit Converter"

Use this tool to convert a broad range of input values and units into output values and units.

Since some unit conversions depend on the system's "Impedance", you can specify this parameter. The default is "50 Ohms".

4.9 Administration



Access: "Home" > "Administration"

Opens the administration functions for the settings described below.

4.9.1 Backup

Use backups to save copies of your R&S ELEKTRA database in this folder:
`C:\ProgramData\Rohde-Schwarz\ELEKTRA\x.xx.xx\Backup`

The "Backup" dialog defines all backup settings.

The dialog headline has four functions:

- "Save" stores the Configuration settings. Without saving, your changed settings have no effect and are lost upon shutting down R&S ELEKTRA.
- "Discard all Changes" resets the configuration to the state before you changed these settings.
- "Reset to Default" resets the configuration settings to their default state.
- **"Create a backup"** immediately creates a backup of the R&S ELEKTRA database.

Below the dialog headline, the following functions are available:

Backup Files

Lists the names of the created backup files with the following parameters:

- "File Size" of the backup files
- "Date of Creation" and time of creation of the backup files
- "Version Binding" shows the R&S ELEKTRA version number, under which each of the backup files was created

To sort the list by file size or by date, click the column header. For reverse order, click the header again.

Restore **Restore**

Overwrites the currently used database with the selected backup file. This action restarts R&S ELEKTRA with the restored database.

NOTICE

Risk of losing data

If you restore an older database without saving the current data before this action, your current data is irrevocably lost. Especially the data of previously executed tests can be a serious loss.

Therefore, always create a backup of the current database before you restore an older one.

Delete

Deletes the backup file in the same row as the button.

Configuration

Defines the following backup timing settings:

- **"Keep the last <n> backups."**
  The setting of <n> defines the number of backups to keep. Minimum is one backup, maximum is 50.
- **"Make a backup" ...**
  Upon shutting down R&S ELEKTRA, the software prompts you to save a backup, if the latest backup is older than the specified timeframe:
  - "Daily"
  - "Every 2 days"
  - "Every week"
  - "Every month"

4.9.2 Graphic Settings

Defines global settings for color, font size, style, etc. of the background of graphic charts, of their labels, legends, markers, grid lines, axes and traces.

While these settings are globally valid for all new graphics, you can also define the same settings differently for individual graphic charts. To do so while working with a graphic chart, right-click the chart and select Graphic Properties.

To reset the graphic settings to their default state, click the "Reset to Default" button. Note that this button does not only reset the settings to their default that are currently visible in the dialog. Instead, all the following settings are reset to their default.

Graphics
This dialog defines the following graphics settings:

- **"General"** selects the "Background Color" of the chart.
- **"LEGEND"**
  - **"Legend On for Grid Chart"** enables showing a legend below each chart.
  - **"Show Beside"** enables showing the legend beside the chart instead of below it.
- **"Font Family"** selects the "Font", "Typeface" and "Size" of text in the title, axis labels and legend of graphics

Marker
This dialog defines the following marker settings:

- **"General"**
  - If the checkbox "Use the color of the referenced trace" is enabled (= default), the color of each un-referenced marker is set to the color of its own trace.
  - To select a global "Marker Color" for unreferenced markers, disable the checkbox.
    As an exception, the currently selected marker is always highlighted in a light blue color.
  - Optionally select the "Marker Size" to be "Small", "Medium" (= default) or "Large". This setting is valid for all kinds of markers.
- **"Delta Marker"**
  - If the checkbox "Use the color of the referenced marker" is enabled (= default), the color of delta markers (synchronized or not) is set to the trace color of the referenced markers.
  - To select a global "Marker Color" for delta markers, disable the checkbox.
    As an exception, the currently selected marker is always highlighted in a light blue color.
- **"Pixel Mode"**
  The default "Show Pixel Mode" enables markers to be moved from pixel to pixel between the frequency (measurement) points. If disabled, markers can only jump from one frequency point to the next. The effect of this setting becomes especially noticeable, if only a few frequency points are visible, for example when zooming deeply into a trace.
  To access this setting in a graphic chart, right-click the chart and select "Graphic Properties" > "Marker" > "Pixel Mode". Alternatively, right-click the chart and select "Marker" > "Pixel Mode", or right-click a marker and select "Pixel Mode".
- **"Search"**
  Specifies the "Peak Excursion" value (in dB). This parameter determines the relative level offset to differentiate between peak and non-peak measurement results. Hence, the size of this difference determines whether a marker detects separate peaks or classifies them as a single peak.
  For example, consider a level dip between two local maxima being 2 dB down, and the level values left and right of them being 5 dB down. In this case, with a "Peak

Excursion" of 3 dB, the two local maxima are regarded as one peak. But with a "Peak Excursion" of 1 dB, the two maxima would be seen as two separate peaks.

Grid

This dialog defines the following grid settings:

- **"Horizontal Grid"** selects "Color" and "Style" of horizontal grid lines. The "Color" setting requires "Style" to be set different from "None".
- **"Vertical Grid"** selects "Color" and "Style" of vertical grid lines. The "Color" setting requires "Style" to be set different from "None".
- **"AXIS"** enables or disables "Logarithmic 'x' Axis" and "Title of 'x' Axis rotated by 90 deg", selects "Label Color" and "Font Size".

Traces

This dialog defines the following marker settings:

- **"Trace"** selects the "Trace", "Limit Line" or "Symbol Trace" to be configured.
- **"Line"** specifies "Color", "Thickness" and "Style" of the selected trace or line. The settings "Color" and "Thickness" require "Style" to be set different from "None".
- **"Symbol"** specifies "Color", "Size" and "Shape" of symbols on the selected trace or line. The settings "Color" and "Size" require "Shape" to be set different from "None".
- **"Line To Bottom"** specifies "Color", "Thickness" and "Style" of lines that connect symbols (or points) on the selected trace to the lower edge of the chart. The settings "Color" and "Thickness" require "Style" to be set different from "None".
- **"Use for EMI Detector"** selects a detector type, and assigns it the properties of a selected trace. Hence, you can use this function to define individual trace layouts for up to 4 specific detectors.
  This selection is only available for traces 1 to 4, not for "All other Traces". Automatically, the detector that you select for one "Trace" is assigned also to the "Limit Line" and "Symbol Trace" with the same index number.

4.9.3 Report Settings

General

Specifies the "Report Title", "Header", "Footer", "Logo", "Font" and "Export Format", which are then available in the "General" section of Report Templates.

Before you leave this dialog, save your changes to activate them. To reset the report configuration to the default settings, click the "Reset to Default" button .

For the "Header" and "Footer" of reports, the following selections are available for the left, center and right sections, respectively:

- "None" leaves this section blank
- "Date" in the format "dd.mm.yyyy"
- "Time" in 24-hour clock format "hh:mm"
- "Date / Time"

- "Page Number" = the current page number in a report
- "Page Number / Count" = "Page Number" and the total number of pages, separated by "/"
- "Test Name" = the name of the test that is described by the report
- Verdict"Verdict" = a "Passed", "Failed" or "Inconclusive" statement resulting from a test
- "Version" = the name "ELEKTRA" together with this software's version number
- "Title" = the "Report Title" specified above
- "Logo" = the logo image file selected below

The "Logo" image file is stored within the R&S ELEKTRA database. To select a new logo, click the button. The existing logo is replaced by the new logo. To view the currently selected logo, click the button. To restore the original logo, click the "Reset to Default" button. Note that this action resets all other report settings, too.

The font of reports can be specified individually for the following "Font Items":

- "Title"
- "Component Title"
- "Table Contents"
- "Normal Text"

The "Export Format" of reports can either be "PDF" (Adobe Acrobat portable document format = default) or "DOCX" (MS Word for Windows). The option that you select determines the export format offered in a report (PDF or DOCX). However, with one file format preselected, the other file format is still available in the "Save As" dialog.

Graphics

"Add Graphics Title" globally activates or deactivates the graphics title as a default for reports.

"Graphics Arrangement" specifies either one chart over the full page width or up to four charts next to each other, at a reduced width.

4.9.4 License Key Manager

Manages the licenses for R&S ELEKTRA.

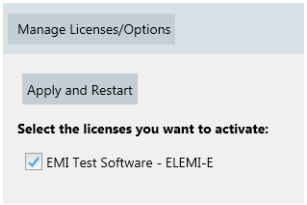


Figure 4-34: License key manager dialog

Without licenses: "demo mode"

The R&S ELEKTRA EMC Test Software runs in demo mode, if any of the following conditions applies:

- You do not own a license
- Your License Dongle is not connected
- No license checkbox shown in Figure 4-34 is enabled

In demo mode, no physical measurements can be made. If you have selected to Allow Device Simulation, all test data comes from simulation and tests are labeled as simulated.

Manage Licenses/Options

Brings up the following dialog:

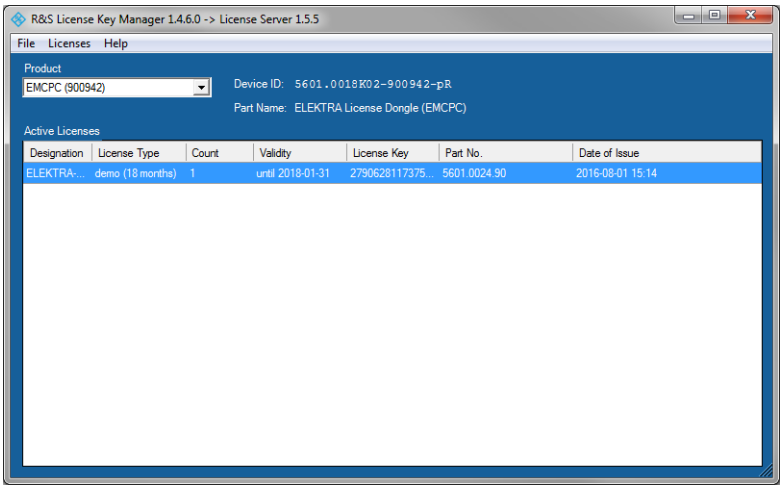


Figure 4-35: Example of a license key manager dialog

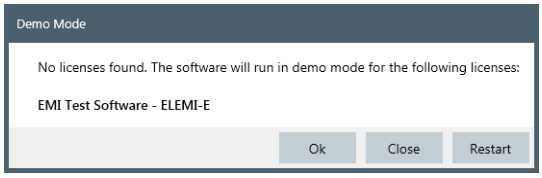
Use this dialog to view the licenses that are contained in your License Dongle.

Apply and Restart

Restarts the software to apply your selection of enabling or disabling the checkbox for "EMI Test Software - ELEMI-E".

"Enabled" You can use the restarted R&S ELEKTRA with the licenses available on your License Dongle, as shown in the "License Key Manager" dialog, see Figure 4-35.

"Disabled" You can use the restarted R&S ELEKTRA in demo mode, only. Disabling the licenses is equivalent with not inserting your license dongle. During restart, the following dialog comes up:



Select OK to proceed with starting in demo mode. R&S ELEKTRA displays the words "Demo Mode" on the right-hand side of the title bar (see Graphical User Interface).

Note: If, while starting R&S ELEKTRA, this dialog comes up because you have not yet inserted your license dongle, insert the dongle and click "Restart".

To leave the demo mode and use the software with your licenses enabled, go to "Home " > "Administration" > "License Key Manager". Enable the one or more checkboxes for your licenses and click "Apply and Restart".

4.9.5 Log Settings

The logging function of R&S ELEKTRA tracks software events by a specific protocol transscript and saves the log information in several files to the folder `C:\ProgramData\Rohde-Schwarz\ELEKTRA\x.xx.x\Logs`.

Use the "Log Settings" dialog to configure the Log Information.

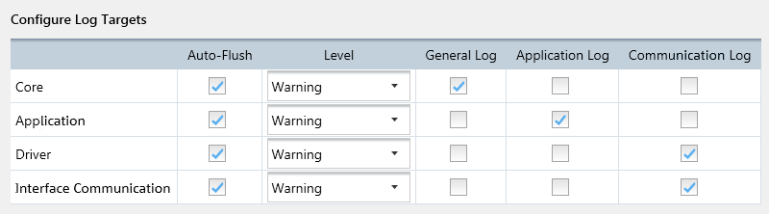
The dialog headline has four functions:

- "Save" stores the log settings. Without saving, your changed settings have no effect and are lost upon shutting down R&S ELEKTRA.
- "Discard all Changes" resets the log settings to the state before you changed these settings.
- "Reset to Default" resets the log settings to their default state.
- **"View Logs"** opens a dialog for viewing the log entries, as described in Chapter 9.2, "Log Information", on page 171

You can also open the **"View Logs"** dialog by the keyboard shortcut ALT+L.

Configure Log Targets

Use the configuration table in this section to specify, which type of event is stored in which log file.



The type of event depends on the source of log information. For example, if R&S ELEKTRA observes an event in a device driver and wants to log this event, the "source of log information" determines the event type "Driver".

- Source of log information:
  - "Core"
  - "Application"
  - "Driver"
  - "Interface Communication"
- "Auto-Flush" enables or disables R&S ELEKTRA to open the appropriate log file automatically, enter new data and save the file for external access to log data.
- "Level" assigns one the following log information levels for each source of log information:
  - "Info"
  - "Warning"
  - "Error"
- Events of the various types can be logged in the following log classes:
  - "General Log"
  - "Application Log"
  - "Communication Log"

  Events in one log class are saved to the same log file at `C:\ProgramData\Rohde-Schwarz\ELEKTRA\x.xx.x\Logs`. Individual log classes also facilitate finding events in the Log Information dialog.

Log File Settings

Defines the maximum log data volume (in Megabytes) and the maximum log file count.

4.9.6 General Settings

Access: "Home" > "Administration" > "General Settings"

Selects the settings described below. Click "Save" to keep your changes. To reset the general settings to their default state, click the "Reset to Default" button.

Allow Device Simulation

Enables or disables running tests with simulated data. The software distinguishes the following cases:

- If you use R&S ELEKTRA **without licenses** in demo mode, no physical measurements can be made. All test data comes from device simulation. The tests are labeled as simulated.
- If you use R&S ELEKTRA **with a license**, the measurement mode depends on the availability of the devices required for a test:
  - If all devices are available and the automatic test validation confirms the connection, the software uses the physical data, even if you have allowed simulation.
  - If one or more devices are not connected, and if you confirm that you wish to let R&S ELEKTRA simulate a measurement, all test data comes from this simulation. The tests are labeled as simulated.

Show Welcome Screen on start up

Enables or disables the "Welcome Screen" upon starting R&S ELEKTRA. This screen also allows creating sample test data, as described in Chapter 2.4, "Configuration Wizard for Creating Basic Data", on page 20.

5 Measurement Basics

This chapter introduces the users to the fundamental measurement principles for EMI tests and helps to structure tests in an application-related matrix.

5.1 Fundamental Principles

Electrical appliances that emit electromagnetic waves (conducted or radiated) can interfere with other appliances that receive these waves. With a transmitter, this behavior can be intentional or unintentional.

To ensure reasonable operation of electrical appliances, international EMI Standards regulate the maximum level of emitted interfering power of an appliance.

EMI tests (electromagnetic interference, or emission) that simulate the actual interference situation serve to evaluate the compliance of equipment with these standards. The measurements and the applicable limit lines defined in the standards are frequency-dependent.

5.2 Test Matrix

The type of electrical appliance (EUT) and its field of application determine, which EMI tests must be performed according to which standard. The following table provides an overview:

Table 5-1: EUT-related test matrix

EUT type	Interference type	Run EMI tests according to
automotive / boats (with combustion engines)	conducted emission	CISPR 12 / 25
	radiated emission	
broadcast	conducted emission	CISPR 13 / 32
	radiated emission	
household	conducted emission	CISPR 14-1
	radiated emission	
industrial, scientific, medical (ISM)	conducted emission	CISPR 11 / 28
	radiated emission	
IT equipment	conducted emission	CISPR 22 / 32
	radiated emission	
lighting	conducted emission	CISPR 15

EUT type	Interference type	Run EMI tests according to
	radiated emission	
military, aerospace	conducted emission	MIL-STD-461
	radiated emission	
multimedia	conducted emission	CISPR 32
	radiated emission	

The regulations in the applicable EMI Standards lead to:

- The measurement devices that have to be used (see Device List)
- The Test Templates that have to be configured
- The Limit Lines that have to be applied
- The measurement distances between emitter and receiver that have to be observed
- The frequency ranges that have to be covered by the various test methods. An example for non-military EMI tests is shown in Figure 5-1:

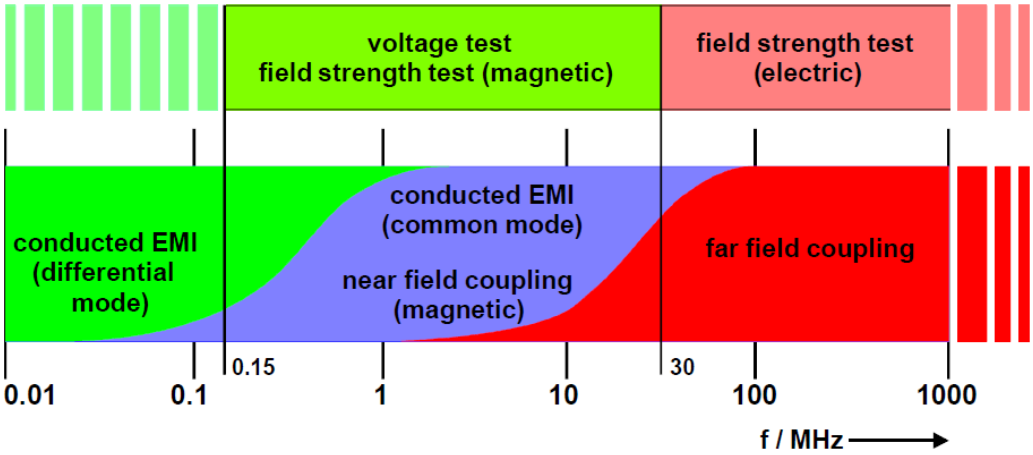


Figure 5-1: Signal propagation and appropriate EMI setups in different frequency ranges

Voltage test = see EMI tests (with artificial mains network / LISN)
Field strength test = see Figure 4-8 (magnetic: with loop antenna / electric: with dipole antenna)
Conducted EMI = see Common Mode or Differential Mode
Near field coupling (magnetic) = For example, in RFID tests, use an H near-field probe
Far field coupling = see below

Regarding the near-field to far-field transition shown at a frequency f = 30 MHz in Figure 5-1, consider the following: At a given distance r = 10 m between the EUT and an antenna, the near-field condition $r < \lambda$ is fulfilled at frequencies f below 30 MHz. The reason is that the wavelength $\lambda = c/f$ is then >10 m (with signal propagation speed $c = 3 \cdot 10^8$m/s). This relation is valid for radiated measurements in EMI tests.

5.3 Detectors

In EMI measurements, detectors are algorithms that specify how to weight the envelope of the measured IF signal.

Table 5-2: Detector types

Detector name	Detector description
Average (AVG)	In the case of average measurements, the linear time-averaged value of the rectified voltage at the output of the envelope demodulator is indicated. It is calibrated using the RMS value of an unmodulated sinusoidal signal. If an unmodulated sinusoidal signal is applied to the receiver input, its RMS value is thus indicated. If an AM signal is present, the RMS value of the carrier is indicated. With the ESCS, analog averaging is performed using low-pass filters, the time constants of which are switched depending on the measuring time.
Maximum Peak (MaxPeak, Peak, PK+)	Peak value measurements return the maximum value of the rectified voltage at the output of the envelope demodulator within the selected measuring time. The detector is calibrated using the RMS value of an unmodulated sinusoidal signal that supplies the same detection voltage. Average and peak value of an unmodulated sinusoidal signal basically return the same indication. However, with peak value weighting, the noise voltage indication is about 11 dB higher than with average weighting. Therefore, higher values are indicated when the signal-to-noise ratio is not sufficient. Peak value indication serves for determining the levels of keyed carriers, pulse signals or peak voltages of AM signals. As peak value measurements can be carried out considerably faster than quasi-peak measurements, we recommend for RFI measurements to begin with a general measurement in indicating peak mode. After that, run a quasi-peak measurement at the critical frequencies.
Minimum Peak (MinPeak, PK-)	In the case of negative peak value measurement, the minimum value of the rectified voltage at the output of the envelope demodulator within the selected measuring time is indicated.
Quasi Peak (QPK)	Quasi-peak measurement weights pulse signals using a quasi-peak detector with defined charge and discharge time. IF bandwidth and mechanical time constant of the meter are also specified. The characteristics the receiver has in this indication mode are defined in CISPR 16 or in VDE 0876. Due to the long time constants of weighting, it takes relatively long until a valid measurement result is displayed after every change in frequency or attenuation at the receiver. It is therefore futile to use measuring times of less than 1 s, especially in the case of automatic measurements. The maximum level value during the measuring time set is shown on the digital level display. The timing of the quasi-peak test voltage can be observed on the analog meter at the same time. In addition to monitoring of the interference source, this measurement often allows you to draw useful conclusions as to the character of the interference. Quasi-peak weighting places high demands on the dynamic characteristics of the receiver. With low pulse frequencies, however, the operating range cannot be fully utilized, as otherwise the RF input would be overloaded. When an overload occurs, the software informs you about it by way of the overload indication (

) in the test window. In this case, increase the RF attenuation to such an extent that the overload message disappears. In automatic operation, the receiver itself correctly sets the attenuation. |
RMS	For RMS value measurements, the RMS value of the rectified voltage at the envelope demodulator output is indicated. Irrespective of the signal shape, the envelope demodulator power is indicated. Analog RMS value generation is performed. The time constant for RMS value generation is set via the measuring time and is identical with the time constant of average value generation with the measuring time already specified.
CISPR Average (CISPR AV, CAV)	CISPR Average is the weighting average detector according to CISPR 16-1-1.The CISPR average detector supplies a weighted average. When measuring the average according to CISPR 16-1-1, the maximum value of the linear average during the measurement time is displayed. The detector is used, for example, to measure pulsed sinusoidal signals with a low pulse repetition frequency. It is calibrated with the RMS value of an unmodulated sinusoidal signal. Averaging is with lowpass filters of the second order (simulation of a mechanical instrument).
RMS Average (RMSAV)	RMS Average is the weighting detector according to a amendment of CISPR 16-1-1 (CISPR/A/628/CD).The RMS average detector supplies a weighted reading of the input signal. When measuring the RMS average according to the amendment, RMSAV returns the maximum value of the RMS - Average during the measurement time. This detector is used, for example, to measure pulsed sinusoidal signals with a low pulse repetition frequency. It is calibrated with the RMS value of an unmodulated sinusoidal signal. Averaging uses lowpass filters of the second order (simulation of a mechanical instrument).

6 Special Software Features

This chapter provides helpful information for operating some specific features in the graphical user interface (GUI) of R&S ELEKTRA.

6.1 Handling Changed Items

If you change any content in a dialog that supports saving, the "Save" button of the dialog is marked by an asterisk (*).

- To keep the changes (upon closing the dialog, at the latest), select "Save" or "Save As".
- To discard the changes upon closing the dialog, select "Don't Save". To avoid accidental loss of data, R&S ELEKTRA prompts you to confirm, if you would like to save your changes or not.
- To return to the dialog without saving and without closing it, select "Cancel".

Changed content or items are handled differently in the "Device List", see Save All Changes, Discard All Changes, Save and Delete.

6.2 Searches

R&S ELEKTRA offers a versatile search and filter functionality. Many dialogs provide a field for entering a search term and for setting filters:

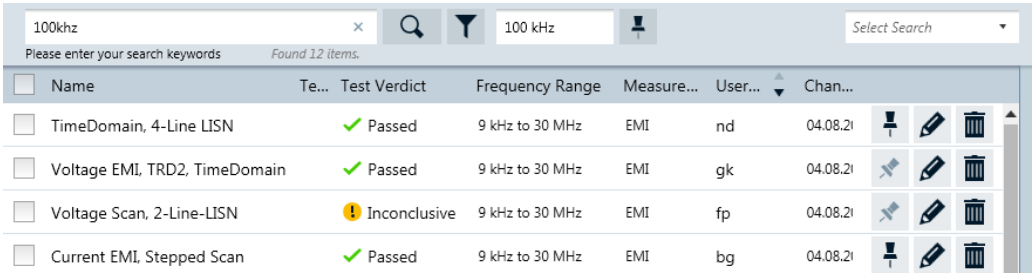


Figure 6-1: Example: Results of a search for the string "EMI" in the list of tests

"100khz" = Search string in the search field
"100 kHz" = User-defined name to label this search

To confine the currently displayed list of items to those items that contain a certain **search** criterion, enter it into the search field, as shown in Figure 6-1.

Permitted search criteria are:

- **Arbitrary text**. Any text string that could appear in the name of an item, in its description, in the "User Tags" or similar fields.
- **Physical data**. For example, searching the list of "Tests" for the frequency value *7 GHz* finds items that are specified for the frequency range *1 to 8 GHz* or for *3 to 24 GHz*. However, this search does not find an item that is specified for *150 kHz to 30 MHz*.

To confine the currently displayed list of items to those items that contain a certain **filter** criterion, click the filter button . In the "Filters and Tags" subdialog that opens, select from the available filter criteria, see Figure 6-2. R&S ELEKTRA adds the selected filter criterion to the search field as a search string. If there is already some search string, before you add a new filter criterion, the software combines the strings in the search field by a Boolean "AND" operation.

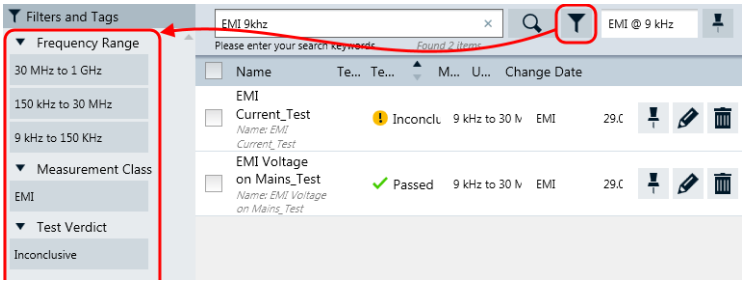


Figure 6-2: The filter button opens the list of available filter criteria

To close the "Filters and Tags" subdialog, click the filter button again.

To pin the current search to the "Dashboard" dialog, specify a user-defined name for your search and select "Add to Dashboard" . The search is shown there as an item with magnifying lens icon among the appropriate category of items. For example, a pinned "Test" search (from the original dialog "Tests") is shown together with the other "Test" items that you have pinned to the "Dashboard" (see Figure 3-4).

Since you can not pin Tables to the "Dashboard", the following exception applies: You can only access saved searches for tables in the "Select Search" field of the respective table's list dialog.

To reopen a search result list in the original dialog, click its search item in the "Dashboard" dialog. Alternatively, within the search's original list dialog (for example "'Tests"), open the drop-down list in the field "Select Search" and click the name of the search. The reopened result list includes all items that meet the search criteria, also those items that have been created after defining the search.

To cancel the current search or filter in the original dialog, click the "x" button in the search field. Note that this action leaves pinned searches in the "Dashboard" dialog untouched.

There are two ways to remove a search from the list dialog's "Select Search" field:

- Open the drop-down list in the "Select Search" field and click the "x" button next to the search you want to remove. This action also unpins the corresponding search item from the "Dashboard" dialog.
- Go to the "Dashboard" dialog and unpin the corresponding search item there. To do so, check the checkbox in the top right corner of the search item and click the "Unpin from Dashboard" button in the actions bar.

Each list of items (e.g. "Tests") remains reduced, as long as a search or filter criterion is entered in the search field. This reduction pertains even after leaving the dialog and returning to it, later on. To see all items in a list, make sure to clear the search field (which also removes any filters) by clicking the "x" button in the search field.

If at some point you return to a list and miss any items, we recommend to check the search field for any entries that you may have left there unintentionally.

6.3 Arranging Elements in Tests

You can rearrange the following elements of a test window:

- Charts (top)
- Tables (bottom)
- Dialogs (or control elements) in the side panels

6.3.1 Charts and Tables

For arranging **charts** and **tables**, R&S ELEKTRA offers the following features:

- To minimize the charts or tables, click their top bar. The charts or tables become as slim as their top bar, placed at the top or bottom edge of the test window. Minimizing both charts and tables leaves their top bars visible, only.
  If originally both graphics and tables are visible (half screen, each), minimizing the graphics shows the tables in full size, and vice versa.
- To open a minimized chart or table, click the slim bar that represents the minimized element. Opening the graphics while the tables are minimized shows the charts in full size, and vice versa.
- To change the ratio of shared space of graphics and tables, move the mouse pointer over the separation line between graphics and tables, until the pointer becomes an arrows icon. Drag this vertical arrows icon down to enlarge the charts and reduce the tables, or vice versa.
- To arrange several charts or several tables either horizontally or vertically or to cascade them behind each other, use the buttons .

- To make a chart or table **float** over the test window, click and hold its top bar and drag it out of its original position. As a result, the chart or table jumps out of its original position and floats nearby.
  This feature is only available, if more than one chart or more than one table is opened in the test window.
- To move a floating chart or table to an arbitrary position, click and hold its top bar and drag it to the desired position.
  Note that you cannot immediately drag a chart or table anywhere, after you made it float by dragging it out of its original position. Instead, you must release the mouse pointer, then click and hold the element's top bar again and drag it to the desired position.
- To resize a floating chart or table, move the mouse pointer over any edge of the chart or any corner of the table, until the pointer becomes an arrows icon. Drag this arrows icon to resize the dialog.
- To move a floating chart or table back to its original position, click the "Window Position" button ( ) again and select "Dock".
- You can dock a floating chart or table in the central region of the test window. To dock a floating chart or table, click and hold its top bar and drag it to a position where a cross icon appears:

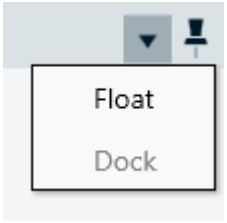
  

  Proceed as described in Chapter 6.3.3, "Cross Icons", on page 147.

6.3.2 Dialogs

For arranging dialogs, R&S ELEKTRA offers the following features:

- To minimize a dialog, click the vertical "Auto Hide" button ( ). The dialog becomes a slim tab marker at the left or right edge of the test window.
- To open a minimized dialog (instead of its slim tab marker), click the tab marker. A slim version of the dialog opens, in which you can click the horizontal "Auto Hide" button ( ). This action opens the dialog in its original position.
- To make a dialog **float** over the test window, click the "Window Position" button ( ) and select "Float".

  Note: If you use more than one screen, the floating dialog can have jumped to a different screen than the original one.
- To resize a floating dialog, move the mouse pointer over any of the dialog's edges or corners, until the pointer becomes an arrows icon. Drag this arrows icon to resize the dialog.

- To move a floating dialog back to its original position, click the "Window Position" button ( ) again and select "Dock".
- To move a floating dialog to an arbitrary position, click and hold its top bar and drag it to the desired position.
- You can dock a floating dialog in the left or right region of the test window. To dock a floating dialog, click and hold its top bar and drag it to a position where a cross icon appears:

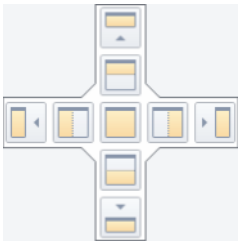
  

  Proceed as described in Chapter 6.3.3, "Cross Icons", on page 147.

6.3.3 Cross Icons

This chapter describes positioning a floating element, such as a chart, table or dialog in a test window, with the help of a cross icon.

The cross icon can appear in two versions:

- 
- 

It comes up in the following procedure:

1. Click and hold the top bar of a floating element (chart, table or dialog).
2. Drag it to any position where you can dock the element.

   The cross icon appears.
3. Keep holding the element at its top bar.
4. Without letting the element go, drag the mouse pointer over any of the square sections of the cross icon.

   An outline like in Figure 6-3 comes up that corresponds with your selection in the cross icon:

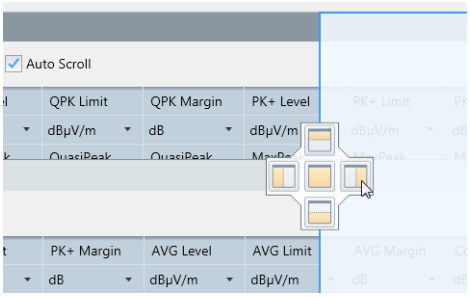


Figure 6-3: When using the cross icon for positioning a table, an outline appears in light blue color

In this example, the mouse pointer is positioned over the square section on the right-hand side of the cross icon. This mouse position creates an outline (shown in light blue color) in the place, where you can dock the element. In Figure 6-3, the outline indicates that the element can be docked at the right-hand side.

5. Release the mouse pointer.

   The element is docked in the outlined position.

To move an element to a different position, use any of the features described in Chapter 6.3.1, "Charts and Tables", on page 145 and Chapter 6.3.2, "Dialogs", on page 146.

7 Running Tests

This chapter explains how to run tests, handle the test container, use the side panels and work with test results.

- For an overview of which EMI test has to be performed according to which standard, see Chapter 5.2, "Test Matrix", on page 140.
- For information on how to configure test templates for these tests, see Chapter 4.4, "Test Templates ", on page 64.
- For getting started with testing, see Chapter 3.4, "Performing a Test", on page 39.

A completed EMI test in R&S ELEKTRA is not just a single result table, but a Test Container. It typically contains:

- Test definition (Test Template with hardware setup, Measurement Settings and Device Properties
- References for used Tables, including Limit Lines
- Measurement Flow information (hence, information about the current position in a test sequence)
- Test Result Tables with configuration parameters
- Test Result Graphics with configuration parameters
- Test Reports with configuration parameters

7.1 EMI Tests

For the general steps of preparing a test, see Chapter 3.4, "Performing a Test", on page 39.

After test preparation, the steps that are repeatedly required to create and run (series of) tests, are performed as follows:

Creating and running tests

1. To **create** a test, alternatively execute one of the following options:
   - Select "Home" > "Dashboard" and click the "New Test" button ( ).
     In the first dialog that opens ("New Test"), select at least the test template on which to base the new test.
     Then click "New Test".
   - Alternatively, select "Home" > "Tests" > "Create Test" ( ). Then proceed as above.
   - Alternatively, select a test template at "Home" > "Test Templates" and select "New Test" ( ). Then proceed with the "New Test" dialog as above.
   - Alternatively, open a test template at "Home" > "Test Templates" and select "Create test from template" ( ).
   - Alternatively, at "Home" > "Test Templates" click "Create test from template" ( ) in the line of the test template you wish to select.
   - Or alternatively, open ( ) an *existing* test by selecting it at "Home" > "Tests", for example to rerun it with updated device properties.
     Note that you cannot run or rerun an imported test. If you have opened an imported test, it is labeled as "Imported Test (Read Only)".

   Note: In an opened test template, the button "Create test from template" is only available, if the test template has been saved.

2. To run an **automated measurement** ( ), click the "Start" button ( ) in the Test Control Toolbar.

   The software performs a Test Validation, then executes the test and automatically displays the results in both graphical and tabular format, labeled "Overview Graphic" and "Final Results Table" as in Figure 3-7.

3. Optionally run **interactive measurements** ( ), using the side panels.
   If you remeasure the level value at a "Critical Point", R&S ELEKTRA uses for this measurement the same detector that has originally measured this "Critical Point".

4. Click "Save" ( ) or "Save As" ( ) to save the test and to specify a name for it - ideally, use speaking names. Additional options in the "Save" dialog:

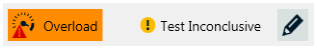
- Optionally enable "Add to Dashboard" to pin the saved test to the "Dashboard" dialog, see Graphical User Interface.
- Optionally add user-defined "Tags" to the test. Tagging allows to search for tagged tests, which facilitates finding (groups of) tests with specific tags.

Firewall

For information on what to do, if a firewall message comes up, see Chapter 2.7, "Network Firewall Settings", on page 26.

Overload

If a measured level overloads the receiver, a flashing "Overload" warning is displayed in the top of the test window:



In this case, the measurement is **invalid**.

Stop the measurement and eliminate the overload condition, for example by setting a higher RF Attenuation in the test template. Then run a new test based on the modified setting.

You can stop the "Overload" warning from flashing by clicking it.

The test result representation is based on the frequency range (X-axis) and level range (Y-axis) as defined in the test template. The number of traces in the overview graphic and columns in the overview table depend on the number of detectors and limit lines specified in the test template.

Scan settings download

After an EMI measurement with a test receiver, R&S ELEKTRA programms the scan settings (as specified in the test template) into the test receiver's internal scan table. You can instantly use these settings at the test receiver.

Optionally select "Refresh" ( ) to rerun a Test Validation. If you have changed any settings in the test template that the test uses, "Refresh" also activates these changes.

Optionally select "Clear Results" ( ) to delete all measured values. This action is protected by the following message: "Please confirm: Are you sure you want to refresh the test and thus delete the existing test results?"

After having executed and saved a test, proceed with **Test Results** and **Reporting**.

7.1.1 Automated Measurement

After creating a test based on a test template, you can let R&S ELEKTRA perform an automated measurement. To do so, select the automated measurement mode ( ) and click the "Start" button ( ) in the Test Control Toolbar.

The software runs a Test Validation and automatically performs the measurement according to the Measurement Flow specified in the test template. Typically, an automated measurement consists of an Overview Measurement (see Settings (Overview)), followed by Data Reduction and Final Measurement.

When the measurement is completed, the Test Results and the Verdict are displayed. You can configure the result graphics and tables according to your needs and generate a report.

These steps complete the automated measurement. To examine the EUT in more detail for selected frequencies, run an Interactive Measurement.

7.1.2 Interactive Measurement

Interactive measurements are typically performed after an automated measurement, which gives you an overview of the spectral emission situation and identifies critical points. We recommend to save ( ) the test with this automated measurement before you proceed.

When you change to the interactive mode, the Final Measurement settings are loaded from the test template into the Measurements dialog.

You can run two kinds of interactive measurement ( ):

- For a **manually controlled** interactive measurement, click the "Start measurement" button ( ) in the Test Control Toolbar.
  The software runs a Test Validation.
  Use the Measurements dialog and the Frequency Control dialog to control the measurement. To save individual measured level values at selected frequency points, click record ( ). These values are labeled "Interactive" in the "Source" column of the "Final Results" table.
- For a **semi-automatic** interactive measurement, which requires "Critical Points" identified in a previous automated measurement, click the "Start" button ( ) or the "Start reverse" button ( ) in the Test Control Toolbar.
  Note that you can edit the list of "Critical Points" manually, as described in Chapter 7.3, "Test Result Tables", on page 164. For example, you can add points from the "Overview" table to the "Critical Points" table or delete one or more critical points.
  The software runs a Test Validation and then measures each critical point. This measurement leads to additional level values that are labeled "Critical Points" in the "Source" column of the "Final Results" table.

7.2 Using the Test Control Elements

The buttons and dialogs in the top menu and in the left-hand and right-hand side panels of an opened test are described in the following chapters:

7.2.1 Test Control Top Menu

The test control top menu in the top left part of a "Test" window has some buttons for basic functions in a test.

For the buttons in the test control toolbar (top right part of the "Test" window), see Chapter 7.2.2, "Test Control Toolbar", on page 154.

The buttons in test control top menu have the following functions:

Save
Opens the "Save Test" dialog, if you save this test for the first time. Saving the same again later does not open the dialog, but overwrites the previously saved state of the test.

Save As
Only available, if the test has been saved before. "Save As" allows saving the test under a different name and with different user tags.

Refresh
Reruns a test validation, but does not delete existing test results.

Clear Results
Refreshes the test and deletes existing test results.

Add Report
Creates a report in the same way as described in Chapter 3.7, "Reporting", on page 43.

Chart Menu
Opens the graphics context menu in the same way as right-clicking a chart.

Marker Menu
Opens the marker context menu in the same way as right-clicking a marker.

7.2.2 Test Control Toolbar

Most buttons of the test control toolbar in the top right part of the "Test" window are similar to a video recorder.

An exception is the twin button with the robot and hand icons at the left end of the toolbar: This button is a changeover switch that toggles between the automated and interactive measurement modes.

The **test control toolbar** is available in different versions that depend on the measurement type:

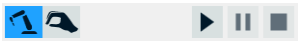
- 

  Figure 7-1: For automated EMI measurements

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  Figure 7-2: For interactive EMI measurements

You can only switch between automated and interactive measurement mode, while the test is paused or stopped.

For the buttons in the test control top menu (top left part of the "Test" window), see Chapter 7.2.1, "Test Control Top Menu", on page 153.

The buttons in the test control toolbar have the following functions:

Automated Measurement
If the robot icon is highlighted, the test is in **automated measurement** mode. For changing to interactive measurement mode, click the toggle switch.

Interactive Measurement
If the hand icon is highlighted, the test is in **interactive measurement** mode. For changing to automated measurement mode, click the toggle switch.

Start measurement
Starts an interactive measurement (or "single measurement") at the frequency point that is currently selected in the Frequency Control dialog (see Figure 7-7). The measured value appears in bold font in the lowest row of the results table. As long as you do not select "Record", the measured value is continuously updated, depending on the settings in the Measurements dialog. As soon as you select "Record", R&S ELEKTRA keeps the measured value in the lowest row of the results table.

"Start measurement" is only available in interactive measurement mode.

Record
Performs the following actions:
- Records a measured value in the lowest row of the results table
- Labels this value as "Interactive" in the table's "Source" column
- Creates a new row for the next measurement value
- Starts measuring at the next frequency point

"Record" is only available in an interactive measurement that has been started.

Start Reverse
Starts a reverse measurement from the current frequency point to lower frequency points, if available.

"Start Reverse" is only available in interactive measurement mode, if "Source" > "Critical Points" is selected in the Frequency Control dialog (see Figure 7-7). "Start Reverse" is not available, if the test has already been started. If no critical points are available, the button has no effect.

Start
- In automated measurement mode, this button starts a measurement from the lowest to the highest frequency point, across all steps of the test template's Measurement Flow, unless disabled in the Measurement Flow Control. In automated measurement mode, "Start" is always available unless the test has already been started.
- In interactive measurement mode, this button starts a measurement from the lowest to the highest critical frequency point. The measured values are labeled as "Critical Points" in the "Source" column of the results table. If no critical points are available, the button has no effect. In interactive measurement mode, "Start" is only available, if "Source" > "Critical Points" is selected in the Frequency Control dialog (see Figure 7-7).

Pause
Interrupts the active measurement of a test sequence, but does not change the frequency value (in contrast to "Stop"). After starting the sequence again, the measurement continues for the rest of the test sequence.

Stop
Stops the active measurement and terminates the test sequence. Stopping the measurement influences the "Verdict", as described in Chapter 3.6, "Verdict", on page 42. In contrast to "Pause", stopping the measurement resets the frequency to the start value of the current frequency range. After starting again, the test sequence is repeated from the beginning.

7.2.3 Test Components

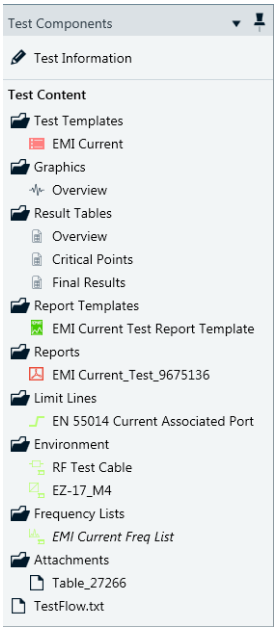


Figure 7-3: Test components dialog

The "Test Components" dialog in a "Test" window lists all content that is relevant for an individual EMI test. This content is stored in the R&S ELEKTRA database within a so-called Test Container, with a hierarchy as illustrated in Figure 3-1.

The dialog allows opening each test component. Depending on the type of component, you can right-click to "Open", "Close", "Rename", "Remove" or "Copy" items in the list of components. Also, you can open most tables as a chart by selecting "Open Graphic".

"Test Information" shows a dialog with information for this test predefined in the test template and optionally edited for the individual test. The content of this dialog is not reset upon rerunning the test.

Test Container

The test container comprises the following components:

- "Test Templates" shows the embedded copy of the Test Template that was used to generate this test, containing:
  - Hardware setups as integrated parts of this test template
  - All measurement settings
  - References for the devices, signal paths and limit lines that are used by this test template

  Note that you can open such a template copy within the test window.
- "Graphics" shows a list of the physically measured values of this test in the format of frequency-dependent Charts.

- "Result Tables" shows a list of the physically measured values of this test in the format of the following frequency-dependent Test Tables:
  - "Overview" measurement
  - "Critical Points"
  - "Final Results"

  Each test has at least one "Overview" graphic.
- "Report Templates" shows a list of copies of the Report Templates that are used in this test.
- "Reports" shows a list of all Reports that you have created for this test.
- "Limit Lines" shows a list of the Limit Lines selected for this test.
- "Environment" lists the copies of all Attenuation Tables and Transducer Correction tables used by the test
- "Frequency Lists" shows any Frequency List that are used by this test.
- "Attachments" shows a list of user-selected files saved with this test, for example pictures of the test setup.
- `TestFlow.txt` shows a log file of the test execution with timestamps and test details.

Every user is responsible for thoughtfully handling the test containers' contents. The following examples are relevant for **modified test templates**:

- If settings in a test template are altered, these changes only become effective for tests created in the future.
- If settings in a test template's copy within a test container are altered, these changes only become effective for tests executed in the future. Existing test results are **cleared**. Hence, such changes make it difficult or impossible to reproduce previously executed tests. However, existing reports are not affected.
- In most scenarios, we recommend generating new test templates rather than modifying or overwriting existing ones. This procedure is easily implemented, for example:
  - Open an existing test template
  - Modify it as required
  - Save it under a different name

  However, circumstances could require that you radically modify basic test templates. This modification could be appropriate, for example, if standards have evolved, requiring different settings, or if a measurement device has been exchanged, requiring a different correction table.

When **rerunning** a test, the software **clears** (deletes) all existing measurement values in this test container. Another Test Validation is performed, and the new measurement values are written into the overview table. Therefore, if you wish to keep existing results, make a copy of the overview table within the opened test before you rerun it. To generate such a table copy, go to the "Test Components" > "Test Content" > "Result Tables" and right-click "Overview" > "Copy". The copy is saved in the same test container folder "Result Tables", for example as "Overview - Copy".

7.2.4 Measurement Flow Control

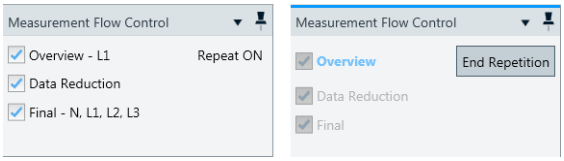


Figure 7-4: Two examples of the Measurement Flow Control dialog

Left = Before a test with LISN, "Repeat Measurement" is activated
Right = During a test without LISN, "Repeat Measurement" is running

The "Measurement Flow Control" dialog in a "Test" window summarizes the test template's Measurement Flow settings:

- Overview measurement
- Data reduction
- Final measurement
- "Repeat Measurement" ON or OFF
- Selected LISN lines, if the test uses a LISN

Before running a test, you can individually enable or disable the overview, the data reduction and/or the final measurement in this dialog.

While a test is running, the active step is highlighted in blue.

If the overview measurement runs in Repeat Measurement mode, you can manually terminate the repetition by clicking "End Repetition".

7.2.5 Accessories

Accessories side panels are only available in a "Test" window, if the test template uses at least one of the devices described in the following chapters (listed below).

Accessories Control Summary

The "Accessories Control Summary" is a side panel that provides a condensed overview of the status of controllable devices used in a test. The content of the summary is only for your information. For more details and for user interaction, refer to the dialogs described in the following chapters:

- LISN 158
- GTEM 159

7.2.5.1 LISN

The "LISN" side panel is an accessories dialog that allows switching the LISN lines in an Interactive Measurement.

You can only interact with the LISN via this dialog, while the measurement is paused. While the test is running, the dialog highlights the active LISN line in blue.

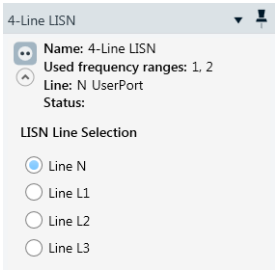


Figure 7-5: Accessories dialog for LISN control

7.2.5.2 GTEM

The "GTEM" side panel is an accessories dialog that tells you, for which EUT orientation inside a TEM Waveguide the current measurement values are stored. While the test is running, the dialog highlights the active EUT orientation (or "GTEM AXIS") in blue.

You **cannot** interact with the settings via this dialog, because GTEM cells are not suited for interactive measurements.

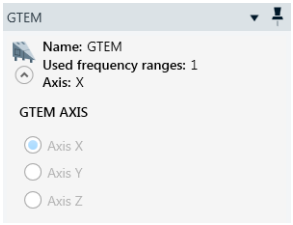


Figure 7-6: Accessories dialog for GTEM control

7.2.6 Frequency Control

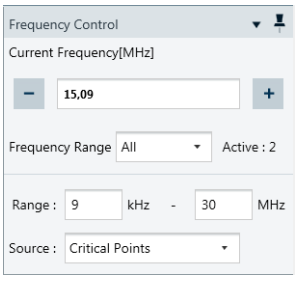


Figure 7-7: Frequency control dialog

The "Frequency Control" dialog sets the receiver frequency for automated and interactive measurements.

- "Current Frequency"
  Shows the current frequency value. You can change both the value and the unit ("[Hz]", "[kHz]", "[MHz]" or "[GHz]") while the measurement is paused or stopped.

For editing the frequency value, you have several alternatives:

– **Type** a new frequency value into the field.
If the "Source" setting (see below) is "Critical Points", your entry is adjusted to the closest frequency value in the critical points table.

– **Step** the frequency value up or down by the + or - buttons.
The step size depends on the "Source" setting (see below): If "Source" = "Test Template" or "Arbitrary", the step size is as specified in the test template. If "Source" = "Critical Points", the steps correspond with the frequency values in the critical points table.

– Click and hold a detail from a test chart or table and **drag-&-drop** it into the "Current Frequency" field.
The detail (the origin of the drag-&-drop action) can be any spot in a graphic (trace node, limit line node or marker) or any field in a table. The action copies the corresponding frequency value into the "Current Frequency" field.
To drag-&-drop a detail in touch operation, touch and hold the detail, then drag it to the destination and release it there.

- "Frequency Range"
Selects one or all frequency ranges defined in the test template. You can change the selection while the measurement is paused or stopped. For example, if you set "Frequency Range" = "1", only frequencies from the first frequency range are available for the measurement and for the field "Current Frequency". If you set "Frequency Range" = "All", the software also displays the number of the currently active frequency range. If you select a frequency range that was previously not active, the "Current Frequency" value is automatically changed to the lowest frequency of the newly selected frequency range.
- "Range"
Unless edited, these fields show the lower and upper end of the one or more frequency ranges selected above. To restrict this overall frequency range, for example, to analyze details in a second scan, you can change the "Range" values while the measurement is paused or stopped: Either type new frequency values into the fields or drag-&-drop details from a test chart or table, as described for "Current Frequency".
- "Source"
Only available for interactive measurements. Defines the domain from which the frequency values are taken:
  – "Test Template"
  Permits using only frequency values that are defined by the steps in the test template.
  – "Arbitrary"
  Permits using any frequency value within the test template's frequency range.
  – "Critical Points"
  Permits using only frequency values from the critical points table.
- "Step"
Only available for interactive measurements with "Source" = "Test Template" or "Arbitrary".
If "Source" = "Test Template", this field displays the step size as defined in the test template.

If "Source" = "Arbitrary", you can specify the step size and step mode, even during the measurement:

– "Lin": linear steps in frequency units ("Hz" or "kHz")
– "Log": logarithmic steps of a relative size ("%")

7.2.7 Parameter

Only available in EMI tests running in interactive measurement mode.

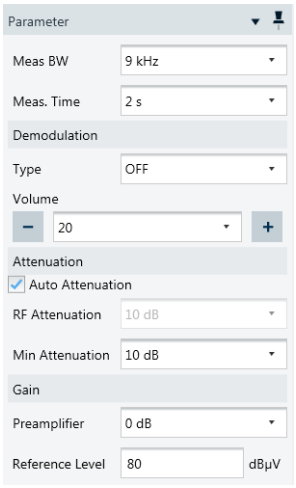


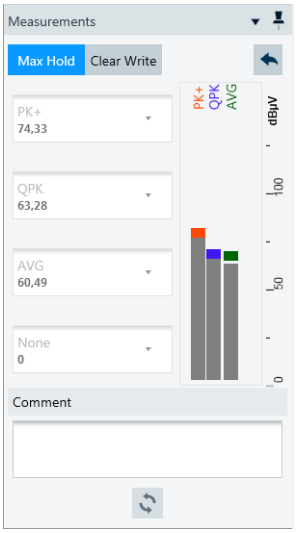
Figure 7-8: Receiver parameter dialog in an interactive EMI test

This dialog allows an individual configuration of the receiver parameters, overriding the settings specified in the test template. For a description of these settings, see "Settings (Overview)" on page 82, except for "Demodulation", which is described in "Audio Demodulation Type" on page 72.

The last parameter in this dialog, "Reference Level", is only available, if the Operating Mode is "Spectrum Analyzer".

7.2.8 Measurements

The "Measurements" dialog serves for controlling the detectors in an Interactive Measurement.

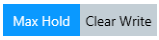


This dialog offers the following features:

Detectors
Selects up to four detectors and displays their measured "Clear Write" level values. The values are shown in numerical form (top to bottom) and as bargraphs (left to right).

The bargraphs with one vertical bar per detector display the "Clear Write" level. On top of each bar is a colored rectangle as "Max Hold" indicator. The colors correspond with the trace colors in the chart.

You can only change the detector selection, if the measurement is paused or stopped.



Max Hold / Clear Write
Toggles between the "Max Hold" and "Clear Write" mode.

Max Hold ← Max Hold / Clear Write
Measures the level values of the selected detectors and keeps the maximum value during a measurement. In this mode, the "Max Hold" value appears in the active row of the results table, while the "Clear Write" values are shown in the "Detectors" selection fields.

Note: The "Max Hold" level value is only stored in the results table, if you click the Record button ( ).

The "Max Hold" value is either reset by changing the measurement frequency or by the clicking the "Reset Max Hold" button.

Reset Max Hold ← Max Hold ← Max Hold / Clear Write
Resets the max-hold value and the max-hold indicator back to the currently measured "Clear Write" value. Only available, if "Max Hold" is enabled.

Clear Write ← Max Hold / Clear Write
Continuously overwrites the level value of the previous measurement with the level value of the most recent measurement. In this mode, the "Clear Write" level value is entered and continuously overwritten both in the active row of the results table and in the "Detectors" selection fields.

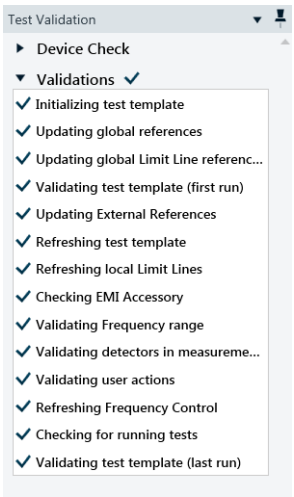
Note: The "Clear Write" level value is only stored in the results table, if you click the Record button ( ).

Comment
Enter arbitrary text to be saved with the measurement value in the "Comment" column of the result table.

Restore Test Template Settings
Sets all changed parameters back to the settings in the test template.

7.2.9 Test Validation

After starting (/) or refreshing ( ) a test, R&S ELEKTRA first performs a "Test Validation":



This process is to verify that all conditions required in the test template are met.

If the conditions are **not** all met, R&S ELEKTRA prompts you with details of the problem. For example, the dialog could state that a limit line has the wrong unit for the measurement values of the selected transducer. In this case, select or define the correct limit line.

Two examples of test validations are shown below:

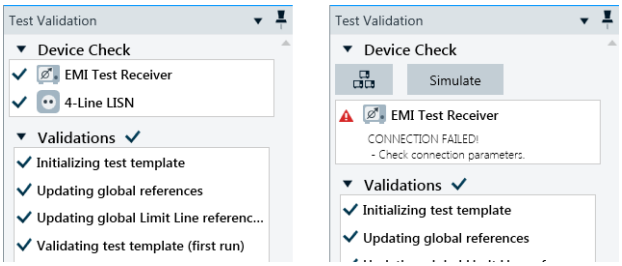


Figure 7-9: Test validation, left: successful, right: receiver connection check failed

In the right-hand example in Figure 7-9, the receiver's connection cannot be confirmed.

To solve this issue, you can try the following:

- Search for the missing device in a network
- Revise your Receiver settings in the Device List
- Recheck the connection
- Simulate the device (which leads to simulated random test results)

If the "Test Template Validation" is successful, R&S ELEKTRA continues with the action that led to the validation process, for example running a test.

7.3 Test Result Tables

- For information on how to configure test result tables, see Chapter 4.3.3, "Configuring Test Tables", on page 59.

R&S ELEKTRA permits **creating tables** by either of the following actions:

- Measurements
- Manual editing (including copy/paste from external spreadsheets)
- Import of compatible data in XML format

Some **basic features** of the three types of test result tables:

- "Overview" tables are generated during an Automated Measurement. You can edit data in the "Level" and "Comment" columns. See also Chapter 7.4, "Test Result Graphics", on page 166.
- "Critical Points" tables are generated automatically during the data reduction to help selecting a limited number of frequencies for a closer examination of the EUT. The selected frequency points come from the "Overview" measurement, while the selection depends on the "Measurement Flow" settings. You can edit the "Critical Points" table.
- "Final Results" tables are either generated in the Automated Measurement mode by remeasuring at "Critical Points", or in the Interactive Measurement mode by manual frequency selection. A new row in a "Final Results" table is created when you click the "Record" button. An automatic scan in the interactive measurement mode is only possible, if you have selected "Source" = "Critical Points" (see Frequency Control). You can edit the final results.

The following limitations apply to **editing values**:

- You cannot edit values during an active test.
- You cannot edit values in columns that are controlled by given settings or by calculation. Examples are the "Limit", "Margin" and "Correction" columns. As an exception, you can edit "Limit" values in "Critical Points" tables.

Editing measured level values can influence the test's Verdict.

7.3.1 Editing Critical Points

You can let R&S ELEKTRA measure at more or other frequencies than the automatically selected "Critical Points". To do so, add frequency points from the "Overview" table to the "Critical Points" table or enter your own arbitrary frequency points. Also, you can delete existing critical points from this table or edit existing "Range", "Frequency" and "Limit" values.

For example, if you have identified one or more additional frequency points in the "Overview Graphic" that you want to include into the interactive measurement, we recommed to proceed as follows:

1. In the trace you want to examine, set a Marker to the frequency point that interests you.
2. Optionally, zoom into the chart at the marker position, for example to place the marker exactly at a given peak.
3. Read the frequency from the marker label.
4. Open the "Overview" table.
5. Scroll down in the table to find the frequency point identified before.
6. Arrange the tables vertically (rather than cascaded,) to display both the "Overview" and "Critical Points" tables next to each other.
7. Drag the identified frequency point from the "Overview" table to the "Critical Points" table.

   This copies not only the frequency value but also the level and margin values and other information to the "Critical Points" table. R&S ELEKTRA automatically adds the row in the right order of frequency values.

7.3.2 Margin

At each frequency point, the margin is defined as the limit line's value minus the measured level value.

Example:

Level [dBµA/m]	Limit [dBµA/m]	Margin [dB]	Remark
20.1	15	-5.1	If the **level value is too high** (above limit), the **margin is negative**.
23.2	25	1.8	If the **level value is low enough** (below limit), the **margin is positive**.

R&S ELEKTRA automatically calculates this difference. You cannot edit margin values.

7.4 Test Result Graphics

- For information on how to configure test result graphics, see Chapter 4.3.2, "Configuring Test Charts", on page 49.
- For information on how to preconfigure graphics, see Chapter 4.9.2, "Graphic Settings", on page 132.

Test result charts are a graphical representation of Test Result Tables. A table is either automatically shown as a chart, or you can bring up a chart by clicking the Show Graphic Display button ( ).

In test charts, the results of an "Overview" measurement are represented by a continuous line. "Final Results" are shown as individual nodes, each with a symbol and a vertical line to the bottom. Additionally, "Limit Lines" are superimposed in test result charts as continuous lines.

Overview of LISN results

If the transducer used in the measurement is a LISN, the "Overview Graphic" and the "Overview Table" show merged maximum levels measured on any of the selected lines.

For example, if your test template defines measurements on lines N and L1, the overview results can comprise levels measured on line N in some parts of the frequency range and measured on line L1 in other parts of the frequency range. The "Line" column in the test table indicates, from which line the level result in each row was taken.

To see the results of an individual line, open its "Result Table" from the Test Components dialog and click the "Show Graphic Display" button ( ).

Some basic features of charts:

- You can use markers to identify individual measured values and set them into relation with other values.
- You can use the Zoom function to view details in a chart.
- You can integrate charts into your reports and configure them there.

8 Measurement Examples

The procedure for preparing and executing tests is described in Chapter 3.4, "Performing a Test", on page 39 and Chapter 7.1, "EMI Tests", on page 150. The following example describes how these steps are typically executed in practice.

Note that the Configuration Wizard can support you by automatically creating various items required for tests.

Example:

For a radiated EMI test in the frequency range of 30 MHz to 1 GHz, prepare the following settings:

- Three **tables**:
  - A transducer correction table "corrAnt1" (30 MHz to 1 GHz) for your antenna "Ant1"
  - An attenuation table "attCable1" (30 MHz to 1 GHz) for "Cable1"
  - A limit line "EMI-rad-30M-1G"
- Three **device list** entries:
  - The radiated transducer "Ant1", containing a reference for "corrAnt1"
  - The signal path "Cable1", containing a reference for "attCable1"
  - The receiver "EMI Test Receiver" (entry created automatically by the Configuration Wizard, adjusted by you to your Type of receiver, and connected)
- One **test template** "EMI-rad1" with a single frequency range (30 MHz to 1 GHz), containing:
  - A reference for the limit line "EMI-rad-30M-1G"
  - The hardware setup diagram with:
    A reference for receiver "EMI Test Receiver"
    A reference for signal path "Cable1"
    A reference for antenna "Ant1"
  - Your specific measurement settings as described in the test template configuration

  Note that the entries for devices (here: receiver, signal path and antenna transducer) and for the limit line are integrated into the test template as **references** that establish "links" towards the original data sets. **No copies** of these data sets are ever integrated into a test template. Hence, changing the original data set of any such item modifies all test templates that use this item.
- One **report template** "EMI-rad-Report" (optional)

With these preparatory steps completed, create the **test** by selecting "Create test from template" in the test template "EMI-rad1". The test contains:

- A copy of the test template "EMI-rad1"
- A copy of the report template "EMI-rad-Report"
- And more components in the test container

To execute the test in Automated Measurement mode, click the "Start" button (▶). The software runs the test and displays the results in an Overview Graphic and in the Final Results Table. You can enhance your test with more results acquired in Interactive Measurement mode. Optionally, use Report Templates for Reporting your results. Save the test, for example as "EMI-rad_001".

To run the same test for another EUT, first select "Create test from template" in the same test template "EMI-rad1" with a different EUT physically in place. The software automatically copies the test template (and report template) into a new test container, together with references for the hardware setup, devices, signal paths and tables in it. Execute this new test and save it, for example as "EMI-rad_002".

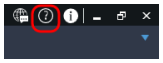
9 Getting Help

Rohde & Schwarz would like to give you the best possible product experience. The following chapters are a guide to finding a solution, if help is required:

For **context-sensitive** help, press **F1** from any dialog in the software, as described in the chapter Embedded Help.

9.1 Embedded Help

The help system embedded in R&S ELEKTRA is available in Microsoft Windows HTML help format.



To display the help dialog and open it in the chapter "Getting Help", click the help button in the program menu.

To display a **context-sensitive** help dialog, press the **help key F1** from any dialog in the software. This selection brings up a help topic with information about the current menu or the currently opened dialog and its functions.

For efficiently using the context sensitivity, set the focus to the relevant part of the user interface that interests you. For example, set the curser into an entry field or select a checkbox.

If you set the focus appropriately, you avoid opening the help content at a superordinate theme or chapter.

Contents of the help dialog

The help dialog is split into two main areas.

- In the left-hand part of the dialog, you can select one of the following functions:
  - "Contents" opens a navigation tree of help subjects
  - "Index" provides an index table of help contents
  - "Find" allows searching for arbitrary text and keywords
- The right-hand part of the dialog displays the contents of the selected help topic.

A navigation bar on top of the help dialog with "Back", "Previous" and "Next" buttons allows navigating between the help topics.

Navigating in the table of contents

1. To navigate within the table of contents, click entries or use the UP/DOWN keys.
2. Entries that contain subsections have a plus sign. To expand the navigation tree at this point, click the plus sign or press the RIGHT arrow key.
3. To display a help topic, click it (in the "Index", double-click it) or press the ENTER key.

   The corresponding help topic is displayed.

Navigating in the help topics

1. To scroll through a page, use the mouse wheel, a scroll bar or the UP/DOWN arrow keys.
2. To follow a cross-reference, click the link.
3. To return to the previous page, select "Back".
   This function follows back all steps that you have gone before.
4. Use the horizontal scroll bar to shift the content of the navigation window to the left or right.
5. You can "Hide" the navigation window or minimize it by shifting the separation line with the "Topics" window.

Using the Index

1. Select the "Index" tab.
2. Enter the first characters of the topic you are interested in. The index jumps to the first entry that starts with these characters.
3. Press the ENTER key to change the focus.
4. Use the UP/DOWN keys to navigate to the suitable keyword.
5. Press the ENTER key to display the help topic.

   The corresponding help topic is displayed.

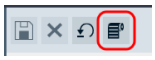
Closing the help window

► Click the "X" button (top right) or press ALT + F4 to close the help window.

The `Documentation` subfolder in the R&S ELEKTRA `Program Files` folder contains a pdf copy of the user manual.

The R&S License Key Manager in the navigation menu Administration has its own help system.

9.2 Log Information



Access: "Home" > "Administration" > Log Settings > "View Logs" button

The "View Logs" button brings up a separate dialog:

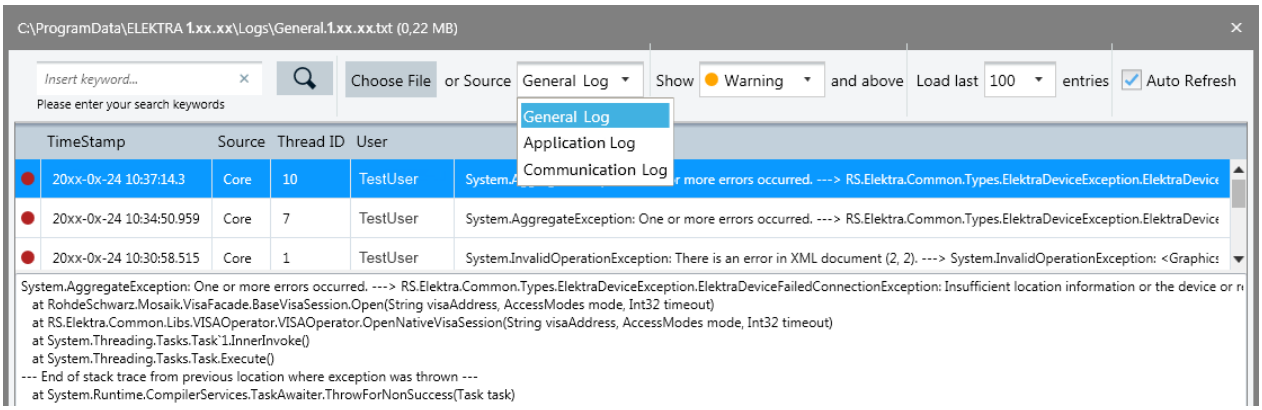


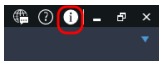
Figure 9-1: Example of a log entries dialog

You can also open this dialog for viewing the log entries by the keyboard shortcut ALT +L.

The dialog shows the existing log entries and offers the following options:

- "Search"
  Searches for log information.
- "Choose File"
  Opens an Explorer window for selecting a log file (in `TXT` format) to be displayed in the log entries dialog. Per default, log files are saved at `C:\ProgramData\Rohde-Schwarz\ELEKTRA\x.xx.xx\Logs`
- "Choose Source"
  Selects the source of the displayed log entries. Available log sources are:
  - "General Log"
  - "Application Log"
  - "Communication Log"
- "Show"
  Selects the type of log information to be displayed, with significance increasing from "Info" to "Warning" to "Error". Available log information types are:
  - Show "Info" and above (includes "Warning" and "Error").
  - Show "Warning" and above (includes "Error").
  - Show "Error".
- "Load last ... entries"
  Sets the maximum number of entries to be loaded.
- "Auto Refresh"

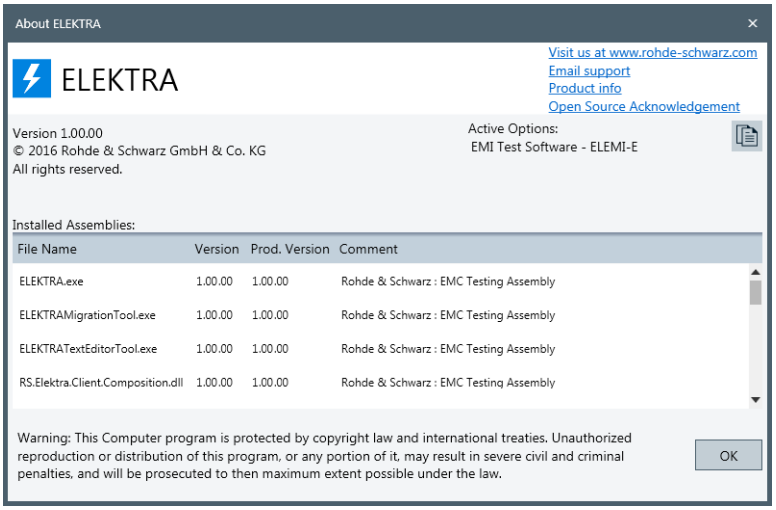
9.3 Product Information



To display information about R&S ELEKTRA, click the info button in the program menu.

This selection brings up a dialog that provides the following information:

- Software version details
- Links for the following online targets:
  - The Rohde & Schwarz homepage
  - An email message to the Rohde & Schwarz customer Support center
  - The R&S ELEKTRA product start page
  - The open source acknowledgment for open source software components used by R&S ELEKTRA
- A list of the installed software components



9.4 R&S ELEKTRA on the Internet

The R&S ELEKTRA product start page www.rohde-schwarz.com/product/elektra provides the most recent information, as detailed in Chapter 1.3, "Documentation Overview", on page 10. The online content also includes updates for current software versions.

For an easy access to the R&S ELEKTRA product start page, click the info button and select "Product info".

9.5 Support

For all service requests, or if you need immediate help, contact the Rohde & Schwarz support center. To send an email message, click the info button and select "Email

support". Regional contact details are available at www.rohde-schwarz.com/en/service-support/customer_support_107711.html.

Before you contact the support team, we recommend reading the corresponding chapter in the user manual or in the context-sensitive Embedded Help. If you contact the support team, have the product license information available.

9.6 Training

The Rohde & Schwarz training services offer in-depth customer seminars and intensive training courses for the application of R&S ELEKTRA. Course schedules are available at www.training.rohde-schwarz.com. Some courses are made available on demand.

Glossary: Frequently Used Terms and Abbreviations

A

AC: Alternating current (or > Anechoic chamber)

ACA: Absorbing clamp assembly

AF: Antenna factor, the ratio of the electromagnetic field strength (E or H) to the voltage U induced across the terminals of an antenna. For an electric field antenna, field strength E is in units of V/m, and the resulting antenna factor E/U is in units of 1/m. For a magnetic field antenna, field strength H is in units of A/m, and the resulting antenna factor H/U is in units of A/(Vm).

AFC: Automatic frequency control, a tracking mechanism to keep a monitoring device tuned to a signal with a frequency that is drifting over time, typically due to thermal or mechanical effects

AMN: Artificial mains network

Anechoic chamber: A room that is lined with absorbing material to not reflect electromagnetic waves

ANSI: American National Standards Institute

AVG: Average, a detector type

B

BCI: Bulk current injection / bulk cable injection, conducted susceptibility tests according to various standards as for example: ISO 11451-4 (EMI tests for continuous narrowband EM fields interfering with electronic components in vehicles), MIL-STD-461, CS114 (electrical disturbances from radiated EM energy at 10 kHz to 200 MHz)

BER: Bit error rate, the number of bit errors divided by the total number of transferred bits

BNC: Bayonet Neill-Concelman connector for coaxial cables that transmit RF signals, limited to frequencies <4 GHz and <500 V

C

CC: Current clamp

CD-ROM: Compact disc read-only memory, an optical data storage medium

CDN: Coupling / decoupling network

CE: Conducted emission (cable-based EMI tests)

CEE: Commission for Electrical Equipment, former name of a standardization organization; since 1985 the IEC

CF: Clamp factor (current injecting or absorbing clamp)

CISPR: International special committee on radio interference (in French: Comité International Spécial des Perturbations Radioélectriques), a standardization organization (part of the IEC) for controlling electromagnetic interference in electrical and electronic devices

Corner frequency: The pulse repetition frequency above which the rms-average detector behaves like an rms detector and below which the rms-average detector has the slope of a linear average detector.

CS: Conducted susceptibility (cable-based EMS tests)

CW: Continuous wave, a narrow bandwidth signal of constant amplitude and frequency

D

D-Sub: Electrical D-subminiature connector, surrounded by a D-shaped metal support

dB: Decibel, 10 times the common (decadic) logarithm of the ratio of two power quantities, or of the ratio of the squares of two field amplitude quantities

dBm: Decibel milliwatt, the power level based on a power ratio in decibels (dB) of the measured power, referenced to 1 mW

DC: Direct current

Detector: An algorithm that specifies how to weight the envelope of the measured IF signal, see Table 5-2

DUT: Device under test

Dwell Time: An EMS test parameter that determines how long the EUT is at least exposed to the immunity signal. Hence, the dwell time is the delay between the end of the field leveling process and the start of the EUT monitoring cycle.

E

EIRP: Equivalent (or effective) isotropically radiated power

EMC: Electromagnetic compatibility (with both EMI and EMS requirements)

EMI: Electromagnetic interference: Ability of an electrical appliance to avoid disturbing its environment by emitting an interfering signal

EMS: Electromagnetic susceptibility: Property of an electrical appliance to tolerate a disturbance of a particular level without showing any faults

ERP: Equivalent (or effective) radiated power

ESD: Electrostatic discharge

EUT: Equipment under test

EUT monitoring: Monitoring of different EUT parameters during an EMS measurement by using several measurement instruments with the goal of detecting EUT failures

F

FAR: Fully anechoic room

FC: Ferrule connector for optical fibers

FFT: Fast Fourier transform, an algorithm for time-domain scans

FSMA: Fiber Sub-Miniature Assembly, a connector for optical fibers, developed based on the SMA connector

G

Gain: The increase in power or amplitude of a signal, typically generated by an amplifier. In decibel (dB) calculus, power gain is 10 log (P_{out} / P_{in}).

Gasket: A mechanical seal

GHz: Giga Hertz, a frequency of 10^9/s

GPI: Ground plane interference

GPIB: General-purpose interface bus according to standard IEEE-488

I

IEC: International Electrotechnical Commission, a standardization organization for electrical, electronic and related technologies. One of IEC's groups is CISPR.

IEEE: Institute of Electrical and Electronics Engineers, among other activities an important publisher of standards that are produced by the IEEE's standardization committees

IF: Intermediate frequency, in heterodyne signal processing the resulting sum or difference frequency when a carrier signal is mixed with a local oscillator signal

Impedance: Electrical impedance Z is the complex ratio of AC voltage over current, representing a circuit's opposition towards a current under an applied voltage

IP: Internet protocol, a network communication technology for routing data packets from a source to a destination, based on IP addresses in the packet headers

ISO: International standardization organization, based in Geneva, Switzerland, and composed of representatives from national standards authorities. ISO and IEC have joint committees.

K

kHz: Kilo Hertz, a frequency of 10^3/s

L

LAN: Local area network within a limited space, such as an office building. LAN connects computers or electronic equipment with processing capability, using network media technologies such as Ethernet (over electric or fiber-optic cables) or wireless LAN (Wi-Fi).

Laser: LASER is the acronym for Light Amplification by Stimulated Emission of Radiation. Coherence, which allows monochromatic laser light to be focused and collimated, is among a laser's most special qualities. Spatial coherence enables high power densities, especially when modulated to be emitted in short pulses.

Level: The power level of RF radiation, typically specified in dBm, or in Watts.

Limit Line: In all EMI standards, maximum permissible levels for any interference signal generated by the EUT are defined, depending on the EUT class. A table containing these limit values over frequencies for an EUT class is called a "Limit Line" in R&S ELEKTRA.

LNA: Low Noise Amplifier, typically a solid-state preamplifier

LTE: Long Term Evolution, a mobile communication standard

M

M2M: Facilitates machine-to-machine ("M2M") communication of wireless or wire-bound devices

MHz: Mega-Hertz, a frequency of 10^6/s

Modulation Depth: In amplitude modulation, the modulation depth is the ratio M/A (in %) of the modulation amplitude M to the unmodulated carrier amplitude A. In this rela-

tion, M is the peak change (positive or negative) in the RF amplitude from its unmodulated value. For example, 80% modulation depth represents a signal with an envelope that oscillates between 100% and 20% of A. (20% of A is an amplitude 80% down from the unmodulated signal level A.)

MSC: Mode-stirred chamber, see RVC (reverberation chamber)

N

NIST: National Institute of Standards and Technology (USA)

Noise Factor: The noise factor (F) is a measure of the SNR degradation due to components in an RF signal chain. Lower F values indicate better system performance, with F being the ratio of input SNR to output SNR: $F = SNR_{input} / SNR_{output}$.

Noise Figure: The noise figure (NF) is equivalent to the noise factor (F) given in dB: $NF = 10 \log F$

NSA: Normalized site attenuation, a measurement of test chamber characteristics (typically with a transmitting and a receiving antenna), in comparison with theoretical free-space attenuation at an OATS

NTIA: National Telecommunications and Information Administration (USA)

O

OTA: Over-the-air (tests)

P

P-: Minimum peak, a detector type

P+: Maximum peak, a detector type

PC: Personal computer

Q

QPK: Quasi peak, a detector type

R

RC: Reference calibration (table)

RE: Radiated emission (antenna-based EMI tests)

RF: Radio frequency, electromagnetic oscillation in the frequency range of around 3 kHz to 300 GHz

RFID: Radio frequency identification, a (typically near-field) technology for automatic identification and tracking of objects

RMS: Root mean square, a statistical measure defined as the square root of the arithmetic mean of the squares of the original values

RS: Radiated susceptibility (antenna-based EMS tests)

RVC: Reverberation chamber, or electromagnetic mode-stirred chamber (MSC), a cavity resonator room used for testing EUTs under high field strength conditions. These conditions are generated using reflective walls and so-called stirrers (or tuners) that inhomogeneously reflect electromagnetic power to avoid the formation of standing RF waves.

S

SC: Standard connector for optical fibers

Scan: A scan is a measurement run, during which the receiver or the signal generator is tuned step by step over the whole frequency range (as opposed to a sweep). The definition parameters for a scan are the start frequency, the stop frequency, the step width (absolute, or in percent of the current frequency) and the dwell time at each frequency.

SMA connector: Sub-Miniature Assembly, a coaxial RF connector, version A (standard)

SMP connector: Sub-Miniature Precision assembly, a coaxial RF connector, version P (precision)

SNR: Signal-to-noise ratio is the ratio of the level of a desired signal to the level of background noise (measured in quantities of power). SNR > 1 (or SNR > 0 dB) indicates more signal than noise.

ST: Straight tip bayonet connector for optical fibers

Sweep: A sweep is an EMI measurement run, during which the frequency analyzer is tuned (quasi) continuously over the whole frequency range (as opposed to a scan). The definition parameters for a sweep are the start frequency, the stop frequency and the sweep time that it takes the analyzer to cover the whole frequency range.

T

TEM: Transverse electromagnetic (as in a TEM waveguide or GTEM cell, for example)

TG: Test generator, generates test signals for EMS tests

TPL: Short for template, in R&S ELEKTRA destinguish between test templates and report templates

TRD: Also written as "Trd", short for transducer

TRP: Total radiated power, the sum of all RF power radiated by an antenna (source power included in the measurement)

TT: Test template

TTL: Transistor–transistor logic, a class of integrated circuits with transistors performing both logic and amplifying functions

U

UA: Uniform area

USB: Universal Serial Bus, industrial connector standard for a serial interface

V

VA: Volt-Ampere = voltage (RMS) * current (RMS), is the unit for apparent power in an electrical AC circuit with sinusoidal voltages and currents of the same frequency. In DC circuits, VA is the real power in watts.

Video bandwidth: The video signal or (DC) video voltage is the envelope of a modulated RF signal. A lowpass filter that removes the higher frequency components of the IF signal and outputs the envelope, only, is called the video filter. The video bandwidth is hence the bandwidth of the filtered signal envelope.

VSWR: Voltage standing wave ratio, ratio of the maximum standing wave amplitude over the minimum standing wave amplitude

X

XML: Extensible markup language, a simple and generality usable text format code that can be easily read both by humans and machines

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