

R&S[®]ESW-K55E and -K55R

Real-Time Spectrogram

User Manual



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Version 02

ROHDE & SCHWARZ
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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.

The following firmware options are described:

- R&S®ESW-K55E (1351.1026.02)
- R&S®ESW-K55R (1351.1226.02)

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

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1 Preface

1.1 About this manual

This Real-Time Spectrogram 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 Real-Time Spectrogram 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 Real-Time Spectrogram Measurements**
Remote commands required to configure and perform Real-Time Spectrogram 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.
<i>Input</i>	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 real-time spectrogram application

The real-time spectrogram application provides functionality to perform real-time spectrogram measurements with the R&S ESW.

Requirements

- The R&S ESW-K55E requires an R&S ESW equipped with R&S ESW-B350 or -B1000
- The R&S ESW-K55R requires an R&S ESW equipped with R&S ESW-B350R or -B1000R

The application features real-time spectrogram measurements with two main result displays:

- Sweep
- Sweep spectrogram

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 real-time spectrogram measurements

Real-time spectrogram measurements is a separate application on the R&S ESW.

To activate real-time spectrogram 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 "Real-Time Spectrogram" 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 real-time spectrogram configuration 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.

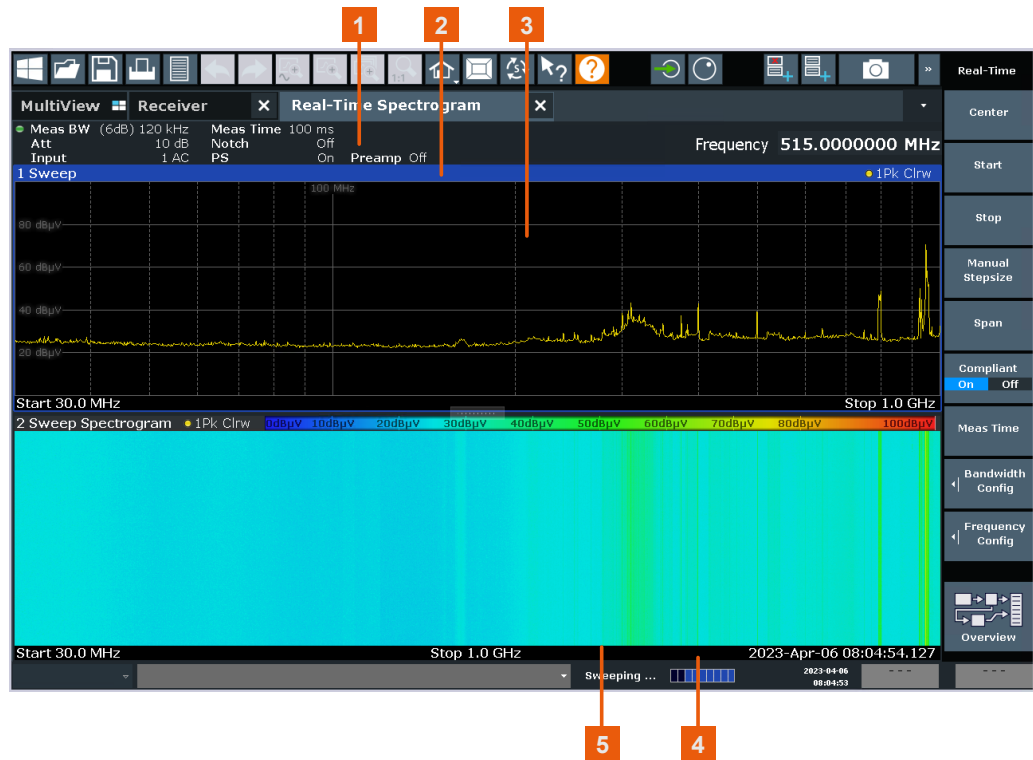
If activated, the measurements configured in the currently defined "Channel"s are performed one after the other in the order of the tabs. The currently active measurement is indicated by a  symbol in the tab label.

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 real-time spectrogram 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 = Window title bar with diagram-specific (trace) information
- 3 = Diagram area
- 4 = Instrument status bar with error messages and date/time display
- 5 = Diagram footer with diagram-specific information, depending on result display

Channel bar information

In the Real-Time Spectrogram application, the R&S ESW shows the following settings:

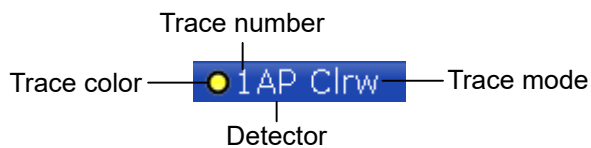
Table 2-1: Information displayed in the channel bar in the application for real-time spectrogram measurements

Meas BW	Measurement bandwidth
Att	RF attenuation applied to input
Input	Input toggle state
Meas Time	Measurement time for data acquisition
Notch	Notch filter state
PS	Preselector state
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

The data that was measured by the R&S ESW can be evaluated using various different methods. In the Real-Time Spectrogram application, multiple result displays can be used simultaneously.

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3.1 Result display

Access: "Overview" > "Display Config"

Or: [MEAS] > "Display Config"

The R&S ESW provides several result displays that show different aspects of the measured data.

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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 51)

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 51)

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 51)

Preselector

Provides an overview of the active preselector filters. For more information on preselector filters, refer to the R&S ESW user manual.

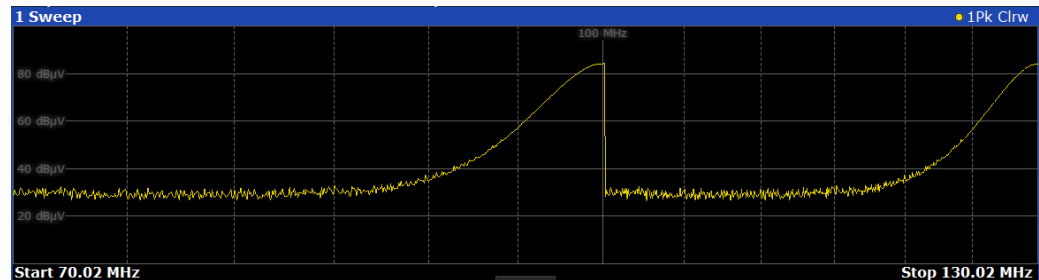
Remote command:

LAY:ADD? '1', RIGH, PRES

(See [LAYout:ADD\[:WINDow\]?](#) on page 51)

Sweep

Displays a frequency sweep of the input signal over a specified span.



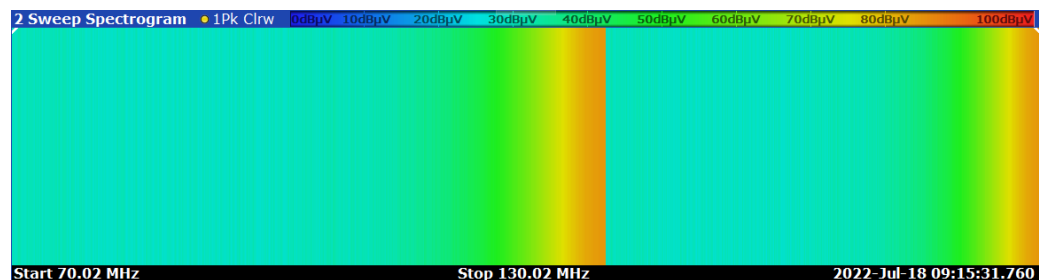
Remote command:

LAY:ADD? '1', RIGH, SCAN

(See [LAYout:ADD\[:WINDow\]?](#) on page 51)

Sweep Spectrogram

Displays a spectrogram of a frequency sweep of the input signal over a specified span.



Remote command:

LAY:ADD? '1', RIGH, SCSS

(See [LAYout:ADD\[:WINDow\]?](#) on page 51)

3.2 How to run a real-time spectrogram

The following step-by-step instructions demonstrate how to perform a basic real-time spectrogram measurement with the Real-Time Spectrogram application.

1. Press the [MODE] key on the front panel and select the "Real-Time Spectrogram" application.
2. Select the "Overview" softkey to display the "Overview" for an Real-Time Spectrogram measurement.

3. Select the "Amplitude" button to define the required level parameters.
4. Select the "Frequency" button to define the center frequency of the measurement.
5. Optionally, select the "Trigger" button to use an external trigger.
6. Select the "Bandwidth" button to configure the bandwidth parameters.
 - "RBW": Define the resolution bandwidth in Hz
 - "Sweep Time": Define how long data is captured for one line in the spectrogram
7. Select the "Analysis" button and then the "Spectrogram/Waterfall" tab to configure the spectrogram.
 - "History Depth": number of lines (frames) to be stored in the spectrogram (possibly for several consecutive measurements).
 - Optionally, deactivate the "Time Stamp" option to refer to the individual lines (frames) using an index number instead of the time they were captured.
 - Optionally, select "Color Mapping" to change the colors with which the power levels are represented in the spectrogram.
 - Select "Clear Spectrogram" to start a new spectrogram display.
8. Press the "Sweep" key and set the "Sweep Count" to define the number of measurements taken.
9. Press [RUN SINGLE] to start a measurement.
10. Scroll through the individual frames of the "Spectrogram":
 - a) Tap the "Spectrogram" window.
 - b) Press the [Sweep] key.
 - c) Select the "Select Frame" softkey and change the index number (negative numbers from 0 downwards).

The "Real-Time Spectrogram" displays the stored spectrum for the selected frame.

11. Optionally, export the trace data of the spectrogram to a file.
 - a) Select the "Analysis" button in the "Overview".
 - b) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
 - c) From the "Specifics for" list, select the spectrogram display.
 - d) Select "Export Trace to ASCII File".
 - e) Define a file name and storage location and select "OK".

4 Configuration

Access: [MODE] > "Real-Time Spectrogram"

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

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4.1 Notes about configuring real-time spectrogram measurements

In the real-time spectrogram application, the hardware uses different signal paths for certain frequency ranges. A switch to another signal path occurs on certain frequencies. The use of different signal paths prevent the R&S ESW from measuring in real-time across these frequency borders. Therefore, the frequency settings have several dependencies in the real-time spectrogram application.

Center frequency dependencies

For measurements in the vicinity of the frequency border, the R&S ESW tries to preserve the span. If you enter a center frequency that is too close to a frequency border to accommodate the span, the R&S ESW adjusts the center frequency to the next possible frequency and shows a corresponding message in the status bar.

The measurement still includes the frequency you have entered, but it is not possible to use this frequency as the center frequency with the given span. If you decrease the span, you can set a center frequency that is closer to the hardware border.

Span dependencies

Possible spans depend on the frequency range you are measuring in and the currently selected measurement bandwidth. If you change the frequency range or the bandwidth, the R&S ESW adjusts the span to the next possible value.

Note that due to the fact that the bandwidth also has an effect on the span, possible spans can be different for a certain frequency.

Example:

You are doing a measurement with a 9 kHz bandwidth, a center frequency of 75 MHz and a span of 90 MHz.

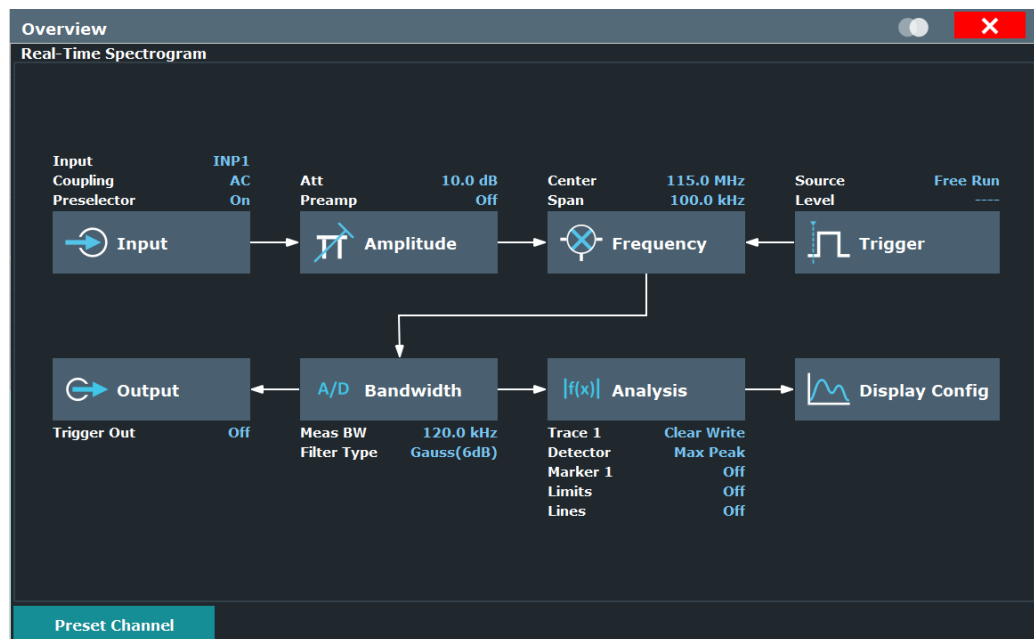
If you set the center frequency to 60 MHz, the center frequency remains the same, because a frequency border at 30 MHz in combination with 90 MHz span prevents a 60 MHz center frequency. If you decrease the span to 80 MHz, setting the center frequency of 60 MHz is possible.

If you now set the center frequency to 25 MHz, the span will be adjusted to the largest possible value in the frequency range below 30 MHz. In this case, you end up with a new span of 29.85 MHz and a new center frequency of 15.075 MHz.

4.2 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 EMI Real-Time measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

[Preset Channel](#)..... 17

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 50

4.3 General measurement settings

Access: [MEAS CONFIG]

General measurement settings are settings that define the overall measurement process.

Compliant

Turns CISPR compliant measurements on and off.

"On" Measurements compliant with CISPR 16-1-1. Preselector is on.

"Off" Measurements not compliant with CISPR 16-1-1. Preselector is off.

Remote command:

[INPut:PRESelection:COMPLiance\[:STATe\]](#) on page 59

4.4 Data input and output

Access: "Overview" > "Input"

Access: "Overview" > "Output"

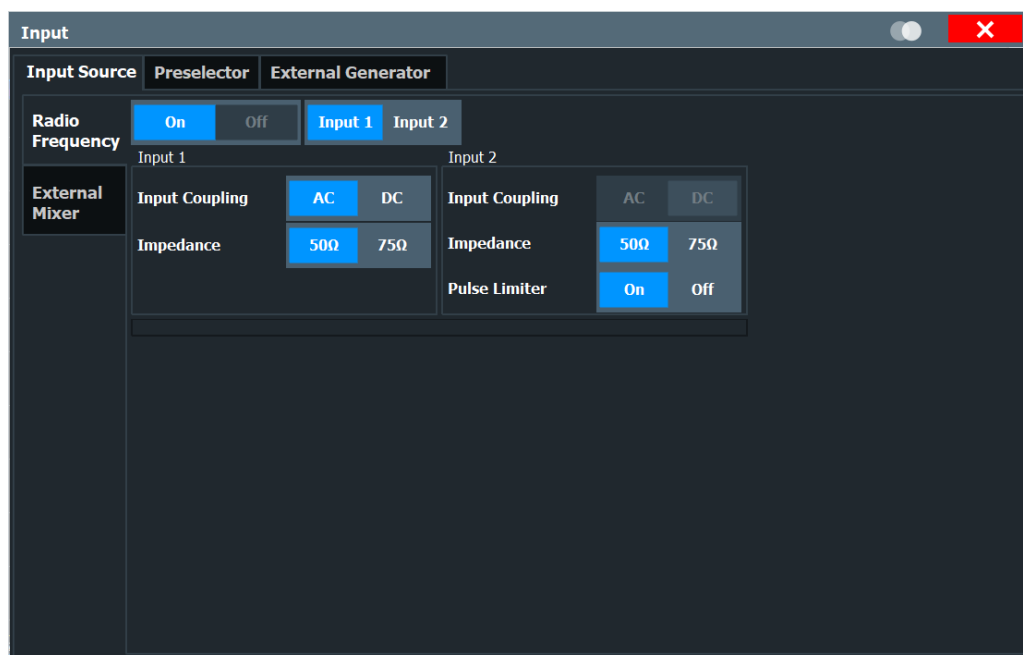
The R&S ESW can analyze signals from different input sources and provide various types of output (such as video or trigger signals).

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- [Configuring additional outputs](#).....20

4.4.1 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 6.5.1, "RF input"](#), on page 58.

Input Selection	19
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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 58

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 58

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 25 Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75 Ω /50 Ω).

This value also affects the unit conversion.

Remote command:

[INPut:IMPedance](#) on page 58

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 59

4.4.2 Configuring the preselector

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

The preselector works similar to the preselector in the receiver application and can be deactivated if needed.

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

4.4.3 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.

4.4.4 Configuring additional outputs

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

The R&S ESW provides several additional outputs. The functionality is the same as in the receiver application.

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

4.5 Frequency configuration

The frequency and span settings define the scope of the signal and spectrum that you want to analyze.

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- [Frequency settings](#).....22

4.5.1 Coping with large frequency ranges - logarithmic scaling

In a linear display, the frequencies are distributed linearly across the x-axis. That means the entire frequency range is divided by the number of measurement points, and the distance between measurement points is equal. Linear scaling is useful to determine precise frequencies within a small range.



Figure 4-1: Linear x-axis scaling: the distance between the measurement points is equal, e.g. 200 kHz

However, if high and low frequencies appear in the same display, it is difficult to determine individual frequencies precisely or to distinguish frequencies that are close together.

In a logarithmic display, lower frequencies are distributed among a much larger area of the display, while high frequencies are condensed to a smaller area. Now it is much easier to distinguish several lower frequencies, as they are spread over a wider area. Logarithmic scaling is useful for overview measurements when a large frequency range must be displayed in one diagram.

However, with logarithmic scaling, the frequency resolution between two measurement points deteriorates with higher frequencies.

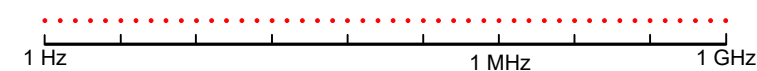
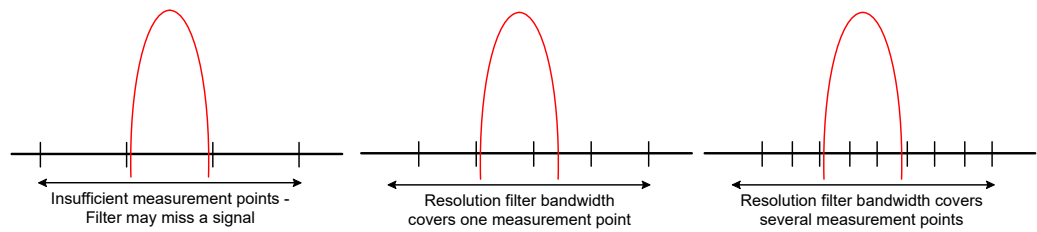


Figure 4-2: Logarithmic x-axis scaling: the distance between measurement points is variable

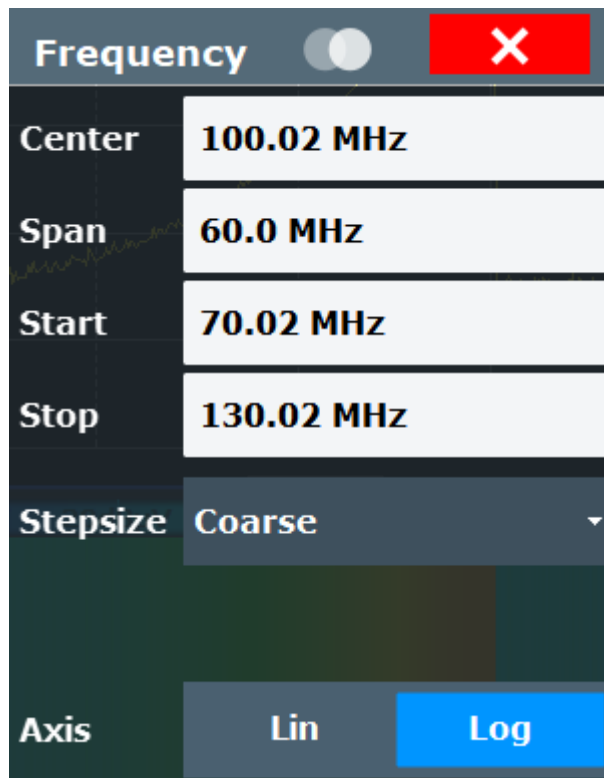
In the spectrum from 10 Hz to 100 Hz, the distance is a few Hz. Between 100 MHz and 1 GHz, the distance is several MHz.

Thus, for logarithmic x-axis scaling, the number of measurement points must be sufficiently high in order to distinguish high frequencies precisely. The resolution bandwidth should cover at least one measurement point (that means: the distance between two measurement points should not exceed the RBW). If this condition is not met, signals or interferers could be missed, especially narrowband interferers.



4.5.2 Frequency settings

Access: "Overview" > "Frequency"



The remote commands required to configure the frequency are described in [Chapter 6.5.4, "Frequency configuration"](#), on page 60.

Frequency

Defines the center frequency of the measurement.

For dependencies of the center frequency in the real-time spectrogram application, see [Chapter 4.1, "Notes about configuring real-time spectrogram measurements"](#), on page 16.

Note that turning on the low noise preamplifier limits the lower frequency to 150 kHz.

Tip: You can lock the frequency with the corresponding button in the toolbar. If you turn on the frequency lock, the frequency does not change when you turn the rotary knob. Changing the frequency with the cursor keys or the numeric keys still works.

Remote command:

[SENSe:] FREQuency: CENTer on page 60

Start / Stop Frequency

Defines the start and stop frequencies for the scan.

The range for the start frequency is f_{\min} to $(f_{\max} - 10 \text{ Hz})$.

The range for the stop frequency is $(f_{\min} + 10 \text{ Hz})$ to f_{\max} .

f_{\min} and f_{\max} are defined in the datasheet.

Remote command:

Start frequency: [SENSe:] FREQuency: START on page 62

Stop frequency: [SENSe:] FREQuency: STOP on page 62

Frequency Stepsize

Defines the stepsize by which the receiver frequency is increased or decreased when you change it with the arrow keys or the rotary knob.

Note that the rotary knob and the arrow keys apply different steps.

When you turn on "Wheel = Up / Down", the rotary knob and cursor keys have the same step size (that of the cursor keys).

"Coarse"	<p>The stepsize is coupled to the receiver frequency.</p> <ul style="list-style-type: none"> • When you change the frequency with the rotary knob, the R&S ESW increases or decreases the 4th digit of the receiver frequency. • When you change the frequency with the arrow keys, the R&S ESW increases or decreases the 2nd digit of the receiver frequency.
"Fine"	<p>The stepsize is coupled to the receiver frequency.</p> <ul style="list-style-type: none"> • When you change the frequency with the rotary knob, the R&S ESW increases or decreases the 7th digit of the receiver frequency. • When you change the frequency with the arrow keys, the R&S ESW increases or decreases the 5th digit of the receiver frequency.
"Manual"	<p>The stepsize is a fixed custom value.</p> <ul style="list-style-type: none"> • When you change the frequency with the rotary knob, the R&S ESW increases or decreases the frequency by 10 % of the manual stepsize. • When you change the frequency with the arrow keys, the R&S ESW increases or decreases the frequency by the manual stepsize.
"Frequency = Stepsize"	<p>The stepsize is equal to the current receiver frequency. This option is useful for measurements of the harmonic content of a signal. Each change of the frequency selects the next harmonic.</p>
"<x> * Meas BW"	<p>The stepsize is a percentage of the measurement bandwidth (10 %, 50 % or a custom percentage).</p>

Remote command:

[\[SENSe:\] FREQuency:CENTer:STEP](#) on page 62

Frequency Axis Scale

Selects the scale of the frequency axis.

Logarithmic scaling is only available for $f_{\text{stop}} \geq 1.4 * f_{\text{start}}$.

More information

"Linear" Selects a linear scaling of the frequency axis.

"Logarithmic" Selects a logarithmic scaling of the frequency axis.

Remote command:

[DISPlay\[:WINDow<n>\]:TRACe<t>:X:SPACing](#) on page 62

Span

Defines the measurement span.

"Full Span" sets the span to the full frequency range supported at the current center frequency.

"Force Full Span" always uses the maximum span that is possible for the current frequency configuration.

Remote command:

Span: [\[SENSe:\] FREQuency:SPAN](#) on page 61

Full span: [\[SENSe:\] FREQuency:SPAN:FULL](#) on page 61

Force full span: [\[SENSe:\] FREQuency:SPAN:FORCe](#) on page 61

CISPR Band A / CISPR Band B

The "CISPR Band A" and "CISPR Band B" features automatically adjust the center frequency and span to the corresponding CISPR bands.

- CISPR band A: Defines a center frequency of 79.5 kHz, a span of 141 kHz (frequency range from 9 kHz to 150 kHz) and a measurement bandwidth of 200 Hz.
- CISPR band B: Defines a center frequency of 15.075 MHz, a span of 29.85 MHz (frequency range from 150 kHz to 30 MHz) and a measurement bandwidth of 9 kHz.

We recommend configuring the frequency properties for real-time measurements of CISPR band A and B in this way. Changing the center frequency afterwards might change the span settings (the available span depends on the selected center frequency).

Remote command:

[\[SENSe:\] FREQuency:CISPr](#) on page 61

4.6 Amplitude and vertical axis configuration

In the real-time spectrogram application, measurement results usually consist of the measured signal levels (amplitudes) displayed on the vertical (y-)axis for the deter-

mined frequency spectrum or for the measurement time (horizontal, x-axis). The settings for the vertical axis, regarding amplitude and scaling, are described here.

- [Increasing measurement sensitivity \(or avoiding an input mixer overload\)](#).....25
- [Amplitude settings](#).....28
- [Diagram scale](#).....31

4.6.1 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.

- [Using the RF attenuator](#).....25
- [Using the preamplifier](#).....26
- [Using the preselector](#).....27

4.6.1.1 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.

4.6.1.2 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".

4.6.1.3 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.

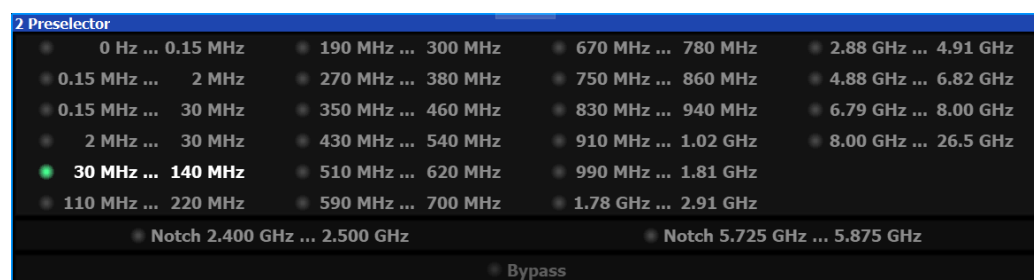


Figure 4-3: Preselector result display. The green LED indicates the currently applied filter.

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.

4.6.2 Amplitude settings

Access: "Overview" > "Amplitude" > "Amplitude"

Amplitude settings determine how the R&S ESW processes or displays the input signals.

Amplitude		Scaling	Preselector
Attenuation		10 dB	
10 dB Min	On	Off	
Auto Range		State	On Off
Mode		Normal	Low Noise
Preamplifier		Auto	Off LN Amplifier Preamp
Value		Off	LN Amplifier Preamp
Input Settings		Unit	Unit/MHz
Input	1 2	dBm	dBμV
Input Coupling	AC DC	dBpW	dBμA
Input Impedance	50Ω 75Ω	dBmV	dBpT
		dBμV/m	dBμA/m
			dBpW/MHz
			dBμA/MHz
			dBmV/MHz
			dBpT/MHz
			dBμV/mMHz
			dBμA/mMHz
			Specifics for 2: Preselector

Functions in the "Amplitude" dialog box described elsewhere:

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

The remote commands required to configure the amplitude are described in [Chapter 6.5.5, "Amplitude configuration"](#), on page 63.

Attenuation.....	29
10 dB Minimum Attenuation.....	29
Auto Range.....	29
Unit.....	30
L dBx/MHz.....	30
Preamplifier.....	31

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 65

Attenuation mode: `INPut:ATTenuation:AUTO` on page 65

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 66

Auto Range

Turns automatic configuration of the attenuation and gain on and off.

When you turn on auto ranging ("State"), the R&S ESW automatically selects an attenuation (and gain, if auto mode for the preamplifier is on) that allows for an ideal analysis of the received signal (without overloading the RF input).

Depending on your measurement task, select one of the following **auto range modes** ("Overview" > "Amplitude" > "Auto Range Mode").

- **Normal**

The "Normal" mode selects an attenuation and gain that results in a good signal-to-noise ratio.

Thus, it reduces the display of spurious products. It also leads to an increased display of the inherent noise (because of a higher attenuation).

- **Low noise**

The "Low Noise" mode selects an attenuation and gain that increases the sensitivity of the R&S ESW.

This mode gives a better impression of spurious products and is thus useful to analyze signals whose level is near the noise level. However, the signal-to-noise ratio in general can deteriorate.

Both auto range modes are designed to maintain the best dynamic range possible.

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.

Auto ranging is not available for fixed frequency scans.

Notice: For more information, see [Chapter 4.6.1, "Increasing measurement sensitivity \(or avoiding an input mixer overload\)"](#), on page 25.

Remote command:

General: `INPut:ATTenuation:AUTO` on page 65

Scan range: `[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO` on page 67

Auto range mode: `INPut:ATTenuation:AMODE` on page 66

Unit

Selects the unit displayed on the vertical axis.

The unit on the vertical axis represents the unit the results are evaluated in. You can select one of the following units: dBm, dB μ V, dBpW, dB μ A, dBmV, dBpT.

Remote command:

`CALCulate<n>:UNIT:POWer` on page 69

dBx/MHz ← Unit

Turns the display of results in units relative to a 1 MHz bandwidth on and off.

You can normalize the following units to 1 MHz.

Unit	Relative unit
dB μ V	dB μ V/MHz
dB μ V/m	dB μ V/mMHz (Available for active transducers only.)
dBmV	dBmV/MHz
dB μ A	dB μ A/MHz
dB μ A/m	dB μ A/mMHz (Available for active transducers only.)
dBpW	dBpW/MHz
dBpT	dBpT/MHz

The conversion to 1 MHz bandwidth is realized via the pulse bandwidth of the selected resolution bandwidth.

Example:

Conversion example for dBμV:

$$P[\text{dB}\mu\text{V}/\text{MHz}] = P[\text{dB}\mu\text{V}] - 20 \cdot \log\left(\frac{B_{\text{imp}}[\text{MHz}]}{1\text{MHz}}\right)$$

P = Displayed level

B_{imp} = Pulse bandwidth of the selected RBW

If you are using another unit, replace "dBμV" with the corresponding unit.

The conversion is also possible when a transducer defines the used unit.

Remote command:

[CALCulate<n>:UNIT:POWer](#) on page 69

Preamplifier

Configures the preamplifier.

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

[More information.](#)

Remote command:

Preamplifier:

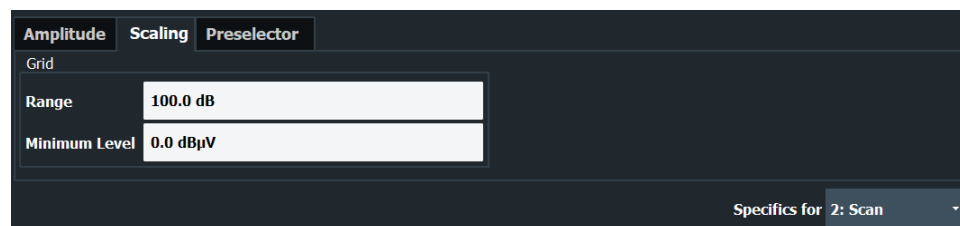
Low noise preamplifier:

State (global): [INPut:GAIN:LNA:STATE](#) on page 66

4.6.3 Diagram scale

Access: "Overview" > "Amplitude" > "Scaling"

Scaling settings configure the vertical axis of diagrams.



The remote commands required to configure the y-axis scale are described in [Chapter 6.5.6, "Y-Axis scaling"](#), on page 67.

[Grid Range / Minimum Level](#).....31

Grid Range / Minimum Level

Defines the scale of the vertical diagram axis.

The display ranges go from 10 dB to 200 dB in 0.01 dB steps. Invalid entries or combinations of range and minimum level are rounded off to the nearest valid value.

- **"Range"**
Defines the level display range for the scan diagram.
- **"Minimum Level"**
Defines the minimum level of the display range.

Remote command:

Range: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]`
on page 67

Min. level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom` on page 70

4.7 Bandwidth configuration

The bandwidth parameters define how the data is measured and which filters are used.

- [Selecting the measurement bandwidth](#)..... 32
- [Bandwidth settings](#)..... 33

4.7.1 Selecting the measurement bandwidth

The measurement bandwidth corresponds to the bandwidth of the resolution filter. The RF signal is evaluated and displayed according to the bandpass characteristics of the resolution filter.

The receiver application supports the following types of resolution filter.

- Filters with a 3 dB bandwidth
The R&S ESW provides bandwidths with a stepsize of 1-2-3-5-10-.... For details, refer to the data sheet.
- Filters with a 6 dB bandwidth
The 6 dB bandwidths are designed and required for receiver tests and measurements. The R&S ESW provides bandwidths that comply to commercial and military standards. For details, refer to the data sheet.

Note that the available bandwidth is limited by the current receiver frequency. The measurement bandwidth must be less than or equal to half of the current receiver frequency:

$$BW \leq f_{in} / 2$$

The resolution filters are implemented as digital Gaussian bandpass filters. Concerning the attenuation characteristic, the filters behave like analog filters, but their measurement speed is much higher than the measurement speed of comparable analog filters. This is because the transient response can be compensated because the filters have an accurately defined behavior.

The highest sensitivity is obtained at the smallest bandwidth. If the bandwidth is increased, the reduction in sensitivity is proportional to the change in bandwidth. Increasing the bandwidth by a factor of 3 increases the displayed noise by approx.

5 dB (4.77 dB precisely). If the bandwidth is increased by a factor of 10, the displayed noise increases by a factor of 10 (= 10 dB).

The higher spectral resolution with smaller bandwidths leads to longer measurement times at each frequency, because the measurement time has to allow the resolution filters to settle during a sweep at all signal levels and frequencies to be displayed.

For large measurement bandwidths, signal parts that are very far away (for example from a different signal) are considered in the measurement and distort the results. The displayed noise increases.

For small measurement bandwidths, the measurement time increases.



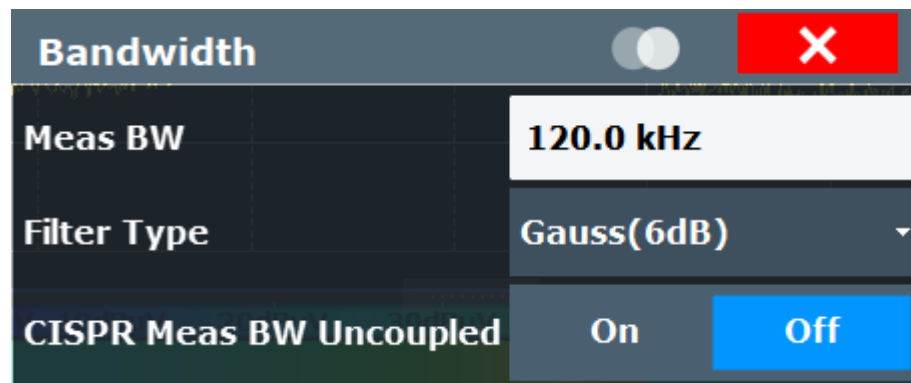
Bandwidths and detectors

If you use the Quasipeak, CISPR Average or RMS Average detector, the R&S ESW by default couples the resolution bandwidth to the receiver frequency.

If you need a different bandwidth, you can decouple the bandwidth from the frequency. When decoupled, you can select any of the supported CISPR bandwidths.

4.7.2 Bandwidth settings

Access: "Overview" > "Bandwidth"



The remote commands required to configure the bandwidth are described in [Chapter 6.5.7, "Bandwidth settings"](#), on page 70.

Measurement Bandwidth

Defines the measurement bandwidth (or resolution bandwidth) used for the measurement.

You can define a different bandwidth for the bargraph and each scan range defined in the scan table. The R&S ESW displays an exclamation mark if the selected measurement bandwidth is not compatible to the bandwidth required by CISPR for the corresponding frequency range.

If you perform a scan that is not based on a scan table, the bandwidth for the scan is the same as for the bargraph.

The final measurement uses the bandwidths defined in the scan table, or, if the scan is not based on a scan table ([Current](#) parameters), the bandwidth of the bargraph.

The R&S ESW supports a selected set of resolution bandwidths. If you enter a number that is not supported, the R&S ESW rounds the value up to next available bandwidth.

[More information](#)

Remote command:

Bargraph: `[SENSe:]BANDwidth[:RESolution][:VALue]` on page 70

Scan table: `[SENSe:]SCAN<sr>:BANDwidth:RESolution` on page 72

CISPR RBW Uncoupled

Cancels the coupling of the IF bandwidth to the frequency range with the activated quasipeak detector, CISPR average or RMS average detector.

Remote command:

`[SENSe:]BANDwidth[:RESolution]:AUTO` on page 71

Filter Type

Selects the type of resolution filter used in the measurement.

The available resolution bandwidths depend on the filter selection.

You can select from the following filter types.

- **Normal (3 dB)**
Gaussian filter with a 3 dB bandwidth.
- **Gauss (6 dB)**
Gaussian filter with a 6 dB bandwidth. 6 dB bandwidths that comply with CISPR and MIL standards are available.
- **CISPR (6 dB)**
Gaussian filter with a 6 dB bandwidth. 6 dB bandwidths that comply with CISPR standards are available.
- **MIL (6 dB)**
Gaussian filter with a 6 dB bandwidth. 6 dB bandwidths that comply with military standards are available.

6 dB bandwidths correspond approximately to the pulse bandwidth.

3 dB bandwidths correspond approximately to the noise bandwidth.

[More information](#)

Remote command:

`[SENSe:]BANDwidth[:RESolution]:TYPE` on page 71

Scan Parameter

Turns the scan table on and off.

"Scan Table" The R&S ESW performs scans based on the configuration defined in the scan table.

"Current" The R&S ESW performs scans on the general receiver configuration. The scan table becomes unavailable.

Remote command:

not supported

4.8 Sweep settings

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

The remote commands required to configure the sweep are described in [Chapter 6.5.8, "Sweep configuration"](#), on page 72.

Continuous Sweep / Run Cont	35
Single Sweep / Run Single	35
Select Frame	35
Meas Time	36
Sweep Count	36

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 73

Run measurement: [INITiate<mt>\[:IMMediate\]](#) on page 73

Single Sweep / Run Single

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 73

Run measurement: [INITiate<mt>\[:IMMediate\]](#) on page 73

Select Frame

Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

Remote command:

[CALCulate<n>:SPECTrogram:FRAMe:SElect](#) on page 72

Meas Time

Defines the measurement time used to analyze the signal.

Tip: Make sure to select a measurement time that is appropriate for the analyzed signal and that allows the various filters and detectors in the signal path to settle.

Remote command:

[SENSe:] SWEep: TIME on page 75

Sweep Count

Defines the number of sweeps to be performed in a single measurement. The displayed trace represents an average over the sweep count.

When you measure continuously, the R&S ESW calculates a moving average over the sweep count.

Note that a sweep count = 0 is not possible.

Remote command:

[SENSe:] SWEep: COUNT on page 74

4.9 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.

- [Trigger source settings](#).....36
- [Trigger input and output settings](#).....38

4.9.1 Trigger source settings

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

The remote commands required to configure the trigger are described in [Chapter 6.5.9, "Trigger configuration"](#), on page 75.

Trigger Source.....	37
L Free Run.....	37
L Ext. Trigger 1/2.....	37
Trigger Level.....	37
Trigger Offset.....	37

Drop-Out Time.....	38
Slope.....	38
Trigger Holdoff.....	38

Trigger Source

In the Real-Time Spectrogram 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 37).

Remote command:

`TRIGger<tp>[:SEquence]:SOURce` on page 75

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 75

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 75

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 76

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 76

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 76

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 77

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.

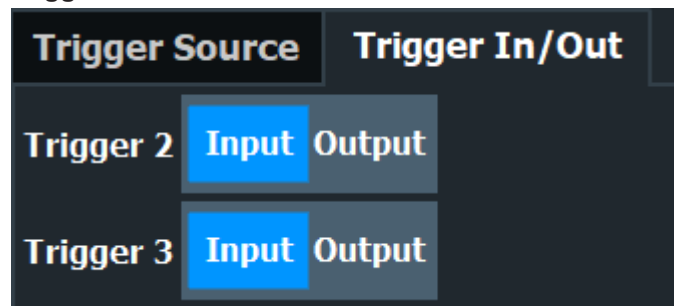
Remote command:

`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 77

4.9.2 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 77

4.10 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.

4.11 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 with them, refer to the R&S ESW user manual.

5 Analysis

Access

- "Overview" > "Analysis"

General result analysis settings concerning the trace, markers, lines etc. are similar to the analysis functions in the Spectrum application.

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

- [Trace settings](#).....40
- [Marker settings](#).....40
- [Line settings](#).....40

5.1 Trace settings

Access: "Overview" > "Analysis" > "Traces"

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

(Note that the Real-Time Spectrogram application does not support all trace functions mentioned in the Spectrum application.)

5.2 Marker settings

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

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

5.3 Line settings

Access: "Overview" > "Analysis" > "Lines"

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

(Note that the Real-Time Spectrogram application does not support all line functions mentioned in the Spectrum application.)

6 Remote commands for real-time spectrogram measurements

The following commands are specific to performing measurements in the Real-Time Spectrogram 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.

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• Common suffixes	46
• Application selection	46
• Result display configuration	50
• Configuration	58
• Analysis	78

6.1 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.

6.1.1 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.

6.1.2 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`.

6.1.3 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.

6.1.4 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.

6.1.5 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`.

6.1.6 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.

- [Numeric values](#)..... 44
- [Boolean](#)..... 45
- [Character data](#)..... 45
- [Character strings](#)..... 45
- [Block data](#)..... 45

6.1.6.1 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.

6.1.6.2 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

6.1.6.3 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 6.1.2, "Long and short form"](#), on page 42.

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

6.1.6.4 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'`

6.1.6.5 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.

6.2 Common suffixes

In the Real-Time Spectrogram application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the Real-Time Spectrogram 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.

6.3 Application selection

INSTrument:CREate:DUPLicate	47
INSTrument:CREate[:NEW]	47
INSTrument:CREate:REPLace	47
INSTrument:DELeTe	48
INSTrument:LIST?	48
INSTrument:REName	49
INSTrument[:SELeCt]	49
SYSTem:PRESet:CHANnel[:EXEC]	50

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 48.

<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 48.

<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 48).
 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 6-2: 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 47

Parameters:

<ChannelType> Channel type of the new channel.
 For a list of available channel types see [INSTrument:LIST?](#) on page 48.

<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 17

6.4 Result display configuration

- [General window commands](#)..... 50
- [Screen layout](#)..... 51

6.4.1 General window commands

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

DISPlay:FORMat	50
DISPlay[:WINDow<n>]:SIZE	50

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 54).

Suffix:	
<n>	Window
Parameters:	
<Size>	<p>LARGE Maximizes the selected window to full screen. Other windows are still active in the background.</p> <p>SMALI Reduces the size of the selected window to its original size. If more than one measurement window was displayed originally, these are visible again.</p> <p>*RST: SMALI</p>
Example:	DISP:WIND2:SIZE LARG

6.4.2 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]?	51
LAYout:CATalog[:WINDow]?	52
LAYout:IDENtify[:WINDow]?	53
LAYout:REMOve[:WINDow]	53
LAYout:REPLace[:WINDow]	53
LAYout:SPLitter	54
LAYout:WINDow<n>:ADD?	55
LAYout:WINDow<n>:IDENtify?	55
LAYout:WINDow<n>:REMOve	56
LAYout:WINDow<n>:REPLace	56
CALCulate<n>:MARKer<m>:X	57
CALCulate<n>:MARKer<m>:Y?	57
CALCulate<n>:MARKer<m>:Z?	57

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 "[Fast Access](#)" on page 13
See "[Marker Table](#)" on page 13
See "[Notes](#)" on page 13
See "[Preselector](#)" on page 14
See "[Sweep](#)" on page 14
See "[Sweep Spectrogram](#)" on page 14

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 51 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.

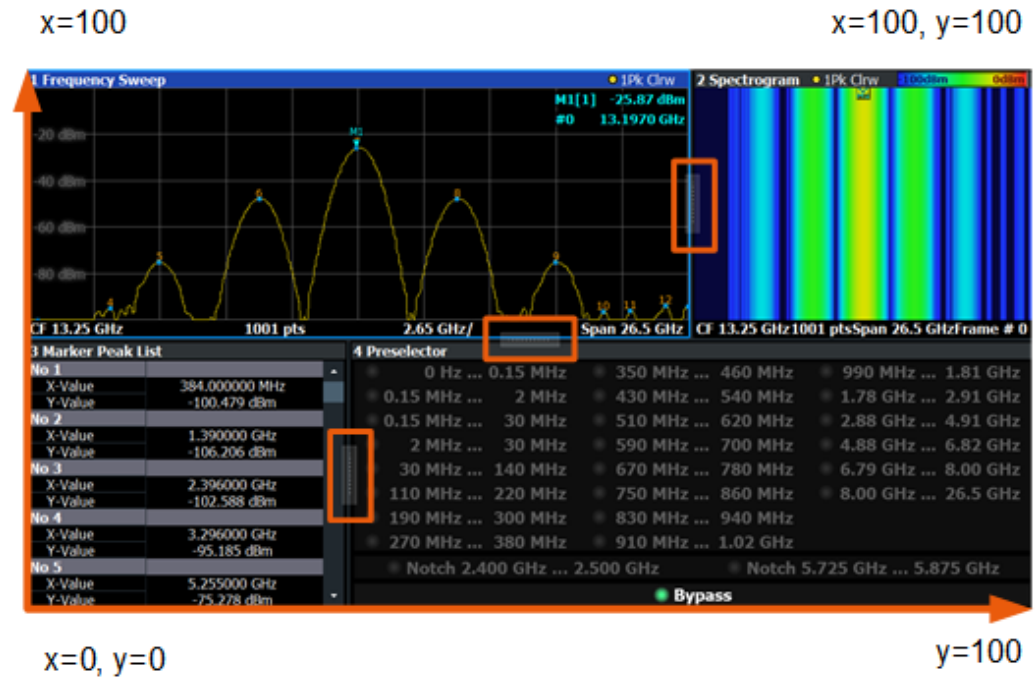


Figure 6-1: SmartGrid coordinates for remote control of the splitters

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 6-1.)
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>: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 51 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 51 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

6.5 Configuration

6.5.1 RF input

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INPut:ATTenuation:LIMiter[:STATe].....	59
INPut:PRESelection:COMPLiance[:STATe].....	59

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:PRESelection:COMPLiance[:STATe] <State>

Turns CISPR 16-1-1 compliance mode on and off.

Parameters:

<State> ON | OFF | 1 | 0

Example: //Turn on CISPR 16-1-1 compliance
INP:PRE:COMP ON

Manual operation: See ["Compliant"](#) on page 18

6.5.2 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.

6.5.3 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.

6.5.4 Frequency configuration

[SENSe:]FREQUency:CENTer.....	60
[SENSe:]FREQUency:CENTer:STEP.....	60
[SENSe:]FREQUency:CISPr.....	61
[SENSe:]FREQUency:OFFSet.....	61
[SENSe:]FREQUency:SPAN.....	61
[SENSe:]FREQUency:SPAN:FORCe.....	61
[SENSe:]FREQUency:SPAN:FULL.....	61
[SENSe:]FREQUency:STARt.....	62
[SENSe:]FREQUency:STOP.....	62
[SENSe:]FREQUency:CENTer:STEP.....	62
DISPlay[:WINDow<n>]:TRACe<t>:X:SPACing.....	62
CALCulate<n>:TFLine:STATe.....	63
CALCulate<n>:MARKer<m>:FUNCTion:CENTer.....	63

[SENSe:]FREQUency:CENTer <Frequency>

This command defines the measurement frequency for measurements in the frequency or time domain.

Parameters:

<Frequency> <numeric value>
 Numeric value in Hz.
 Range: Refer to the datasheet
 *RST: fmax / 2
 Default unit: Hz

Example: //Define receiver frequency
 FREQ:CENT 100MHz

Manual operation: See "Frequency" on page 22

[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

[SENSe:]FREQuency:CISPr <Mode>

Setting parameters:

<Mode> ABANd | BBANd

Usage: Setting only

Manual operation: See "[CISPR Band A / CISPR Band B](#)" on page 24

[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`

**[SENSe:]FREQuency:SPAN **

Defines the frequency span.

Manual operation: See "[Span](#)" on page 24

[SENSe:]FREQuency:SPAN:FORCe <State>

Turns usage of the maximum span that is possible for the current frequency configuration on and off.

Parameters:

<State> ON | OFF | 1 | 0
 *RST: ON

Example: `//Turn on maximum span
 FREQ:SPAN:FORC ON`

Manual operation: See "[Span](#)" on page 24

[SENSe:]FREQuency:SPAN:FULL

Restores the full span.

Manual operation: See "[Span](#)" on page 24

[SENSe:]FREQuency:STARt <Frequency>

This command defines the start frequency of a scan.

In the spectrum application, the command defines the start frequency of a measurement.

Parameters:

<Frequency> <numeric value>
Range: Refer to the datasheet
*RST: depends on application
Default unit: Hz

Example: //Define start frequency
 FREQ:STAR 30 kHz

Manual operation: See ["Start / Stop Frequency"](#) on page 23

[SENSe:]FREQuency:STOP <Frequency>

This command defines the stop frequency of a scan.

In the Spectrum application, the command defines the stop frequency of a measurement.

Parameters:

<Frequency> <numeric value>
Range: Refer to the datasheet
*RST: depends on application
Default unit: Hz

Example: //Define stop frequency
 FREQ:STOP 100MHz

Manual operation: See ["Start / Stop Frequency"](#) on page 23

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

This command defines the center frequency step size.

Parameters:

<StepSize> <numeric value>
 Numeric value in Hz.

Example: //Define frequency step size
 FREQ:CENT:STEP 4KHZ

Manual operation: See ["Frequency Stepsize"](#) on page 23

DISPlay[:WINDow<n>]:TRACe<t>:X:SPACing <Scale>

This command selects the scale of the x-axis.

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<Scale>

LINear

Linear scale of the frequency axis.

LOGarithmic

Logarithmic scale of the frequency axis.

*RST: LOGarithmic

Example:

```
//Select a linear scale for the x-axis
DISP:TRAC:X:SPAC LIN
```

Manual operation: See "[Frequency Axis Scale](#)" on page 24

CALCulate<n>:TFLine:STATe <State>

This command turns the frequency line representing the current receiver frequency on and off.

Suffix:

<n> irrelevant

Parameters:

<State>

ON | OFF | 1 | 0

*RST: ON

Example:

```
//Turn on the frequency line
CALC:TFL:STAT ON
```

CALCulate<n>:MARKer<m>:FUNCtion:CENTer

This command matches the receiver frequency to the frequency of a marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Example:

```
CALC:MARK2:FUNC:CENT
Sets the receiver frequency to the frequency of marker 2.
```

Usage:

Event

6.5.5 Amplitude configuration

Remote commands to configure level characteristics described elsewhere:

- [INPut:COUPling](#) on page 58

CALCulate<n>:MARKer<m>:FUNction:REFerence.....	64
CALCulate<n>:UNIT:POWER.....	64
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel.....	64
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....	65
INPut:ATTenuation[:VALue].....	65
INPut:ATTenuation:AUTO.....	65
INPut:ATTenuation:PROTection[:STATe].....	66
INPut:ATTenuation:AMODE.....	66
INPut:GAIN:LNA:STATe.....	66
INPut:GAIN:STATe.....	67
[SENSe]:JSCAN<sr>:INPut:ATTenuation:AUTO.....	67

CALCulate<n>:MARKer<m>:FUNction:REFerence

Matches the reference level to the power level of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Example:

CALC:MARK2:FUNC:REF

Sets the reference level to the level of marker 2.

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`

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`

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 66.

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

Manual operation: See "[Attenuation](#)" on page 29

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 29
See "[Auto Range](#)" on page 29

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 29

INPut:ATTenuation:AMODe <State>

This command selects the auto ranging mode.

Parameters:

<State>

LOWNoise

Selects the low noise mode.

NORMAl

Selects the normal mode.

*RST: NORMAl

Example: //Select low noise auto ranging mode
INP:ATT:AMOD LOWN

Manual operation: See "[Auto Range](#)" on page 29

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 31

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

[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO <State>

This command turns auto ranging in a scan range on and off.

Suffix:

<sr> [Scan range](#)

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn off auto ranging in the 4th scan range
SCAN4:INP:ATT:AUTO OFF

Manual operation: See "Auto Range" on page 29

6.5.6 Y-Axis scaling

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe].....	67
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE.....	68
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE.....	68
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition.....	68
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue.....	69
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing.....	69
CALCulate<n>:UNIT:POWer.....	69
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom.....	70

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

Defines the display range of the y-axis (for all traces).

Suffix:

<n> [Window](#)
<w> subwindow
Not supported by all applications

<t> irrelevant

Example: DISP:TRAC:Y 110dB

Manual operation: See "[Grid Range / Minimum Level](#)" on page 31

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

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n> [Window](#)

<t> irrelevant

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:MODE <Mode>

Selects the type of scaling of the y-axis (for all traces).

When the display update during remote control is off, this command has no immediate effect.

Suffix:

<n> [Window](#)

<w> subwindow

<t> irrelevant

Parameters:

<Mode> **ABSolute**
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example: DISP:TRAC:Y:MODE REL

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RPOSition
<Position>**

Defines the vertical position of the reference level on the display grid (for all traces).

The R&S ESW adjusts the scaling of the y-axis accordingly.

Suffix:

<n> [Window](#)

<w> subwindow
Not supported by all applications

<t> irrelevant

Example: DISP:TRAC:Y:RPOS 50PCT

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue <Value>

Defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:

<n> [Window](#)
 <w> subwindow
 <t> irrelevant

Parameters:

<Value> Default unit: DB

Example:

DISP:TRAC:Y:RVAL 0
 Sets the value assigned to the reference position to 0 Hz

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing <ScalingType>

Selects the scaling of the y-axis (for all traces, <t> is irrelevant).

Suffix:

<n> [Window](#)
 <w> subwindow
 <t> [Trace](#)

Parameters:

<ScalingType> **LOGarithmic**
 Logarithmic scaling.
LINear
 Linear scaling in %.
LDB
 Linear scaling in the specified unit.
PERCent
 Linear scaling in %.
 *RST: LOGarithmic

Example:

DISP:TRAC:Y:SPAC LIN
 Selects linear scaling in %.

CALCulate<n>:UNIT:POWER <Unit>

This command selects the unit for the y-axis.

Suffix:

<n> irrelevant

Parameters:

<Unit> DBM | V | A | W | DBPW | DBPW_MHZ | DBUV | DBUV_MHZ |
 DBMV | DBMV_MHZ | DBUA | DBUA_MHZ | DBPT |
 DBPT_MHZ | DBUV_M | DBUV_MMHZ | DBUA_M |
 DBUA_MMHZ
 *RST: dB μ V

Example:

```
//Select unit
CALC:UNIT:POW DBM
```

Manual operation:

See "[Unit](#)" on page 30
 See "[dBx/MHz](#)" on page 30

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom <Level>

This command defines the minimum level displayed on the vertical diagram axis.

Suffix:

<n> [Window](#)
 <t> irrelevant

Parameters:

<Level> Minimum displayed level. The unit and value range depend on the unit you have selected.
 *RST: 0 dB μ V

Example:

```
//Define a minimum grid level
DISP:TRAC:Y:BOT -20
```

Manual operation:

See "[Grid Range / Minimum Level](#)" on page 31

6.5.7 Bandwidth settings

[SENSe:]BANDwidth[:RESolution]	70
[SENSe:]BANDwidth[:RESolution][:VALue]	70
[SENSe:]BANDwidth[:RESolution]:TYPE	71
[SENSe:]BANDwidth[:RESolution]:AUTO	71
[SENSe:]SCAN<sr>:BANDwidth:RESolution	72

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

Example:

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

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

This command defines the measurement (or resolution) bandwidth.

The available bandwidths depend on the selected filter type.

A change of the resolution bandwidth automatically turns the coupling to the frequency off.

Parameters:

<Bandwidth> <numeric value>

Refer to the datasheet for available bandwidths.

Default unit: Hz

Example:

```
//Select measurement bandwidth
BAND 3MHZ
```

Manual operation: See "[Measurement Bandwidth](#)" on page 33

[SENSe:]BANDwidth[:RESolution]:TYPE <FilterType>

This command selects the resolution filter type.

When you change the filter type, the command selects the next larger filter bandwidth if the same bandwidth is unavailable for that filter.

Parameters:

<FilterType>

CFILter

Channel filters

Available in the spectrum application.

NORMal

Gaussian filters

P5

5-pole filters

Available for FFT sweeps in the spectrum application.

RRC

RRC filters

CISPr | PULSe

CISPR (6 dB)

Return value for query is always PULS.

MIL

MIL Std (6 dB)

*RST: NORMal

Example:

```
BAND:TYPE NORM
```

Manual operation: See "[Filter Type](#)" on page 34

[SENSe:]BANDwidth[:RESolution]:AUTO <State>

This command couples or decouples the resolution bandwidth to the selected frequency.

The resolution bandwidth is coupled to the frequency only if you have selected the Quasipeak, CISPR Average or CISPR RMS detector.

Parameters:

<State> ON | OFF | 1 | 0
 *RST: ON

Example:

```
//Decouple measurement bandwidth from frequency range
BAND:AUTO OFF
```

Manual operation: See "[CISPR RBW Uncoupled](#)" on page 34

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

This command defines the resolution bandwidth applied in the selected scan range.

Suffix:

<sr> Selects the scan range.

Parameters:

<Bandwidth> <numeric value>

If you enter a resolution bandwidth that is not supported, the R&S ESW uses the next available bandwidth instead.

Range: Refer to datasheet

Default unit: Hz

Example:

```
//Define a measurement bandwidth for the 4th scan range
SCAN4:BAND:RES 1MHz
```

Manual operation: See "[Measurement Bandwidth](#)" on page 33

6.5.8 Sweep configuration

CALCulate<n>:SPECtrogram:FRAMe:SElect	72
INITiate<n>:CONTinuous	73
INITiate<mt>[:IMMediate]	73
[SENSe:]SWEEp:COUNT	74
[SENSe:]SWEEp:TIME	75

CALCulate<n>:SPECtrogram:FRAMe:SElect <Frame> | <Time>

Selects a specific frame for further analysis.

The command is available if no measurement is running or after a single sweep has ended.

Suffix:

<n> [Window](#)

Parameters:

<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
 The range depends on the history depth.
 Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.

Example: INIT:CONT OFF
Stop the continuous sweep.
CALC:SGR:FRAM:SEL -25
Selects frame number -25.

Manual operation: See "[Select Frame](#)" on page 35

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 35
See "[Single Sweep / Run Single](#)" on page 35

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 35
 See ["Single Sweep / Run Single"](#) on page 35

[SENSe:]SWEep:COUNT <Measurements>

This command defines the number of measurements that the application uses to average traces.

For continuous measurements, the application calculates the moving average over the average count.

For single measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<Measurements> <numeric value> (integer only)
 Number of measurements considered in calculating an average
 trace.
 When you set a count of 1, the R&S ESW performs a single
 measurement over the selected scan range.
 Range: 0 to 32767
 *RST: 0

Example:

```
//Define 10 measurements in single measurement mode
SWE:COUN 10
INIT:CONT OFF
//Start sweep and wait for its end
INIT;*WAI
```

Manual operation:

See ["Sweep Count"](#) on page 36

[SENSe:]SWEep:TIME <Time>

This command defines the measurement or acquisition time for bargraph measurements.

For scans not based on a scan table, the command also defines the measurement time for the scan.

In the real-time spectrogram application, the command defines the measurement time (min. value: 5 ms).

Parameters:

<Time> <numeric value>
 Range: 5 μ s to 100 s
 *RST: 0.1
 Default unit: s

Example: //Define measurement time
 SWE:TIME 10s

Manual operation: See "Meas Time" on page 36

6.5.9 Trigger configuration

TRIGger<tp>[:SEQuence]:SOURce.....	75
TRIGger<tp>[:SEQuence]:LEVel[:EXTernal].....	76
TRIGger<tp>[:SEQuence]:HOLDoff[:TIME].....	76
TRIGger[:SEQuence]:DTIME.....	76
TRIGger<tp>[:SEQuence]:SLOPe.....	77
TRIGger[:SEQuence]:IFPower:HOLDoff.....	77
OUTPut:TRIGger<tp>:DIRectioN.....	77

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 37
 See ["Free Run"](#) on page 37
 See ["Ext. Trigger 1/2"](#) on page 37

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 37

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 37

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 38

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 38

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 38

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 38

6.6 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.

6.6.1 Export data with multimode

The following commands describe the spectrogram data export with the help of the multimode. Multimode is required to enable multiple (hidden) spectrograms for every detector to run in parallel. The spectrograms are not available on the instrument itself and not visible on the display and only used for the purpose of remote data capturing.

CALCulate<n>:SPECtrogram:MMODE	78
TRACe<n>:DATA:SPECtrogram:FINFo?	79
TRACe<n>:DATA:SPECtrogram:FDATA?	79

CALCulate<n>:SPECtrogram:MMODE <State>

Queries or toggles the multimode.

Suffix:	
<n>	1..n Irrelevant
Parameters:	
<State>	ON OFF 1 0
	*RST: 0
Example:	CALC:SPEC:MMOD? //would return e.g. 1

Example: //Activate multimode
 CALC:SPEC:MMOD 1

TRACe<n>:DATA:SPECTrogram:FINFo?

Requests the current available frames during spectrogram measurement.

Suffix:

<n> 1..n
 Irrelevant

Return values:

<Result> **<oldest>**
 Index of the oldest (first triggered) frame which is available.
 <latest>
 Index of the latest (last triggered) frame which is available.

Example: TRAC:SPEC:FINF?
 //would return e.g.
 1, 86

Usage: Query only

TRACe<n>:DATA:SPECTrogram:FDATa? <StartIdx>, <StopIdx>

Requests the data of specific frames during the spectrogram measurement.

Suffix:

<n> 1..n
 Irrelevant

Query parameters:

<StartIdx> Index of the first frame to read.
<StopIdx> Index of the last frame to read.

Return values:

<Result> All frames with frame index <StartIdx> ≤ frame index ≤ <StopIdx> are sent in a byte stream.
 The prefix contains the total length of bytes Y after the prefix in the ASCII coded prefix segment of maximum 10 bytes, starting with '#'.
 The byte stream ends with the first and last available frame, equal to what TRACe[:DATA]:SPECTrogram:FINFo? returns.

Usage: Query only

Table 6-3: Prefix (ASCII coded)

Byte	0	1	2	3	4	5	6	7	8	9	10
Value	#	X	Y1	Y2 (opt)	Y3 (opt)	Y4 (opt)	Y5 (opt)	Y6 (opt)	Y7 (opt)	Y8 (opt)	Y9 (opt)

X= Length of Y in bytes (range 1 to 9)

Y= Total length of following binary data of all requested frames data in bytes

Table 6-4: Binary data

Number of frames	4 bytes (uint32)
Frame start timestamp (seconds since 01.01.1970)	8 bytes (double)
Frame start timestamp fraction in ns (10^{-9} s)	8 bytes (double)
Reduction Factor	4 bytes (uint32)
Loop 1 ≤ Frame index ≤ number of frames:	
Frame index	4 bytes (uint32)
Number of traces	4 bytes (uint32)
Loop 1 ≤ Trace index ≤ number of traces:	
Trace index	4 bytes (uint32)
Status (bit 0 = overload flag)	1 byte (uint8)
Trace stop timestamp seconds (seconds since 01.01.1970)	8 bytes (double)
Trace stop timestamp fraction in ns (10^{-9} s)	8 bytes (double)
Number of trace points	4 bytes (uint32)
Data bytes (n)	n bytes (float32) with $n = 4 \cdot$ trace points
Index of current oldest (first triggered) available frame	4 bytes (uint32)
Index of current latest (last triggered) available frame	4 bytes (uint32)

Rules of handling:

Error message ERROR_INDEX_OUTOFRANGE appears if the number of the last requested frame is lower than the number of the first.

Error message ERROR_INDEX_OUTOFRANGE appears if there is no overlap between the available and requested range of frames.

If any requested frame is no longer available in the buffer, the field “Number of traces” of the concerning frame sets to 0 and no data bytes follow.

If the next requested bar is not available yet, no further data is sent for this request.

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