R&S®EPL-K55E
Real-Time Spectrogram
User Manual

ROHDE & SCHWARZ

Make ideas real

This manual applies to the following R&S®EPL1000 models with firmware version 1.20 and higher:

- R&S®EPL1000 (1350.4444K10)

The following firmware options are described:

- R&S®EPL-K55E (1350.4473.02)

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

Contents

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 EPL1000 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 EPL1000 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 EPL1000 user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/EPL

1.2.1 Getting started manual

Introduces the R&S EPL1000 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 EPL1000 is not included.

The contents of the user manuals are available as help in the R&S EPL1000. 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 compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

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 EPL1000 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 EPL1000. 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/EPL

1.2.7 Release notes and open source acknowledgment (OSA)

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

The software 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/EPL

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/EPL

1.2.9 Video tutorials

Video tutorials that show you how to get started and perform basic tasks with the R&S EPL1000 are available on the Rohde & Schwarz internet site:

https://www.rohde-schwarz.com/manual/r-s-fpl1000-trying-out-basic-measurement-tasks-manuals_78701-567115.html

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

1.2.10 Calibration certificate

The document is available on https://gloris.rohde-schwarz.com/calcert. You need the device ID of your instrument, which you can find on a label on the rear panel.

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for procedure descriptions

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

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

1.3.3 Notes on screenshots

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

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

2 Welcome to the real-time spectrogram application

The real-time spectrogram application provides functionality to perform real-time spectrogram measurements with the R&S EPL1000.

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 EPL1000 user manual. The latest version is available for download at the product homepage http://www.rohde-schwarz.com/product/EPL1000.

Installation

You can find detailed installation instructions in the R&S EPL1000 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 EPL1000.

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 EPL1000.

2. Select the "Real-Time Spectrogram" item.

   The R&S EPL1000 opens a new channel setup 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 Channel setups and sequencer function

When you activate an application, a new channel setup 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 channel setups 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 setup. 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 channel setups 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 EPL1000 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.
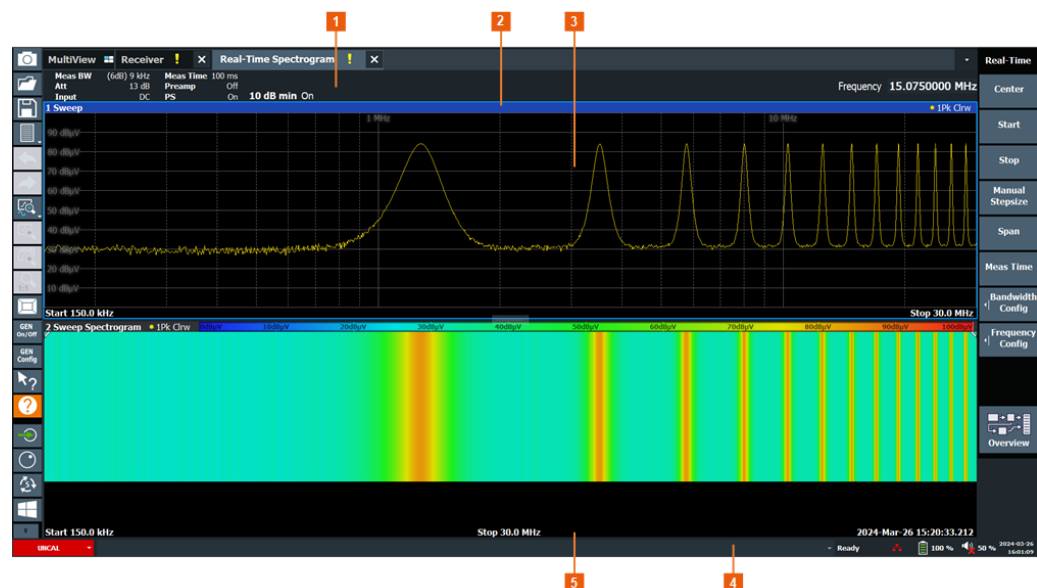
1 = Channel setup bar for firmware and measurement settings
2 = Window title bar with diagram-specific (trace) information
3 = Diagram area
4 = Instrument status bar with error messages and date/time display
5 = Diagram footer with diagram-specific information, depending on result display

Channel setup bar information

In the Real-Time Spectrogram application, the R&S EPL1000 shows the following settings:

Table 2-1: Information displayed in the channel setup 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 EPL1000 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.
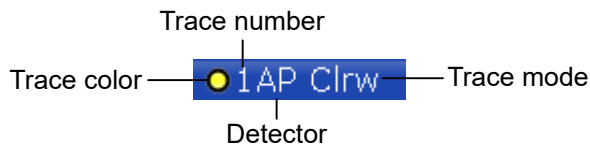
For further information on the window title bar, see R&S EPL1000 user manual.

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 EPL1000 can be evaluated using various different methods. In the Real-Time Spectrogram application, multiple result displays can be used simultaneously.

3.1 Result display

Access: "Overview" > "Display Config"

Or: [MEAS] > "Display Config"
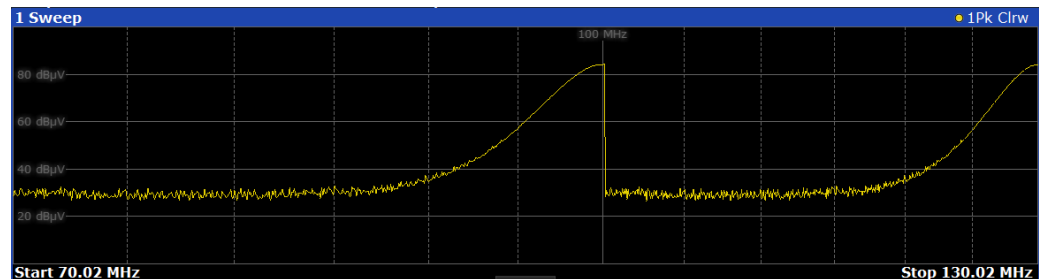
The R&S EPL1000 provides several result displays that show different aspects of the measured data.

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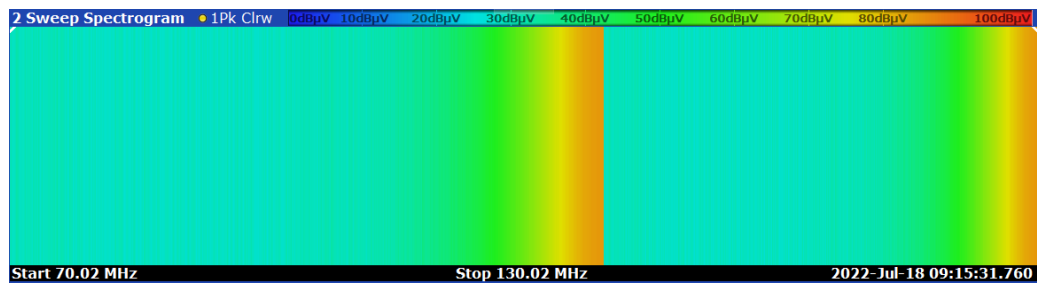Displays a frequency sweep of the input signal over a specified span.

Remote command:
```
LAY:ADD? '1',RIGH,SCAN
```
(See `LAYout:ADD[:WINDow]?` on page 48)

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

Remote command:
`LAY:ADD? '1',RIGH,SCSG`
(See `LAYout:ADD[:WINDow]?` on page 48)

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 EPL1000 user manual.

Remote command:
`LAY:ADD? '1',RIGH,FACC`
(See `LAYout:ADD[:WINDow]?` on page 48)

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 EPL1000 user manual.

Remote command:
`LAY:ADD? '1',RIGH,MTAB`
(See `LAYout:ADD[:WINDow]?` on page 48)

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 EPL1000 user manual.

Remote command:
`LAY:ADD? '1',RIGH,NOT`
(See `LAYout:ADD[:WINDow]?` on page 48)

Preselector

Provides an overview of the active preselector filters. For more information on preselector filters, refer to the R&S EPL1000 user manual.

Remote command:
`LAY:ADD? '1',RIGH,PRES`
(See `LAYout:ADD[:WINDow]?` on page 48)

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.

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 EPL1000 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 near the frequency border, the R&S EPL1000 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 EPL1000 adjusts the center frequency to the next possible frequency and shows a corresponding message in the status bar.

The measurement still includes the frequency that 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.

Example:

You are doing a measurement with a 9 kHz bandwidth, a center frequency of 79.5 kHz and a span of 141.0 kHz.

When you move to the next center frequency using the rotary knob, the center frequency changes to 220.5 kHz, but the span remains at 141.0 kHz.

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.
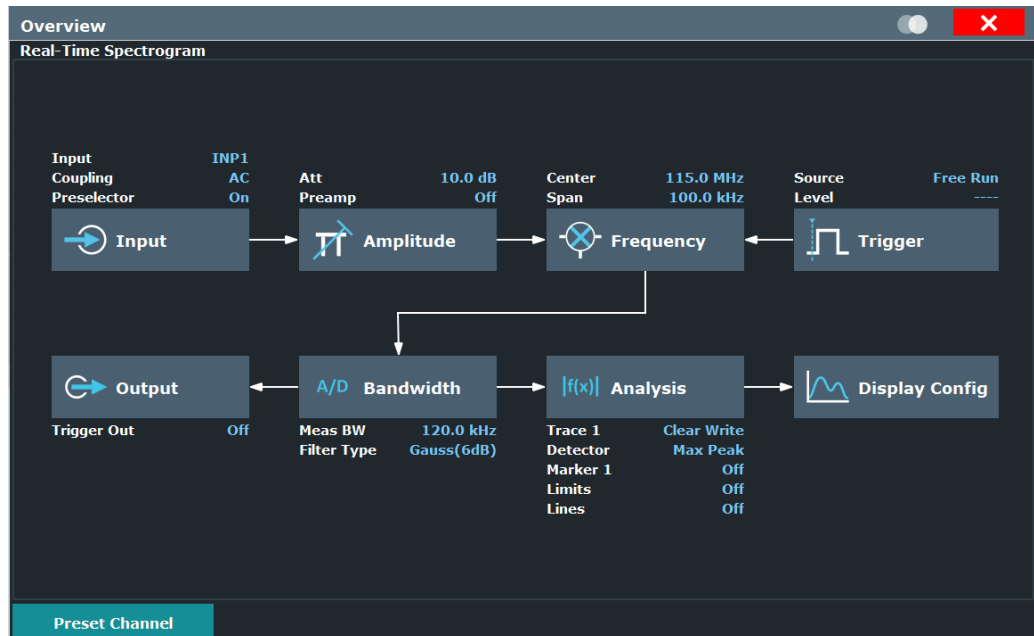
In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire EMI Real-Time measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

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

Remote command:
SYSTem:PRESet:CHANnel[:EXEC] on page 46

4.3 Data input and output

Access: "Overview" > "Input"

Access: "Overview" > "Output"

The R&S EPL1000 can analyze signals from different input sources and provide various types of output (such as video or trigger signals).

4.3.1 Configuring the RF input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Radio Frequency"
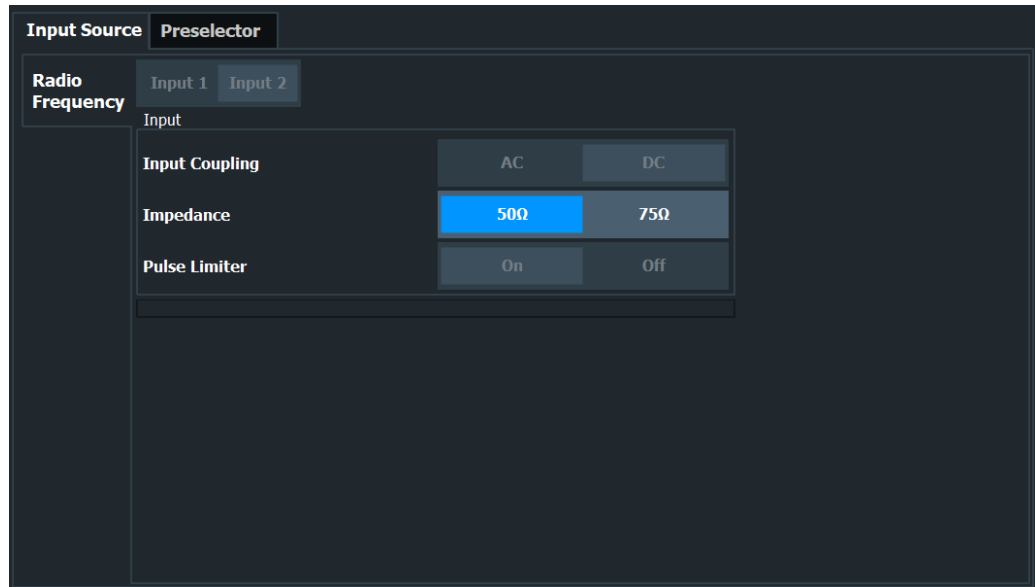
The remote commands required to configure the RF input are described in Chapter 6.5.1, "RF input", on page 55.

Input Coupling
DC coupling only. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the specifications document.

Impedance
For some measurements, the reference impedance for the measured levels of the R&S EPL1000 can be set to 50 Ω or 75 Ω.

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

This value also affects the unit conversion.

Remote command:
INPut:IMPedance<ant> on page 55

Pulse Limiter

The pulse limiter is a protection mechanism against high level pulses or signals (which can damage the input mixer). With the pulse limiter, the attenuation is always at least 10 dB.

4.3.2 Configuring the preselector

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

The preselector works similarly 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 EPL1000.

4.3.3 Configuring line impedance stabilization networks (LISN)

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

The R&S EPL1000 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 EPL1000.

4.4 Frequency configuration

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

4.4.1 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.
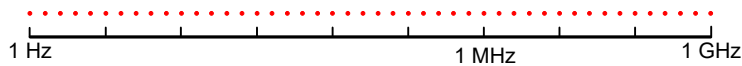
Figure 4-2: Logarithmic x-axis scaling: the distance between measurement points is variable

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.
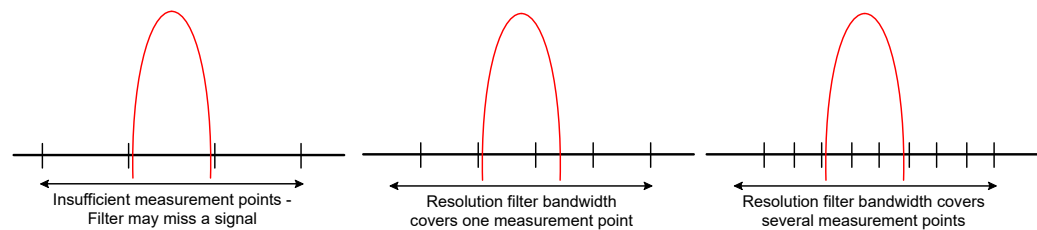
4.4.2 Frequency settings

Access: "Overview" > "Frequency"
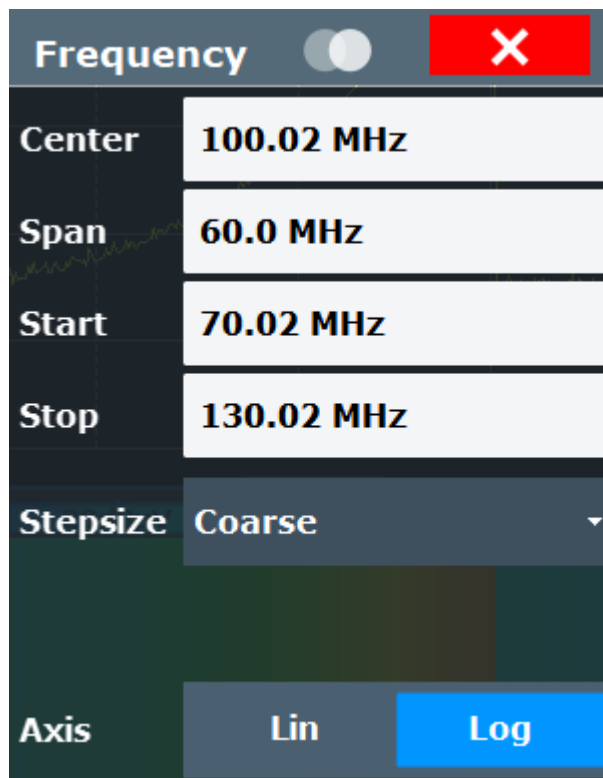
The remote commands required to configure the frequency are described in Chapter 6.5.4, "Frequency configuration", on page 56.

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.

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 56

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 Hz).

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

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

Remote command:
Start frequency: [SENSe:]FREQuency:STARt on page 58
Stop frequency: [SENSe:]FREQuency:STOP on page 58

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"	The stepsize is coupled to the receiver frequency. • When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the 4th digit of the receiver frequency. • When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the 2nd digit of the receiver frequency.
"Fine"	The stepsize is coupled to the receiver frequency. • When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the 7th digit of the receiver frequency. • When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the 5th digit of the receiver frequency.
"Manual"	The stepsize is a fixed custom value. • When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the frequency by 10 % of the manual stepsize. • When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the frequency by the manual stepsize.
"Frequency = Stepsize"	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.
"<x> * Meas BW"	The stepsize is a percentage of the measurement bandwidth (10 %, 50 % or a custom percentage).

Remote command:

[SENSe:]FREQuency:CENTer:STEP on page 59

Frequency Axis Scale

Selects the scale of the frequency axis.

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

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 59

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 57
Full span: `[SENSe:]FREQuency:SPAN:FULL` on page 58
Force full span: `[SENSe:]FREQuency:SPAN:FORCe` on page 58

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 57

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

4.5.1   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 EPL1000 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.

4.5.1.1 Using the RF attenuator

The first tool provided by the R&S EPL1000 to control measurement sensitivity is the RF attenuator.

The RF attenuator is available in all hardware configurations of the R&S EPL1000.

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 EPL1000 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. Deter-

mining 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 EPL1000 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.

4.5.1.2 Using the preamplifier

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

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 EPL1000 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 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".

4.5.1.3 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 EPL1000 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.
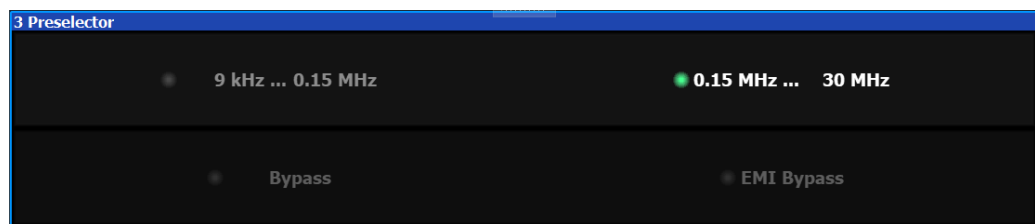
Figure 4-3: Preselector result display. The green LED indicates the currently applied filter.

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 EPL1000 displays the combined results.

4.5.2 Amplitude settings

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

Amplitude settings determine how the R&S EPL1000 processes or displays the input signals.
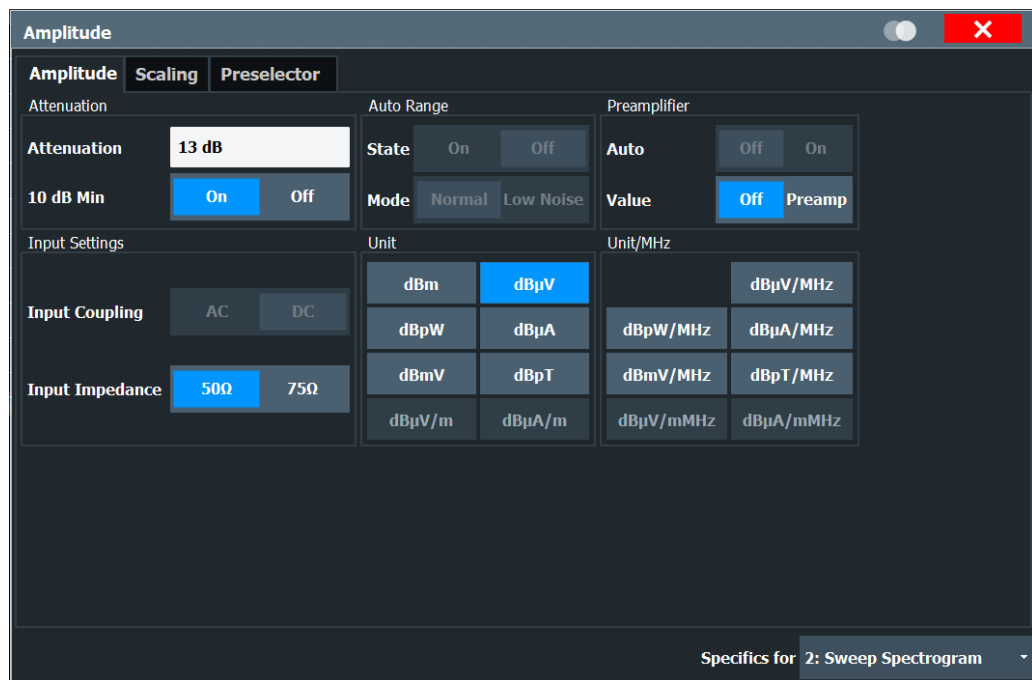
Functions in the "Amplitude" dialog box described elsewhere:

- Chapter 4.3.1, "Configuring the RF input", on page 18
- "Impedance" on page 18

The remote commands required to configure the amplitude are described in Chapter 6.5.5, "Amplitude configuration", on page 60.

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.

For more information, see the Preamplifier description in the R&S EPL1000 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 EPL1000 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 62

Attenuation mode: `INPut:ATTenuation:AUTO` on page 62

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 62

Auto Range

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

When you turn on auto ranging ("State"), the R&S EPL1000 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 EPL1000.
  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.

Notice: For more information, see Chapter 4.5.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 23.

Remote command:

General: `INPut:ATTenuation:AUTO` on page 62

Scan range: `[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO` on page 63

Auto range mode: `INPut:ATTenuation:AMODe` on page 63

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, dBµV, dBpW, dBµA, dBmV, dBpT.

Remote command:
CALCulate<n>:UNIT:POWer on page 66

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
dBµV	dBµV/MHz
dBµV/m	dBµV/mMHz (Available for active transducers only.)
dBmV	dBmV/MHz
dBµA	dBµA/MHz
dBµA/m	dBµA/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:

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

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 66

Preamplifier
Configures the preamplifier.

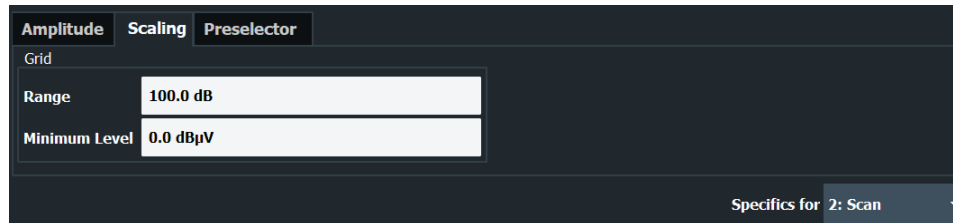The preamplifier amplifies the signal by 20 dB.

More information.

Remote command:
INPut:GAIN:STATe on page 63

4.5.3 Diagram scale

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

Scaling settings configure the vertical axis of the diagrams.

Amplitude	**Scaling**	Preselector
Grid		
Range	100.0 dB	
Minimum Level	0.0 dBµV	

Specifics for 2: Scan

The remote commands required to configure the y-axis scale are described in Chapter 6.5.6, "Y-Axis scaling", on page 63.

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 64
Min. level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom` on page 66

4.6 Bandwidth configuration

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

4.6.1 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 EPL1000 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 EPL1000 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 EPL1000 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.

4.6.2 Bandwidth settings

Access: "Overview" > "Bandwidth"
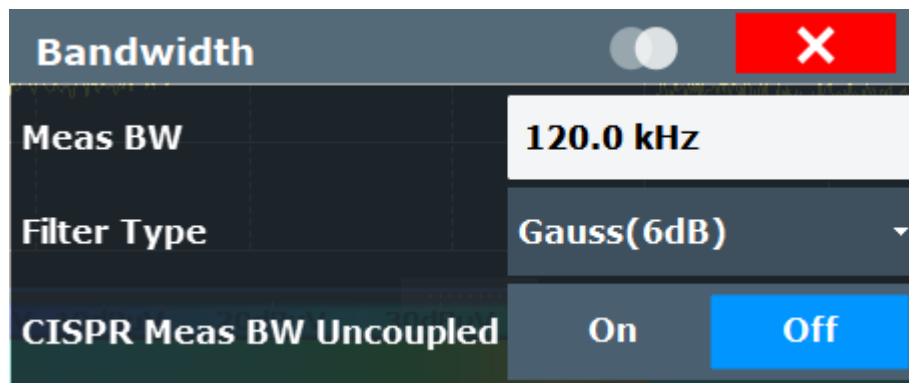
The remote commands required to configure the bandwidth are described in Chapter 6.5.7, "Bandwidth settings", on page 67.

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

The R&S EPL1000 supports a selected set of resolution bandwidths. If you enter a number that is not supported, the R&S EPL1000 rounds the value up to the next available bandwidth.

More information

Remote command:
Bargraph: [SENSe:]BANDwidth[:RESolution][:VALue] on page 67
Scan table: [SENSe:]SCAN<sr>:BANDwidth:RESolution on page 68

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 68

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 bandwidth. 6 dB bandwidths that comply with CISPR and MIL standards are available.
- **CISPR (6 dB)**
  Gaussian filter with a 6 bandwidth. 6 dB bandwidths that comply with CISPR standards are available.
- **MIL (6 dB)**
  Gaussian filter with a 6 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 67

4.7 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 68.

Continuous Sweep / Run Cont
After triggering, starts the measurement and repeats it continuously until stopped.

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 69
Run measurement: INITiate<mt>[:IMMediate] on page 70

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 setup is updated.

Remote command:
Measurement mode: INITiate<n>:CONTinuous on page 69
Run measurement: INITiate<mt>[:IMMediate] on page 70

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 69

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 71

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 EPL1000 calculates a moving average over the sweep count.

Note that a sweep count = 0 is not possible.

Remote command:
[SENSe:]SWEep:COUNt on page 70

4.8 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 EPL1000 can be output to a connected device, and an external trigger signal from a connected device can be used by the R&S EPL1000.

For more information, refer to the description of the spectrum application user manual of the R&S EPL1000.

4.8.1 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 71.

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 35).

Remote command:
TRIGger<tp>[:SEQuence]:SOURce on page 71

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 71

External Trigger 1 ← Trigger Source

Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

For details, see the "Instrument Tour" chapter in the R&S EPL1000 Getting Started manual.

Remote command:
TRIG:SOUR EXT
TRIGger<tp>[:SEQuence]:SOURce on page 71

Trigger Level

Defines the trigger level for the selected trigger source.

The trigger level is always 1.4 V.

Remote command:
n/a

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 72

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 72

4.9 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.

4.10 Transducer

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

For more information on how to use transducers and how to work with them, refer to the R&S EPL1000 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 EPL1000 Spectrum Analyzer User Manual.

5.1 Trace settings

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

For more information, refer to the R&S EPL1000 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 EPL1000.

5.3 Line settings

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

For more information, refer to the R&S EPL1000 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 EPL1000 must already be set up for remote operation in a network as described in the base unit manual.

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 EPL1000.

ⓘ **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 EPL1000 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.

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 39.

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 setup**)
<t>	1..6	Trace
	1 to 8	Limit line
<k>	1..8 (Limit line) 1 | 2 (Display line)	Selects a limit or display line.
<pk>	1..3000	Selects a peak.
<ou>	irrelevant	

ⓘ **Selecting windows in multiple channel setups**

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

6.3 Application selection

INSTrument:CREate:DUPLicate

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

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

Example: `INST:SEL 'Receiver'`
                      `INST:CRE:DUPL`
                      Duplicates the channel setup named 'Receiver' and creates a
                      new channel setup 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 45.

<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 setup with another one.

Setting parameters:

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

<ChannelType>   Channel type of the new channel setup.
                      For a list of available channel setup types, see `INSTrument:`
                      `LIST?` on page 45.

<ChannelName2>   String containing the name of the new channel setup.
                      Note: If the specified name for a new channel setup already
                      exists, the default name, extended by a sequential number, is
                      used for the new channel setup (see `INSTrument:LIST?`
                      on page 45).
                      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 setup named "Receiver" by a new chan-
                      nel setup of type "Receiver" named "REC2".

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel setup.

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

Setting parameters:

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

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

Usage: Setting only

INSTrument:LIST?

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

Return values:

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

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

Example: `INST:LIST?`
`'RTSGram','Real-Time Spectrogram'`

Usage: Query only

Table 6-2: Available channel setup types and default channel setup names

Application	<ChannelType> Parameter	Default Channel setup Name*)
Analog Modulation Analysis	ADEMod	Analog Demod
Click Rate Analyzer	CRANalyzer	Click Rate Analyzer
I/Q Analyzer	IQ	IQ Analyzer
Real-Time Spectrogram	RTSGram	Real-Time Spectrogram
Receiver	RECeiver	Receiver
Spectrum	SANalyzer	Spectrum

Note: the default channel setup name is also listed in the table. If the specified name for a new channel setup already exists, the default name, extended by a sequential number, is used for the new channel setup.

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel setup.

Setting parameters:

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

<ChannelName2>   String containing the new channel setup name.
Note that you cannot assign an existing channel setup name to a new channel setup. 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 setup with the name 'Receiver' to 'REC'.

Usage: Setting only

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

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

Also see

* INSTrument:CREate[:NEW] on page 44

Parameters:

<ChannelType>   Channel type of the new channel setup.
For a list of available channel setup types see INSTrument: LIST? on page 45.

<ChannelName>   String containing the name of the channel setup.

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

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default instrument settings in the current channel setup.

Use INST:SEL to select the channel setup.

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

Usage:	Event
Manual operation:	See "Preset Channel setup" on page 17

6.4 Result display configuration

- General window commands...47
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6.4.1 General window commands

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

DISPlay:FORMat.. 47
DISPlay[:WINDow<n>]:SIZE.. 47

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 51).

Suffix:

<n>   Window

Parameters:

<Size>   **LARGe**

Maximizes the selected window to full screen.

Other windows are still active in the background.

SMALl

Reduces the size of the selected window to its original size.

If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

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]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel setup.

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 "Sweep" on page 13
See "Sweep Spectrogram" on page 13
See "Fast Access" on page 14
See "Marker Table" on page 14
See "Notes" on page 14
See "Preselector" on page 14

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel setup 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 setup.

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 setup 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 setup, 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 48 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.
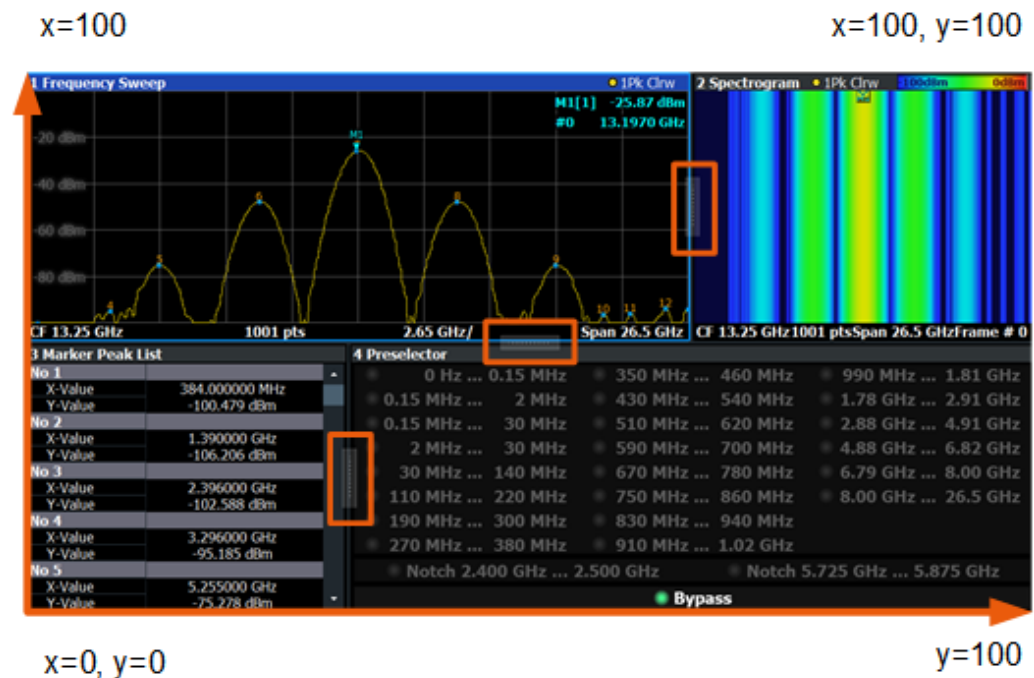

Figure 6-1: SmartGrid coordinates for remote control of the splitters

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 48 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 setup.

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 setup.

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 setup.

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 48 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

INPut:COUPling<ant> <CouplingType>

Selects the coupling type of the RF input.

Suffix:
<ant>   Input source (for MIMO measurements only)

Parameters:
<CouplingType>   AC | DC

                       AC
                       AC coupling

                       DC
                       DC coupling

                       *RST: AC

Example: INP:COUP DC

INPut:IMPedance<ant> <Impedance>

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

Suffix:
<ant>   Input source (for MIMO measurements only)

Parameters:
<Impedance>   50 | 75

                       *RST: 50 Ω
                       Default unit: OHM

Example: INP:IMP 75

Manual operation: See "Impedance" on page 18

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`

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 EPL1000.

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 EPL1000.

6.5.4 Frequency configuration

[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 21

[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 23

[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 <Span>

Defines the frequency span.

Manual operation: See "Span" on page 23

[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 23

[SENSe:]FREQuency:SPAN:FULL

Restores the full span.

Manual operation: See "Span" on page 23

[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 21

[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 21

[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 22

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 22

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<ant> on page 55

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<ant> <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
<ant>	Input source (for MIMO measurements only)

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<ant>: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
<ant>	Input source (for MIMO measurements only)

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 62.

Parameters:

<Attenuation>	Range: 0 dB to 55 dB
	*RST: 10 dB
	Default unit: dB
Example:	//Define attenuation
	INP:ATT 40dB
Manual operation:	See "Attenuation" on page 27

INPut:ATTenuation:AUTO <State>

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

When you turn it on, the R&S EPL1000 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 27
	See "Auto Range" on page 28

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 28

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 28

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on preamplifier
INP:GAIN:STAT ON

Manual operation: See "Preamplifier" on page 29

[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 28

6.5.6 Y-Axis scaling

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 30

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 EPL1000 adjusts the scaling of the y-axis accordingly.

Suffix:

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

Parameters:

<Position>	0 PCT corresponds to the lower display border, 100 percent cor- responds to the upper display border.

*RST: frequency display: 90 PCT; time display: 50 PCT;
     AF spectrum display (K7): 100 PCT;
Default unit: PCT

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: dBµV

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

Manual operation: See "Unit" on page 28
See "dBx/MHz" on page 29

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 dBµV

Example: //Define a minimum grid level
DISP:TRAC:Y:BOTT -20

Manual operation: See "Grid Range / Minimum Level" on page 30

6.5.7 Bandwidth settings

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

Suffix:

<ip>	1..n

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 32

[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
	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 32

[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 32

[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 EPL1000 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 32

6.5.8 Sweep configuration

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 33

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel setup.

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>   irrelevant

Parameters:

<State>   ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 0

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 33 |
| | See "Single Sweep / Run Single" on page 33 |

INITiate<mt>[:IMMediate]

The command initiates a new measurement.

For a single measurement, the R&S EPL1000 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 33 |
| | See "Single Sweep / Run Single" on page 33 |

[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 EPL1000 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 34

[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.

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

Manual operation: See "Meas Time" on page 34

6.5.9 Trigger configuration

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

Selects the trigger source.

Note on external triggers:

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

Suffix:

<tp>	irrelevant

Parameters:

\<Source\>	See table below.
	*RST: IMMediate

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

Manual operation: See "Trigger Source" on page 35
See "Free Run" on page 35
See "External Trigger 1" on page 35

TRIGger[:SEQuence]:LEVel[:EXTernal]?

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

Example: `TRIG:SEQU:LEVE:EXTE?`
Queries the trigger level.
Response:
`1.4V`

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 10 s Range for measurements in the time domain: negative sweep time to 10 s
	*RST: 0 s Default unit: s

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

Manual operation: See "Trigger Offset" on page 35

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 36

List of commands

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