R&S®ESW-K58
Multi CISPR APD
User Manual

1179088002
Version 06

ROHDE&SCHWARZ
Make ideas real

This manual describes the following R&S®ESW models:

- R&S®ESW8 (1328.4100K08)
- R&S®ESW8 (1328.4100K09)
- R&S®ESW26 (1328.4100K26)
- R&S®ESW26 (1328.4100K27)
- R&S®ESW44 (1328.4100K44)
- R&S®ESW44 (1328.4100K45)

The contents of this manual correspond to firmware version 3.20 and higher.

Muehldorfstr. 15, 81671 Muenchen, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

1179.0880.02 | Version 06 | R&S®ESW-K58

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®ESW is indicated as R&S ESW.

Contents

1 Preface

1.1 About this manual

This Multi CISPR APD User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S ESW User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the Multi CISPR APD Application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **Measurement Examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Remote Commands for Multi CISPR APD Measurements**
  Remote commands required to configure and perform Multi CISPR APD measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S ESW User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation overview

This section provides an overview of the R&S ESW user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/esw

1.2.1 Getting started manual

Introduces the R&S ESW and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

1.2.2 User manuals and help

Separate user manuals are provided for the base unit and the firmware applications:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Firmware application manual
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S ESW is not included.

The contents of the user manuals are available as help in the R&S ESW. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

All user manuals are also available for download or for immediate display on the Internet.

1.2.3 Service manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.2.4 Instrument security procedures

Deals with security issues when working with the R&S ESW in secure areas. It is available for download on the internet.

1.2.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.2.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S ESW. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/esw

1.2.7 Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The firmware uses several valuable open source software packages. An open source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/esw

1.2.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/esw

1.2.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.
`Filenames, commands, program code`	Filenames, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3.2 Conventions for procedure descriptions

When operating the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.3.3 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Welcome to the Multi CISPR APD application

The R&S ESW-K58 Multi CISPR APD application provides functionality to perform CISPR APD measurements on multiple frequencies in parallel with the R&S ESW.

The application allows fast interference signal analysis at up to 67 frequencies simultaneously. It meets all requirements of CISPR 16-1-1 for measuring receivers with amplitude probability distribution (APD) measurement function.

The Multi CISPR APD application covers the complete frequency range of CISPR 11 Ed.6.2. All frequencies that are specified in CISPR 11 Ed.6.2 can be measured in parallel in just one sweep.

The application features Multi CISPR APD measurements with various result displays:

- CISPR APD at Tuned Frequency
- Multi APD
- Result Summary

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S ESW user manual. The latest version is available for download at the product homepage http://www.rohde-schwarz.com/product/esw.

Installation

You can find detailed installation instructions in the R&S ESW getting started manual or in the release notes.

2.1 Starting multi CISPR APD measurements

Multi CISPR APD measurements is a separate application on the R&S ESW.

To activate Multi CISPR APD measurements

1. Select the [MODE] key.

   A dialog box opens that contains all operating modes and applications currently available on your R&S ESW.

2. Select the "Multi CISPR APD" item.

   The R&S ESW opens a new channel for the application.

The measurement is started immediately with the default settings. It can be configured in the Multi CISPR APD Configuration overview dialog box, which is displayed when you select the "Overview" softkey from any menu.

Multiple Channels and Sequencer Function

When you activate an application, a new channel is created which determines the measurement settings for that application ("Channel"). The same application can be activated with different measurement settings by creating several "Channel"s for the same application.

The number of channels that can be configured at the same time depends on the available memory on the instrument.

Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

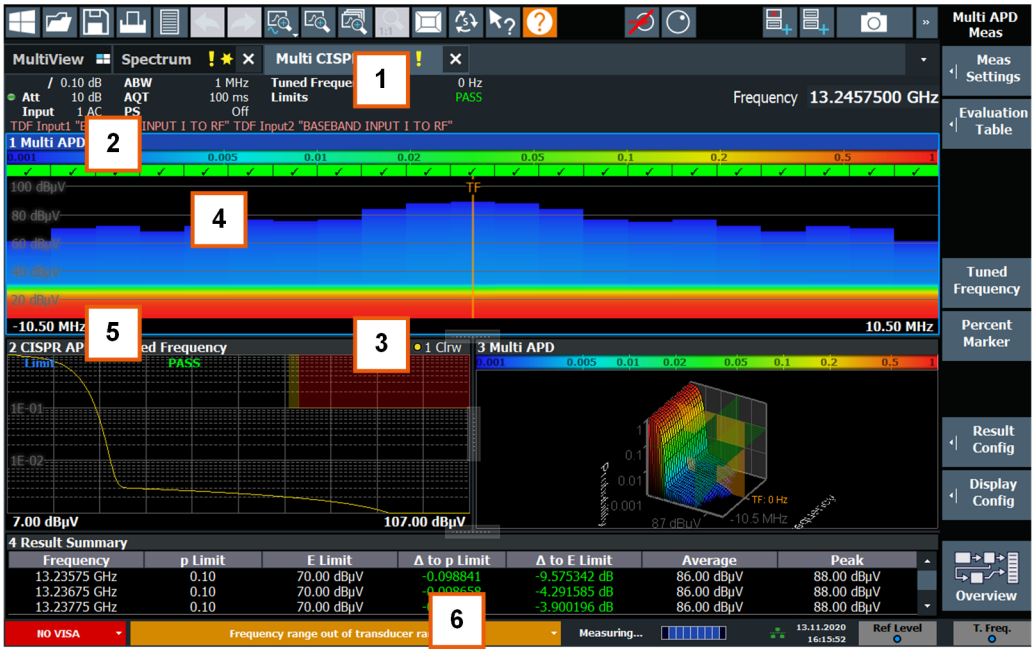
If activated, the measurements configured in the currently defined "Channel"s are performed one after the other in the order of the tabs. The currently active measurement is indicated by a ⚙ symbol in the tab label.

The result displays of the individual channels are updated in the tabs (as well as the "MultiView") as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

For details on the Sequencer function see the R&S ESW user manual.

2.2 Understanding the display information

The following figure shows a measurement diagram during Multi CISPR APD measurements. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Channel bar for firmware and measurement settings
2+3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information, depending on result display
6 = Instrument status bar with error messages and date/time display

Channel bar information

In the Multi CISPR APD application, the R&S ESW shows the following settings:

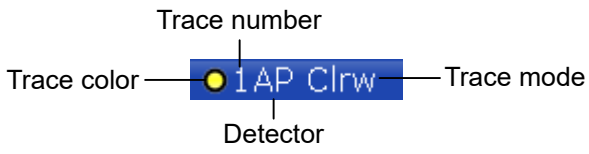
Table 2-1: Information displayed in the channel bar in the application for Multi CISPR APD measurements

Ref Level	Reference level
Att	RF attenuation applied to input
Input	Input toggle state
ABW	Analysis bandwidth
AQT	Measurement time for data acquisition.
PS	Current state of the preselector.
Tuned Frequency	Frequency of the current measurement results
Limits	PASS or FAIL of defined limits.
SGL	Indicates the progress of single measurements. The first number is the current measurement. The second number is the total number of measurements. Only displayed for single measurements and if the scan count is greater than 1.
Frequency	Receiver Frequency

Window Title Bar

Each channel in the R&S ESW display can contain several windows. Each window can display either a graph or a table as a result of the channel measurement. The window's title bar indicates which type of evaluation is displayed.

Information on the displayed traces is indicated in the window title bar.



For further information on the Window Title Bar, see R&S ESW User Manual.

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram.

Furthermore, the progress of the current operation is displayed in the status bar.

3 Measurements and result displays

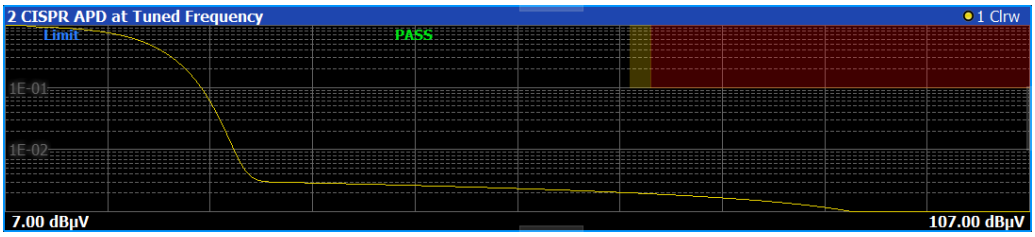
Access: "Overview" > "Display Config"

Or: [MEAS] > "Display Config"

The data that was measured by the R&S ESW can be evaluated using various different methods. In the Multi CISPR APD application, multiple result displays can be used simultaneously.

CISPR APD at Tuned Frequency

Displays the likelihood that a disturbance is above a specified level at a particular frequency.



Remote command:
`LAY:ADD? '1',RIGH,CAPD`
(See `LAYout:ADD[:WINDow]?` on page 57)

Fast Access

By default, the Fast Access panel provides functionality to control the Reference Level and the Tuned Frequency. For more information on how to change the functionality and how to work with the Fast Access panel, refer to the R&S ESW user manual.

Remote command:
`LAY:ADD? '1',RIGH,FACC`
(See `LAYout:ADD[:WINDow]?` on page 57)

Marker Table

Provides functionality to display information for all active markers. For more information on how to work with the Marker Table, refer to the R&S ESW user manual.

Remote command:
`LAY:ADD? '1',RIGH,MTAB`
(See `LAYout:ADD[:WINDow]?` on page 57)

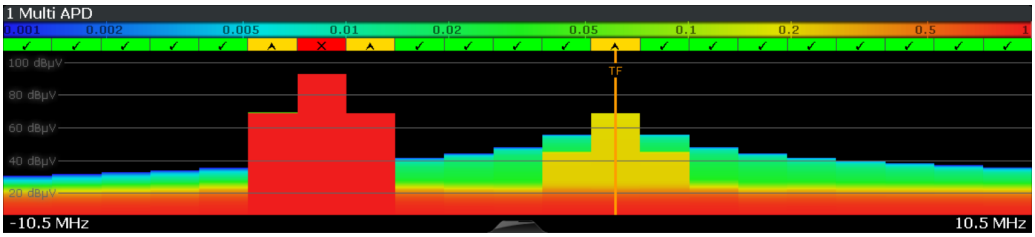
Multi APD

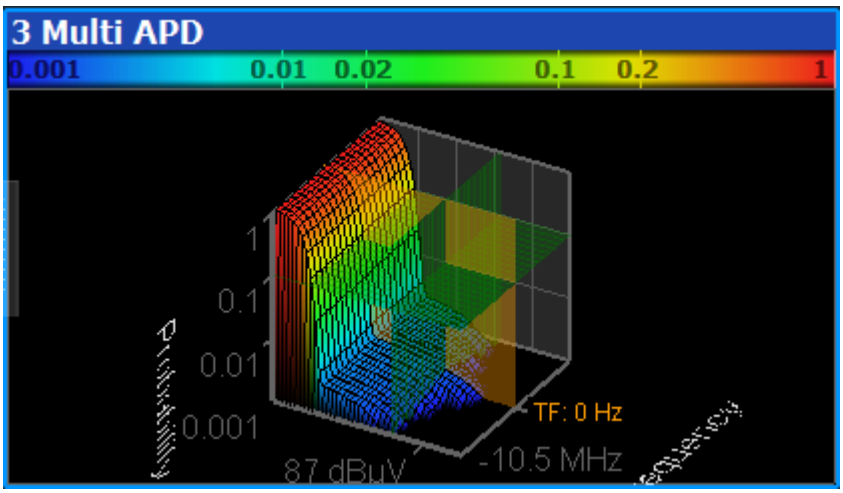
Displays the results of the CISPR APD measurement for all frequencies within the current span.

A view selection between Flat (2D) and 3D view of the Multi APD result display is possible.

Table 3-1: Multi APD Label Description

Label	Description
✓	Pass
^	Margin
✗	Fail





Remote command:
`LAY:ADD? '1',RIGH,MAPD`
(See `LAYout:ADD[:WINDow]?` on page 57)

Notes
Provides functionality to add comments or explanations to the current measurement. For more information on how to work with the Notes panel, refer to the R&S ESW user manual.

Remote command:
`LAY:ADD? '1',RIGH,NOT`
(See `LAYout:ADD[:WINDow]?` on page 57)

Result Summary
The Result Summary table contains the following values:

4 Result Summary

Frequency	p Limit	E Limit	Δ to p Limit	Δ to E Limit	Average	Peak
13.23395 GHz	0.10	70.00 dBµV	-0.098841	-9.575342 dB	86.00 dBµV	88.00 dBµV
13.23495 GHz	0.10	70.00 dBµV	-0.098658	-4.291585 dB	86.00 dBµV	88.00 dBµV
13.23595 GHz	0.10	70.00 dBµV	-0.098592	-3.900196 dB	86.00 dBµV	88.00 dBµV
13.23695 GHz	0.10	70.00 dBµV	-0.098636	-5.270059 dB	86.00 dBµV	88.00 dBµV
13.23795 GHz	0.10	70.00 dBµV	-0.098544	-3.900196 dB	86.00 dBµV	88.00 dBµV

Table 3-2: Result summary description

Label	Description
Frequency	Channel frequency
p Limit	Limit for the probability
E Limit	Limit for the power
Δ to p Limit	Distance to the p limit for the channel
Δ to E Limit	Distance to the E limit for the channel
Average	Average amplitude for the channel
Peak	Peak amplitude for the channel

For calculating the deltas, the minimum distance to the limits is used in case of a Pass or Margin and the maximum distance is used in case of a Fail.

Remote command:

`LAY:ADD? '1',RIGH,RSUM`, see `LAYout:ADD[:WINDow]?` on page 57
`TRACe<n>[:DATA]?` on page 65
`CALCulate<n>:STATistics:RESult<res>?` on page 67
`FETCh:SUMMary<n>[:ALL]?` on page 67
`FETCh:SUMMary<n>:AVERage?` on page 67
`FETCh:SUMMary<n>:AVERage:ALL?` on page 68
`FETCh:SUMMary<n>:DELimit?` on page 68
`FETCh:SUMMary<n>:DELimit:ALL?` on page 68
`FETCh:SUMMary<n>:DPLimit?` on page 68
`FETCh:SUMMary<n>:DPLimit:ALL?` on page 69
`FETCh:SUMMary<n>:ELIMit?` on page 69
`FETCh:SUMMary<n>:ELIMit:ALL?` on page 69
`FETCh:SUMMary<n>:FREQuency?` on page 70
`FETCh:SUMMary<n>:FREQuency:ALL?` on page 70
`FETCh:SUMMary<n>:LIMit?` on page 70
`FETCh:SUMMary<n>:LIMit:ALL?` on page 70
`FETCh:SUMMary<n>:PEAK?` on page 71
`FETCh:SUMMary<n>:PEAK:ALL?` on page 71
`FETCh:SUMMary<n>:PLIMit?` on page 71
`FETCh:SUMMary<n>:PLIMit:ALL?` on page 72

4 Measurement basics

Some background knowledge on basic terms and principles used in Multi CISPR APD measurements is provided here for a better understanding of the required configuration settings.

The Amplitude Probability Distribution (APD) is a statistical measurement that shows the "cumulative distribution of the probability of time that the amplitude of disturbance exceeds a specified level" (CISPR 16-1-1, Amendment 1:2005). So, basically, the measurement determines the likelihood that a disturbance is above a specified level at a particular frequency (the measurement is usually performed on a fixed frequency).

The amplitude of the disturbance is expressed in terms of the corresponding field strength or voltage at the receiver input.

The APD is measured at the output of the envelope detector. Therefore, the APD yields the probability information over the entire disturbance envelope within the measurement bandwidth and a particular period of time.

The APD function has the following advantages:

- It provides an alternative way to present peak and average measurements (for example for microwave ovens in accordance with CISPR 11).
- It is able to calculate true average values.
- It shows high sensitivity and allows you to measure, for example, a single impulse.
- It allows you to measure unsteady levels.

The Multi CISPR APD application allows you to measure up to 20 channels at 1 MHz bandwidth and up to 67 channels at 120 kHz bandwidth in parallel, thus saving a significant amount of measurement time. Traditional measurement methods only allowed to measure the APD at one frequency at a time.

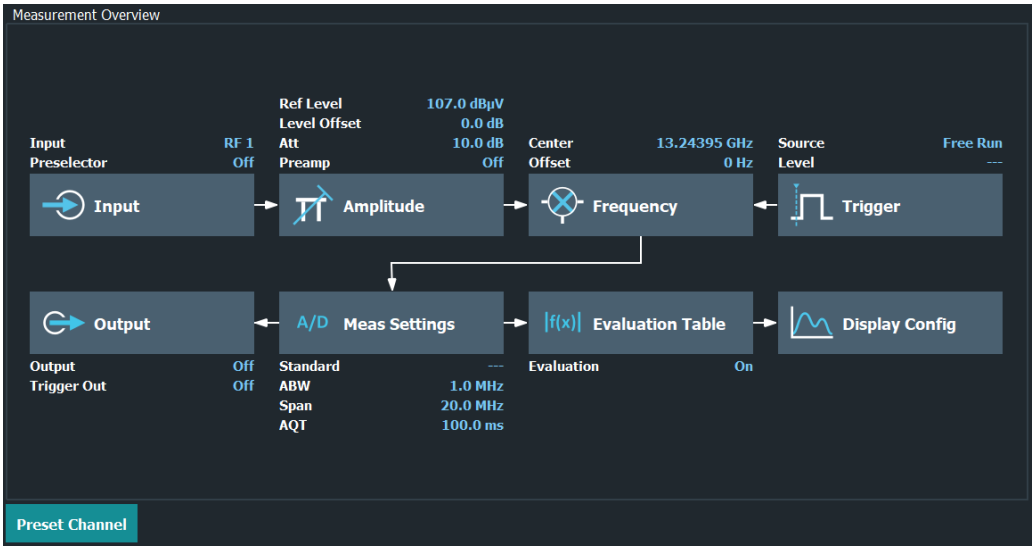
5 Configuration

Access: [MODE] > "Multi CISPR APD"

When you activate the Multi CISPR APD application, a Multi CISPR APD measurement for the input signal is started automatically with the default configuration. It can be configured in the Multi CISPR APD "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu.

5.1 Configuration overview

Throughout the measurement configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire Multi CISPR

APD measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

Preset Channel
Select "Preset Channel" in the lower left-hand corner of the "Overview" to restore all measurement settings *in the current channel* to their default values.

Note: Do not confuse "Preset Channel" with the [Preset] *key*, which restores the entire instrument to its default values and thus closes *all channels* on the R&S ESW (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 56

5.2 Data input and output

Access: "Overview" > "Input"

Access: "Overview" > "Output"

The R&S ESW can analyze signals from different input sources and provide various types of output (such as video or trigger signals).

I/Q data import and export

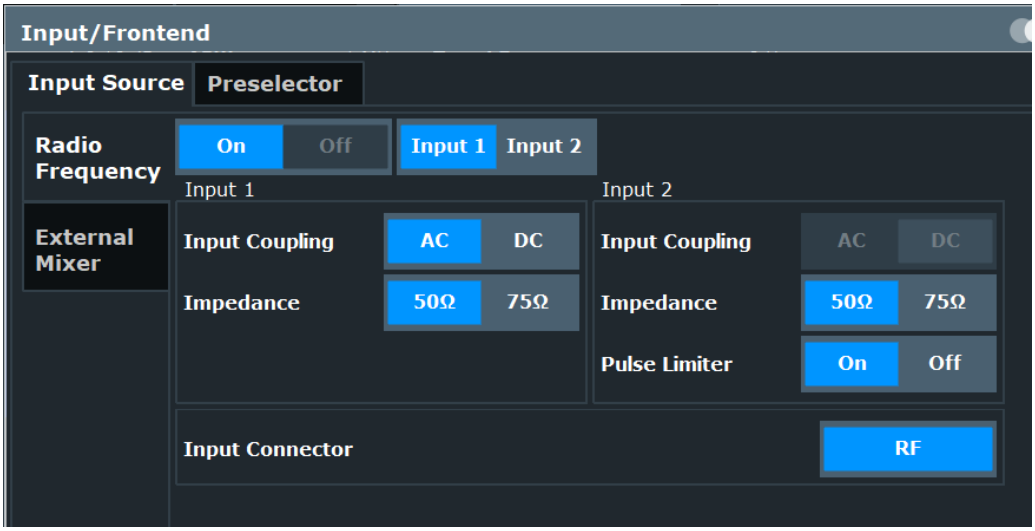
You can also analyze I/Q data that you have previously recorded.

For a comprehensive description about I/Q data import and export, refer to the user manual of the R&S ESW.

5.2.1 Configuring the RF input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Radio Frequency"

The R&S ESW supports various signal input sources. The default input source is the RF input.



Functions in the "Input" dialog box described elsewhere:

- "Input Selection" on page 19

The remote commands required to configure the RF input are described in Chapter 8.5.1.1, "RF input", on page 72.

Input Selection

Selects the RF input connector you would like to use for a measurement.

Note that you cannot use both RF inputs simultaneously.

Remote command:
Global: `INPut:TYPE` on page 73

Input Coupling

The RF input of the R&S ESW can be coupled by alternating current (AC) or direct current (DC).

Note that the "Input Coupling" feature is only available for input 2 when the pulse limiter is turned off. When the pulse limiter is on, the input is always DC coupled.

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the specifications document.

Remote command:
`INPut:COUPling` on page 72

Impedance
For some measurements, the reference impedance for the measured levels of the R&S ESW can be set to 50 Ω or 75 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

This value also affects the unit conversion.

Remote command:
`INPut:IMPedance` on page 73

Pulse Limiter
The pulse limiter, available for the second RF input, is a protection mechanism against high level pulses or signals (which can damage the input mixer).

When you turn on the pulse limiter, the attenuation is always at least 10 dB. Attenuation smaller than 10 dB is only available when you turn off the pulse limiter.

Remote command:
`INPut:ATTenuation:LIMiter[:STATe]` on page 73

Input Connector
Determines which connector the input data for the measurement is taken from.

"RF" (Default:) The "RF Input" connector

Remote command:
`INPut:CONNector` on page 73

5.2.2 Configuring external mixers

Access: "Overview" > "Input / Frontend" > "Input Source" > "External Mixer"

Controlling external mixer is available with the optional External Mixer support.

The functionality is the same as in the spectrum application.

For more information about configuring external mixers, refer to the user manual of the spectrum application.

5.2.3 Configuring the preselector

Access: "Overview" > "Input / Frontend" > "Preselector"

The preselector works similar to the preselector in the Receiver application. Notch filters are not supported in the Multi CISPR APD application.

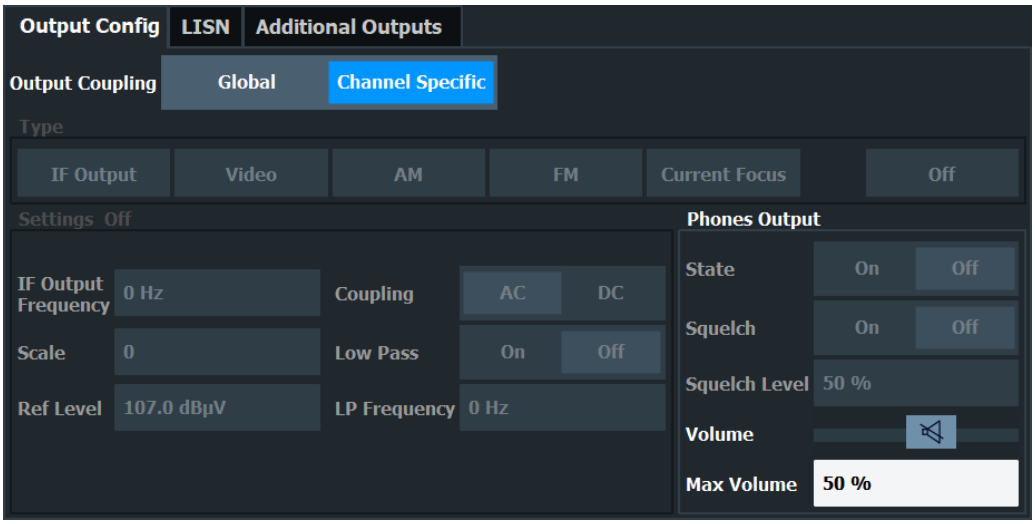
For more information refer to the user manual of the R&S ESW.

5.2.4 Configuring output

Access: "Overview" > "Output" > "Output Config"

The R&S ESW provides functionality to configure the volume of the phone output as required.

For details on the connectors refer to the R&S ESW Getting Started manual, chapter "Instrument Tour".



The remote commands required to configure the outputs are described in Chapter 8.5.2, "Output configuration", on page 74.

Output Coupling

Selects the scope of the output settings.

"Global"	The output settings apply to all measurement channels / applications.
"Channel Specific"	The output settings apply to the current measurement channel / application only. You can configure each channel separately.

Remote command:
`OUTPut<ou>:LINK` on page 74

Controlling the volume

CAUTION! Risk of hearing damage. To protect your hearing, make sure that the volume setting is not too high before putting on the headphones.

When you output an audio signal and listen to it with headphones, for example, you can control the volume of the output.

One way to control the volume is to use the **volume control knob** on the front panel of the R&S ESW.

A similar functionality is available in the "Phones" tab of the "Output Config" dialog box.

The **volume control slider** has the same effect as the volume control knob. For the slider, the volume is a percentage from 0 % to 100 % with 100 % being the loudest.

In addition to simply changing the volume, you can also define a **maximum volume level**. The maximum volume level limits the audio output to a certain level.

The volume control knob and slider will not go further than this level.

Remote command:
Volume: `SYSTem:SPEaker:VOLume` on page 75
Maximum volume: `SYSTem:SPEaker:MAXVolume` on page 75
Mute: `SYSTem:SPEaker:MUTE` on page 75

5.2.5 Configuring line impedance stabilization networks (LISN)

Access: "Overview" > "Output" > "LISN"

The R&S ESW supports several LISN models and provides functionality to control these devices. The functionality is the same as in the Receiver application.

For more information refer to the user manual of the R&S ESW.

5.2.6 Configuring additional outputs

Access: "Overview" > "Output" > "Additional Outputs"

The R&S ESW provides additional outputs that you can use for various tasks.

The remote commands required to configure the outputs are described in Chapter 8.5.2, "Output configuration", on page 74.

The trigger output settings are described in Chapter 5.5.2, "Trigger input and output settings", on page 32.

Probe Power Supply
Selects the probe connector that is supplied with power.

The probe power supply is a global setting - when you change it in one measurement channel, it is also changed in the others.

"Probe 1" Supplies the 3-pin probe connector with power.

"Probe 2" Supplies the 5-pin probe connector with power.

"Off" Turns off the power supply for the probe connectors.

Remote command:
`OUTPut<ou>:PROBe<pb>[:POWer]` on page 76

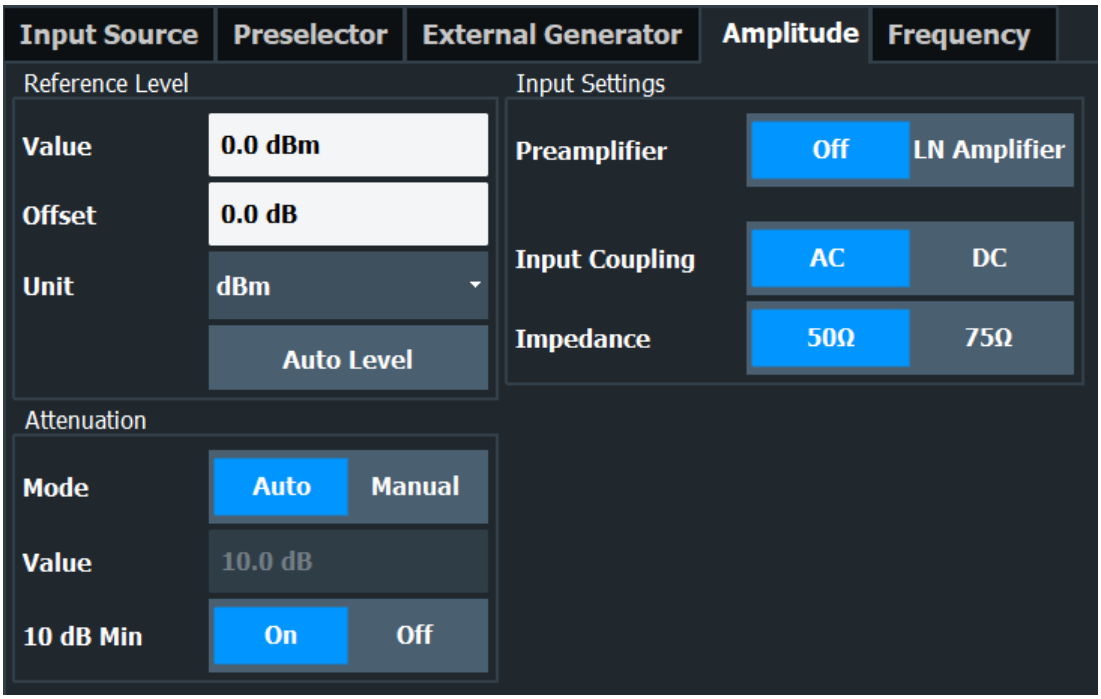
5.3 Amplitude

5.3.1 Amplitude configuration

Access: "Overview" > "Input / Frontend" > "Amplitude"

The amplitude is configured in the "Amplitude" tab of the "Input" dialog box.

For background information on amplitude settings see the R&S ESW User Manual.



The remote commands required to define these settings are described in Chapter 8.5.3, "Amplitude configuration", on page 76.

Functions to configure level characteristics described elsewhere:

- "Input Coupling" on page 19
- "Impedance" on page 20

Reference Level
Defines the expected maximum reference level. Signal levels above this value are possibly not measured correctly. Signals above the reference level are indicated by an "IF Overload" or "OVLD" status display.

The reference level can also be used to scale power diagrams; the reference level is then used for the calculation of the maximum on the y-axis.

Since the hardware of the R&S ESW is adapted according to this value, it is recommended that you set the reference level close above the expected maximum signal level. Thus you ensure an optimal measurement (no compression, good signal-to-noise ratio).

Note that for input from the External Mixer (R&S ESW-B21) the maximum reference level also depends on the conversion loss; see the R&S ESW base unit user manual for details.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 77

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the R&S ESW so the application shows correct power results. All displayed power level results are shifted by this value.

The setting range is ±200 dB in 0.01 dB steps.

Note, however, that the *internal* reference level (used to adjust the hardware settings to the expected signal) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S ESW must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 77

Attenuation
Defines the attenuation of the signal.

You can attenuate the signal in 1 dB steps. The range is specified in the datasheet. Attenuation of less than 10 dB is only possible if you turn off 10 dB Minimum Attenuation.

If you are using the preamplifier in frequency ranges above 8 GHz, the available attenuation can be reduced.

For more information, see the Preamplifier description in the R&S ESW base unit user manual.

The auto ranging feature in the receiver remains active even if you change the attenuation and preamplifier properties in other measurement channels and then return to the receiver application.

The R&S ESW also allows you to determine the best attenuation automatically.

- In the receiver application, turn on the "Auto Ranging" feature.
- In the other applications, select attenuation "Mode" → "Auto"

Remote command:
Global: `INPut:ATTenuation[:VALue]` on page 78
Attenuation mode: `INPut:ATTenuation:AUTO` on page 77

10 dB Minimum Attenuation
Turns the availability of attenuation levels of less than 10 dB on and off.

When you turn on this feature, the attenuation is always at least 10 dB. This minimum attenuation protects the input mixer and avoids accidental setting of 0 dB, especially if you measure EUTs with high RFI voltage.

When you turn it off, you can also select attenuation levels of less than 10 dB.

The setting applies to a manual selection of the attenuation as well as the automatic selection of the attenuation.

Remote command:
`INPut:ATTenuation:PROTection[:STATe]` on page 78

Preamplifier
Configures the preamplifier.

In addition to the standard preamplifier, a low noise amplifier is available as an optional hardware component.

- **"Off"**
  Turns off the preamplifier.
- **"LN Amplifier"**
  Turns on the optional low noise amplifier.

Note that if you want to use the standard preamplifier, you have to route the signal through the preselector.

More information.

Remote command:
Preamplifier:
State (global): `INPut:GAIN:STATe` on page 79
Low noise preamplifier:
State (global): `INPut:GAIN:LNA:STATe` on page 79

5.3.2 Increasing measurement sensitivity (or avoiding an input mixer overload)

Measurements often confront you with unknown or unintentional signals with unknown signal levels (and often with pulse characteristics). Such signals can either have very weak signal levels, in which case you might miss them during the measurement. Or

they can have very strong signal levels, in which case they can damage the input mixer.

Protecting the input mixer

Always consider how to protect the input mixer from damage when setting up a measurement.

► **NOTICE!** EMC measurements often measure unknown signals that contain pulses with possibly strong signal levels. Strong signal levels can damage the input mixer.

Read the following topics carefully before you apply a signal to learn more about protecting the input mixer and avoid an overload.

Note that pulses have different level characteristics. Refer to the specifications document for more information on the allowed maximum pulse energy.

The signal level at the input mixer is calculated as follows.

Mixer Level = Input Level - attenuation + gain

The R&S ESW is equipped with an overload protection mechanism. This mechanism becomes active as soon as the signal level at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

In this case, you must decrease the level at the RF input connector and then close the message box. Then measurements are possible again.

5.3.2.1 Using the RF attenuator

The first tool provided by the R&S ESW to control measurement sensitivity is the RF attenuator.

The RF attenuator is available in all hardware configurations of the R&S ESW.

Attenuation has the following effects on the measurement:

- High attenuation protects the input mixer: the main purpose of the attenuator is to protect the input mixer.
- High attenuation makes sure that the measurement results are reliable (signals that are stronger than allowed can distort the results)
- High attenuation helps you to avoid intermodulation
- High attenuation increases inherent noise (i.e. the noise floor) and thus decreases measurement sensitivity: if you increase attenuation by 10 dB, the sensitivity is reduced by 10 dB (in other words: the displayed noise increases by 10 dB)

Depending on the required test setup, you must find a compromise between a high sensitivity, low intermodulation and input mixer protection. We recommend to let the R&S ESW determine the ideal attenuation automatically.

You can determine the attenuation automatically with the auto ranging feature in the receiver application and the auto attenuation feature in the other applications. Determining the attenuation automatically might not necessarily utilize the maximum dynamic range, but still yields valid and reliable results.

When you select the attenuation manually and are measuring unknown signals, especially DUTs with a high RFI voltage, always select the highest possible attenuation level before you apply the signal.

If you need a better sensitivity or signal-to-noise ratio, make sure that the applied signal does not exceed the specified limits, before you lower the attenuation.

For further protection of the input mixer, the R&S ESW does not allow you to select attenuation levels of less than 10 dB unless you explicitly turn on this feature ("10 dB Minimum Attenuation").

Protecting the input mixer

1. **NOTICE!** EMC measurements often measure unknown signals that contain pulses with possibly strong signal levels. Strong signal levels can damage the input mixer.

   Select an appropriate attenuation when you measure unknown signals or RFI voltage in combination with an artificial network (LISN). Do not apply a 0 dB attenuation for such measurements.
   During phase switching, such test setups generate very strong pulses which can damage the input mixer.

2. Make sure that the signal level at the RF input does not exceed the allowed limits when you allow attenuation of less than 10 dB in combination with auto ranging
   Exceeding the limits can damage the input mixer.

5.3.2.2 Using the preamplifier

The second tool that allows you to control measurement sensitivity is the preamplifier.

In addition to the standard preamplifier available in every R&S ESW, an additional low noise amplifier is available as an optional component (R&S ESW-B24).

Signal gain has the following effects on the measurement:

- The preamplifier allows you to detect even weak signals.
- The preamplifier reduces the noise figure of the R&S ESW and thus increases its sensitivity. Thus, it is recommended to use the preamplifier for measurements that require maximum sensitivity.
- The preamplifier reduces the dynamic range. To perform a measurement using the maximum dynamic range, turn off the preamplifier.
- The preamplifier is located after the preselection filters, reducing the risk of overloading the input mixer by strong out-of-band signals.
- The optional low noise amplifier is located in front of the preselection filters which increases the measurement sensitivity.

The gain of the preamplifier is automatically considered in the level display. The disadvantage of a lower large-signal immunity (intermodulation) is reduced by the "preselector".

5.3.2.3 Using the preselector

The "preselector" is another tool to control measurement sensitivity.

Preselection has the following effects on the measurement:

- Preselection rejects most of the spectral energy which helps to protect the input mixer and thus makes sure that the measurement results are valid and reliable.
- Preselection filters out signals that you do not want to be displayed (selectivity) and thus allows you to analyze only the frequency range you are interested in.

The preselector of the R&S ESW consists of several filters which are automatically applied during measurements. The filter that is used depends on the frequency that is currently measured. You can see the list of filters and the progress in the "Preselector" result display. The currently applied filter is indicated by a green LED, filters that are outside the scan range are ignored.

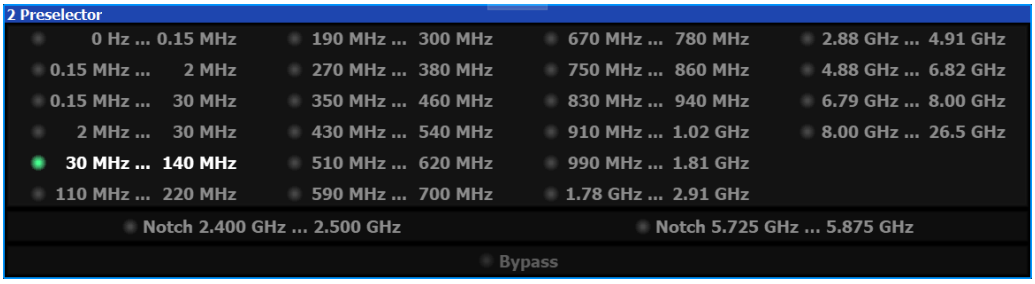


Figure 5-1: Preselector result display. The green LED indicates the currently applied filter.

In the frequency range from 150 kHz to 30 MHz, you can preselect in a single stage (150 kHz to 30 MHz). Or, you can split the preselection into two stages, each of which applies a separate filter: one from 150 kHz to 2 MHz, and another from 2 MHz to 30 MHz.

In addition, the R&S ESW provides several notch filters to suppress certain frequency ranges completely.

Using the preselector

Switching the filters is a mechanical process. Avoid excessive filters switches, because the hardware can wear out.

Note that results in a frequency band are only displayed if there is at least one valid measurement point in the corresponding range. If a particular measurement point is captured by more than one filter, the R&S ESW displays the combined results.

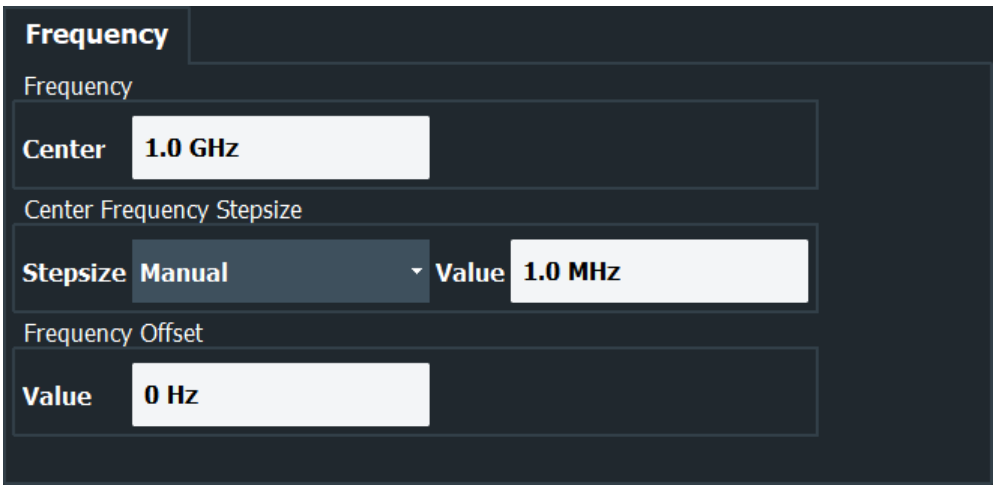
Notch filter

The R&S ESW provides additional notch filters that suppress signals in the frequency bands from 2.4 GHz to 2.5 GHz and 5.725 GHz to 5.875 GHz.

5.4 Frequency

Access: "Overview" > "Frequency"

Frequency settings for the input signal can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:



The remote commands required to configure the frequency are described in Chapter 8.5.4, "Frequency configuration", on page 79.

Center Frequency

Defines the center frequency of the signal in Hertz.

The allowed range of values for the center frequency depends on the frequency span.

span > 0: $span_{min}/2 \leq f_{center} \leq f_{max} - span_{min}/2$

f_{max} and $span_{min}$ depend on the instrument and are specified in the specifications document.

If the center frequency is within an undefined CISPR frequency region, it has to be set according to the following table to be inside a valid band again:

Table 5-1: Center frequency bands

2.4 GHz < f < 2.45 GHz (no CISPR band)	set f to 2.4 GHz - Span / 2 (next valid band below the gap)
2.45 GHz <= f < 2.5 GHz (no CISPR band)	set f to 2.5 GHz + Span / 2 (next valid band above the gap)
5.725 GHz < f < 5.8 GHz (no CISPR band)	set f to 5.725 GHz - Span / 2 (next valid band below the gap)
5.8 GHz <= f < 5.875 GHz (no CISPR band)	set f to 5.875 GHz + Span / 2 (next valid band above the gap)

Remote command:
`[SENSe:]FREQuency:CENTer` on page 79

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased using the arrow keys.

When you use the rotary knob the center frequency changes in steps of only 1/10 of the span.

The step size can be coupled to another value or it can be manually set to a fixed value.

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 80

Frequency Offset
Shifts the displayed frequency range along the x-axis by the defined offset.

This parameter has no effect on the instrument's hardware, on the captured data, or on data processing. It is simply a manipulation of the final results in which absolute frequency values are displayed. Thus, the x-axis of a spectrum display is shifted by a constant offset if it shows absolute frequencies. However, if it shows frequencies relative to the signal's center frequency, it is not shifted.

A frequency offset can be used to correct the display of a signal that is slightly distorted by the measurement setup, for example.

The allowed values range from -1 THz to 1 THz. The default setting is 0 Hz.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 80

Tuned Frequency
Defines the currently selected measurement frequency as a positive or negative deviation from the selected center frequency. The Tuned Frequency line can also be moved by drag and drop. By default, the Tuned Frequency is equal to the Center Frequency when the Multi CISPR APD application is started.

Remote command:
`[SENSe:]FREQuency:TUNed` on page 80

5.5 Trigger

Access: "Overview" > "Trigger"

Triggering means to capture the interesting part of the signal. Choosing the right trigger type and configuring all trigger settings correctly allows you to detect various incidents in your demodulated signals.

Optionally, the trigger signal used by the R&S ESW can be output to a connected device, and an external trigger signal from a connected device can be used by the R&S ESW.

For more information, refer to the description of the Spectrum application in User Manual of the R&S ESW.

5.5.1 Trigger source settings

Access: "Overview" > "Trigger" > "Trigger Source"

Trigger Source
In the Multi CISPR APD application, the next measurement can be triggered if the selected input signal exceeds the threshold specified using the "Trigger Level" setting (see "Trigger Level" on page 32).

Remote command:
`TRIGger<tp>[:SEQuence]:SOURce` on page 81

Free Run ← Trigger Source
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitly.

Remote command:
`TRIGger<tp>[:SEQuence]:SOURce` on page 81

Ext. Trigger 1/2 ← Trigger Source
Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

Note: "External Trigger 1" automatically selects the trigger signal from the "TRIGGER 1 INPUT" connector on the front panel.

For details, see the "Instrument Tour" chapter in the R&S ESW Getting Started manual.

"External Trigger 1"
Trigger signal from the "TRIGGER 1 INPUT" connector.

"External Trigger 2"
Trigger signal from the "TRIGGER 2 INPUT / OUTPUT" connector.

"External Trigger 3"
Trigger signal from the "TRIGGER 3 INPUT / OUTPUT" connector on the rear panel.

Remote command:
`TRIGger<tp>[:SEQuence]:SOURce` on page 81

Trigger Level
Defines the trigger level for the specified trigger source.

For details on supported trigger levels, see the instrument specifications document.

Remote command:
`TRIGger<tp>[:SEQuence]:LEVel[:EXTernal]` on page 81

Trigger Offset
Defines the time offset between the trigger event and the start of the measurement.

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger)

Remote command:
`TRIGger<tp>[:SEQuence]:HOLDoff[:TIME]` on page 82

Drop-Out Time
Defines the time that the input signal must stay below the trigger level before triggering again.

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 82

Slope
For all trigger sources except time, you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`TRIGger<tp>[:SEQuence]:SLOPe` on page 82

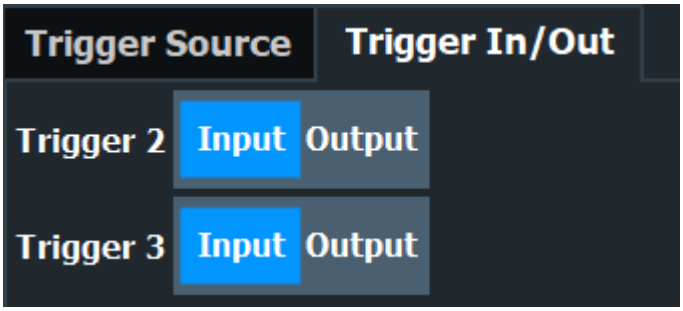
Trigger Holdoff
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 83

5.5.2 Trigger input and output settings

Access: "Overview" > "Trigger" > "Trigger In/Out"

Trigger 2/3



Defines the usage of the variable Trigger Input/Output connectors, where:

"Trigger 2": Trigger Input/Output connector on the front panel

"Trigger 3": Trigger 3 Input/Output connector on the rear panel

(Trigger 1 is INPUT only.)

Providing trigger signals as output is described in detail in the R&S ESW User Manual.

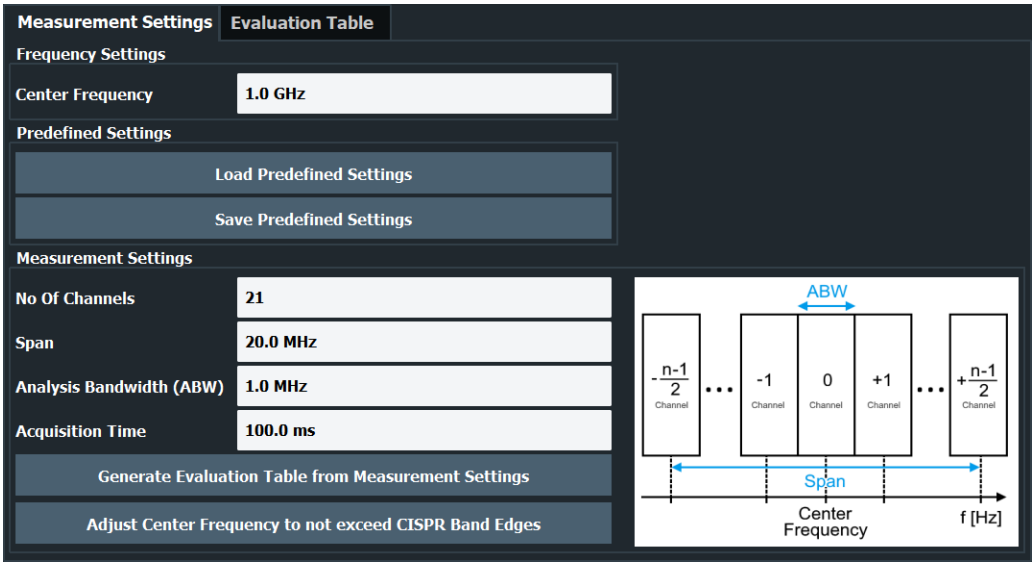
"Input" The signal at the connector is used as an external trigger source by the R&S ESW. Trigger input parameters are available in the "Trigger" dialog box.

"Output" The R&S ESW sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<tp>:DIRection` on page 83

5.6 Measurement settings

Access: "Meas Config" > "Meas Settings"



The remote commands required to define these settings are described in Chapter 8.5.6, "Measurement settings", on page 83.

Center Frequency

Defines the center frequency of the signal in Hertz.

The allowed range of values for the center frequency depends on the frequency span.

span > 0: $span_{min}/2 \leq f_{center} \leq f_{max} - span_{min}/2$

f_{max} and $span_{min}$ depend on the instrument and are specified in the specifications document.

If the center frequency is within an undefined CISPR frequency region, it has to be set according to the following table to be inside a valid band again:

Table 5-2: Center frequency bands

2.4 GHz < f < 2.45 GHz (no CISPR band)	set f to 2.4 GHz - Span / 2 (next valid band below the gap)
2.45 GHz <= f < 2.5 GHz (no CISPR band)	set f to 2.5 GHz + Span / 2 (next valid band above the gap)
5.725 GHz < f < 5.8 GHz (no CISPR band)	set f to 5.725 GHz - Span / 2 (next valid band below the gap)
5.8 GHz <= f < 5.875 GHz (no CISPR band)	set f to 5.875 GHz + Span / 2 (next valid band above the gap)

Remote command:
`[SENSe:]FREQuency:CENTer` on page 79

Predefined Settings

The predefined settings area provides functionality to load and save predefined measurement settings or standards.

The predefined settings do not include the center frequency. All other parameters of the measurement settings are included, together with the evaluation table.

Load Predefined Settings — The button "Load Predefined Settings" opens the file load dialog with the default directory of standard files: `C:\R_S\INSTR\mapd_std`. You can select one of the standards that are stored here. The firmware, in default case, provides the standard file `CISPR_11_Ed.6.2.xml`. The standard can only be loaded if the Center Frequency is 1 GHz >= f <= 2,4 GHz, 2,5 GHz >= f <= 5,72 GHz and 5,88 GHz >= f <= 18 GHz.

Save Predefined Settings — The button "Save Predefined Settings" saves the current settings (Measurement Settings except Center Frequency + Evaluation Settings) to a user-selected standard file. The default directory for the save dialog is `C:\R_S\INSTR\mapd_std`.

Remote command:
`[SENSe:]MAPD[:STANdard]:LOAD` on page 84
`[SENSe:]MAPD[:STANdard]:SAVE` on page 84

Measurement Settings

The measurement settings area provides functionality to define the parameters of the measurement.

If parameters in the measurement settings are changed in a way that they no longer correspond to the evaluation table, the corresponding column in the table is grayed out.

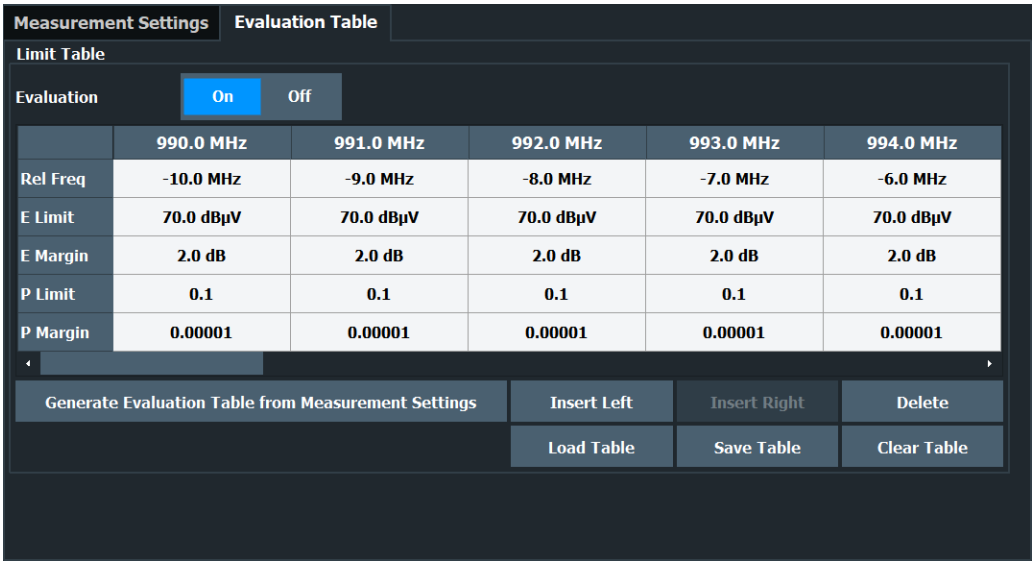
No of Channels	Defines the number of measurement channels.
Span	Defines the measurement span.
Analysis Bandwidth	Defines the analysis bandwidth for the measurement.
Acquisition Time	Defines the acquisition time for the measurement.
Generate Evaluation Table from Measurement Settings	Takes the user set center frequency, span and analysis bandwidth and populates the evaluation table out of these values.
Adjust Center Frequency to not exceed CISPR Band Edges	Provides functionality to resolve CISPR band selection issues. If the center frequency exceeds the CISPR band egdes, a yellow warning message is displayed in the status bar.

Remote command:

`[SENSe:]MAPD:NCHannels` on page 84
`[SENSe:]FREQuency:SPAN` on page 85
`[SENSe:]BANDwidth[:RESolution]` on page 85
`[SENSe:]SWEep:TIME` on page 85
`[SENSe:]MAPD:CHANnel<n>:POPulate` on page 85
`[SENSe:]MAPD:FADJust` on page 86

5.7 Evaluation table

Access: "Meas Config" > "Evaluation Settings"



The remote commands required to define these settings are described in Chapter 8.5.7, "Evaluation table", on page 86.

Evaluation Table

The evaluation table is populated by pressing the Populate All Channels to Evaluation Settings button in the Measurement Settings tab.

If parameters in the measurement settings are changed in a way that they no longer correspond to the limit table, the corresponding column in the table is grayed out.

Evaluation	Turns the evaluation on and off.
Insert Left	Inserts a new column on the left side of the selected column.
Insert Right	Inserts a new column on the right side of the selected column.
Delete	Deletes the selected column.
Load Table	Loads an existing table from an XML file in the specified location. The default path is `<USER_ROOT>\MultiApd`.
Save Table	Saves the table in XML format to the specified location. The default path is `<USER_ROOT>\MultiApd`.
Clear Table	Clears all columns except for the one at center frequency from the table.
Generate Evaluation Table from Measurement Settings	See "Measurement Settings" on page 35.

Remote command:

`[SENSe:]MAPD:CHANnel<n>:CLEar` on page 86
`[SENSe:]MAPD:CHANnel<n>:COUNt?` on page 86
`[SENSe:]MAPD:CHANnel<n>:DELete` on page 87
`[SENSe:]MAPD:CHANnel<n>:ELIMit` on page 87
`[SENSe:]MAPD:CHANnel<n>:EMARgin` on page 87
`[SENSe:]MAPD:CHANnel<n>:EVALuation` on page 87

[SENSe:]MAPD:CHANnel<n>:INSert on page 88
[SENSe:]MAPD:CHANnel<n>:LOAD on page 88
[SENSe:]MAPD:CHANnel<n>:PLIMit on page 88
[SENSe:]MAPD:CHANnel<n>:PMARgin on page 88
[SENSe:]MAPD:CHANnel<n>:POPulate on page 85
[SENSe:]MAPD:CHANnel<n>:RFRequency on page 89
[SENSe:]MAPD:CHANnel<n>:SAVE on page 89

5.8 Display configuration

Access: "Overview" > "Display Config"

The signal can be displayed using various evaluation methods. All evaluation methods available for the current application are displayed in the evaluation bar in SmartGrid mode.

For a description of the available evaluation methods see Chapter 3, "Measurements and result displays", on page 13.

5.9 Sweep settings

The sweep settings provide functionality to switch between a single measurement and a continuous measurement.

Continuous Sweep / Run Cont
While the measurement is running, "Continuous Sweep" and [RUN CONT] are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again. The results are not deleted until a new measurement is started.

Note: Sequencer. Furthermore, [RUN CONT] controls the Sequencer, not individual sweeps. [RUN CONT] starts the Sequencer in continuous mode.

Remote command:
Measurement mode: `INITiate<n>:CONTinuous` on page 90
Run measurement: `INITiate<mt>[:IMMediate]` on page 90

Single Sweep / Run Single
Initiates a single measurement. If measurement parameters were changed after the previous sweep, the results of the previous sweep are cleared when a new sweep is started.

While the measurement is running, "Single Sweep" and [RUN SINGLE] are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Note: Sequencer. Furthermore, [RUN SINGLE] controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.
If the Sequencer is off, only the evaluation for the currently displayed channel is updated.

Remote command:
Measurement mode: `INITiate<n>:CONTinuous` on page 90
Run measurement: `INITiate<mt>[:IMMediate]` on page 90

5.10 Transducer

Many EMC test setups contain a transducer (for example antennas, cables, probes or current probes). The transducer converts the interference variables like field strength, current or RFI voltage into a voltage across 50 Ω. Because most transducers have a characteristic frequency response, it is necessary to correct the measurement results by the frequency characteristics of the transducer. These characteristics are defined in a transducer factor or transducer sets.

For more information on how to use transducers and how to work them, refer to the R&S ESW user manual.

5.11 Using the user port panel

Access: ▣ > "User Port"

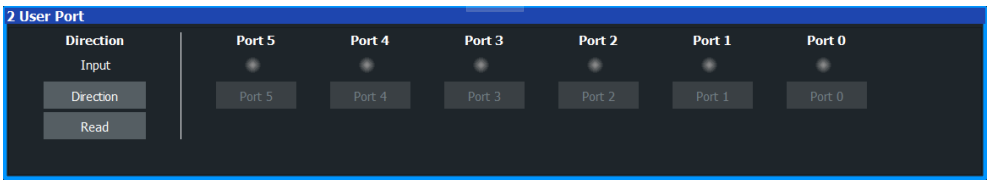
The "User Port" panel is designed to configure the optional user port (AUX port) on the rear of the R&S ESW. Using the user port, you can transmit bit patterns in two directions, depending on the actual selected signal direction.

When you add the user port panel to the user interface, you can configure the user ports as required.

User port configuration
You can configure the user port as an input or an output by selecting the signal "Direction".

- When you configure the user port as an output, you can select the required bit patterns by changing the state of the indivdiual ports ("Port <x>").
  An active port shows a green LED.

- When you configure the user port as an input, you can read out the user port configuration. The value is displayed in the panel. Individual port selection becomes unavailable.



For more information about the pin to bit assignment, refer to the description of the remote command.

Remote command:
Output state: `OUTPut:UPORt:STATe` on page 92
Set bit pattern: `OUTPut:UPORt[:VALue]` on page 92
Input state: `INPut:UPORt:STATe` on page 91
Query bit pattern: `INPut:UPORt[:VALue]` on page 91

6 Analysis

Access

- "Overview" > "Analysis"

General result analysis settings concerning the trace, markers, lines etc. are similar to the analysis functions in the Spectrum application, except for the features described here.

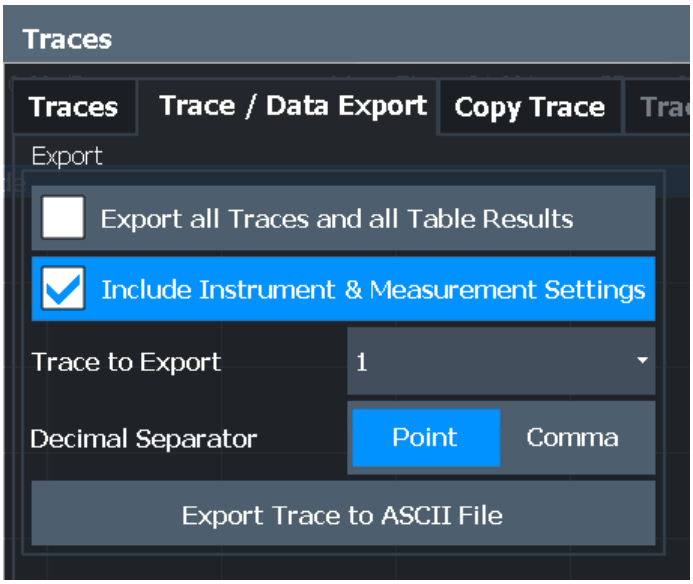
For more information, refer to the R&S ESW User Manual.

6.1 Trace / data export configuration

Access: "Trace" > "Trace / Data Export"

The standard data management functions (e.g. saving or loading instrument settings) that are available for all R&S ESW applications are not described here.

See the R&S ESW base unit user manual for a description of the standard functions.



Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. "Result Summary", marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`FORMat:DEXPort:TRACes` on page 93

Include Instrument & Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 93

Export All Traces for Selected Graph
Includes all traces for the currently selected graphical result display in the export file.

Remote command:
`FORMat:DEXPort:GRAPh` on page 94

Trace to Export
Defines an individual trace to be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 94

6.2 Marker settings

Access: "Overview" > "Analysis" > "Marker"

For more information, refer to the user manual of the R&S ESW.

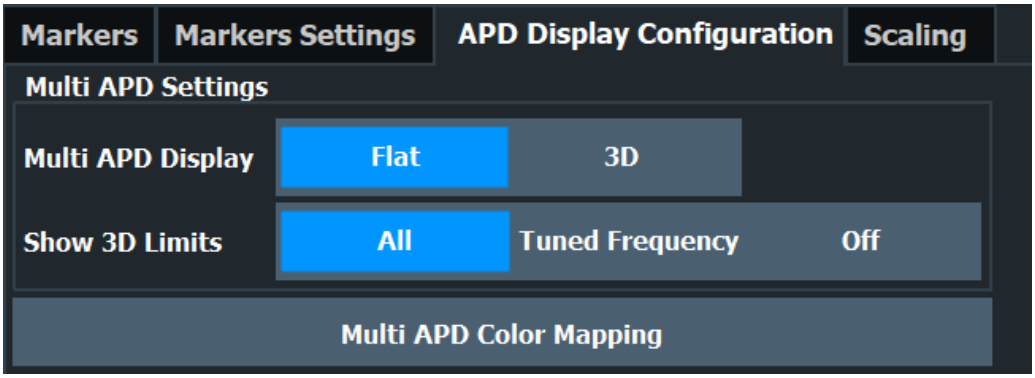
Percent Marker
Defines a probability value. Thus, the power which is exceeded with a given probability can be determined very easily. If marker 1 is deactivated, it is switched on automatically.

Remote command:
`CALCulate<n>:MARKer<m>:Y:PERCent` on page 95

6.3 APD display configuration

Access

- "Marker Config" > "APD Display Configuration"



Multi APD Display
The Multi APD result display can either be configured to display a "Flat" 2-dimensional power vs. frequency diagram or a "3D" 3-dimensional power vs. frequency vs. probability diagram.

Remote command:
`CALCulate<n>:SGRam:THReedim[:STATe]` on page 95
`CALCulate<n>:SPECtrogram:THReedim[:STATe]` on page 96

Show 3D Limits
The Show 3D limits switch enables and disables the limits on the 3D plot. If Tuned Frequency is selected, only the limits on the Tuned Frequency are shown.

Remote command:
`CALCulate<n>:SGRam:THReedim:LIMits` on page 96
`CALCulate<n>:SPECtrogram:THReedim:LIMits` on page 96

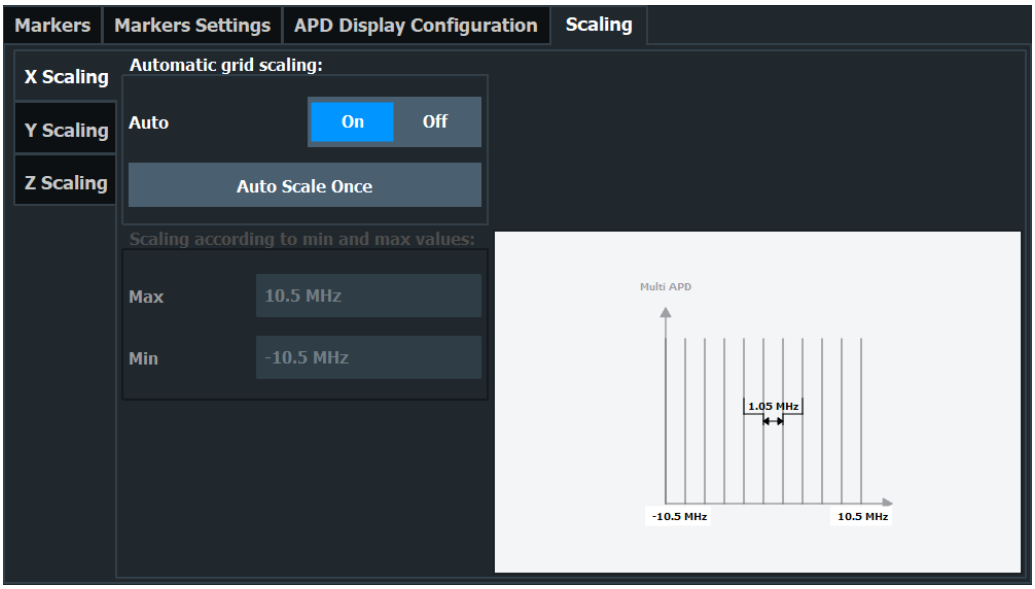
Multi APD Color Mapping
Opens the dialog for color scheme settings. The dialog is similar to the "Color Mapping Spectrogram" dialog in the R&S ESW-B1 spectrum application. Refer to the R&S ESW-B1 user manual for further information.

6.4 Scaling

Access

- "Marker Config" > "Scaling"

The R&S ESW Multi CISPR APD application offers a configurable scaling functionality. The functionality is provided for X-axis (Frequency), Y-axis (Power) and Z-axis (Probability) in the Multi APD result display as well as for X-axis (Power) and Y-axis (Probability) in the CISPR APD at Tuned Frequency result display. The respective axis can be selected through a tab on the left side of the "Scaling" dialog. The configuration is similar for all three coordinate axes.



Automatic grid scaling

If "Automatic grid scaling" is activated, the R&S ESW automatically determines the optimal range and reference level position to be displayed for the current measurement settings.

The "Auto Scale Once" function scales the display only once; it is not adapted further if the measurement settings are changed again.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:AUTO` on page 97

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 97

`DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:AUTO` on page 98

Scaling according to min and max values

If Automatic grid scaling is deactivated, scaling parameters consisting of minimum and maximum values can be defined for each axis.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:MINimum` on page 98

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:MAXimum` on page 99

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum` on page 99

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum on page 99
DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:MINimum on page 100
DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:MAXimum on page 100

6.5 Test reports

The R&S ESW provides specific test report templates for Multi APD and CISPR APD measurements.

For more information on how to create test reports and how to work with templates, refer to the R&S ESW user manual.

7 How to run a Multi CISPR APD measurement

This chapter gives an example on how to run a Multi CISPR APD Measurement in a remote environment.

```
//------Preparing the instrument and setting up scan table ----------
*RST
// Configure the scan table according to your needs
// (For scan table configuration, see R&S ESW user manual)
// Start scan
// Marker to peak
CALCulate:MARKer:MAXimum:PEAK
// Tune to marker
CALCulate:MARKer:FUNCtion:CENTer

// ------ Multi CISPR APD settings for standard CISPR 11 Ed.6.2. ------
// Switch to Multi CISPR APD
INSTrument:SELect MAPD
// Switch to run single
INITiate:CONTinuous Off
// Load standard settings for CISPR 11 Ed.6.2.
SENSe:MAPD:STANdard:LOAD "CISPR_11_Ed.6.2.xml"
// Start a measurement
INITiate:IMMediate
// Query the results
FETCh:SUMMary:ALL?
// Add the results to a report
HCOPy:MODE REPort
HCOPy:TREPort:APPend

// ------- Optional: Multi CISPR APD Settings without CISPR standard ------
// Change the analysis bandwidth
SENSe:BANDwidth:RESolution 167e3
// Change number of channels
SENSe:MAPD:NCHannels 67
// Change the sweep time
SENSe:SWEep:TIME 10s
// Populate the channels to the evaluation table
SENSe:MAPD:CHAN:POPulate
// Start a measurement to execute the changes
INITiate:IMMediate

// In evaluation table, clear the list
SENSe:MAPD:CHANnel1:CLEar
// In evaluation table, add a channel left to the middle channel
SENSe:MAPD:CHANnel1:INSert BEFore
// In evaluation table, add a channel right to the middle channel
```

```
SENSe:MAPD:CHANnel2:INSert AFTer
// Change the P limit for channel 3
SENSe:MAPD:CHANnel3:PLIMit 40
// Change the E limit for channel 1
SENSe:MAPD:CHANnel1:ELIMit 1e-5
// Start a measurement to execute the changes
INITiate:IMMediate
// Query the results for all
FETCh:SUMMary:ALL?
// Query the result for the delta to P limit for all channels
FETCh:SUMMary:DPLimit:ALL?
// Query the result for the delta to E limit for all channels
FETCh:SUMMary:DELimit:ALL?
// Query the result of the peak measurment for channel 2
FETCh:SUMMary2:PEAK?
```

8 Remote commands for Multi CISPR APD measurements

The following commands are specific to performing measurements in the Multi CISPR APD application in a remote environment. The R&S ESW must already be set up for remote operation in a network as described in the base unit manual.

8.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S ESW.

Remote command examples

Note that some remote command examples mentioned in this general introduction are possibly not supported by this particular application.

8.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.

If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.

- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S ESW follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

8.1.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

8.1.3 Numeric suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

8.1.4 Optional keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

If an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

8.1.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

8.1.6 SCPI parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, they are separated by a comma.

Example:

`LAYout:ADD:WINDow Spectrum,LEFT,MTABle`

Parameters can have different forms of values.

8.1.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

With unit: `SENSe:FREQuency:CENTer 1GHZ`

Without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. for discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.
- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN

Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

8.1.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "`ON`" or the numeric value 1. The "off" state (logically untrue) is represented by "`OFF`" or the numeric value 0.

Querying Boolean parameters

When you query Boolean parameters, the system returns either the value 1 ("`ON`") or the value 0 ("`OFF`").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

8.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 8.1.2, "Long and short form", on page 48.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

8.1.6.4 Character strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELete 'Spectrum'`

8.1.6.5 Block data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until

all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8.2 Common suffixes

In the Multi CISPR APD application, the following common suffixes are used in remote commands:

Table 8-1: Common suffixes used in remote commands in the Multi CISPR APD application

Suffix	Value range	Description
<m>	1..16	Marker
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line
<i>	1..3	Selects one of the analog output channels (1, 2 or Phones).
<k>	1..8 (Limit line) 1 | 2 (Display line)	Selects a limit or display line.
<peak>	1..3000	Selects a peak.
<sr>	1..10	Selects a scan range.

Selecting windows in multiple channels

Note that the suffix <n> always refers to a window in the currently selected channel.

8.3 Application selection

INSTrument:CREate:DUPLicate

Duplicates the currently selected channel, i.e creates a new channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

Example:
```
INST:SEL 'Receiver'
INST:CRE:DUPL
```
Duplicates the channel named 'Receiver' and creates a new channel named 'Receiver 2'.

Usage: Event

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

Adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 54.

<ChannelName> String containing the name of the channel.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

Example:
```
INST:CRE SAN, 'Spectrum 2'
```
Adds a spectrum display named "Spectrum 2".

INSTrument:CREate:REPLace <ChannelName1>, <ChannelType>, <ChannelName2>

Replaces a channel with another one.

Setting parameters:

<ChannelName1> String containing the name of the channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 54.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 54).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:CRE:REPL 'Receiver',REC,'REC2'`
Replaces the channel named "Receiver" by a new channel of type "Receiver" named "REC2".

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

If you delete the last channel, the default "Receiver" channel is activated.

Setting parameters:

<ChannelName> String containing the name of the channel you want to delete. A channel must exist to delete it.

Example: `INST:DEL 'Receiver'`
Deletes the channel with the name 'Receiver'.

Usage: Setting only

INSTrument:LIST?

Queries all active channels. The query is useful to obtain the names of the existing channels, which are required to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 2 channels:
`'REC','Receiver','REC','Receiver 2'`

Usage: Query only

Table 8-2: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Receiver	RECeiver	Receiver
CISPR APD	n/a	CISPR APD
Real-Time Spectrogram	RTSG	Real-Time Spectrogram
Multi CISPR APD	MAPD	Multi CISPR APD
Spectrum	SANalyzer	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> Parameter	Default Channel Name*)
Real-Time Spectrum	RTIM	Real-Time Spectrum
Analog Modulation Analysis	ADEMod	Analog Demod
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'Receiver','REC'`
Renames the channel with the name 'Receiver' to 'REC'.

Usage: Setting only

INSTrument[:SELect] <ChannelType> | <ChannelName>

Activates a new channel with the defined channel type, or selects an existing channel with the specified name.

Also see

- `INSTrument:CREate[:NEW]` on page 53

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 54.

<ChannelName> String containing the name of the channel.

Example: `INST IQ`
Activates a channel for the I/Q Analyzer application (evaluation mode).
`INST 'MyIQSpectrum'`
Selects the channel named 'MyIQSpectrum' (for example before executing further commands for that channel).

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default <instrument> settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST:SEL 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 18

8.4 Result display configuration

8.4.1 General window commands

Note that the suffix <n> always refers to the window in the **currently selected measurement channel**.

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

Maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 60).

Suffix:
<n> Window

Parameters:
<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

8.4.2 Screen layout

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window in the **currently selected measurement channel**.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation: See "CISPR APD at Tuned Frequency" on page 13
See "Fast Access" on page 13
See "Marker Table" on page 13
See "Multi APD" on page 13
See "Notes" on page 14
See "Result Summary" on page 14

Table 8-3: <WindowType> parameter values for Multi CISPR APD application

Parameter value	Window type
CAPD	CISPR APD at Tuned Frequency
FACC	"Fast Access"
MTAB	"Marker Table"
MAPD	Multi APD
NOT	Notes
RSUM	"Result Summary"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:
<WindowName> String containing the name of a window.

Return values:
<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:
<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 57 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command does not work, but does not return an error.

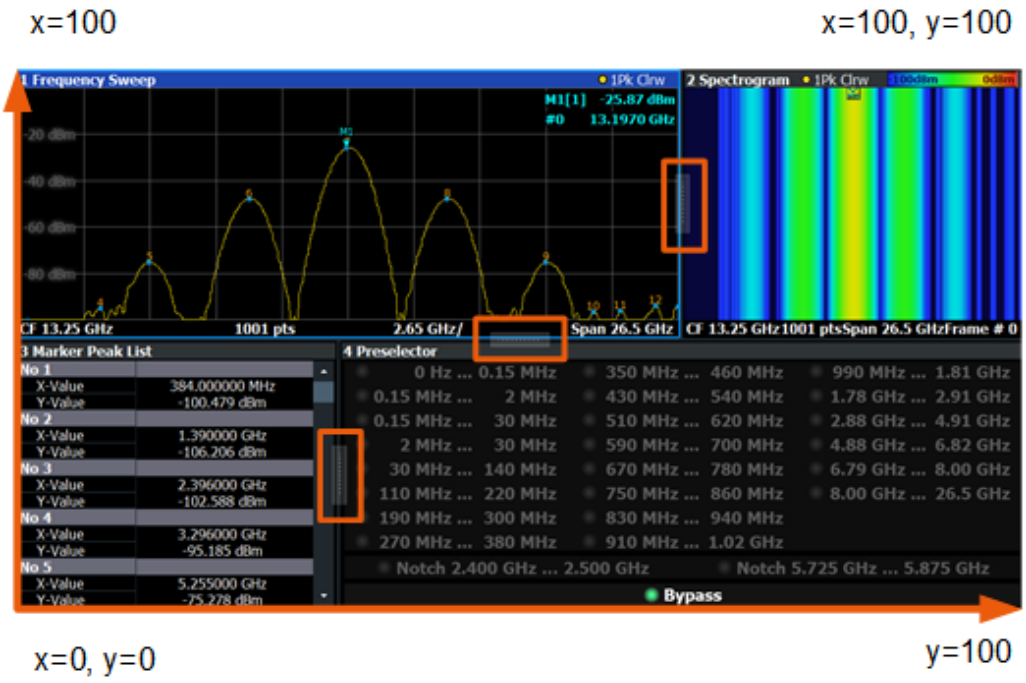


Figure 8-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 8-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Table"') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 57.

Note that this command is not available in all applications and measurements.

Suffix:
<n> 1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 57 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 57 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:
<n> Window

<m> Marker

Parameters:
<Position> Numeric value that defines the marker position on the x-axis. The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:

<n>	1..n
<m>	1..n

Return values:

<Result>	Default unit: DBM

Usage: Query only

CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Position>	<numeric value> Default unit: Depends on result display

Example: //Query marker position
`CALC:MARK:Z?`

Usage: Query only

8.4.3 Result summary

FORMat[:DATA] <Format>[, <BitLength>]

Selects the data format that is used for transmission of trace data from the R&S ESW to the controlling computer.

Note that the command has no effect for data that you send to the R&S ESW. The R&S ESW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

REAL
Floating-point numbers (according to IEEE 754) in the "definite length block format".
The format setting `REAL` is used for the binary transmission of trace data.

<BitLength>

Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on `FORMat[:DATA]` on page 65.

Suffix:

<n> Window

Query parameters:

<ResultType> Selects the type of result to be returned.

TRACE1
Returns the trace data for trace 1 for Channel1 to ChannelM, TracePoint1 to TracePointN.
The data are returned in the order Channel1/TracePoint1, ... , Channel1/TracePointN, Channel2/TracePoint1, ... , Channel2/TracePointN, ... , ChannelM/TracePoint1, ... ChannelM/TracePointN.
Channels that are not active return NAN values.

Example: `TRAC? TRACE3`
Queries the data of trace 3.

Manual operation: See "Result Summary" on page 14

TRACe<n>[:DATA]:X? <TraceNumber>

Queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements.

Suffix:

<n> Window

Query parameters:

<TraceNumber> Trace number.

Return values:

<X-Values>

Example: `TRAC3:X? TRACE1`
Returns the x-values for trace 1 in window 3.

Usage: Query only

TRACe<n>[:DATA]:Y? <Trace>

This command queries the measurement results as displayed on the y-axis in result displays with three axes.

Suffix:

<n> 1..n
Window

Query parameters:

<Trace> TRACE1 | ... | TRACE6

Selects the trace to be queried.
Note that the available number of traces depends on the result display.

Example: `TRAC:DATA TRACE1`
Queries the results displayed on trace 1.

Usage: Query only

CALCulate<n>:STATistics:RESult<res>? <ResultType>

Queries the results of a measurement for a specific trace.

Suffix:

<n> Window

<res> Trace

Query parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example: `CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>[:ALL]?

Querys all Result Summary table values.

Suffix:

<n> irrelevant

Example: `FETCh:SUMMary?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:AVERage?

Querys the Result Summary Average value for the specified table row.

Suffix:

<n> Result Summary table row

Return values:

<Value> Average value

Example: `FETCh:SUMMary1:AVERage?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:AVERage:ALL?

Querys all Result Summary Average values.

Suffix:
<n> irrelevant

Return values:
<Value> Average values

Example: `FETCh:SUMMary1:AVERage:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:DELimit?

Querys the Result Summary Delta to E Limit value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> Delta to E Limit value

Example: `FETCh:SUMMary1:DELimit?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:DELimit:ALL?

Querys all Result Summary Delta to E Limit values.

Suffix:
<n> irrelevant

Return values:
<Value> Delta to E Limit values

Example: `FETCh:SUMMary1:DELimit:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:DPLimit?

Querys the Result Summary Delta to P Limit value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> Delta to P Limit value

Example: `FETCh:SUMMary1:DPLimit?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:DPLimit:ALL?

Querys all Result Summary Delta to P Limit values.

Suffix:
<n> irrelevant

Return values:
<Value> Delta to P Limit values

Example: `FETCh:SUMMary1:DPLimit:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:ELIMit?

Querys the Result Summary E Limit value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> E Limit value

Example: `FETCh:SUMMary1:ELIMit?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:ELIMit:ALL?

Querys all Result Summary E Limit values.

Suffix:
<n> irrelevant

Return values:
<Value> E Limit values

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:FREQuency?

Querys the Result Summary Frequency value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> Frequency value

Example: `FETCh:SUMMary1:FREQuency?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:FREQuency:ALL?

Querys all Result Summary Frequency values.

Suffix:
<n> Result Summary table row

Return values:
<Value> Frequency values

Example: `FETCh:SUMMary1:FREQuency:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:LIMit?

Querys the Result Summary Limit state for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Limit> PASS | MARGin | FAIL

Example: `FETCh:SUMMary1:LIMit?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:LIMit:ALL?

Querys all Result Summary Limit states.

Suffix:
<n> irrelevant

Return values:
<Limit> PASS | MARGin | FAIL

Example: `FETCh:SUMMary1:LIMit:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:PEAK?

Querys the Result Summary Peak value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> Peak value

Example: `FETCh:SUMMary1:PEAK?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:PEAK:ALL?

Querys all Result Summary Peak values.

Suffix:
<n> irrelevant

Return values:
<Value> Peak values

Example: `FETCh:SUMMary1:PEAK:ALL?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:PLIMit?

Querys the Result Summary P Limit value for the specified table row.

Suffix:
<n> Result Summary table row

Return values:
<Value> P Limit value

Example: `FETCh:SUMMary1:PLIMit?`

Usage: Query only

Manual operation: See "Result Summary" on page 14

FETCh:SUMMary<n>:PLIMit:ALL?

Querys all Result Summary P Limit values.

Suffix:
<n> irrelevant

Return values:
<Value> P Limit values

Usage: Query only

Manual operation: See "Result Summary" on page 14

8.5 Configuration

8.5.1 Input configuration

8.5.1.1 RF input

INPut:COUPling <CouplingType>

Selects the coupling type of the RF input.

Parameters:
<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 19

INPut:IMPedance <Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 20

INPut:TYPE <Input>

The command selects the input path.

Parameters:

<Input> **INPUT1**
Selects RF input 1.

INPUT2
Selects RF input 2.

*RST: INPUT1

Example: //Select input path
`INP:TYPE INPUT1`

Manual operation: See "Input Selection" on page 19

INPut:ATTenuation:LIMiter[:STATe] <State>

This command turns the pulse limiter on and off.

The pulse limiter is an additional protection mechanism for the second RF input that attenuates high level pulses.

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on pulse limiter
`INP:ATT:LIM ON`

Manual operation: See "Pulse Limiter" on page 20

INPut:CONNector <ConnType>

Determines which connector the input for the measurement is taken from.

Parameters:

<ConnType> **RF**
RF input connector
*RST: RF

Example: `INP:CONN RF`
Selects input from the RF input connector.

Manual operation: See "Input Connector" on page 20

8.5.1.2 External mixer

The remote commands to configure external mixers are the same as in the Spectrum application.

For a comprehensive list of commands, refer to the user manual of the R&S ESW Spectrum application.

8.5.1.3 Preselector configuration

The remote commands to configure the preselector are the same as in the Receiver application.

For a comprehensive list of commands, refer to the user manual of the R&S ESW.

8.5.1.4 LISN configuration

The remote commands to configure LISNs are the same as in the Receiver application.

For a comprehensive list of commands, refer to the user manual of the R&S ESW.

8.5.2 Output configuration

8.5.2.1 Signal output

OUTPut<ou>:LINK <Scope>

This command selects the scope of the output settings.

Suffix:
<ou> irrelevant

Parameters:
<Scope> **ON | 1**
Output settings apply to the current measurement channel.
OFF | 0
Output settings apply to all measurement channels.

Example: //Apply output configuration to all measurement channels
`OUTP:LINK OFF`

Manual operation: See "Output Coupling" on page 21

SYSTem:SPEaker:MAXVolume <Volume>

This command defines the maximum volume level for audio output (for example over headphones).

Parameters:
<Volume> Numeric value between 0 and 1, with 1 being the loudest.

Example: //Define a maximum volume of 60 %
`SYST:SPE:MAXV 0.6`

Manual operation: See "Controlling the volume" on page 21

SYSTem:SPEaker:MUTE

This command turns off audio output.

To turn the volume back on again, use `SYSTem:SPEaker:VOLume`.

Example: //Turn off audio output
`SYST:SPE:MUTE`
//Turn audio output back on
`SYST:SPE:VOL 25`

Usage: Event

Manual operation: See "Controlling the volume" on page 21

SYSTem:SPEaker:VOLume <Volume>

This command defines the volume with which audio signals are output.

Parameters:
<Volume> Numeric value between 0 and 1, with 1 being the loudest.
Note that if you have defined a maximum volume level with `SYSTem:SPEaker:MAXVolume`, the value range is limited by the maximum volume.

Example: //Define a volume of 25 %.
`SYST:SPE:VOL 0.25`

Manual operation: See "Controlling the volume" on page 21

8.5.2.2 Other outputs

OUTPut<ou>:PROBe<pb>[:POWer] <State>

This command selects the probe connector that is supplied with power.

Suffix:
<ou> irrelevant

<pb> Selects the probe power connector.

Parameters:
<State> ON | OFF | 1 | 0

Example: //Supply 5-pin probe connector with power
`OUTP:PROB2 ON`

Manual operation: See "Probe Power Supply" on page 22

8.5.3 Amplitude configuration

Commands to configure the amplitude described elsewhere.

- `INPut:COUPling` on page 72
- `INPut:IMPedance` on page 73

CALCulate<n>:UNIT:POWer <Unit>

Selects the power unit.

The unit applies to all power-based measurement windows with absolute values.

In addition, the unit of the reference level is adapted to the same unit.

Suffix:
<n> irrelevant

Parameters:
<Unit> *RST: dBm

Example: `CALC:UNIT:POW DBM`
Sets the power unit to dBm.

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:
<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:
<ReferenceLevel> The unit is variable.

Range: see specifications document
*RST: 0 dBm
Default unit: DBM

Example: `DISP:TRAC:Y:RLEV -60dBm`

Manual operation: See "Reference Level" on page 24

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

Defines a reference level offset (for all traces in all windows).

Suffix:
<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:
<Offset> Range: -200 dB to 200 dB
*RST: 0dB
Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Shifting the Display (Offset)" on page 24

INPut:ATTenuation:AUTO <State>

This command turns automatic determination of the attenuation level on and off.

When you turn it on, the R&S ESW selects an attenuation that results in a good signal-to-noise ratio without overloading the RF input.

Parameters:

<State> ON | OFF

ON
Selects automatic attenuation mode.

OFF
Selects manual attenuation mode.

*RST: ON

Example: //Turn on auto ranging
`INP:ATT:AUTO ON`

Manual operation: See "Attenuation" on page 24

INPut:ATTenuation:PROTection[:STATe] <State>

This command turns the availability of attenuation levels of 10 dB or less on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: 1

Example: //Turn on input protection
`INP:ATT:PROT ON`

Manual operation: See "10 dB Minimum Attenuation" on page 25

INPut:ATTenuation[:VALue] <Attenuation>

This command defines the attenuation at the RF input.

To protect the input mixer, attenuation levels of 10 dB or less are possible only if you have turned off the input protection with `INPut:ATTenuation:PROTection[:STATe]` on page 78.

Example: //Define attenuation
`INP:ATT 40dB`

Manual operation: See "Attenuation" on page 24

INPut:GAIN:AUTO <State>

This command includes and excludes the preamplifier from the auto ranging feature.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Consider preamplifier for auto ranging
`INP:GAIN:AUTO ON`

INPut:GAIN:LNA:AUTO <State>

This command includes and excludes the optional low noise amplifier from the auto ranging feature.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Allow to turn the amplifier on and off manually

```
INP:GAIN:LNA:STAT ON
INP:GAIN:LNA:AUTO OFF
```

INPut:GAIN:LNA:STATe <State>

This command turns the optional low noise amplifier on and off.

Note that it is not possible to use the low noise amplifier and the preamplifier at the same time.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on low noise preamplifier

```
INP:GAIN:LNA:STAT ON
```

Manual operation: See "Preamplifier" on page 25

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on preamplifier

```
INP:GAIN:STAT ON
```

Manual operation: See "Preamplifier" on page 25

8.5.4 Frequency configuration

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Parameters:

<Frequency> For the allowed range and f_{max}, refer to the specifications document.

*RST: fmax/2
Default unit: Hz

Example:

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency" on page 29

[SENSe:]FREQuency:CENTer:STEP <StepSize>

Defines the center frequency step size.

Parameters:

<StepSize> For f_{max}, refer to the specifications document.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:

//Set the center frequency to 110 MHz.

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Manual operation: See "Center Frequency Stepsize" on page 30

[SENSe:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

Parameters:

<Offset> Range: -1 THz to 1 THz
*RST: 0 Hz
Default unit: HZ

Example:

```
FREQ:OFFS 1GHZ
```

Manual operation: See "Frequency Offset" on page 30

[SENSe:]FREQuency:TUNed <TunedFrequency>

Sets/queries the tuned frequency in Hz.

Parameters:

<TunedFrequency> Default unit: Hz

Example: `SENS:FREQ:TUNed 1 GHz`

Manual operation: See "Tuned Frequency" on page 30

8.5.5 Trigger configuration

TRIGger<tp>[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure that this situation is avoided in your remote control programs.

Suffix:
<tp> irrelevant

Parameters:
<Source> See table below.

*RST: IMMediate

Example: //Select external trigger input as source of the trigger signal
`TRIG:SOUR EXT`

Manual operation: See "Trigger Source" on page 31
See "Free Run" on page 31
See "Ext. Trigger 1/2" on page 31

TRIGger<tp>[:SEQuence]:LEVel[:EXTernal] <Level>

Defines the level the external signal must exceed to cause a trigger event.

Note that the variable [Input/Output] connectors must be set for use as input using the `OUTPut:TRIGger<tp>:DIRection` command.

Suffix:
<tp> irrelevant

Parameters:
<Level> Default unit: V

Example: //Define a trigger level of 2 V for an external trigger source
`TRIG:SOUR EXT`
`TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 32

TRIGger<tp>[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the measurement (data capturing).

A negative offset is possible for time domain measurements.

For the trigger sources "External" or "IF Power", a common input signal is used for both trigger and gate. Therefore, changes to the gate delay affect the trigger offset as well.

Suffix:
<tp> irrelevant

Parameters:
<Offset> Range for measurements in the frequency domain:
0 s to 30 s
Range for measurements in the time domain:
negative sweep time to 30 s

*RST: 0 s
Default unit: s

Example: //Define a trigger offset
`TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 32

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:
<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Drop-Out Time" on page 32

TRIGger<tp>[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Suffix:
<tp> irrelevant

Parameters:
<Type> **POSitive**
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: //Select trigger slope
`TRIG:SLOP NEG`

Manual operation: See "Slope" on page 32

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:
<Period>
Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 32

OUTPut:TRIGger<tp>:DIRection <Direction>

Selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:
<tp>
Selects the used trigger port.
2 = trigger port 2 (front)
3 = trigger port 3 (rear panel)

Parameters:
<Direction>
INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 33

8.5.6 Measurement settings

Useful commands to configure measurements described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 79

[SENSe:]MAPD[:STANdard]:LOAD <FileName>

Loads a measurement configuration. Standard definitions are stored in an xml file. The default directory for Multi CISPR APD standards is `<SYSTEM_ROOT>\predefined\MultiApd\`.

If you have stored the file in a subdirectory of the directory mentioned above, you have to include the relative path to the file.

Parameters:
<FileName> String containing the file name

Example: `MAPD:LOAD "CISPR_Ed.6.2.xml"`

Manual operation: See "Predefined Settings" on page 34

[SENSe:]MAPD[:STANdard]:SAVE <FileName>

Saves the current configuration to a standard file. Standard definitions are stored in an xml file. The default directory for Multi CISPR APD standards is `<USER_ROOT>\predefined\MultiApd\`.

If you have stored the file in a subdirectory of the directory mentioned above, you have to include the relative path to the file.

Parameters:
<FileName> String containing the file name

Example: `MAPD:SAVe "MyFile.xml"`

Manual operation: See "Predefined Settings" on page 34

[SENSe:]MAPD:NCHannels <Value>

Sets or queries the number of channels that are analyzed.

Parameters:
<Value> Number of channels

Example: `SENS:MAPD:NCH 21`

Manual operation: See "Measurement Settings" on page 35

[SENSe:]FREQuency:SPAN <Span>

Defines the frequency span.

Parameters:
<Span> Default unit: Hz

Example: `FREQ:SPAN 20MHZ`
Defines a span of 20 MHz.

Manual operation: See "Measurement Settings" on page 35

[SENSe:]BANDwidth[:RESolution] <Bandwidth>

Defines the resolution bandwidth and decouples the resolution bandwidth from the span.

Example: //Select resolution bandwidth
```
BAND:AUTO OFF
BAND 100KHZ
```

Manual operation: See "Measurement Settings" on page 35

[SENSe:]SWEep:TIME <Time>

Defines the measurement time. It automatically decouples the time from any other settings.

Parameters:
<Time> refer to specifications document
*RST: depends on current settings (determined automatically)
Default unit: S

Manual operation: See "Measurement Settings" on page 35

[SENSe:]MAPD:CHANnel<n>:POPulate

Populates the evaluation table using the current settings. All channels that can be calculated using the current span / analysis bandwidth settings are inserted into the evaluation table. The settings in the evaluation table are overwritten by the populate operation.

Suffix:
<n> 1..n
irrelevant

Example: `SENS:MAPD:CHAN1:POP`

Usage: Event

Manual operation: See "Measurement Settings" on page 35
See "Evaluation Table" on page 36

[SENSe:]MAPD:FADJust

Adjusts the centre frequency to be in range of CISPR band edges.

Example: `SENS:DEM:FORM:BURS ON`

Usage: Event

Manual operation: See "Measurement Settings" on page 35

8.5.7 Evaluation table

[SENSe:]MAPD:CHANnel<n>:CLEar

Clears the evaluation table. All columns except the Center column are removed. The Center column always stays in the table.

Suffix:
<n> irrelevant

Example: `SENS:MAPD:CHAN1:CLE`

Usage: Event

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:COUNt?

Queries the number of channels in the evaluation table.

Suffix:
<n> irrelevant

Example: SENS:MAPD:CHAN1:COUN?

Usage: Query only

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:DELete

Removes a channel from the evaluation table.

Suffix:
<n> 1..n
Channel

Example: `SENS:MAPD:CHAN1:DEL`

Usage: Event

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:ELIMit <Value>

Sets and queries the E Limit value in the evaluation table.

Suffix:
<n> 1..n
Channel

Parameters:
<Value> numeric value
Default unit: dBuV

Example: `SENS:MAPD:CHAN1:ELIM 69`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:EMARgin <Value>

Sets and queries the E Margin value in the evaluation table.

Suffix:
<n> 1..n
Channel

Parameters:
<Value> numeric value
Default unit: dB

Example: `SENS:MAPD:CHAN1:EMAR 1.8`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:EVALuation <Value>

This command enables the evaluation table.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

Example: `SENS:MAPD:CHAN1EVAL ON`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:INSert <Direction>

Inserts a channel into the evaluation table before or after the selected channel.

Suffix:
<n> 1..n
Channel

Setting parameters:
<Direction> BEFore | AFTer

Example: `SENS:MAPD:CHAN1:INS BEFore`

Usage: Setting only

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:LOAD <FileName>

Loads an evaluation table configuration. Evaluation tables are stored in an xml file. The default directory for evaluation lists is C:\R_S\INSTR\user\MAPD.

Suffix:
<n> 1..n
irrelevant

Parameters:
<FileName> String containing the file name.

Example: `SENS:MAPD:CHAN1:LOAD 'test.xml'`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:PLIMit <Value>

Sets and queries the P Limit value in the evaluation table.

Suffix:
<n> 1..n
Channel

Parameters:
<Value> numeric value

Example: `SENS:MAPD:CHAN1:PLIM 0.2`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:PMARgin <Value>

Sets and queries the P Margin value in the evaluation table.

Suffix:
<n> 1..n
Channel

Parameters:
<Value> numeric value

Example: `SENS:MAPD:CHAN1:PMAR 0.01`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:POPulate

Populates the evaluation table using the current settings. All channels that can be calculated using the current span / analysis bandwidth settings are inserted into the evaluation table. The settings in the evaluation table are overwritten by the populate operation.

Suffix:
<n> 1..n
irrelevant

Example: `SENS:MAPD:CHAN1:POP`

Usage: Event

Manual operation: See "Measurement Settings" on page 35
See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:RFRequency <Value>

Sets and queries the receiver frequency in the evaluation table.

Suffix:
<n> 1..n
Channel

Parameters:
<Value> numeric value
Default unit: Hz

Example: `SENS:MAPD:CHAN1:RFR 1 MHZ`

Manual operation: See "Evaluation Table" on page 36

[SENSe:]MAPD:CHANnel<n>:SAVE <FileName>

Suffix:
<n> 1..n

Parameters:
<FileName>

Manual operation: See "Evaluation Table" on page 36

8.5.8 Sweep configuration

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> 1 | 2
INITiate1 selects single or continuous bargraph measurements.
INITiate2 selects single or continuous scans.

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

Manual operation: See "Continuous Sweep / Run Cont" on page 37
See "Single Sweep / Run Single" on page 37

INITiate<mt>[:IMMediate]

The command initiates a new measurement.

For a single measurement, the R&S ESW stops measuring when it has reached the end frequency. When you start a continuous measurement, it stops only if you abort it deliberately.

If you are using trace modes MAXHold, MINHold and AVERage, previous results are reset when you restart the measurement.

- **Single measurements**
  Synchronization to the end of the measurement is possible with `*OPC`, `*OPC?` or `*WAI`.
- **Continuous measurements**

Synchronization to the end of the measurement is not possible.
It is thus recommended to use a single measurement for remote controlled measurements, because results like trace data or markers are only valid after synchronization.

Suffix:
<mt> INITiate1 initiates a bargraph measurement.
INITiate2 initiates a scan.

Example: //Start a single scan (with a scan count = 20), and wait until the measurement is done

```
INIT2:CONT OFF
SWE:COUN 20
INIT2;*WAI
```

Usage: Event

Manual operation: See "Continuous Sweep / Run Cont" on page 37
See "Single Sweep / Run Single" on page 37

8.5.9 User port configuration (AUX port)

INPut:UPORt:STATe <State>

Toggles the control lines of the user ports for the **AUX PORT** connector. This SUB-D male connector is located on the rear panel of the R&S ESW.

See the R&S ESW Getting Started manual for details.

Parameters:
<State> **ON | 1**
User port is switched to INPut

OFF | 0
User port is switched to OUTPut

*RST: 1

Manual operation: See "User port configuration" on page 38

INPut:UPORt[:VALue]

Queries the control lines of the user ports.

For details see `OUTPut:UPORt[:VALue]` on page 92.

Return values:

<Level> bit values in hexadecimal format

TTL type voltage levels (max. 5V)

Range: #B00000000 to #B00111111

Example: `INP:UPOR?`
`//Result: #B00100100`
Pins 5 and 7 are active.

Manual operation: See "User port configuration" on page 38

OUTPut:UPORt[:VALue] <Value>

Sets the control lines of the user ports.

The assignment of the pin numbers to the bits is as follows:

Bit	7	6	5	4	3	2	1	0
Pin	N/A	N/A	5	3	4	7	6	2

Bits 7 and 6 are not assigned to pins and must always be 0.

The user port is written to with the given binary pattern.

If the user port is programmed to input instead of output (see `INPut:UPORt:STATe` on page 91), the output value is temporarily stored.

Parameters:

<Value> bit values in hexadecimal format

TTL type voltage levels (max. 5V)

Range: #B00000000 to #B00111111

Example: `OUTP:UPOR #B00100100`
Sets pins 5 and 7 to 5 V.

Manual operation: See "User port configuration" on page 38

OUTPut:UPORt:STATe <State>

Toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S ESW.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
User port is switched to INPut

ON | 1
User port is switched to OUTPut

Example: `OUTP:UPOR:STAT ON`

Manual operation: See "User port configuration" on page 38

8.6 Analysis

The functionality to analyze measurement results is the same as that of the Spectrum application.

For a comprehensive list and description of remote commands, refer to the corresponding topics in the user manual of the R&S ESW.

8.6.1 Trace export

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 94).

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See "Export all Traces and all Table Results" on page 41

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Include Instrument & Measurement Settings" on page 41

FORMat:DEXPort:GRAPh <State>

If enabled, all traces for the currently selected graphical result display are included in the export file.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Export All Traces for Selected Graph" on page 41

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 41

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

Secure User Mode

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S ESW base unit user manual.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

8.6.2 APD display configuration

CALCulate<n>:MARKer<m>:Y:PERCent <Probability>

Sets a marker to a particular probability value. You can query the corresponding level with `CALCulate<n>:MARKer<m>:X`.

Using the command turns delta markers into normal markers.

Suffix:

<n> Window

<m> Marker

Parameters:

<Probability> Range: 0 % to 100 %
Default unit: %

Example: `CALC1:MARK:Y:PERC 95PCT`
Positions marker 1 to a probability of 95 %.

Manual operation: See "Percent Marker" on page 41

CALCulate<n>:SGRam:THReedim[:STATe] <State>

Activates or deactivates a 3-dimensional spectrogram.

Suffix:

<n> Window

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:SGRA:THRE:STAT ON`

Manual operation: See "Multi APD Display" on page 42

CALCulate<n>:SPECtrogram:THReedim[:STATe] <State>

Activates or deactivates a 3-dimensional spectrogram for the selected result display.

Suffix:
<n> Window

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:SPEC:THR:STAT ON`

Manual operation: See "Multi APD Display" on page 42

CALCulate<n>:SGRam:THReedim:LIMits <Limits>
CALCulate<n>:SGRam:THReedim:LIMits? <Limits>

Sets and queries the 3D Multi APD limit visibility.

Suffix:
<n> 1..n

Parameters for setting and query:
<Limits> NONE | TUNed | ALL

Example: `CALC1:SGR:THR:LIM`

Manual operation: See "Show 3D Limits" on page 42

CALCulate<n>:SPECtrogram:THReedim:LIMits <Limits>
CALCulate<n>:SPECtrogram:THReedim:LIMits? <Limits>

Sets and queries the 3D Multi APD limit visibility.

Suffix:
<n> 1..n

Parameters for setting and query:
<Limits> NONE | TUNed | ALL

Example: `CALC1:SPEC:THR:LIM`

Manual operation: See "Show 3D Limits" on page 42

8.6.3 Scaling

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:AUTO <State>

This command turns automatic scaling of the x-axis in graphical result displays on and off.

Suffix:

<n> Window

<w> irrelevant

<t> irrelevant

Parameters:

<State>

OFF | 0
Selects manual scaling of the diagram.

ON | 1
Automatically scales the diagram when new results are available.

ONCE
Automatically scales the diagram once whenever required.

*RST: ON

Example: //Scale the axis each time new results are available
`DISP:TRAC:X:AUTO ON`

Manual operation: See "Automatic grid scaling" on page 43

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

Automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Setting parameters:

<ONCE>

ALL
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`

Usage: Setting only

Manual operation: See "Automatic grid scaling" on page 43

DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:AUTO <State>

This command turns automatic scaling of the x-axis in graphical result displays on and off.

Suffix:
<n> Window

<t> irrelevant

Parameters:
<State>

OFF | 0
Selects manual scaling of the diagram.

ON | 1
Automatically scales the diagram when new results are available.

ONCE
Automatically scales the diagram once whenever required.

*RST: ON

Example: //Scale the axis each time new results are available
`DISP:TRAC:Z:AUTO ON`

Manual operation: See "Automatic grid scaling" on page 43

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:MINimum <Value>

This command defines the value at the bottom of the y-axis.

Suffix:
<n> Window

<w> irrelevant

<t> irrelevant

Parameters:
<Value> <numeric value>

Default unit: Depends on the result display.

Example: //Define x-axis level range
```
DISP:TRAC:X:AUTO OFF
DISP:TRAC:X:MIN -10DBM
DISP:TRAC:X:MAX -110DBM
```

Manual operation: See "Scaling according to min and max values" on page 43

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X[:SCALe]:MAXimum <Value>

This command defines the value at the top of the x-axis.

Suffix:

<n> Window

<w> irrelevant

<t> irrelevant

Parameters:

<Value> <numeric value>

Default unit: Depends on the result display.

Example: //Define x-axis level range
```
DISP:TRAC:x:AUTO OFF
DISP:TRAC:x:MIN -10DBM
DISP:TRAC:x:MAX -110DBM
```

Manual operation: See "Scaling according to min and max values" on page 43

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
```
DISP:WIND2:SUBW2:TRAC:Y:MIN -50
```

Manual operation: See "Scaling according to min and max values" on page 43

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n> Window

<w> Subwindow

<t> irrelevant

Parameters:

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Scaling according to min and max values" on page 43

DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:MINimum <Value>

This command defines the value at the bottom of the z-axis.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> <numeric value>

Default unit: Depends on the result display.

Example: //Define z-axis level range
`DISP:TRAC:z:AUTO OFF`

Manual operation: See "Scaling according to min and max values" on page 43

DISPlay[:WINDow<n>]:TRACe<t>:Z[:SCALe]:MAXimum <Value>

This command defines the value at the top of the z-axis.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> <numeric value>

Default unit: Depends on the result display.

Example: //Define z-axis level range
`DISP:TRAC:z:AUTO OFF`

Manual operation: See "Scaling according to min and max values" on page 43

List of commands

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