

R&S®FPL1-K41R

Real-Time Spectrum measurements

User Manual



1706913102
Version 01

ROHDE & SCHWARZ
Make ideas real



This manual applies to the following FPL models with firmware version 2.30 and later:

- R&S®FPL1003 (1304.0004K03) - FPL with maximum frequency 3 GHz
- R&S®FPL1007 (1304.0004K07) - FPL with maximum frequency 7.5 GHz
- R&S®FPL1014 (1304.0004K14) - FPL with maximum frequency 14 GHz
- R&S®FPL1026 (1304.0004K26) - FPL with maximum frequency 26.5 GHz
- R&S®FPL1044 (1304.0004K44) - FPL with maximum frequency 44 GHz

This document describes the following firmware options:

- FPL-K41R Real-Time Spectrum (1353.6702.02)

© 2025 Rohde & Schwarz

Muehldorfstr. 15, 81671 Muenchen, Germany

Phone: +49 89 41 29 - 0

Email: info@rohde-schwarz.com

Internet: www.rohde-schwarz.com

Subject to change – data without tolerance limits is not binding.

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

All other trademarks are the properties of their respective owners.

1706.9131.02 | Version 01 | R&S®FPL1-K41R

Throughout this document, R&S® is indicated as R&S.

Contents

1	Welcome to the R&S FPL1-K41R Real-Time Spectrum measurements application.....	5
2	Measurements and result displays.....	8
3	Real-time basics.....	13
4	Configuring the R&S FPL1-K41R Real-Time Spectrum measurements application.....	32
5	Analysis.....	54
6	How to perform Real-Time Spectrum measurements.....	74
7	Remote commands to perform Real-Time Spectrum measurements	81
8	Reference: ASCII file export format.....	188
	List of commands (Real-Time).....	193
	Index.....	198

1 Welcome to the R&S FPL1-K41R Real-Time Spectrum measurements application

The FPL real-time spectrum option provide both an application and an operating mode to display RF spectra in real-time and gapless, allowing for quick and simple error analysis and signal characterization.

Functions not discussed in this manual are the same as in Signal and Spectrum Analyzer mode and are described in the FPL User Manual. The latest version is available for download at the product homepage (<http://www.rohde-schwarz.com/product/FSV3000.html>).

Additional information

An application note discussing the implementation of real-time spectrum analysis is available from the Rohde & Schwarz website:

[1EF77: Implementation of Real-Time Spectrum Analysis](#)

Installation

You can find detailed installation instructions in the FPL Getting Started manual or in the Release Notes.

- [Starting the R&S FPL1-K41R Real-Time Spectrum measurements application](#).....5
- [Understanding the display information](#).....6

1.1 Starting the R&S FPL1-K41R Real-Time Spectrum measurements application

The R&S FPL1-K41R Real-Time Spectrum measurements application adds real-time measurement analysis to the FPL.

To activate the R&S FPL1-K41R Real-Time Spectrum measurements application

1. Press [MODE] on the front panel of the FPL.
A dialog box opens that contains all operating modes and applications currently available on your FPL.
2. Select the "Real-Time Spectrum" item.



The FPL opens a new measurement channel for the R&S FPL1-K41R Real-Time Spectrum measurements application.

The measurement is started immediately with the default settings. It can be configured in the "Real-Time Spectrum" "Overview" (see [Section 4.1, "Configuration overview"](#), on page 32).

1.2 Understanding the display information

The following figure shows a measurement diagram in the R&S FPL1-K41R Real-Time Spectrum measurements application. All different information areas are labeled. They are explained in more detail in the following sections.

Channel bar information

In the R&S FPL1-K41R Real-Time Spectrum measurements application, the FPL shows the following settings:

Table 1-1: Information displayed in the channel bar in the R&S FPL1-K41R Real-Time Spectrum measurements application

"Ref Level"	Reference level
"Att" / "m.+el.Att"	Mechanical RF attenuation / Mechanical and electronic RF attenuation
"Offset"	Reference level offset
"SWT"	Data acquisition time for single spectrogram line in frequency domain
"RBW"	Resolution bandwidth
"Dwell Time"	Measurement time for "Run Single" or "Continuous Sequencer" mode if no trigger is used.
"TRG"	Trigger source
"PreTrigger"/ "Post-Trigger"	Data acquisition time before / after the trigger event
"SGL"	The measurement is set to single sweep mode.

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values. This information is displayed only when applicable for the current measurement. For details see the FPL Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:



- 1 = Window number
- 2 = Window type
- 3 = Trace color
- 4 = Trace number

- 5 = Trace detector
- 6 = Trace mode
- 7 = Color map legend

Diagram footer information

The diagram footer (beneath the diagram) contains the following information, depending on the evaluation.

Spectrum displays:

- Center frequency (CF)
- Displayed frequency span per division
- Displayed frequency span

Spectrograms:

- Center frequency (CF)
- Displayed frequency span
- Timestamp or index of current frame

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.

2 Measurements and result displays

In order to accommodate for different requirements, different measurement types and result displays are provided for Real-Time Spectrum measurements.

2.1 Real-Time Spectrum result displays

The FPL Real-Time Spectrum measurements not only process data in real-time, but also offer several result displays that help you analyze the data as it is displayed. The human eye has a limited capability of detecting changes – therefore the R&S FPL1-K41R Real-Time Spectrum measurements application result displays visualize the time axis, i.e. the changes of a signal over time. Display modes with information on past and present spectra at the same time allow for a quick analysis of changes for human eyes.

For Real-Time Spectrum measurements, up to 4 result displays can be displayed simultaneously in separate windows.

Real-Time Spectrum.....	8
Spectrogram.....	9
Persistence Spectrum.....	10
Marker Table.....	11

Real-Time Spectrum

The "Real-Time Spectrum" diagram displays the measured power levels for the specified frequency span around the selected center frequency.

The displayed data corresponds to one particular frame in the spectrogram. During a running measurement, the most recently captured frame is always displayed. During analysis, which frame is displayed depends on the selected frame in the spectrogram configuration (see [Section 4.7, "Bandwidth and sweep settings"](#), on page 49) or the marker position in the spectrogram (see [Section 5.7.1, "Individual marker setup"](#), on page 63). The displayed frame is indicated by small white arrows on the left and right border of the "Spectrogram".

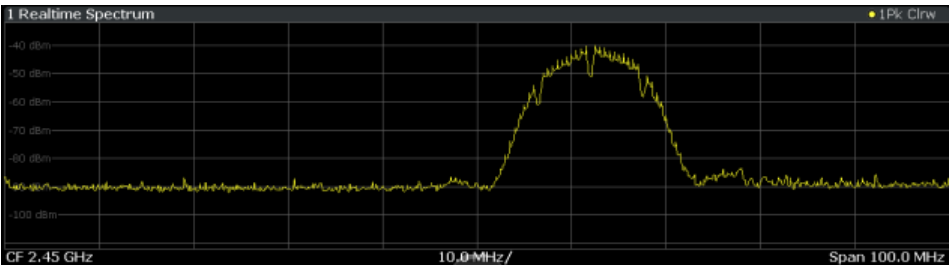


Figure 2-1: Real-Time Spectrum result display

Thus, the "Real-Time Spectrum" is useful to analyze the input signal measured at a specific time in more detail.

Remote command:

LAY:ADD? '1',RIGH, 'XFrequency', see [Section 7.4.10.2, "Working with windows in the display"](#), on page 126

Results:

TRAC<n>:DATA? TRACEx, see [TRACe<n>\[:DATA\]](#) on page 138

[TRACe<n>\[:DATA\]:X?](#) on page 140

[MMEMory:STORe<n>:TRACe](#) on page 142

Spectrogram

The spectrogram is a way of displaying multiple consecutive spectrums over time. The power level, which is usually displayed over frequency, is displayed over frequency and time. Graphically, time and frequency represent the vertical and horizontal axes of the diagram. The color of each point of the diagram represents the power level for the corresponding frequency and time.

At the beginning of a measurement, the diagram is empty. As the measurement advances, the graph is filled line by line. Lines in the spectrogram are called frames, as each frame represents one spectrum.

As the graph fills from top to bottom, the latest spectrum is always the topmost line, whereas older frames move towards the bottom.

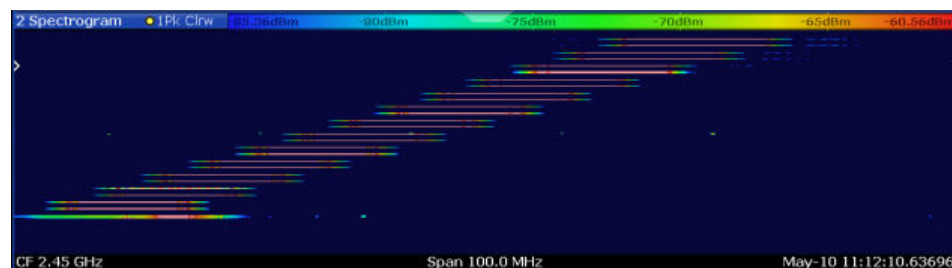


Figure 2-2: Frequency hopper exhibiting a transition with significant RF level from lowest to intermediate frequency

The currently selected frame is indicated by small white arrows on the left and right border of the spectrogram.

The spectrogram is a powerful tool to analyze time-variant spectrums. Typical applications are the transient oscillation of a VCO and the analysis of frequency hopping signals. In [Figure 2-2a](#) frequency hopper is shown. It is clearly visible that the signal is not completely off during the first hop (lowest frequency to middle frequency), whereas no significant RF level can be observed during the second hop.

Real-Time spectrograms are highly configurable. In particular, the number of frames and the colors used to display the power levels can be defined by the user.

Spectrograms are particularly useful in combination with a spectrum display. In this case, the spectrogram provides an overview of events over time, whereas the spectrum provides details for a specific frame.

For more information on working with spectrograms see [Section 3.5, "Working with Spectrogram"](#), on page 21.

Remote command:

LAY:ADD? '1', RIGH, 'XFrequency:SGRam', see LAYout:ADD[:WINDow]?

on page 126

Results:

TRAC<n>:DATA? SPEC, see TRACe<n>[:DATA] on page 138

TRACe<n>[:DATA]:X? on page 140

MMEMory:STORe<n>:SPECTrogram on page 142

Persistence Spectrum

In a persistence spectrum, the probability of appearance for each frequency/level pair is displayed.

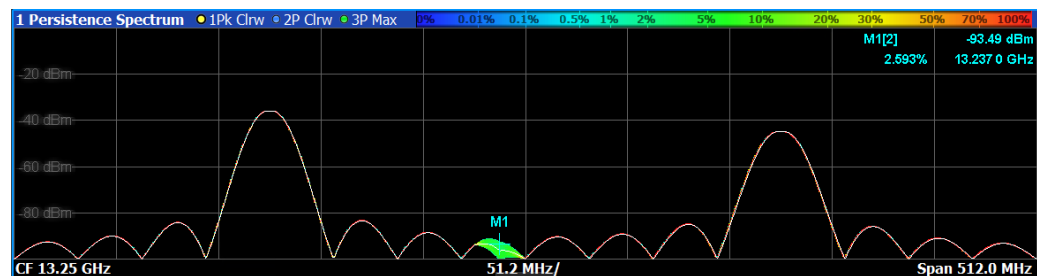


Figure 2-3: Persistence Spectrum result display

The "Persistence Spectrum" result displays 3 traces:

- Trace 1 is a standard trace in clear/write mode with a peak detector, which corresponds to the current "Real-Time Spectrum" trace. This trace is displayed for reference and can be disabled using the common trace settings.
- Trace 2 shows the persistence spectrum in clear/write mode
- Trace 3 shows the persistence spectrum in Max Hold mode. This trace indicates the maximum probabilities ever measured during the entire measurement for each point in the diagram. The intensity of the Max Hold display is configurable so that it can be distinguished from the current trace, but it is not time-dependant (indefinite persistence).

The persistence spectrum result is also referred to as a spectrum histogram. Both terms indicate the main features of this result display: persistence and histogram information. Persistence helps you view even very short events that the human eye could not capture otherwise. Moreover, it also allows for comparison between two events that are separated in time, but which share a time frame called *persistence granularity*. This time frame specifies the amount of time it takes for a singular event to fade completely.

Histogram information is basically a counter that sums up the appearance of a certain frequency/level pair within a certain amount of time. Instead of displaying the total of a counter, the "Persistence Spectrum" displays the counter result normalized to the maximum achievable count, which yields a probability of appearance for each frequency/level pair.

The "Persistence Spectrum" is made up of a horizontal frequency axis and a vertical level axis just as a normal spectrum display. The color of each dot in the "Persistence Spectrum" contains the histogram information, i.e. the probability information.

A typical application for the "Persistence Spectrum" is the analysis of signals that vary over time. It is an especially powerful tool to provide an overview of a signal, before it can be analyzed in detail.

Using a "Persistence Spectrum", fast frequency hops can be distinguished clearly from amplitude drops, whereas conventional analyzers may mislead the user. As opposed to the spectrogram display, the "Persistence Spectrum" offers a higher level resolution, as it does not employ color coding for the power.

Another application for the "Persistence Spectrum" is the separation of superimposed signals if they can be distinguished in terms of probability distribution of frequency/level pairs.

Figure 2-4 shows a "Persistence Spectrum" of a noise-like signal resulting from a motor with brushes. A weak GSM signal is clearly visible in the center of the span. A standard spectrum analyzer cannot resolve the two different signals, as it does not display probabilities for each signal point.

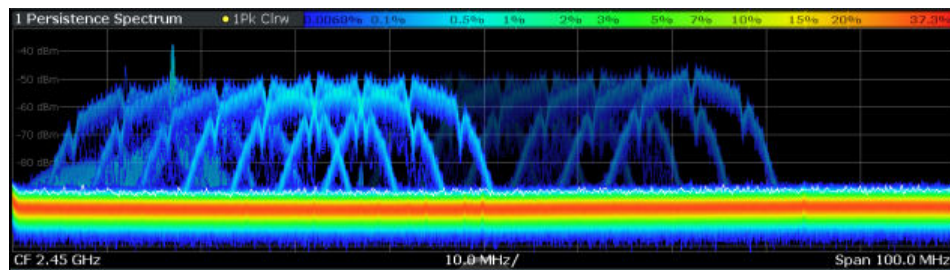


Figure 2-4: Wideband noise-like signal covering a GSM signal

Markers in the Persistence Spectrum

Markers can be assigned to trace 2 and 3 in the "Persistence Spectrum" display.

Markers on the persistence traces are 2-dimensional markers defined by a frequency and level value, similar to fixed reference markers (see [Section 5.7.2, "General marker settings"](#), on page 66). The marker result indicates the probability of appearance for the frequency/level pair.

Dedicated fixed reference markers are not supported in "Persistence Spectrum" displays. Use a normal marker and a delta marker instead.

For more information about markers, see [Section 5.7, "Marker usage"](#), on page 63.

For more information on how the histogram and persistence are evaluated see [Section 3.6, "Understanding persistence"](#), on page 27.

Remote command:

LAY:ADD? '1', RIGH, 'XFrequency:PSpectrum', see [Section 7.4.10.2, "Working with windows in the display"](#), on page 126

Results:

TRAC<n>:DATA? TRACEx, TRAC<n>:DATA? PSP, TRAC<n>:DATA? HMAX, see [TRACe<n>\[:DATA\]](#) on page 138

[TRACe<n>\[:DATA\]:X?](#) on page 140

[MMEMory:STORe<n>:PSpectrum](#) on page 142

Marker Table

Displays a table with the current marker values for the active markers.

This table is displayed automatically if configured accordingly.

1 Marker Table							
Wnd	Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
2	M1		1	2.1725 ms	-6.80 dBm		
2	D2	M1	1	13.859 ms	-0.00 dB		
2	D3	M1	1	4.6259 ms	-0.00 dB		
2	D4	M1	1	9.2331 ms	-0.00 dB		

Tip: To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:

LAY:ADD? '1',RIGH, MTAB, see [LAYout:ADD\[:WINDow\]? on page 126](#)

Results:

[CALCulate<n>:MARKer<m>:X on page 150](#)

[CALCulate<n>:MARKer<m>:Y? on page 151](#)

3 Real-time basics

Some background knowledge on basic terms and principles used in Real-Time Spectrum measurements is provided here for a better understanding of the required configuration settings. For example, the mechanisms behind data capturing without blind times and triggering on frequency masks are described here.

- [Data acquisition and processing in real-time](#)..... 13
- [Defining the resolution bandwidth](#)..... 15
- [Sweep time and detector](#)..... 15
- [Triggering real-time measurements](#)..... 16
- [Working with Spectrogram](#)..... 21
- [Understanding persistence](#)..... 27

3.1 Data acquisition and processing in real-time

This section shows the way the R&S FPL1-K41R Real-Time Spectrum measurements application acquires and processes the data compared to a conventional spectrum analyzer.

A conventional spectrum analyzer typically loses information after it has captured the signal ('blind time'). The blind time is because the LO has to return to the start frequency after a sweep of the selected frequency range (LO flyback). Blind time therefore occurs after the data capture and signal processing and before the next data capture can begin.

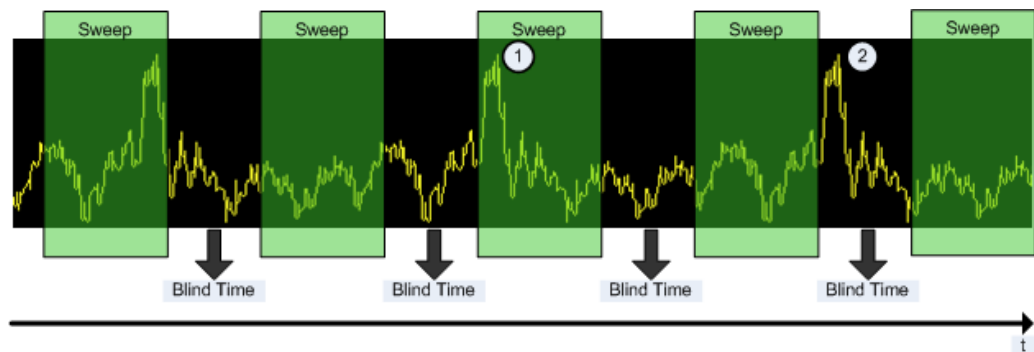


Figure 3-1: Conventional spectrum analyzer measurement principle

1 = Signals are captured by the sweep.

2 = Signal is missed by the sweep because of LO flyback (blind time; extended for clarity).

A real-time spectrum analyzer does not lose any information for the following reasons:

- There is no LO flyback because the LO is set to a fixed frequency in the real-time spectrum analyzer.
- It performs overlapping Fast Fourier transformations (FFT) instead of sweeping the spectrum or performing one FFT after another.

- The FPL captures data and performs FFTs at the same time instead of sequentially.

To get the results, the FPL simultaneously performs several processing stages:

- Acquiring the data
- Processing the data
- Displaying the data

Acquiring the data

The data acquisition process is the same as in a conventional spectrum analyzer. First, the FPL attenuates the signal that you have applied to the RF input to get a signal level that the FPL can handle. If you have a weak signal, the FPL pre-amplifies the signal and then down-converts the RF signal to an intermediary frequency (IF), usually in several stages.

After the down-conversion, the FPL samples the signal into a digital data stream that is the basis for the Fast Fourier transformation (FFT). The sample rate the FPL uses for sampling is variable, but depends on the span you have set.

Processing the data

The FPL then splits the data stream stored in the I/Q memory into data blocks whose length is between 256 and 8192 samples each to prepare it for the FFT.

Then the FPL performs the FFT on all data blocks it has acquired. The FFT processing rate of the FPL is variable.

The distinctive feature of a real-time analyzer is that it uses a particular amount of data more than once to get the measurement results. It takes the first data block of 256 samples, for example, and performs the FFT on it. The second and all subsequent data blocks, however, do not start at the next sample (for the second block, the 257th), but at an earlier one. In fact, all data, except the first few samples, is processed more than once and overlapped to get the results.

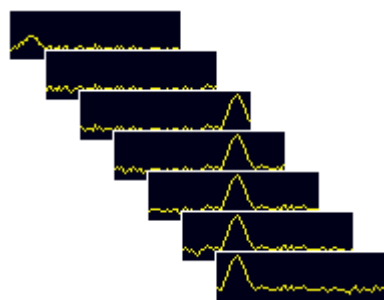


Figure 3-2: Overlapping FFTs

After the FFT is done and the spectra have been calculated, the result is a stream of spectra without information loss.

3.2 Defining the resolution bandwidth

The resolution bandwidth affects how the spectrum is measured and displayed. It determines the frequency resolution of the measured spectrum. A small resolution bandwidth has several advantages. The smaller the resolution bandwidth, the better you can observe signals whose frequencies are close together and the less noise is displayed. However, a small resolution bandwidth also increases the time required to ensure that *all* possible signal distortions are detected and the level is measured accurately. This requirement is also referred to as *100% probability of intercept (POI)*.

The resolution bandwidth parameters can be defined in the bandwidth configuration, see [Section 4.7, "Bandwidth and sweep settings"](#), on page 49.

3.3 Sweep time and detector

The "[Sweep Time](#)" on page 50 parameter determines the amount of time used to sample data for one spectrum. One spectrum is defined by all FFTs calculated and combined from the sampled data in one sweep time period. In conventional spectrum analysis, the sweep time parameter describes the amount of time needed to sweep over the selected frequency span. As the effect is the same, i.e. it takes the sweep time to complete one spectrum, the real-time parameter is also called sweep time.



Sweep Time vs. Dwell Time

The *sweep time* determines the amount of time used to sample data for one spectrum. The *dwell time* determines the amount of time to measure *multiple* spectra. This value is user-definable. It only affects measurements in single sweep mode or for Sequencer measurements in continuous mode. It is not considered for triggered measurements.

For details, see "[Sweep Time](#)" on page 50 and "[Dwell Time](#)" on page 51.

Combining several FFTs into one spectrum during the selected sweep time offers several possibilities of weighting the FFT results: determining the maximum level is an obvious one. Other possibilities of combining several FFTs are selecting the minimum for each frequency point, determining the average result, or selecting an arbitrary FFT result to represent the entire sweep time. The FFTs are combined by detectors.

A detector is available for each of the mentioned methods:

- "Positive Peak"
- "Negative Peak"
- "RMS"
- "Average"
- "Sample"

"Positive Peak" is the default selection to make sure that even the shortest events can be analyzed.

Thus, the detector and sweep time parameters describe the data reduction from multiple FFTs to a single spectrum. A detector is not required for the "Persistence Spectro-

gram" display, which evaluates the individual FFTs (see [Section 3.6, "Understanding persistence"](#), on page 27).

3.4 Triggering real-time measurements

Real-time measurements pose some specific challenges to triggering, which require special trigger functions and options.

- [Triggering on specific frequency events \(frequency mask trigger\)](#).....16
- [Using pretrigger and posttrigger settings](#).....20
- [Trigger modes](#).....20

3.4.1 Triggering on specific frequency events (frequency mask trigger)

One way to analyze rare events in a given frequency range is to capture real-time data over a very long time. This method requires large amounts of fast memory. As a consequence, post-processing the bulk of stored data to find the event can be extremely time consuming.

Another way is to trigger on the event in the frequency spectrum and to acquire exactly the data of interest. This method reduces the necessary memory size dramatically, and in addition keeps the time to spot the event of interest in the acquired memory low. The question is: how can the analyzer trigger on events which show up in a certain frequency range only now and then?

Detecting rare events

The answer is the *Frequency Mask Trigger*. Speaking graphically, the frequency mask trigger is a mask in the frequency domain, which is checked with every calculated FFT. Thus, a 100% probability of intercept with full level accuracy even on short pulses is possible.

The minimum detectable pulse length is specified in the specifications document.

Mask definition

The frequency mask is configured by a list of individual trace points, defined as frequency (position) / level (value) pairs, which are connected to form a mask area. The individual mask points can also be defined simply by dragging the points to the required position on the touchscreen. The frequency mask can consist of up to 1001 points and can have an arbitrary shape.

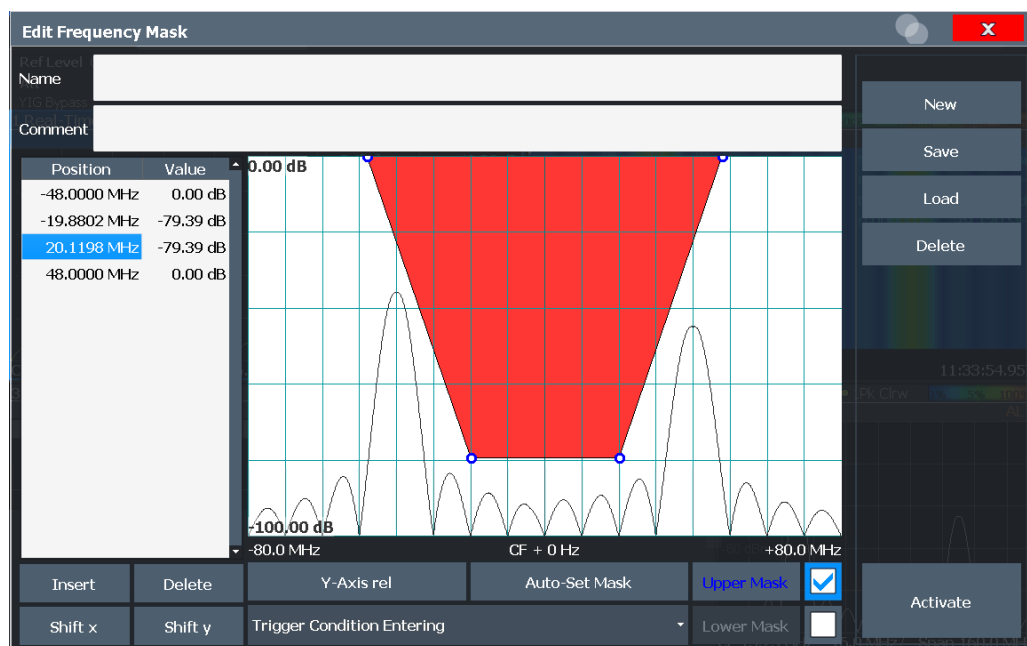


Figure 3-3: Frequency mask defined manually

Alternatively, a mask can be defined automatically according to the currently measured data. In this case, the mask is configured to follow the measurement trace with a specific distance to the power levels.

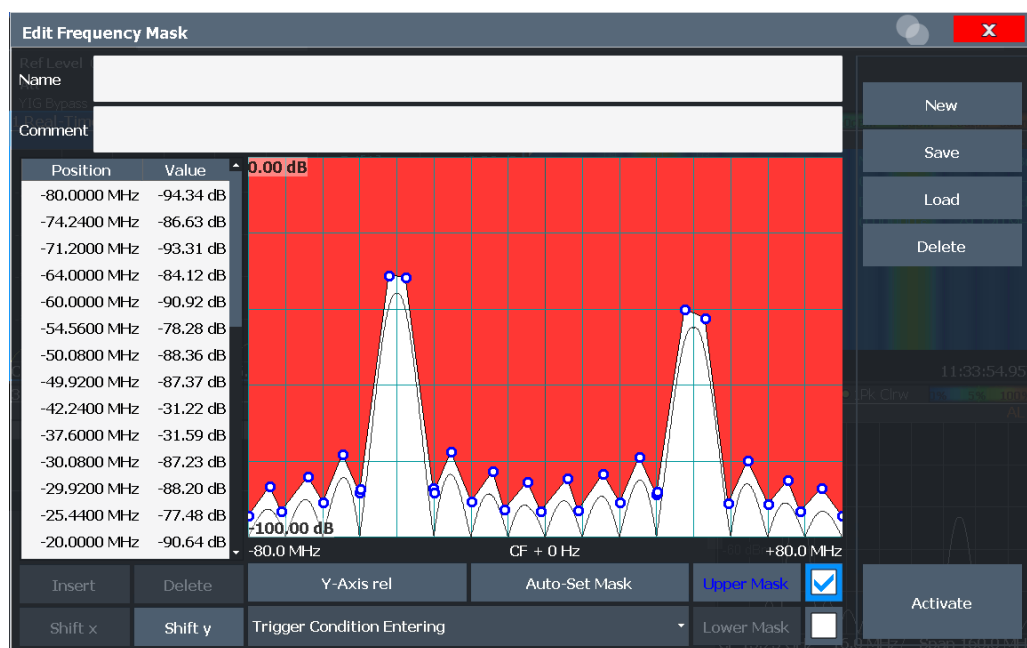


Figure 3-4: Frequency mask defined automatically according to measured data

Upper and lower masks

By default, the configured mask is an upper mask, i.e. the mask is the area *above* the configured mask points. In addition or alternatively, a mask can be defined as a lower mask. In this case, the mask is the area *below* the configured mask points. Lower masks are useful, for example, to determine if the measured signal leaves a defined "corridor" of allowed values.

The lower limit mask is configured in the same manner as the upper limit mask. However, it cannot be configured automatically according to the currently measured values.

Trigger conditions

The frequency mask can be evaluated in different ways to control data acquisition, depending on whether the mask area represents the relevant or irrelevant value range.

"Entering": mask area represents the relevant value range

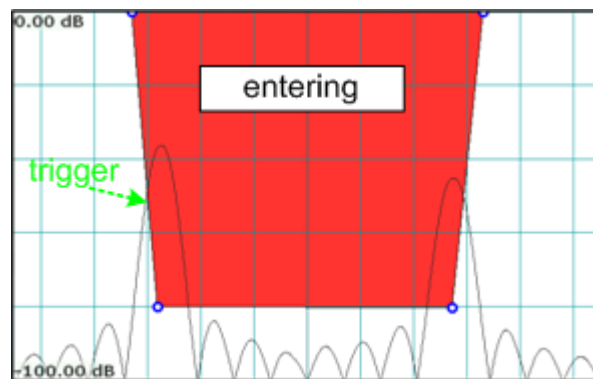


Figure 3-5: Trigger condition "entering": Data acquisition starts when the signal enters the mask area and continues until the measurement is stopped or completed.

"Leaving": mask area represents the irrelevant value range

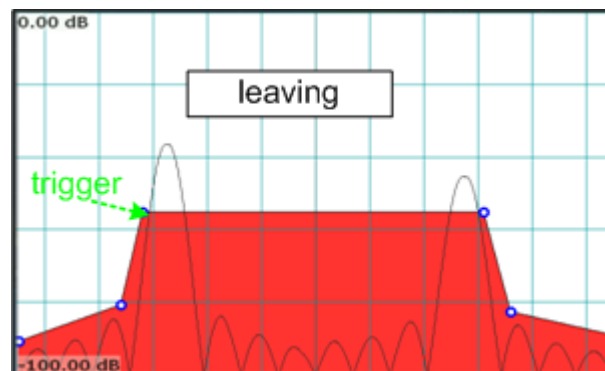


Figure 3-6: Trigger condition "leaving": Data acquisition starts when the signal leaves the mask area and continues until the measurement is stopped or completed.



The selected trigger condition applies to any active limits; that means the calculated FFTs are compared to the upper or lower, or both the upper and lower limits, if activated.

Availability

The frequency mask trigger can be selected as a trigger source for all measurements in the R&S FPL1-K41R Real-Time Spectrum measurements application. As it is evaluated in parallel to the selected result displays, there is no influence on the real-time capabilities of the FPL.

A detailed description of how to define a frequency mask trigger is provided in [Section 6.4, "How to work with frequency mask triggers"](#), on page 78.

Storing and loading frequency masks

As frequency masks can have a very complex structure, they can be stored for later use with other signals. The masks are stored in a file with the extension `.FMT` in the `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask` directory. By default, the mask name is used as the file name.

3.4.1.1 Technical process

Basically the frequency mask trigger is an extended limit line check: the frequency mask is compared to every FFT spectrum calculated by the real-time hardware.

The FPL performs this mask check many times per second according to the FFT update rate. To ensure a real-time trigger, i.e. a given reaction time, the frequency mask trigger is evaluated by the real-time hardware.

[Figure 3-7](#) shows the element-wise comparison of a real-time FFT with a frequency mask. The FFT-result is subtracted from the frequency mask value. If one result is negative, the FPL triggers.

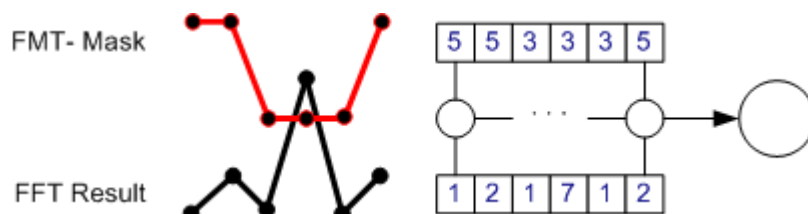


Figure 3-7: Element-wise comparison of frequency mask with current FFT result

Extended limit check means that the frequency mask trigger can link a complex condition to the limit line violation, such as entering or leaving the mask.

As already mentioned, the frequency mask can contain up to 1001 points, but can also be as short as 2 points. Shorter frequency mask trigger definitions are extended to 1001 points by interpolation within the firmware. The frequency mask trigger therefore always compares 1001 FFT points to 1001 frequency mask definition points. If the mask is violated at a single point, the frequency mask triggers.

To get a reliable frequency mask trigger with very short events, it is preferable to set the mask limit levels lower than the expected spectral power levels.

3.4.2 Using pretrigger and posttrigger settings

As described in [Section 3.3, "Sweep time and detector"](#), on page 15, the amount of time required to sample data for one spectrum (or one frame/line in a spectrogram) corresponds to the defined sweep time. If a trigger is used for the measurement, the displayed spectrum starts with the trigger event. However, you can define a pretrigger and posttrigger period in which data is also captured, in addition to the actual sweep time. (As the posttrigger time starts with the trigger event, it only has an effect if it is longer than the sweep time.) Pretrigger data allows you to analyze the data shortly before the actual trigger event or after the regular sweep period.

The data from this "extended" sweep time (pretrigger+posttrigger) is displayed in the real-time Spectrogram.

By default, the frame displayed in the Real-Time Spectrum results is the frame that begins with the trigger event. If a pretrigger time is defined, one or more additional frames are available in the spectrogram beneath the frame currently displayed in the Real-Time Spectrum diagram window, respectively. If a posttrigger time is defined, one or more additional frames are available in the spectrogram above the frame currently displayed in the Real-Time Spectrum diagram window.

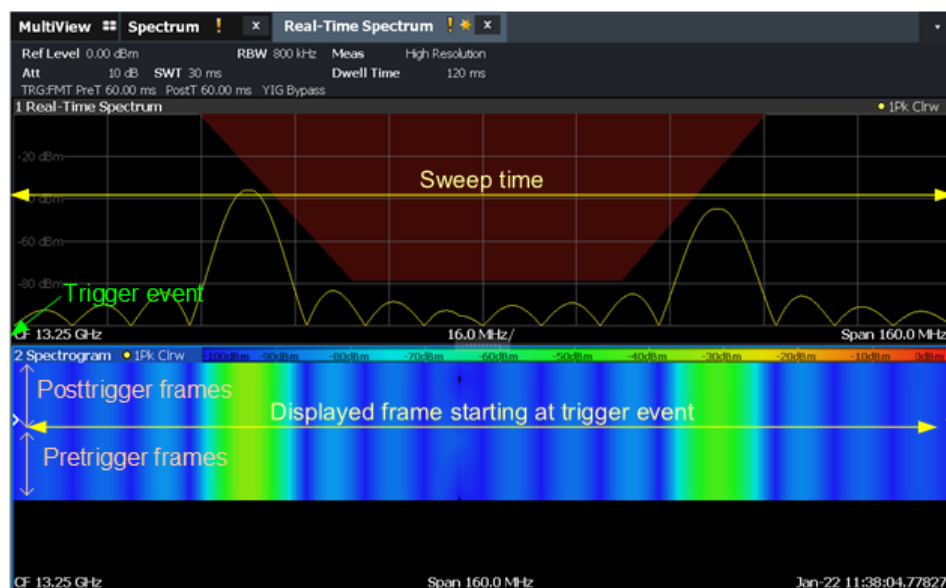


Figure 3-8: Pretrigger, currently displayed, and posttrigger frames

3.4.3 Trigger modes

Possibly you are interested in the results after the first trigger event. For this case, a "Stop on Trigger" option is provided. If active, data acquisition stops after one measurement. The results for that measurement remain on the display, including the pre-trigger and posttrigger periods.

Stop on trigger

When a triggered measurement starts in "Stop on trigger" mode, data is acquired. If a trigger occurs during the pretrigger period, it is ignored. After the pretrigger period, once a trigger occurs, data acquisition continues for the posttrigger period. Then the measurement stops, both for "Run single" and continuous measurement mode. The acquired data is displayed in the frequency domain results without further postprocessing. The trigger event can appear anywhere, depending on the time it occurred within the measurement.

3.5 Working with Spectrogram

In Real-Time measurements, data is captured seamlessly over a specified time. The most recently measured power levels vs. frequency can then be displayed in the "Real-Time Spectrum". In these displays, the results from previous measurements are not included.

However, since the R&S FPL1-K41R Real-Time Spectrum measurements application stores the history of the measured data in its memory, the spectrogram display provides a record of the measured spectrum without gaps. You can then analyze the data in detail later by recalling one of the spectra in the spectrogram history.

3.5.1 Time frames

The time information in the Spectrogram is displayed vertically, along the y-axis. Each line (or trace) of the y-axis represents the data during one sweep time interval and is called a **time frame** or simply "frame". For spectrograms, as with standard spectrum traces, several measured values are combined in one sweep point using the selected detector (see [Section 3.3, "Sweep time and detector"](#), on page 15).

Frames are sorted in chronological order, beginning with the most recently recorded frame at the top of the diagram (frame number 0). With the next sweep, the previous frame is moved further down in the diagram, until the maximum number of captured frames is reached. The display is updated continuously during the measurement, and the measured trace data is stored. Spectrogram displays are continued even after single sweep measurements unless they are cleared manually.



Clearing the Spectrogram

To clear the history buffer and start a new Spectrogram, you must clear it explicitly (see [Section 5.3, "Spectrogram settings"](#), on page 56).

The maximum number of stored frames (history depth) is 3000.

Displaying individual frames

In [Section 3.3, "Sweep time and detector"](#), on page 15, the term "frame" was introduced as *one spectrum containing all FFTs calculated and combined from the sampled*

data in one sweep time period. Thus, one frame/line in the spectrogram corresponds to one spectrum in the "Real-Time Spectrum" view.

The Spectrogram diagram includes all stored frames since it was last cleared. Arrows on the left and right border of the Spectrogram indicate the currently selected frame.

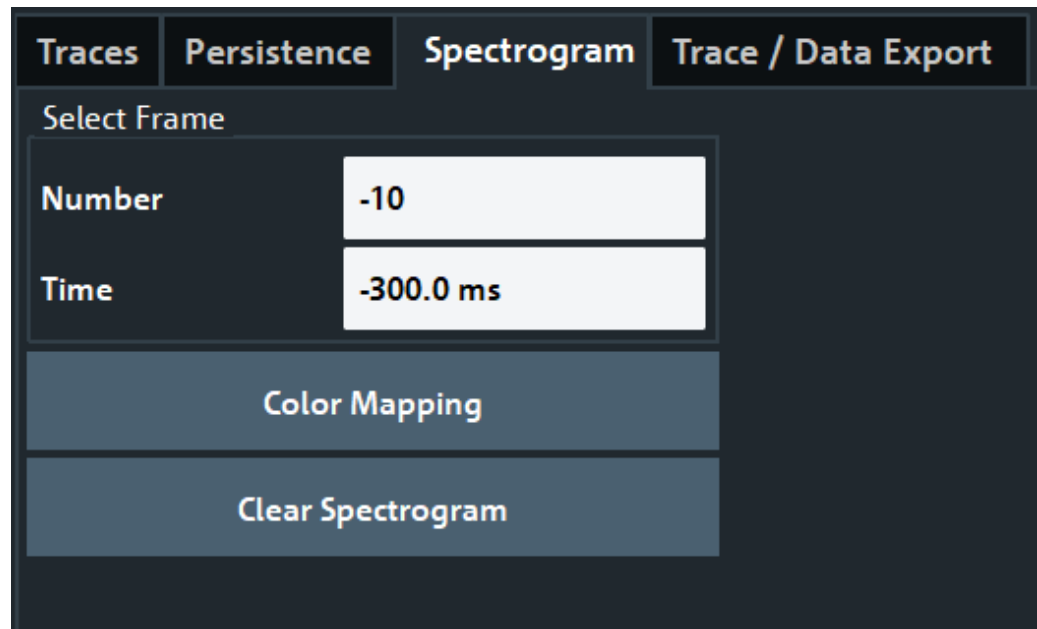


Figure 3-9: Display of a selected frame in the spectrogram

The Real-Time Spectrum diagram always displays the Real-Time Spectrum for the currently selected frame. The current frame number (or alternatively a time stamp, if activated) is indicated in the diagram footer of the Spectrogram. The most recent frame, displayed at the top of the diagram, is frame number 0. Older frames further down in the diagram are indicated by a negative index, e.g. "-10". You can display the Real-Time Spectrum diagram of a previous frame by selecting a different frame number.



Displaying pretrigger and posttrigger results

By default, the frame displayed in the Real-Time Spectrum results is the frame that begins with the trigger event. To display *pretrigger* results, if available, select a frame in the Spectrogram *beneath* the currently selected frame. To display *posttrigger* results (after the sweep time), if available, select a frame in the Spectrogram *above* the currently selected frame.



Scrolling through frames of a spectrogram

The Real-Time Spectrum diagram always displays a single frame of the Spectrogram, namely the currently selected frame. To scroll through the frames of the Spectrogram as they were recorded, use the rotary knob or arrow keys to change the selected frame continuously. The index or time stamp is increased or decreased in steps of one frame.

Time stamps vs. frame index

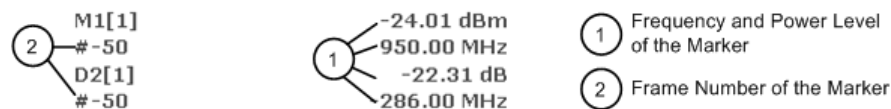
By default, the time information of the selected frame is provided as a time stamp in the footer of the Spectrogram. The time stamp shows the time and date that the selected frame was recorded. The length of one frame corresponds to the sweep time. To select a specific frame, you have to enter the (negative) time in seconds, relative to the frame that was recorded last. The largest (absolute) time available is the sweep time multiplied with the number of sweeps performed since the diagram was last cleared.

Alternatively to time stamps, the time information can be provided as an index. The index is also relative to the frame that was recorded last, which has the index number 0. The lowest index is a negative number that corresponds to the history depth. To select a specific frame, you have to enter the (negative) index number of the frame you want to analyze.

3.5.2 Markers in the spectrogram

Markers and delta markers are shaped like diamonds in the spectrogram. They are only displayed in the spectrogram if the marker position is inside the visible area of the spectrogram. If more than two markers are active, the marker values are displayed in a separate marker table.

In the spectrum and spectrogram result display, the markers and their frequency and level values (1) are displayed as usual. In the spectrogram result display, the frame number or timestamp is shown to indicate the position of the marker in time, depending on whether the timestamp has been activated in the marker settings. (2)



In the spectrogram result display, you can activate up to 16 markers or delta markers at the same time. Each marker can be assigned to a different frame. Therefore, in addition to the frequency you also define the frame number when activating a new marker. The frame to which a marker is assigned automatically becomes the currently selected frame. If no frame number is specified, the marker is positioned on the currently selected frame. (The selected frame is indicated by small white arrows on the left and right border of the diagram.)

All markers are visible that are positioned on a visible frame. Special search functions are provided for spectrogram markers (see [Section 5.7.3, "Marker search settings"](#), on page 68) to include the frame information as search criteria.

In the spectrum result display, only the markers positioned on the currently selected frame are visible. Thus, in "Continuous Sweep" mode, only markers positioned on frame 0 are visible. To view markers that are positioned on a frame other than frame 0 in the spectrum result display, you must stop the measurement and select the corresponding frame.

3.5.3 Color maps

Spectrogram displays assign power levels to different colors to visualize them. The legend above the Spectrogram display describes the power levels the colors represent. Similarly, "Persistence Spectrum" displays assign colors to the relative numbers of occurrence (percentage) of specific power levels.

The color display is highly configurable to adapt the spectrograms to your needs. You can define:

- Which colors to use (Color scheme)
- Which value range to apply the color scheme to
- How the colors are distributed within the value range, i.e. where the focus of the visualization lies (shape of the color curve)

The individual colors are assigned to the power levels automatically by the FPL.

The Color Scheme

- **Hot**



Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.

- **Cold**



Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.

The "Cold" color scheme is the inverse "Hot" color scheme.

- **Radar**



Uses a color range from black over green to light turquoise with shades of green in between. Dark colors indicate low levels, light colors indicate high ones.

- **Grayscale**



Shows the results in shades of gray. Dark gray indicates low levels, light gray indicates high ones.

The value range of the color map

If the measured values only cover a small area in the spectrogram, you can optimize the displayed value range. Then it becomes easier to distinguish between values that are close together. Display only parts of interest.

The shape and focus of the color curve

The color-mapping function assigns a specified color to a specified power level in the spectrogram display. By default, colors on the color map are distributed evenly. How-

ever, to visualize a certain area of the value range in greater detail than the rest, you can set the focus of the color mapping to that area. Changing the focus is performed by changing the shape of the color curve.

The color curve is a tool to shift the focus of the color distribution on the color map. By default, the color curve is linear. If you shift the curve to the left or right, the distribution becomes non-linear. The slope of the color curve increases or decreases. One end of the color palette then covers a large range of results, while the other end distributes several colors over a relatively small result range.

You can use this feature to put the focus on a particular region in the diagram and to be able to detect small variations of the signal.

Example:

In the color map based on the linear color curve, the range from -100 dBm to -60 dBm is covered by blue and a few shades of green only. The range from -60 dBm to -20 dBm is covered by red, yellow and a few shades of green.

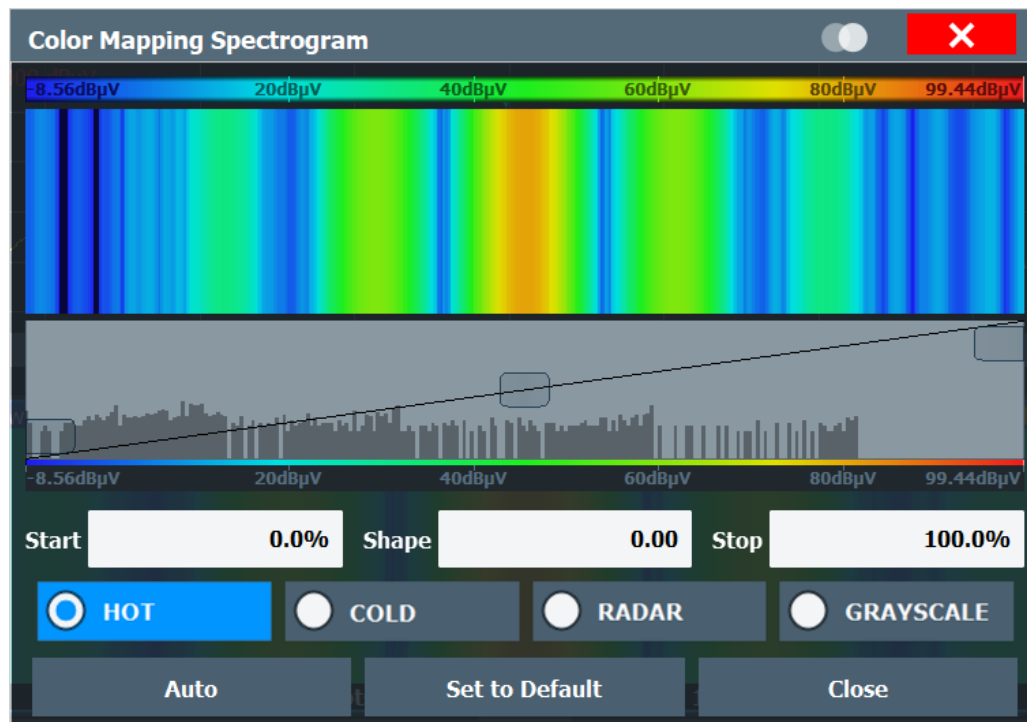


Figure 3-10: Spectrogram with (default) linear color curve shape = 0

The sample spectrogram is dominated by blue and green colors. After shifting the color curve to the left (negative value), more colors cover the range from -100 dBm to -60 dBm (blue, green and yellow). This range occurs more often in the example. The range from -60 dBm to -20 dBm, on the other hand, is dominated by various shades of red only.

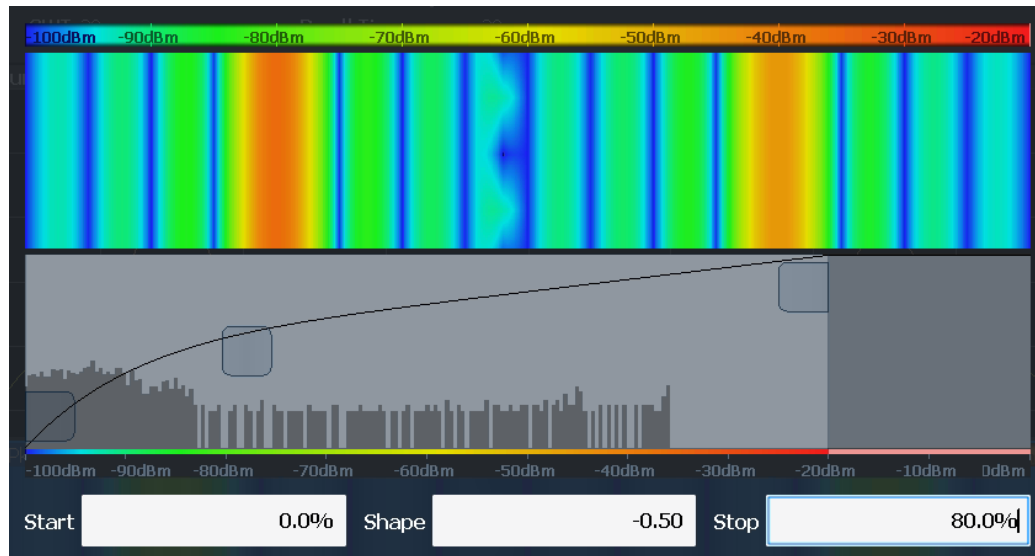


Figure 3-11: Spectrogram with non-linear color curve (shape = -0.5)

3.6 Understanding persistence

Persistence describes the duration that past histogram traces remain visible in the display before fading away.

Historical term

The term persistence has its origins in cathode ray tube devices (CRTs). It describes the time period one point on the display stays illuminated after it has been lit by the cathode ray. The higher the persistence, the longer you could observe the illuminated point on the display.

Moving density

In the "Persistence Spectrum" result display, the persistence results from the moving 'density' (like a moving average) over a certain number of traces. The number of traces that are considered to calculate the density depends on the user-definable persistence duration. The longer the persistence, the more traces are part of the calculation and the deeper the history of displayed information gets. A spectral event that has occurred a single time is visible for up to 8 seconds. As densities get smaller at coordinates with signal parts that are not constantly there, the trace color changes. The rate of the color change is high with a low persistence and low with a high persistence.

Detecting changes over time

Note that a signal with constant frequency and level characteristics does not show the effects of persistence on the trace. As soon as the power or frequency of a signal change slightly, however, the effect of persistence becomes visible through color changes or changes in the shape of the trace.

You can remove persistence by setting its duration to 0 seconds.

Persistence Granularity

The amount of data that the FPL uses to draw a single frame in the persistence spectrum is fixed, i.e. by default, the data that is captured in 33 ms is used to calculate a frame. The time period in which data is captured and the mentioned density is calculated is referred to as the *persistence granularity*.

A single histogram frame is calculated during the persistence granularity time. An initially empty matrix with for example 600 by 819 elements, representing 600 discrete power levels and 819 discrete frequency steps, is provided at the beginning of each histogram frame. After each newly calculated FFT, the matrix is updated according to the occurrence of each frequency/level pair. Every time the persistence granularity interval is completed, the matrix is reset to zero for each element and a new histogram frame is started.

Example: Calculating an individual persistence frame

Figure 3-12 demonstrates this process with a 6 by 8 elements matrix and a ratio of 2 for FFT time to granularity. Thus, two FFTs are calculated for each frame. Both FFTs contain the same signal and varying noise neighboring the signal. The FFTs are converted into a matrix of frequency/level pairs. The two matrices are summed up into the result matrix. The result matrix determines the color of the result trace in the histogram. In this example, red corresponds to a high count or probability, whereas the noise band is displayed in blue for a lower probability.

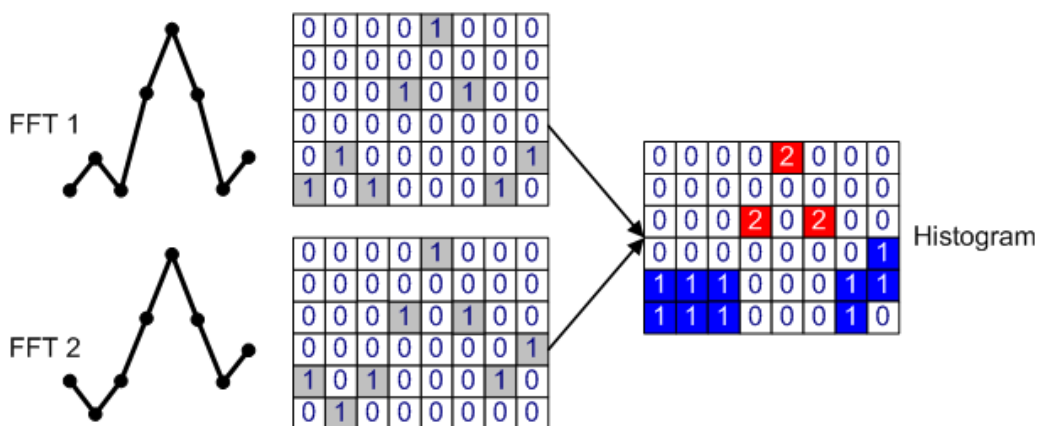


Figure 3-12: Schematic illustration of histogram calculation (dot style)



"Persistence Spectrum" and detectors

The "Persistence Spectrum" display calculates persistence and histogram information directly from the FFT results. There is no need to use detectors for data reduction as in the spectrogram, since the histogram algorithm already reduces data to a rate that can easily be displayed. For persistence spectrum results, the detector setting affects only the "Max hold" values that can be plotted on top of the persistence spectrum (see [Section 3.6.1, "Analyzing maximum density - Max hold function"](#), on page 30).

Matrix style

The individual traces in the persistence spectrum can be displayed using dots.

The FFT matrices in [Figure 3-12](#) contain only a single value per frequency column. This value is the level value returned by the FFT. The example shows a matrix in dot style, i.e. the matrices are filled with dots only. Note that the resulting diagram can contain "holes" where signal levels for neighboring probabilities differ strongly.



Color mapping for different matrix styles

Color mapping for the persistence spectrum is identical to color mapping for the spectrogram or waterfall diagrams. The truncating function is especially useful to display only spectral components of a certain probability (see below).

Usually, you must adjust the color-mapping value range after changing the persistence style from vector to dot or vice versa, as the resulting probabilities can vary significantly as explained above.

For details on color mapping, see [Section 3.5.3, "Color maps"](#), on page 24.

Truncating the persistence spectrum

By default, results outside the defined value range of the color map are displayed in the colors for the minimum or maximum values in the range.

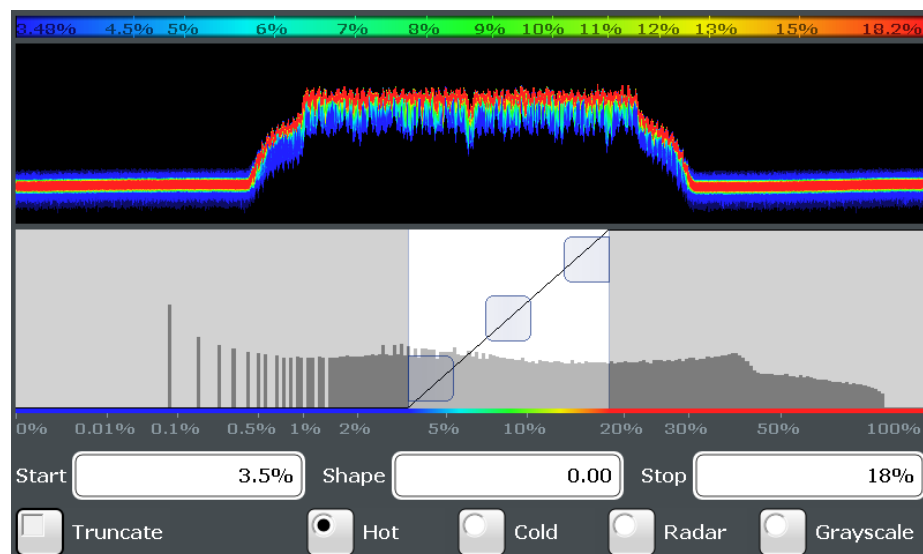


Figure 3-13: Default persistence spectrum coloring without truncating

Usually you restrict the value range displayed by the color map because only specific values are of interest. In that case, you can hide (or *truncate*) the results of the persistence spectrum outside the value range of the color map. Restricting the value range makes the display of the remaining - relevant - results clearer (see [Figure 3-14](#)), and allows you to eliminate the effects of noise, for example.

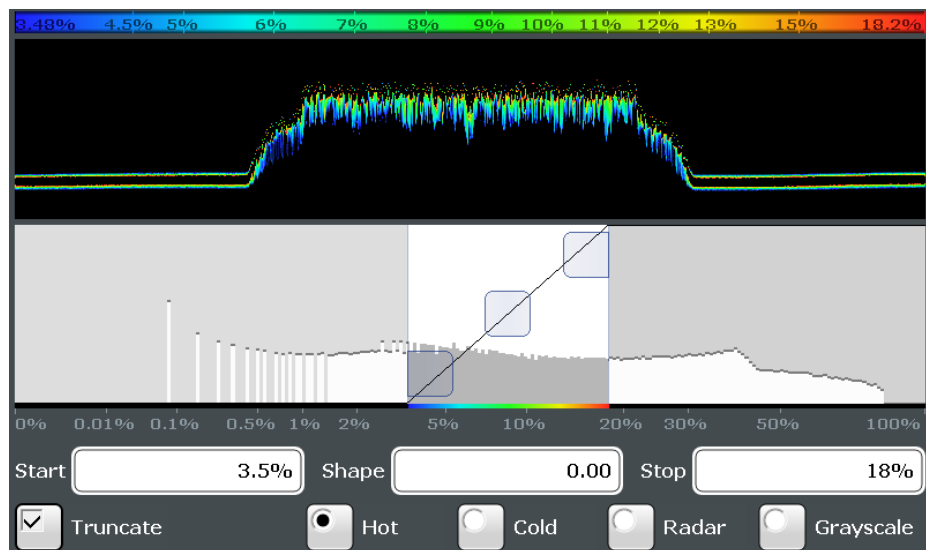


Figure 3-14: Persistence spectrum with truncated coloring

3.6.1 Analyzing maximum density - Max hold function

During analysis of a time-variant signal, level variations are usually of great interest; in particular, the ratio between the current signal and the maximum measured signal. The currently measured Real-Time spectrum is displayed as a standard trace in clear/write mode with a peak detector in the "Persistence Spectrum" diagram.

An optional "Max hold" function indicates the maximum probabilities ever measured during the entire measurement for each point in the diagram. It allows for a worst-case estimation of signal-to-noise-ratios (SNR), when talking about noise or interferers. For useful signals, it allows for an estimation of amplitude variation. The "Persistence Spectrum" display can display the "Max hold" values on top of the persistence spectrum diagram. As mentioned above, the persistence colors fade out by reducing their intensity over time. The "Max hold" values, on the other hand, are assigned a time-independent intensity value to allow you to distinguish the "Max hold" values and the current persistence spectrum.

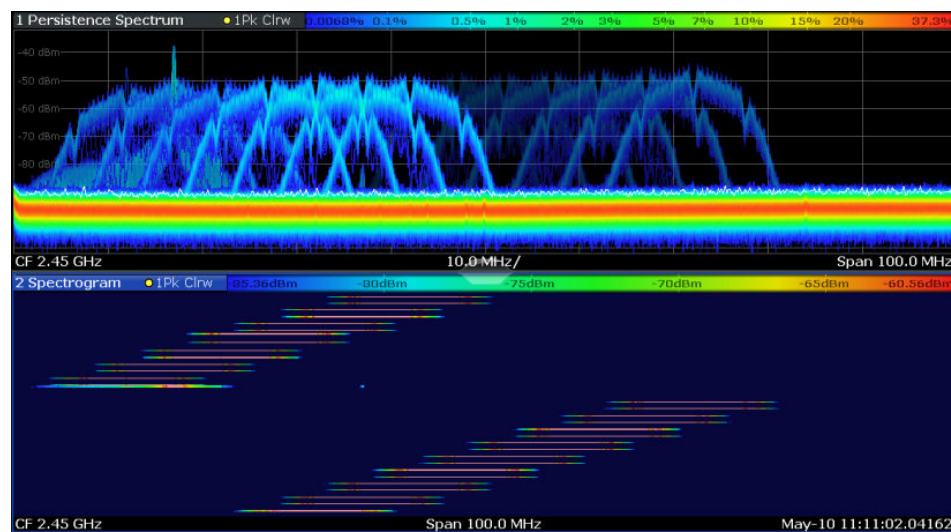


Figure 3-15: Persistence Spectrum with Max hold trace and Spectrogram display

Changing the color intensity

By default, the "Max hold" values are displayed. You can disable the function explicitly, or hide the values by reducing the color intensity to its minimum. The maximum intensity corresponds to one of the current "Persistence Spectrum" displays. Stored "Max hold" values are cleared automatically after each new setting, and can be reset manually by the user.

For details on all settings concerning the "Max Hold" function and the "Persistence Spectrum" display in general, see [Section 5.2, "Persistence spectrum settings"](#), on page 54.

4 Configuring the R&S FPL1-K41R Real-Time Spectrum measurements application

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

Real-Time Spectrum measurements on standard RF input require a special application on the FPL.



When you activate a measurement channel for the R&S FPL1-K41R Real-Time Spectrum measurements application, a Real-Time Spectrum measurement for the input signal is started automatically with the default configuration. The "Real-Time Config" menu is displayed and provides access to the most important configuration functions.

For a description see

- [Section 5.2, "Persistence spectrum settings"](#), on page 54
- [Section 5.3, "Spectrogram settings"](#), on page 56
- [Section 5.4, "Color map settings"](#), on page 58
- [Section 4.6.2, "Frequency mask trigger configuration"](#), on page 45
- [Section 5.1, "Display configuration"](#), on page 54
- [Section 5.8, "Zoom functions"](#), on page 73

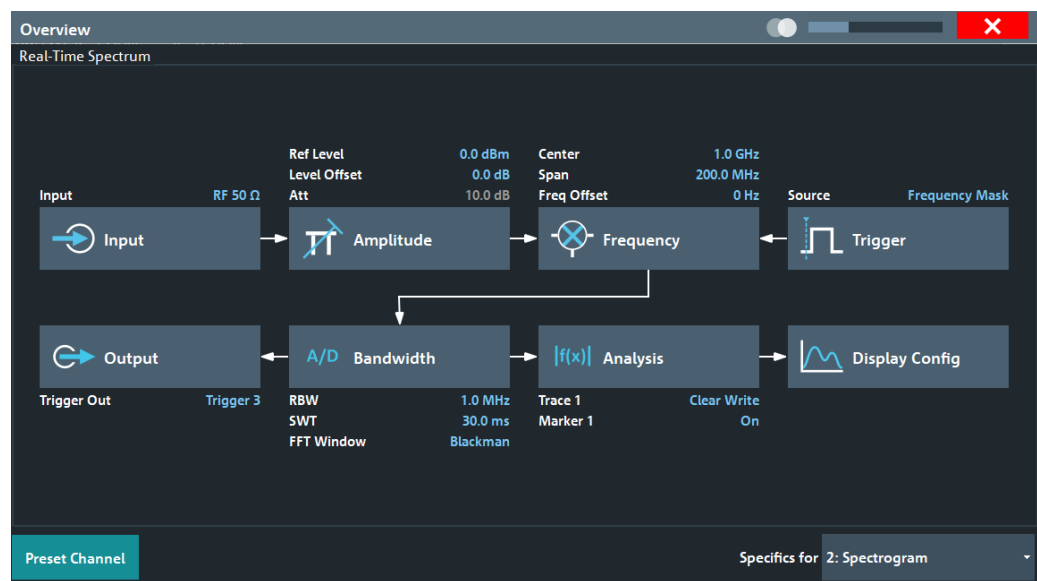
• Configuration overview	32
• Input settings	34
• Frequency and span settings	36
• Amplitude settings	39
• Scaling the y-axis	42
• Trigger configuration	43
• Bandwidth and sweep settings	49
• Adjusting settings automatically	52

4.1 Configuration overview



Access: all menus

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview" dialog box.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".



Multiple access paths to functionality

The easiest way to configure a measurement channel is via the "Overview" dialog box. In this documentation, only the most convenient method of accessing the dialog boxes is indicated - usually via the "Overview" dialog box.

In particular, the "Overview" dialog box provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Input
See [Section 4.2, "Input settings"](#), on page 34
2. Amplitude
See [Section 4.4, "Amplitude settings"](#), on page 39
3. Frequency
See [Section 4.3, "Frequency and span settings"](#), on page 36
4. (Optionally:) Trigger
See [Section 4.6, "Trigger configuration"](#), on page 43
5. Bandwidth
See [Section 4.7, "Bandwidth and sweep settings"](#), on page 49
6. Analysis
See [Section 5, "Analysis"](#), on page 54
7. Display Configuration

See [Section 5.1, "Display configuration"](#), on page 54

To configure settings

- Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

For step-by-step instructions on configuring Real-Time Spectrum measurements, see [Section 6, "How to perform Real-Time Spectrum measurements"](#), on page 74 .

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.

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

Remote command:

`SYSTem:PRESet:CHANnel [:EXEC]` on page 90

Specific Settings for

The channel setup can contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

4.2 Input settings

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

The input source determines which data the FPL analyzes.

The default input source for the FPL is "Radio Frequency", i.e. the signal at the "RF Input" connector of the FPL. If no additional options are installed, this is the only available input source.

- [Radio frequency input](#)..... 34

4.2.1 Radio frequency input

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

Radio Frequency	On	Off
Input Coupling	AC	DC
Impedance	50Ω	75Ω
YIG-Preselector	On	Off
SAW Filter	Auto	Off
Input Connector	RF	



RF Input Protection

The RF input connector of the FPL must be protected against signal levels that exceed the ranges specified in the specifications document. Therefore, the FPL is equipped with an overload protection mechanism. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

The RF input connector of the FPL must be protected against signal levels that exceed the ranges specified in the specifications document. Therefore, the FPL is equipped with an overload protection mechanism for DC and signal frequencies up to 30 MHz. This mechanism becomes active as soon as the power at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

When the overload protection is activated, an error message is displayed in the status bar ("INPUT OVLD"), and a message box informs you that the RF input was disconnected. Furthermore, a status bit (bit 3) in the `STAT:QUES:POW` status register is set. In this case, you must decrease the level at the RF input connector and then close the message box. Then measurement is possible again. Reactivating the RF input is also possible via the remote command `INPut:ATTenuation:PROtection:RESet`.

Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:

`INPut:SELEct` on page 92

Input Coupling

The RF input of the R&S FPL1044 can be coupled by alternating current (AC) or direct current (DC).

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

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

Remote command:

`INPut:COUPling` on page 91

Impedance

For some measurements, the reference impedance for the measured levels of the FPL can be set to 50 Ω or 75 Ω .

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

Remote command:

`INPut:IMPedance` on page 92

YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires the option R&S FPL1-B11 on the FPL.

Note: Note that the YIG-preselector is active only on frequencies greater than 6 GHz (for models R&S FPL1014 and R&S FPL1026) or frequencies greater than 7 GHz (for model R&S FPL1044). Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

For measurements that require I/Q analysis in large bandwidths at frequencies higher than 6 GHz (R&S FPL1014 and R&S FPL1026) or 7 GHz (R&S FPL1044), it is strongly recommended that you disable the YIG-preselector.

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 92

SAW filter

The FPL hardware contains both a wide and a narrow IF path. Depending on the used analysis bandwidth, the FPL determines which IF path to use automatically. The wide IF path allows for a smoother signal at the center frequency, while the narrow IF path suppresses possibly distorting signals further away from the center frequency. Using this setting, you can affect which IF path is used.

"Auto" The FPL determines which IF path to use automatically, depending on the used analysis bandwidth.

"Off" The wide IF path is always used.

Remote command:

`INPut:FILTer:SAW` on page 92

4.3 Frequency and span settings

Access: "Overview" > "Frequency"

Frequency

Frequency/Span

Center

13.25 GHz

Full Span

Span

160.0 MHz

Start

13.17 GHz

Last Span

Stop

13.33 GHz

Center Frequency Stepsize

Stepsize

0.1 * Span

X-Factor

10.0 %

Frequency Offset

Value

0.0 Hz

Center Frequency.....	37
Center Frequency Stepsize.....	37
Span.....	38
Full Span.....	38
Last Span.....	38
Start / Stop.....	38
Frequency Offset.....	38

Center Frequency

Defines the center frequency of the signal in Hertz.

Remote command:

[SENSe:] FREQuency:CENTer on page 99

Center Frequency Stepsize

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

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

- "X * Span" Sets the step size for the center frequency to a defined factor of the span. The "X-Factor" defines the percentage of the span. Values between 1 % and 100 % in steps of 1 % are allowed. The default setting is 10 %.
- "= Center" Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.
- "Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:

[SENSe:] FREQuency:CENTer:STEP on page 99

Span

Allows you to manually define the frequency span (also referred to as "real-time bandwidth") depending on the resolution bandwidth.

The center frequency is kept constant. The allowed range depends on the installed real-time option and is specified in the specifications document.

If the span is changed, the RBW is automatically adjusted.

Remote command:

[SENSe:] FREQuency:SPAN on page 100

Full Span

Sets the span to the full frequency range of the FPL specified in the specifications document. This setting is useful for overview measurements.

Remote command:

[SENSe:] FREQuency:SPAN:FULL on page 101

Last Span

Sets the span to the previous value. With this function you can switch between an overview measurement and a detailed measurement quickly.

Remote command:

[SENSe:] FREQuency:SPAN on page 100

Start / Stop

Defines the start and stop frequencies.

Remote command:

[SENSe:] FREQuency:START on page 100

[SENSe:] FREQuency:STOP on page 100

Frequency Offset

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

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

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

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

Remote command:

[SENSe:] FREQuency:OFFSet on page 100

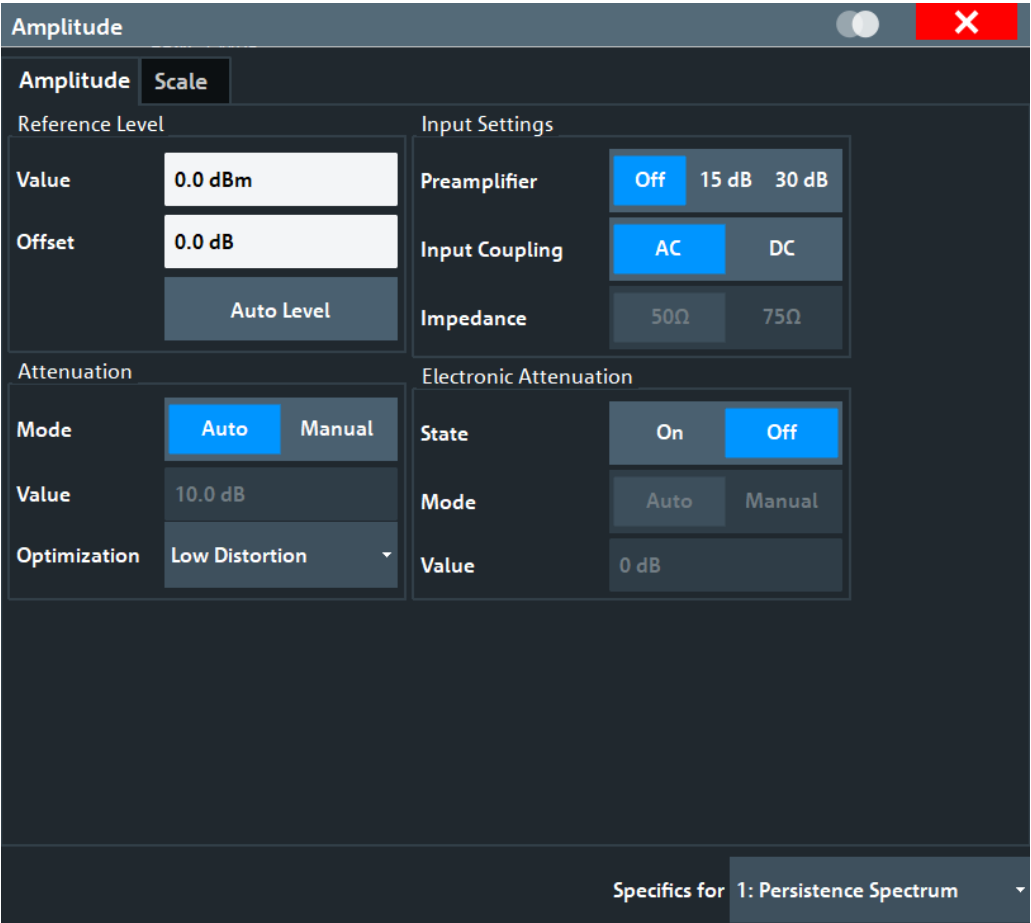
4.4 Amplitude settings

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

Amplitude settings determine how the FPL must process or display the expected input power levels.

Configuring amplitude settings allows you to:

- Adapt the instrument hardware to the expected maximum signal level by setting the [Reference Level](#) to this maximum
- Consider an external attenuator or preamplifier (using the "Offset").
- Optimize the SNR of the measurement for low signal levels by configuring the [Reference Level](#) as high as possible without introducing compression, clipping or overload. Use early amplification by the preamplifier and a low attenuation.
- Optimize the SNR for high signal levels and ensure that the instrument hardware is not damaged, using high attenuation and AC coupling (for DC input voltage).



Reference Level.....	40
L Shifting the Display (Offset).....	40
L Setting the Reference Level Automatically (Auto Level).....	40

Attenuation Mode / Value.....	40
Using Electronic Attenuation.....	41
Input Settings.....	41

Reference Level

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

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel`
on page 94

Shifting the Display (Offset) ← Reference Level

Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

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

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

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

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 95

Setting the Reference Level Automatically (Auto Level) ← Reference Level

Automatically determines a reference level which ensures that no overload occurs at the FPL for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the FPL.

If necessary, you can optimize the reference level further. Decrease the attenuation level manually to the lowest possible value before an overload occurs, then decrease the reference level in the same way.

Remote command:

`[SENSe:]ADJust:LEVel` on page 125

Attenuation Mode / Value

Defines the attenuation applied to the RF input of the FPL.

The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). Automatic attenuation ensures that no overload occurs at the RF Input connector for the current reference level. It is the default setting.

In "Manual" mode, you can set the RF attenuation in 5 dB steps down to 0 dB (with option R&S FPL1-B25: in 1 dB steps). Other entries are rounded to the next integer value. The range is specified in the specifications document. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed.

NOTICE! Risk of hardware damage due to high power levels. When decreasing the attenuation manually, ensure that the power level does not exceed the maximum level allowed at the RF input, as an overload can lead to hardware damage.

Remote command:

`INPut:ATTenuation` on page 95

`INPut:ATTenuation:AUTO` on page 96

Using Electronic Attenuation

If the (optional) Electronic Attenuation hardware is installed on the FPL, you can also activate an electronic attenuator.

In "Auto" mode, the settings are defined automatically; in "Manual" mode, you can define the mechanical and electronic attenuation separately.

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) above 7 GHz.

In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation can provide a better signal-to-noise ratio, however.

When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation can be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

The electronic attenuation can be varied in 1 dB steps. If the electronic attenuation is on, the mechanical attenuation can be varied in 5 dB steps. Other entries are rounded to the next lower integer value.

If the defined reference level cannot be set for the given attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed in the status bar.

Remote command:

`INPut:EATT:STATe` on page 93

`INPut:EATT:AUTO` on page 96

`INPut:EATT` on page 93

Input Settings

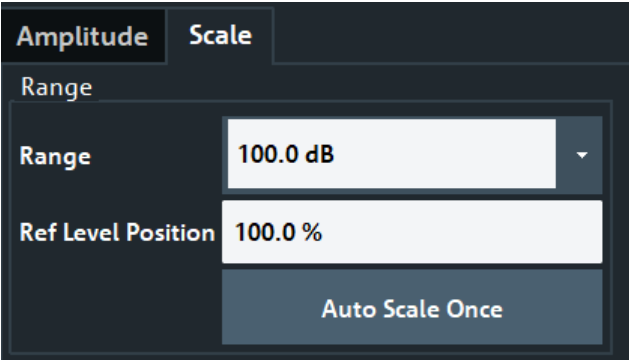
Some input settings affect the measured amplitude of the signal, as well.

The parameters "Input Coupling" and "Impedance" are identical to those in the "Input" settings.

4.5 Scaling the y-axis

The individual scaling settings that affect the vertical axis are described here.

Access: "Overview" > "Amplitude" > "Scale" tab
Or: [AMPT] > "Scale Config"



Range.....	42
Ref Level Position.....	42
Auto Scale Once.....	42

Range
Defines the displayed y-axis range in dB.
The default value is 100 dB.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 96

Ref Level Position
Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %.
0 % corresponds to the lower and 100 % to the upper limit of the diagram.
Values from -120 % to +280 % are available.

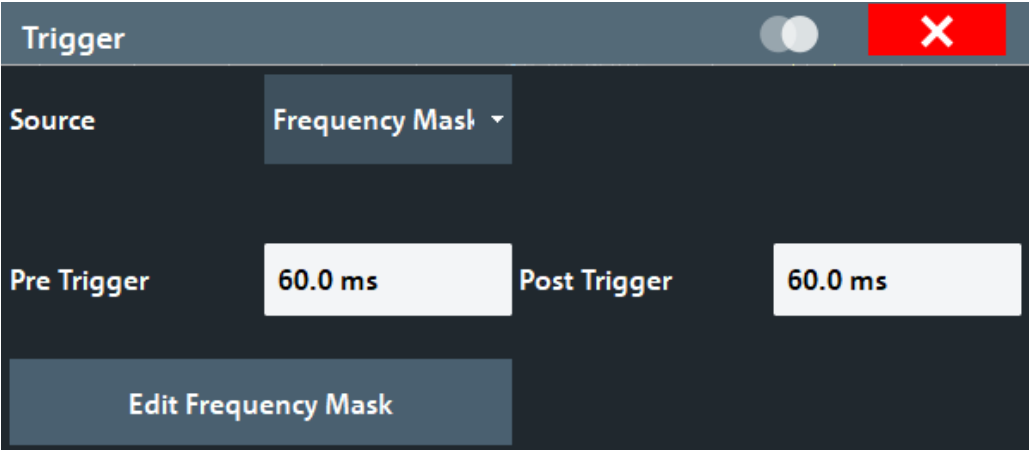
Larger values are useful for small scales, such as a power range of 10 dB or 20 dB, and low signal levels, for example 60 dB below the reference level. In this case, large reference level position values allow you to see the trace again.
Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 98

Auto Scale Once
Automatically determines the optimal range and reference level position to be displayed for the current measurement settings.
The display is only set once; it is not adapted further if the measurement settings are changed again.

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

4.6 Trigger configuration

Access: "Overview" > "Trigger"



- [Trigger source settings](#).....43
- [Frequency mask trigger configuration](#).....45

4.6.1 Trigger source settings

Trigger settings determine when the input signal is measured.

Trigger Source	43
L Free Run	43
L Frequency Mask	44
Pretrigger capture time	44
Posttrigger capture time	44
Trigger mode (Stop on Trigger)	44
Edit Frequency Mask	44

Trigger Source

Defines the trigger source. If a trigger source other than "Free Run" is set, "TRG" is displayed in the channel bar and the trigger source is indicated.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 106

Free Run ← Trigger Source

No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitly.

Remote command:

TRIG:SOUR IMM, see TRIGger[:SEquence]:SOURce on page 106

Frequency Mask ← Trigger Source

Triggers when the measured signal violates the (selected) user-defined frequency mask.

For details see [Section 3.4.1, "Triggering on specific frequency events \(frequency mask trigger\)"](#), on page 16.

Remote command:

TRIG:SOUR MASK, see TRIGger[:SEquence]:SOURce on page 106

Pretrigger capture time

Defines a time period *before* the actual trigger event in which data is also captured, in addition to the posttrigger time.

In this case, one or more additional frames will be available in the Spectrogram *beneath* the frame displayed in the "Real-Time Spectrum" diagram window by default.

Remote command:

TRIGger[:SEquence]:PRETrigger[:TIME] on page 106

Posttrigger capture time

Defines a time period *after* the actual trigger event in which data is captured.

Posttrigger data after the sweep time are displayed as additional frames in the Spectrogram *above* the frame displayed in the "Real-Time Spectrum" diagram window by default.

Remote command:

TRIGger[:SEquence]:POSTtrigger[:TIME] on page 105

Trigger mode (Stop on Trigger)

Determines the behavior of the R&S FPL1-K41R Real-Time Spectrum measurements application after a trigger event.

"Stop on Trigger"	The trigger is not rearmed after the first trigger event has occurred; thus, the measurement stops after one sweep. The measurement results for that sweep remain on the display, including the pretrigger and posttrigger periods. Note, however, that if the trigger event occurs before the defined pretrigger time has elapsed, the period between measurement start and the trigger event is shorter than the defined pretrigger time.
-------------------	---

Remote command:

TRIGger:MODE on page 105

Edit Frequency Mask

Opens the "Edit Frequency Mask" dialog box.

For details see [Section 4.6.2, "Frequency mask trigger configuration"](#), on page 45.

4.6.2 Frequency mask trigger configuration

The Frequency Mask Trigger (FMT) is a mask in the frequency domain, which is checked with every calculated FFT. When a specific condition concerning this mask occurs during the measurement of the input signal, data capturing is triggered.

When configuring a frequency mask, consider the effects an active transducer can have on the measurement results.

For details on transducers, see the FPL user manual.

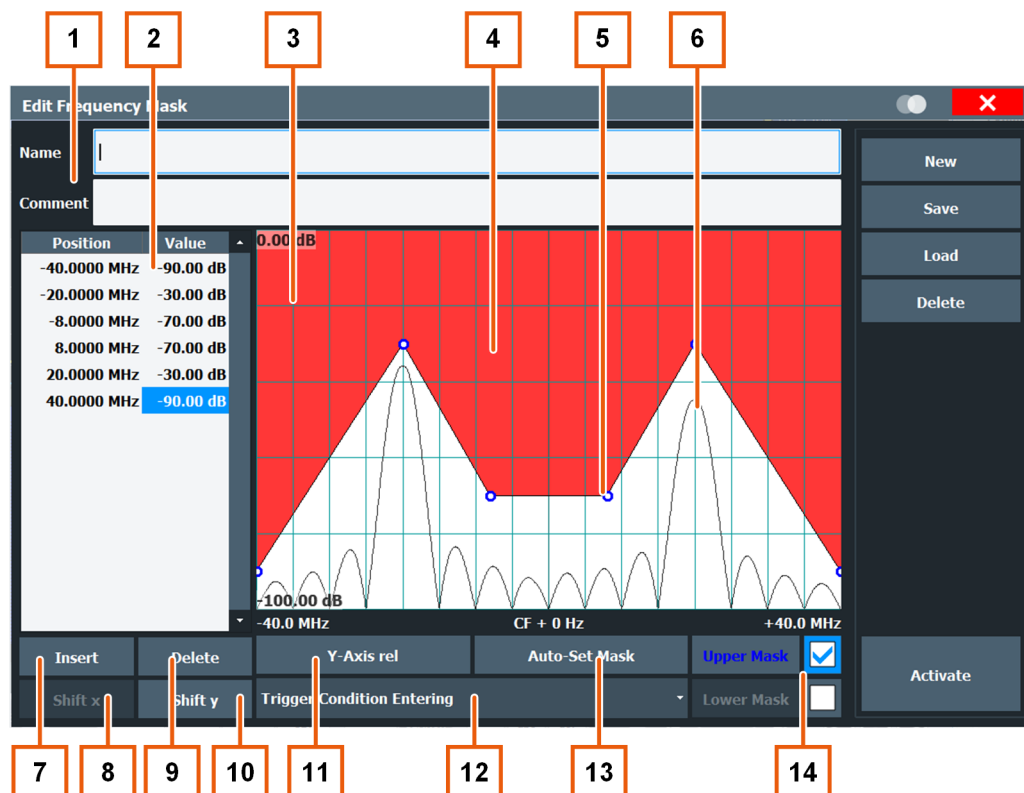


Figure 4-1: Edit Frequency Mask dialog box

- 1 = Name and description of the frequency mask
- 2 = Mask point table: list of position/value pairs defining mask coordinates
- 3 = Preview pane
- 4 = Frequency mask preview: the area the frequency mask currently covers is red
- 5 = Frequency mask mask points: define the shape of the frequency mask
- 6 = Preview of the current measurement trace; type and shape depend on currently selected measurement
- 7 = Insert: inserts a new mask point
- 8 = Shift X: shifts the complete frequency mask horizontally
- 9 = Delete: deletes an existing mask points
- 10 = Shift Y: shifts the complete frequency mask vertically
- 11 = Y-Axis Rel/Abs: switches between relative (dB) and absolute (dBm) amplitude values
- 12 = Auto Set Mask: creates a frequency mask automatically
- 13 = Trigger Condition selection: sets the trigger condition
- 14 = Upper Line/Lower Line: selects/deselects the upper and lower frequency mask lines



When you close the "Edit Frequency Mask" dialog box, the trigger source is not automatically set to "FMT". You must activate it manually (see ["Activate"](#) on page 46).

4.6.2.1 Frequency mask management

As frequency masks can have a very complex structure, they can be stored for later use with other signals. The masks are stored in a file with the extension `.FMT` in the `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask` directory. By default, the mask name is used as the file name; however, it can be edited.

New

Clears the current mask configuration to define a new frequency mask.

Remote command:

`CALCulate<n>:MASK:NAME` on page 110

Save

Opens a file selection dialog box to save the current frequency mask configuration in a file.

By default, the mask name is used as the file name; however, it can be edited.

The mask is stored in a file with the extension `.FMT` in the

`C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask` directory.

Remote command:

Define mask name: `CALCulate<n>:MASK:NAME` on page 110

Load

Opens a file selection dialog box to restore a saved frequency mask.

The dialog box contains all frequency masks with the extension `.FMT` in the

`C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask` directory.

Select the required mask and confirm the selection with "Load".

Remote command:

Load mask: `CALCulate<n>:MASK:NAME` on page 110

Delete

Opens a file selection dialog box to delete a previously saved frequency mask.

If confirmed, the file is deleted.

Remote command:

`CALCulate<n>:MASK:DELeTe` on page 107

Activate

Only selected masks are used for triggering. To deselect a mask, remove the check-mark that defines the mask as an upper or lower mask (see ["Selecting and deselecting upper and lower masks"](#) on page 48).

Remote command:

`TRIG:SOUR MASK`, see `TRIGger[:SEquence]:SOURce` on page 106

4.6.2.2 Frequency mask definition

The "Edit Frequency Mask" dialog box provides a basic structure of an upper frequency mask in the live preview window.

Name

Defines the name of the frequency mask. This name is used as the default file name for storage.

Remote command:

`CALCulate<n>:MASK:NAME` on page 110

Comment

An optional description of the frequency mask.

Remote command:

`CALCulate<n>:MASK:COMMeNt` on page 107

Mask points

Each mask is defined by a minimum of 2 and a maximum of 1001 mask points. Each mask point is defined by its position (x-axis) and value (y-value). Mask points must be defined in ascending order and have unique positions.

Remote command:

`CALCulate<n>:MASK:UPPer[:DATA]` on page 111

`CALCulate<n>:MASK:LOWer[:DATA]` on page 109

Inserting points

Inserts a mask point in the frequency mask above the selected one in the "Position/Value" list and the preview pane.

Remote command:

Redefine the list of data points:

`CALCulate<n>:MASK:UPPer[:DATA]` on page 111

`CALCulate<n>:MASK:LOWer[:DATA]` on page 109

Deleting points

Deletes the selected mask point in the "Position/Value" list and the preview pane.

Remote command:

Redefine the list of data points:

`CALCulate<n>:MASK:UPPer[:DATA]` on page 111

`CALCulate<n>:MASK:LOWer[:DATA]` on page 109

Shifting the mask position horizontally (Shift x)

Shifts the x-value (position) of each mask point horizontally by the defined shift width.

Remote command:

`CALCulate<n>:MASK:UPPer:SHIFt:X` on page 110

`CALCulate<n>:MASK:LOWer:SHIFt:X` on page 108

Shifting the mask vertically (Shift y)

Shifts the y-value of each mask point vertically by the defined shift height

Remote command:

`CALCulate<n>:MASK:UPPer:SHIFt:Y` on page 111

`CALCulate<n>:MASK:LOWer:SHIFt:Y` on page 108

Changing the y-axis scaling (Y-Axis rel/abs)

Switches between absolute scaling (in dBm) or relative scaling (in dB) for the mask (y-)values.

Remote command:

`CALCulate<n>:MASK:MODE` on page 109

Defining a mask automatically (Auto-Set Mask)

Defines a mask automatically according to the currently measured data. The mask is configured to follow the measurement trace with a specific distance to the power levels.

Remote command:

`CALCulate<n>:MASK:UPPer:AUTO` on page 110

Setting the trigger condition

Defines how the frequency mask is evaluated to control data acquisition.

- | | |
|------------|---|
| "Entering" | Activates the trigger as soon as the signal enters the frequency mask. To arm the trigger, the signal initially has to be outside the frequency mask. |
| "Leaving" | Activates the trigger as soon as the signal leaves the frequency mask. To arm the trigger, the signal initially has to be inside the frequency mask. |

Remote command:

`TRIGger[:SEquence]:MASK:CONDition` on page 112

Selecting and deselecting upper and lower masks

Select the masks to be used for triggering. Deselecting a mask allows you to configure it in advance without having to use it immediately.

By default, the configured mask is defined to be an upper mask, i.e. the mask is the area *above* the configured mask points. In addition or alternatively, a lower mask can be configured. In a lower mask, the mask is the area *below* the configured mask points.

The lower mask is configured in the same manner as the upper mask. However, it cannot be configured automatically according to the currently measured values ("Auto-Set Mask").

Both upper and lower masks can be configured at the same time, in order to define a "corridor" of allowed values.

Note that selecting an upper or lower mask to be used for a measurement does not automatically activate them. You must also set the trigger source to "Frequency Mask" (see "Activate" on page 46).

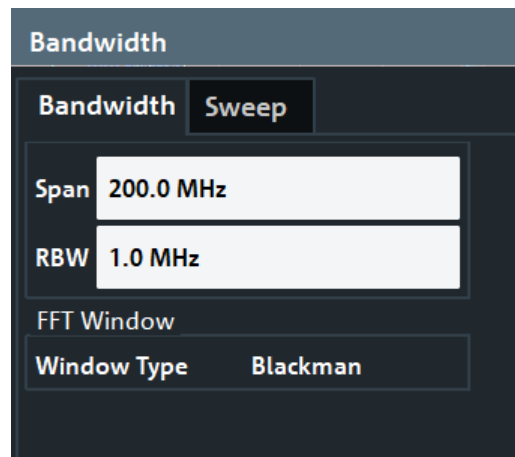
Remote command:

CALCulate<n>:MASK:LOWer:STATe on page 108

CALCulate<n>:MASK:UPPer:STATe on page 111

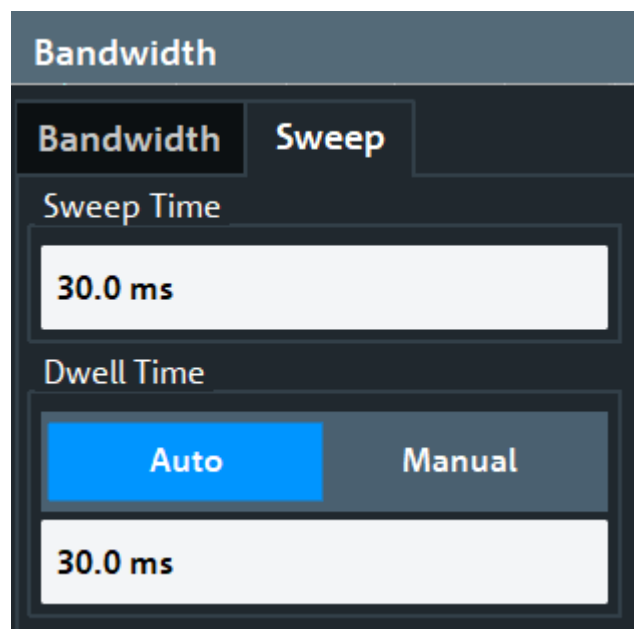
4.7 Bandwidth and sweep settings

Access: "Overview" > "Bandwidth"



The screenshot shows a dialog box titled "Bandwidth". It has two tabs: "Bandwidth" and "Sweep". The "Bandwidth" tab is active. Inside the tab, there are three input fields: "Span" with the value "200.0 MHz", "RBW" with the value "1.0 MHz", and "FFT Window" with the value "Blackman".

Figure 4-2: Bandwidth dialog box



The screenshot shows a dialog box titled "Bandwidth" with two tabs: "Bandwidth" and "Sweep". The "Sweep" tab is active. Inside the tab, there are three input fields: "Sweep Time" with the value "30.0 ms", "Dwell Time" with the value "30.0 ms", and a mode selector with "Auto" selected and "Manual" as an option.

Figure 4-3: Sweep dialog box



The "Span" function is already described in .

Functions that are described somewhere else:

- ["Span"](#) on page 38
- ["Selecting a frame to display"](#) on page 51

RBW	50
FFT Window	50
Sweep Time	50
Dwell Time	51
Continuous Sweep / Run Cont.	51
Selecting a frame to display	51

RBW

Defines the resolution bandwidth. The available resolution bandwidths are specified in the specifications document.

Which resolution bandwidths are available depends on the selected ["FFT Window"](#) on page 50.

The RBW can be defined independently of the selected span.

For more information see [Section 3.2, "Defining the resolution bandwidth"](#), on page 15.

Remote command:

[\[SENSe:\]BANDwidth\[:RESolution\]](#) on page 101

[\[SENSe:\]BANDwidth\[:RESolution\]:RATio](#) on page 102

FFT Window

In the R&S FPL1-K41R Real-Time Spectrum measurements application has a fixed FFT window type. The window type is coupled to the resolution bandwidth.

The following window type is available:

- Blackman

Remote command:

[\[SENSe:\]SWEep:FFT:WINDow:TYPE](#) on page 103

Sweep Time

Determines the amount of time used to sample data for one spectrum. The sweep time can be defined automatically or manually.

The allowed sweep times depend on the device model; refer to the specifications document.

For more information see [Section 3.3, "Sweep time and detector"](#), on page 15.

"Auto"	The sweep time is coupled to the span and resolution bandwidth (RBW). If the span or resolution bandwidth is changed, the sweep time is automatically adjusted.
"Manual"	Define the sweep time manually. Allowed values depend on the coupling ratio of span to RBW. For details refer to the specifications document. Numeric input is always rounded to the nearest possible sweep time.

Remote command:

[\[SENSe:\]SWEep:TIME:AUTO](#) on page 104

[\[SENSe:\]SWEep:TIME](#) on page 104

Dwell Time

Determines the amount of time used to sample a continuous stream of I/Q data. The stream is displayed as multiple rows in the "Spectrogram" diagram (as opposed to the "Sweep Time" on page 50, which defines the time to capture a *single* row in the diagram). Dwell time is never applied for triggered measurements. It is only applied in single sweep mode or when the Sequencer is in continuous mode.

The dwell time can be defined automatically or manually.

For more information see [Section 3.3, "Sweep time and detector"](#), on page 15.

"Auto" The dwell time is set to the maximum of:

- "Sweep Time" on page 50
- 30 ms

"Manual" Define the dwell time manually. Values between 30 ms and 1 hour (3600 s) are allowed.

Remote command:

[\[SENSe:\] SWEep:DTIME:AUTO](#) on page 102

[\[SENSe:\] SWEep:DTIME](#) on page 103

Continuous Sweep / Run Cont

In "Free Run" mode, the measurement starts and continues until it is stopped by the user. In "Stop on trigger" mode, the measurement starts and automatically stops when a trigger is detected.

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: If the Sequencer is active, "Continuous Sweep" only controls the sweep mode for the currently selected channel setup. However, the sweep mode only takes effect the next time the Sequencer activates that channel setup, and only for a channel-defined sequence. In this case, a channel setup in continuous sweep mode is swept repeatedly.

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

For details on the Sequencer, see the FPL base unit user manual.

Remote command:

[INITiate<n>:CONTinuous](#) on page 133

Selecting a frame to display

This function is only available in single sweep mode or if the sweep is stopped.

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

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

Traces

Persistence

Spectrogram

Trace / Data Export

Select Frame

Number

-10

Time

-300.0 ms

Color Mapping

Clear Spectrogram

Remote command:
[CALCulate<n>:SPECTrogram:FRAMe:SElect](#) on page 113

4.8 Adjusting settings automatically

Access: [AUTO SET]

Some settings can be adjusted by the FPL automatically according to the current measurement settings. In order to do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

Setting the Reference Level Automatically (Auto Level)	52
Resetting the Automatic Measurement Time (Meas Time Auto)	52
(Meas Time Manual)	53
Upper Level Hysteresis	53
Lower Level Hysteresis	53

Setting the Reference Level Automatically (Auto Level)

Automatically determines a reference level which ensures that no overload occurs at the FPL for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the FPL.

If necessary, you can optimize the reference level further. Decrease the attenuation level manually to the lowest possible value before an overload occurs, then decrease the reference level in the same way.

Remote command:
[\[SENSe:\]ADJust:LEVel](#) on page 125

Resetting the Automatic Measurement Time (Meas Time Auto)

Resets the measurement duration for automatic settings to the default value.

Remote command:

[\[SENSe:\]ADJust:CONFigure:LEVel:DURation:MODE](#) on page 124

(Meas Time Manual)

This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.

Note: The maximum measurement duration depends on the currently selected measurement and the installed (optional) hardware. Thus, the measurement duration actually used to determine the automatic settings can be shorter than the value you define here.

Remote command:

[\[SENSe:\]ADJust:CONFigure:LEVel:DURation:MODE](#) on page 124

[\[SENSe:\]ADJust:CONFigure:LEVel:DURation](#) on page 123

Upper Level Hysteresis

When the reference level is adjusted automatically using the [Auto Level](#) function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold that the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

[\[SENSe:\]ADJust:CONFigure:HYSTeresis:UPPer](#) on page 124

Lower Level Hysteresis

When the reference level is adjusted automatically using the [Auto Level](#) function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold that the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

[\[SENSe:\]ADJust:CONFigure:HYSTeresis:LOWer](#) on page 124

5 Analysis

Access: "Overview" > "Analysis"

Specific result configuration for persistence and spectrogram or waterfall displays, as well as general result analysis settings concerning the trace, markers, windows etc. can be configured.

• Display configuration	54
• Persistence spectrum settings	54
• Spectrogram settings	56
• Color map settings	58
• Trace settings	60
• Trace / data export configuration	62
• Marker usage	63
• Zoom functions	73

5.1 Display configuration



Access: [MEAS]

Or: "Overview" > "Display Config"

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the "Real-Time Spectrum" application are displayed in the evaluation bar in SmartGrid mode.

Up to 4 evaluation methods can be displayed simultaneously in separate windows. The real-Time evaluation methods are described in [Section 2.1, "Real-Time Spectrum result displays"](#), on page 8.



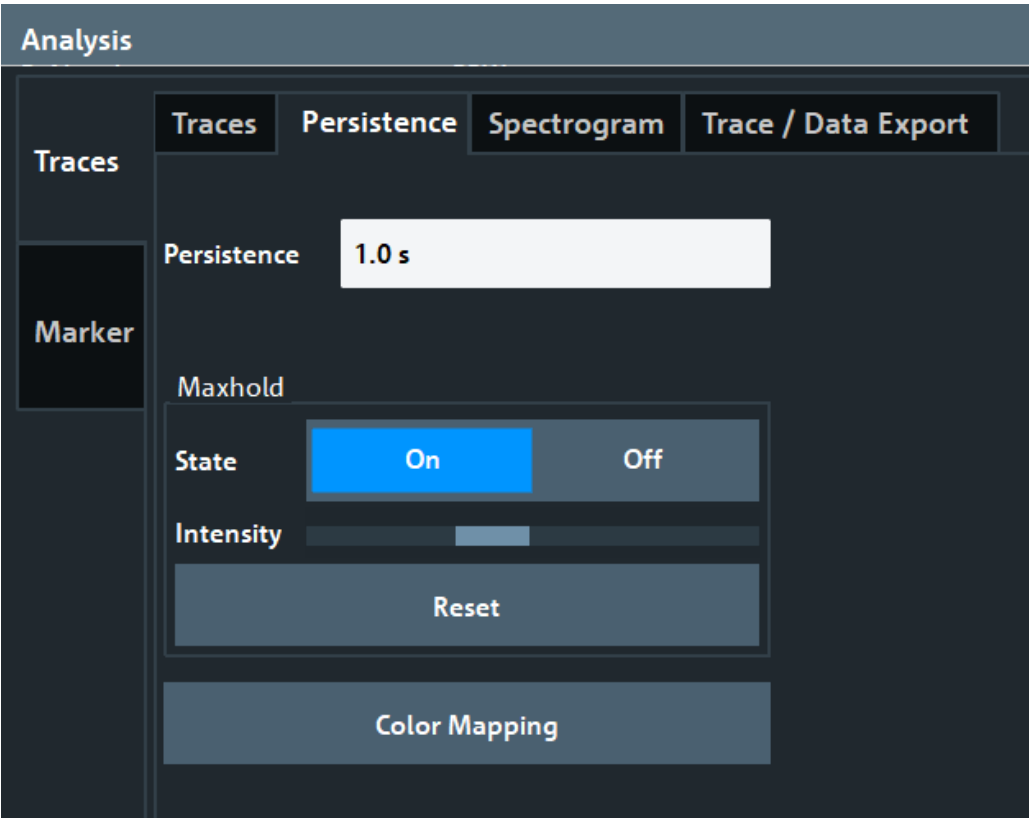
For details on working with the SmartGrid see the FPL Getting Started manual.

5.2 Persistence spectrum settings

Access: "Overview" > "Analysis" > "Persistence" tab

Or: [MEAS CONFIG] > "Persistence Config"

The persistence spectrum is highly configurable. You can change the colors with which the densities are visualized, the persistence of the data, and the style of the displayed results.



Persistence..... 55

Granularity.....55

Configuring the Max Hold Function.....56

 L Intensity.....56

 L Resetting the Max Hold Function.....56

Color Mapping.....56

Persistence

Persistence defines the duration that shadows of past histogram traces remain visible in the display before fading away.

The number of traces that are considered when calculating the density depends on this persistence length.

For low persistence values, the density colors change quickly in the persistence spectrogram.

For high persistence values, the colors change slowly.

A value of 0 seconds deactivates persistence.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence:DURation`
on page 116

Granularity

Defines the amount of data that the FPL uses to draw a single frame in the persistence spectrum.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence:GRANularity` on page 117

Configuring the Max Hold Function

The Max Hold function remembers and shows the maximum densities that have been measured at each point in the diagram.

If activated, the maximum values from all past sweeps are indicated in the persistence spectrum, together with the measured values from the current sweep.

Note: Setting the [Intensity](#) to 0 has the same effect as deactivating the Max Hold function.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MAXHold[:STATe]` on page 116

Intensity ← Configuring the Max Hold Function

The maximum values (that is, the Max Hold trace) are displayed in the defined intensity. The higher the intensity, the brighter the maximum values are displayed. With maximum intensity, the maximum values are displayed just as bright as the currently measured values.

Note: Setting the intensity to 0 has the same effect as deactivating the Max Hold function.

To change the intensity, move the slider to the left (weaker) or right (stronger).

Note that while the intensity of the Max Hold trace may differ to the currently measured trace, the color *mapping* is the same for both traces.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MAXHold:INTensity` on page 115

Resetting the Max Hold Function ← Configuring the Max Hold Function

The previous results of the Max Hold function are cleared and the function starts determining new maximum values.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MAXHold:RESet` on page 115

Color Mapping

Opens the "Color Map" dialog.

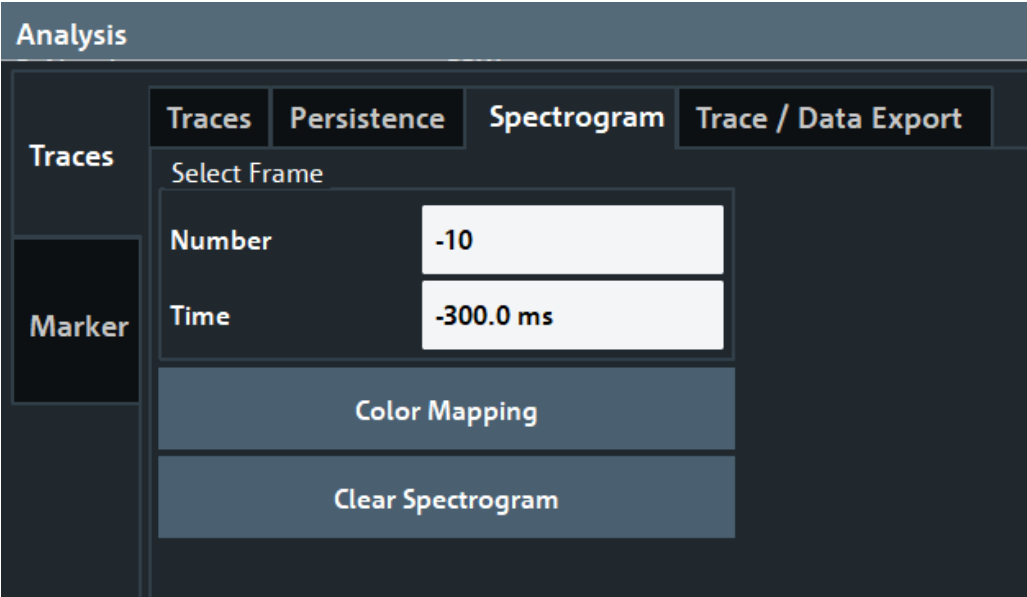
For details see [Section 5.4, "Color map settings"](#), on page 58.

5.3 Spectrogram settings

Access: "Overview" > "Analysis" > "Spectrogram" tab

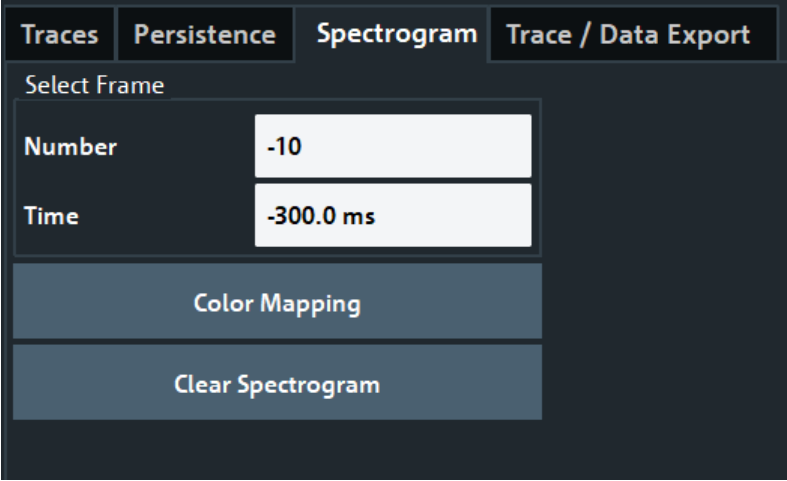
Or: [MEAS CONFIG] > "Spectrogram Config"

The individual settings available for the spectrogram display are described here. For settings on color mapping, see [Section 5, "Analysis"](#), on page 54.



Selecting a frame to display	57
Clear Spectrogram	58
Color Mapping	58

Selecting a frame to display
This function is only available in single sweep mode or if the sweep is stopped.
The most recent frame is number 0, all previous frames have a negative number.
Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.



Remote command:
[CALCulate<n>:SPECTrogram:FRAMe:SElect](#) on page 113

Clear Spectrogram

Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:

`CALCulate<n>:SPECTrogram:CLEar[:IMMediate]` on page 113

Color Mapping

Opens the "Color Map" dialog.

For details see [Section 5.4, "Color map settings"](#), on page 58.

5.4 Color map settings

Access: [MEAS CONFIG] > "Color Mapping"

The settings for color maps are available for spectrograms, persistence spectra, and waterfall displays.

For details on changing color map settings see [Section 6.3, "How to configure the color mapping"](#), on page 75.

In addition to the available color settings, the dialog box displays the current color map and provides a preview of the display with the current settings.

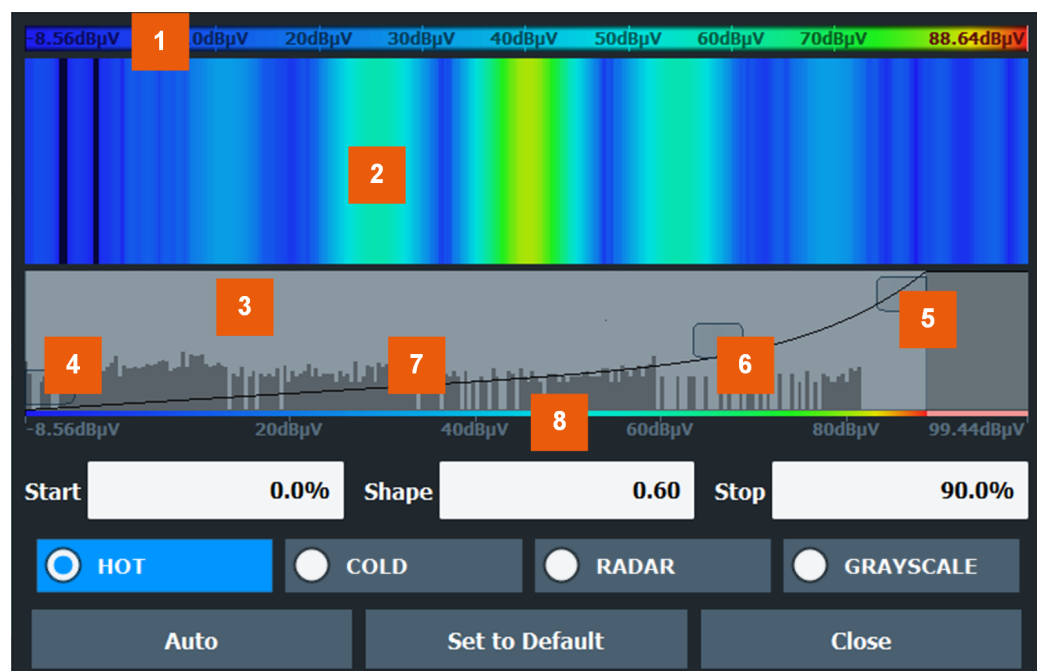


Figure 5-1: Color Mapping dialog box

- 1 = Color map: shows the current color distribution
- 2 = Preview pane: shows a preview of the diagram with any changes that you make to the color scheme
- 3 = Color curve pane: graphical representation of all settings available to customize the color scheme
- 4/5 = Color range start and stop sliders: define the range of the color map or amplitudes for the spectrogram

- 6 = Color curve slider: adjusts the focus of the color curve
- 7 = Histogram: shows the distribution of measured values
- 8 = Scale of the horizontal axis (value range)

Start / Stop

Defines the lower and upper boundaries of the value range of the diagram.

Remote command:

`DISPlay[:WINDow<n>]:SPECTrogram:COLor:LOWer` on page 122

`DISPlay[:WINDow<n>]:SPECTrogram:COLor:UPPer` on page 122

`DISPlay[:WINDow<n>]:PSpectrum:COLor:LOWer` on page 119

`DISPlay[:WINDow<n>]:PSpectrum:COLor:UPPer` on page 120

Shape

Defines the shape and focus of the color curve for the spectrogram result display.

"-1 to <0" More colors are distributed among the lower values

"0" Colors are distributed linearly among the values

Remote command:

`DISPlay[:WINDow<n>]:SPECTrogram:COLor:SHApe` on page 122

`DISPlay[:WINDow<n>]:PSpectrum:COLor:SHApe` on page 119

Truncate

This command is available for "Persistence Spectrum" only.

By default, results that are smaller than the start value of the color map range are displayed in the color for the minimum value. Results that are larger than the stop value of the color map range are displayed in the color for the maximum value.

If the "Truncate" function is activated, the results of the persistence spectrum outside the value range of the color map are truncated, that is, not displayed.

Remote command:

`DISPlay[:WINDow<n>]:PSpectrum:COLor:TRUNcate` on page 120

Hot/Cold/Radar/Grayscale

Sets the color scheme for the spectrogram.

Remote command:

`DISPlay[:WINDow<n>]:SPECTrogram:COLor[:STYLE]` on page 121

`DISPlay[:WINDow<n>]:PSpectrum:COLor[:STYLE]` on page 121

Auto

Defines the color range automatically according to the existing measured values for optimized display.

Set to Default

Sets the color map to the default settings.

Remote command:

`DISPlay[:WINDow<n>]:SPECTrogram:COLor:DEFault` on page 122

`DISPlay[:WINDow<n>]:PSpectrum:COLor:DEFault` on page 119

5.5 Trace settings

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

The trace settings determine how the measured data is analyzed and displayed in the window. Depending on the result display, between 1 and 4 traces may be displayed.

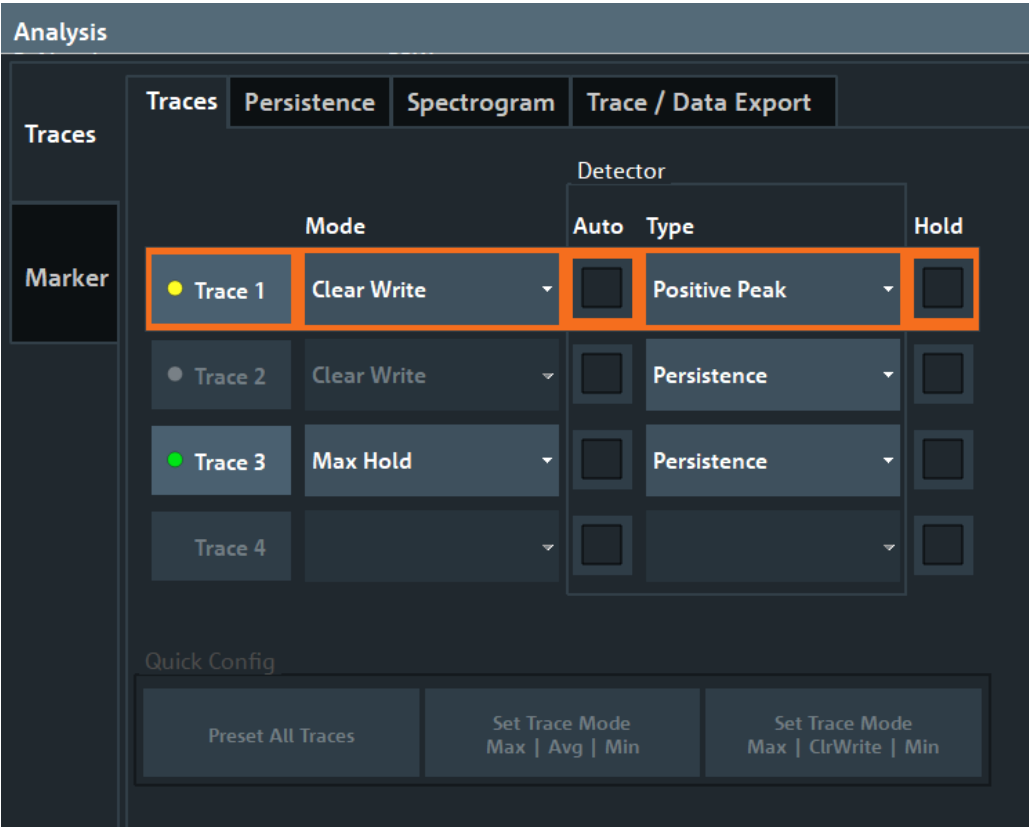


Window-specific configuration

The settings in this dialog box are specific to the selected window. To configure the settings for a different window, select the window outside the displayed dialog box, or select the window from the "Specifics for" selection list in the dialog box (see [Section 4.1, "Configuration overview"](#), on page 32).



Trace data can also be exported to an ASCII file for further analysis. For details see [Section 5.6, "Trace / data export configuration"](#), on page 62.



Trace 1/Trace 2/Trace 3/Trace 4.....	61
Mode.....	61
Detector.....	61
Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys).....	62

Trace 1/Trace 2/Trace 3/Trace 4

Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 146

Selected via numeric suffix of `TRACe<t>` commands

Mode

Defines the update mode for subsequent traces.

"Clear Write"	Overwrite mode: the trace is overwritten by each sweep. This is the default setting.
"Max Hold"	The maximum value is determined over several sweeps and displayed. The FPL saves the sweep result in the trace memory only if the new value is greater than the previous one.
"View"	The current contents of the trace memory are frozen and displayed.
"Blank"	Removes the selected trace from the display.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE` on page 145

Detector

Defines the trace detector to be used for trace analysis.

Detectors perform a data reduction from the swept values to the displayed trace points. The detector type determines which of the samples are displayed for each trace point.

Note: The detector activated for the specific trace is indicated in the corresponding trace information in the window title bar by an abbreviation.

The trace detector can analyze the measured data using various methods:

"Positive Peak"	Determines the largest of all positive peak values from the levels measured at the individual x-values which are displayed in one trace point
"Negative Peak"	Determines the smallest of all negative peak values from the levels measured at the individual x-values which are displayed in one trace point
"Average"	Calculates the linear average of all samples contained in a sweep point. To this effect, FPL uses the linear voltage after envelope detection. The sampled linear values are summed up and the sum is divided by the number of samples (= linear average value). Each sweep point thus corresponds to the average of the measured values summed up in the sweep point. The average detector supplies the average value of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal).
"Sample"	Selects the last measured value of the levels measured at the individual x-values which are displayed in one trace point; all other measured values for the x-axis range are ignored

"Persistence" The "Persistence Spectrogram" display does not require a detector. It evaluates the individual FFTs (see [Section 3.6, "Understanding persistence"](#), on page 27). The "Persistence" detector is indicated only to distinguish the traces in the "Persistence Spectrogram".

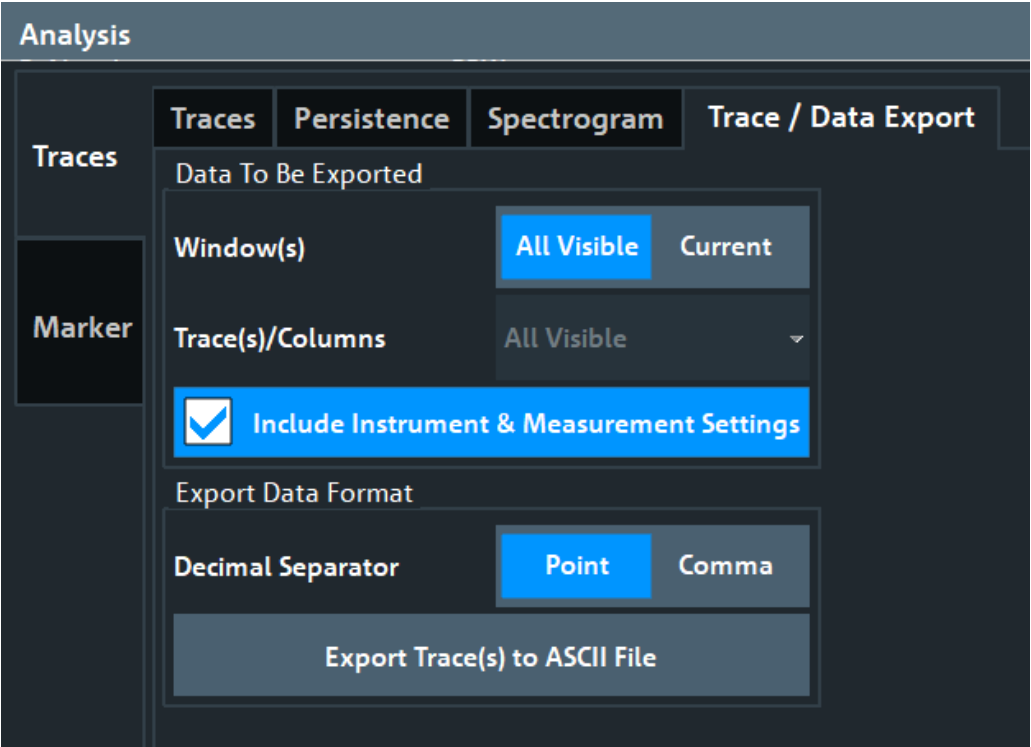
Remote command:
[SENSe:] [WINDow:] DETector<t>[:FUNction] on page 148

Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
DISPlay[:WINDow<n>] [:SUBWindow<w>]:TRACe<t>[:STATe] on page 146

5.6 Trace / data export configuration

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



Data to be exported.....	62
Include Instrument & Measurement Settings.....	63
Decimal Separator.....	63
Export Trace to ASCII File.....	63

Data to be exported
Allows you to select the windows or traces you want to export.

Window(s) Exports the data of all visible windows or of the currently selected window.

Trace(s)/Columns Depending on what you have selected for the windows, you can export all visible traces or you can define specific traces to be exported.

Remote command:

[FORMat:DEXPort:TRACes](#) on page 143

Include Instrument & Measurement Settings

Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:

[FORMat:DEXPort:HEADer](#) on page 143

Decimal Separator

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

Remote command:

[FORMat:DEXPort:DSEParator](#) on page 143

Export Trace to ASCII File

Opens a file selection dialog box and saves the selected trace in ASCII format (.dat) to the specified file and directory.

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

If the spectrogram display is selected when you perform this function, the entire histogram buffer with all frames is exported to a file. The data for a particular frame begins with information about the frame number and the time that frame was recorded. For large history buffers the export operation can take some time.

Remote command:

[MMEMory:STORe<n>:TRACe](#) on page 142

5.7 Marker usage

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

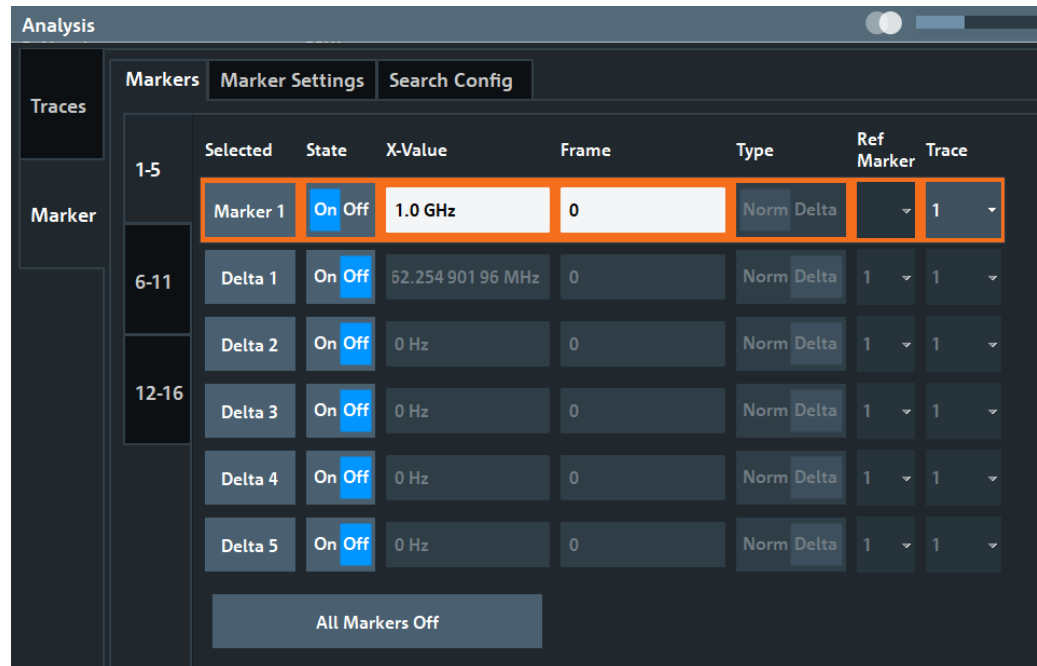
- [Individual marker setup](#).....63
- [General marker settings](#).....66
- [Marker search settings](#).....68
- [Positioning functions](#).....71
- [Example: defining a delta marker in a persistence spectrum](#).....72

5.7.1 Individual marker setup

Access: "Overview" > "Analysis" > "Marker" tab > "Markers" tab

Or: [MKR] > "Marker Config"

Up to 17 markers or delta markers can be activated for each window simultaneously.



The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

Selected Marker.....	64
Marker State.....	64
Marker Position X-value.....	65
Frame.....	65
Marker Type.....	65
Reference Marker.....	65
Assigning the Marker to a Trace.....	65
Select Marker.....	66
All Markers Off.....	66

Selected Marker

Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:

Marker selected via suffix <m> in remote commands.

Marker State

Activates or deactivates the marker in the diagram.

Remote command:

CALCulate<n>:MARKer<m>[:STATe] on page 149

CALCulate<n>:DELTAmarker<m>[:STATe] on page 152

Marker Position X-value

Defines the position (x-value) of the marker in the diagram. For normal markers, the absolute position is indicated. For delta markers, the position relative to the reference marker is provided.

Remote command:

`CALCulate<n>:MARKer<m>:X` on page 150

`CALCulate<n>:DELTamarker<m>:X` on page 153

Frame

"Spectrogram" frame number the marker is assigned to. The most recently swept frame is number 0, all previous frames have negative numbers.

The selected frame is indicated by small white arrows on the left and right border of the "Spectrogram".

Remote command:

`CALCulate<n>:MARKer<m>:SPECTrogram:FRAMe` on page 167

Marker Type

Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 149

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 152

Reference Marker

Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

If the reference marker is deactivated, the delta marker referring to it is also deactivated.

Remote command:

`CALCulate<n>:DELTamarker<m>:MREFerence` on page 152

Assigning the Marker to a Trace

The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

Note: Markers in the persistence spectrum.

In the persistence spectrum result display, you can place each marker on one of the following traces:

- Trace 2: **Clear/write persistence** trace
- Trace 3: **Max Hold persistence** trace

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:

[CALCulate<n>:MARKer<m>:TRACe](#) on page 150

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.



Remote command:

[CALCulate<n>:MARKer<m>\[:STATe\]](#) on page 149

[CALCulate<n>:DELTAmarker<m>\[:STATe\]](#) on page 152

All Markers Off

Deactivates all markers in one step.

Remote command:

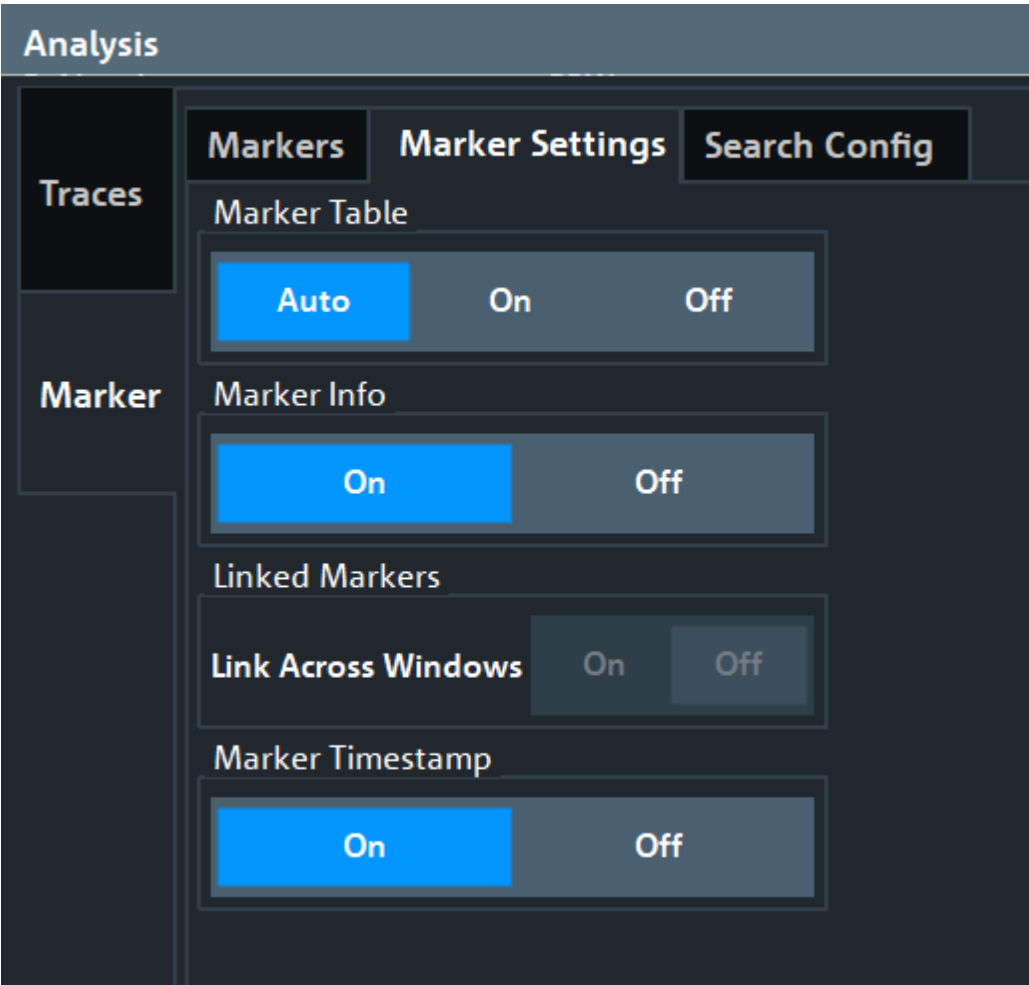
[CALCulate<n>:MARKer<m>:AOFF](#) on page 149

5.7.2 General marker settings

Access: "Overview" > "Analysis" > "Marker" tab > "Marker Settings" tab

Or: [MKR] > "Marker Config" > "Marker Settings" tab

Some general marker settings allow you to influence the marker behavior for all markers.



Marker Table Display.....	67
Marker Info.....	68
Time Stamp.....	68

Marker Table Display

Defines how the marker information is displayed.

- | | |
|--------|---|
| "On" | Displays the marker information in a table in a separate area beneath the diagram. |
| "Off" | No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area. |
| "Auto" | (Default) If more than two markers are active, the marker table is displayed automatically.
If Marker Info is active, the marker information for up to two markers is displayed in the diagram area. |

Remote command:
[DISPlay\[:WINDow<n>\]:MTABle](#) on page 156

Marker Info

Turns the marker information displayed in the diagram on and off.

1AP Clrw	
M1[1]	81.13 dBµV 177.610 MHz
D2[1]	-22.18 dB -28.980 MHz

Remote command:

[DISPlay\[:WINDow<n>\]:MINFo\[:STATe\]](#) on page 156

Time Stamp

Activates and deactivates the time stamp. If activated (default), the time stamp shows the system time while the measurement is running. In single sweep mode or if the sweep is stopped, the time stamp shows the time and date at the end of the sweep.

Individual frames are referred to by their time difference to the end of the sweep.

If deactivated, individual frames are referred to by their frame number in the spectrogram diagrams.

Remote command:

[CALCulate<n>:SPECTrogram:TSTamp\[:STATe\]](#) on page 114

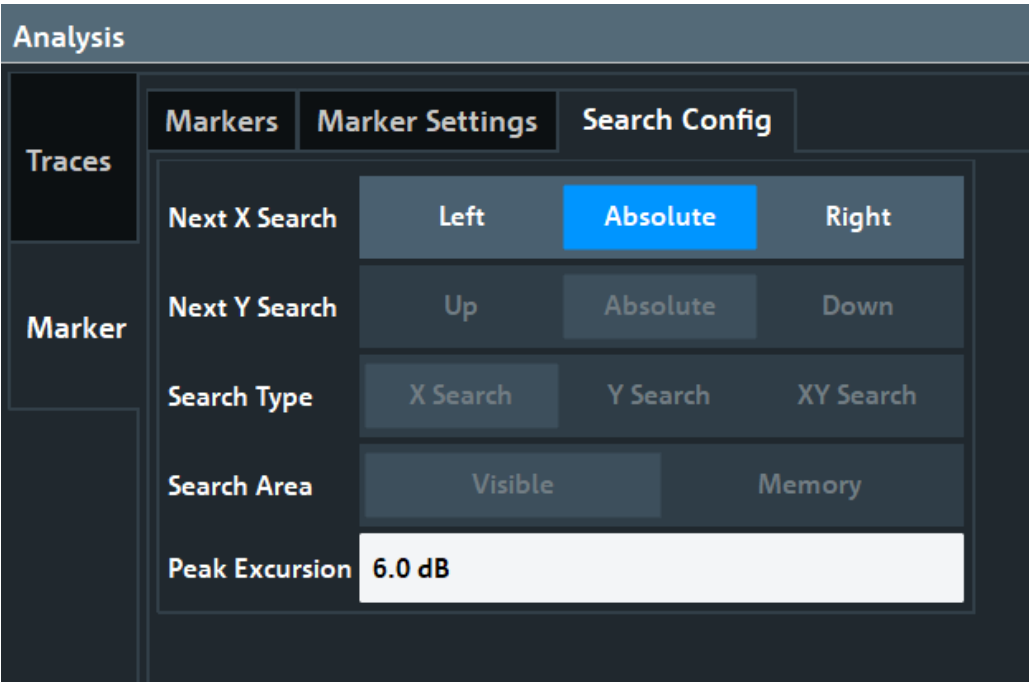
[CALCulate<n>:SPECTrogram:TSTamp:DATA?](#) on page 113

5.7.3 Marker search settings

Access: "Overview" > "Analysis" > "Marker" tab > "Search" tab

Or: [MKR ->] > "Search Config"

Spectrograms show not only the current sweep results, but also the sweep history. Thus, when searching for peaks, you must define the search settings within a single time frame (x-direction) and within several time frames (y-direction).



Search Mode for Next Peak in X Direction.....69

Search Mode for Next Peak in Y Direction.....69

Marker Search Type.....70

Marker Search Area.....71

Peak Excursion.....71

Search Mode for Next Peak in X Direction

Selects the search mode for the next peak search within the currently selected frame.

- "Left" Determines the next maximum/minimum to the left of the current peak.
- "Absolute" Determines the next maximum/minimum to either side of the current peak.
- "Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:

- CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 162
- CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 162
- CALCulate<n>:MARKer<m>:MAXimum:RIGHT on page 162
- CALCulate<n>:MARKer<m>:MINimum:LEFT on page 163
- CALCulate<n>:MARKer<m>:MINimum:NEXT on page 163
- CALCulate<n>:MARKer<m>:MINimum:RIGHT on page 163

Search Mode for Next Peak in Y Direction

Selects the search mode for the next peak search within all frames at the current marker position.

This setting is only available for spectrogram displays.

"Up"	Determines the next maximum/minimum above the current peak (in more recent frames).
"Absolute"	Determines the next maximum/minimum above or below the current peak (in all frames).
"Down"	Determines the next maximum/minimum below the current peak (in older frames).

Remote command:

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVE](#) on page 168

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVE](#)
on page 173

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELOW](#) on page 169

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:BELOW](#)
on page 173

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT](#) on page 169

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:NEXT](#) on page 174

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVE](#) on page 169

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:ABOVE](#)
on page 174

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELOW](#) on page 170

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:BELOW](#)
on page 174

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:NEXT](#) on page 170

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:NEXT](#) on page 175

Marker Search Type

Defines the type of search to be performed in the spectrogram.

"X-Search" Searches only within the currently selected frame.

"Y-Search" Searches within all frames but only at the current marker position.

"XY-Search" Searches in all frames at all positions.

Remote command:

[CALCulate<n>:MARKer<m>:SPECTrogram:XY:MAXimum\[:PEAK\]](#) on page 168

[CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MAXimum\[:PEAK\]](#)
on page 173

[CALCulate<n>:MARKer<m>:SPECTrogram:XY:MINimum\[:PEAK\]](#) on page 168

[CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MINimum\[:PEAK\]](#)
on page 173

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum\[:PEAK\]](#) on page 169

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum\[:PEAK\]](#)
on page 174

[CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum\[:PEAK\]](#) on page 170

[CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum\[:PEAK\]](#)
on page 175

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 162

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 164

[CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 163

[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 165

Marker Search Area

Defines which frames the search is performed in.

This setting is only available for spectrogram displays.

"Visible" Only the visible frames are searched.

"Memory" All frames stored in the memory are searched.

Remote command:

[CALCulate<n>:MARKer<m>:SPECTrogram:SARea](#) on page 168

[CALCulate<n>:DELTamarker<m>:SPECTrogram:SARea](#) on page 172

Peak Excursion

Defines the minimum level value by which a signal must rise or fall so that it is identified as a maximum or a minimum by the search functions.

Remote command:

[CALCulate<n>:MARKer<m>:PEXCursion](#) on page 158

5.7.4 Positioning functions

Access: [MKR ->]

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

Peak Search	71
Search Next Peak	71
Search Minimum	72
Search Next Minimum	72
Reference Level = Marker Level	72

Peak Search

Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 162

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 164

Search Next Peak

Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:

[CALCulate<n>:MARKer<m>:MAXimum:NEXT](#) on page 162

[CALCulate<n>:MARKer<m>:MAXimum:RIGHT](#) on page 162

[CALCulate<n>:MARKer<m>:MAXimum:LEFT](#) on page 162

[CALCulate<n>:DELTamarker<m>:MAXimum:NEXT](#) on page 164

[CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT](#) on page 165

[CALCulate<n>:DELTamarker<m>:MAXimum:LEFT](#) on page 164

Search Minimum

Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:

`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 163

`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 165

Search Next Minimum

Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:

`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 163

`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 163

`CALCulate<n>:MARKer<m>:MINimum:RIGHT` on page 163

`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 165

`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 165

`CALCulate<n>:DELTamarker<m>:MINimum:RIGHT` on page 166

Reference Level = Marker Level

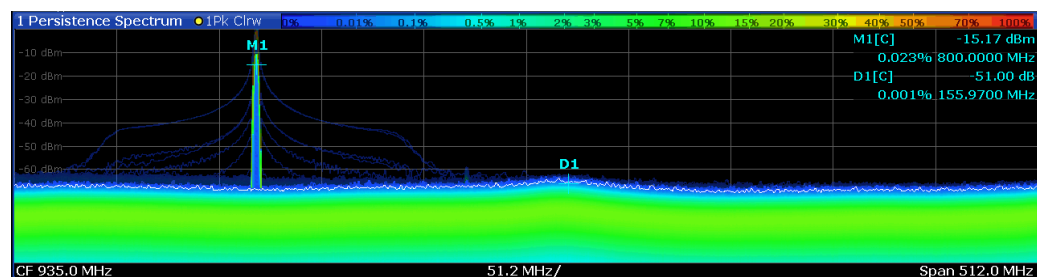
Sets the reference level to the selected marker level.

Remote command:

`CALCulate<n>:MARKer<m>:FUNCTION:REFERENCE` on page 94

5.7.5 Example: defining a delta marker in a persistence spectrum

The following example demonstrates how to define a delta marker in a persistence spectrum. We want to determine the difference in power levels between the spur and the upper noise level.



1. Tap the "Persistence Spectrum" window to set the focus in it.
2. Select the [MKR] key.
3. Select "Marker 1".
A normal marker ("M1") is displayed in the diagram.
4. Drag the marker 1 to the peak of the spur.
5. Select "Marker 2".

A delta marker ("D2") is displayed in the diagram. The delta marker results indicate the difference in frequency, level, and probability of appearance (in %) to the normal marker 1.

6. Drag the delta marker to the upper noise level.

The deviation in the power level of the spur is indicated in the delta marker results. In this example, it is -51 dB.

5.8 Zoom functions

Access: The zoom functions are only available from the toolbar.

Single Zoom.....	73
Restore Original Display.....	73

Single Zoom



Define the zoom area by drawing a rectangle on the touchscreen. When you draw the zoom area, its boundaries are shown as a dashed line.

Note: In Real-Time measurements, this function is only available for a real-time spectrum display.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 176

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 175

Restore Original Display



Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Note: This function only restores graphically zoomed displays. Measurement zooms, for which measurement settings were adapted, are recalculated based on the adapted measurement settings. In this case, the zoomed display is maintained.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 176

6 How to perform Real-Time Spectrum measurements

- [How to perform a basic Real-Time Spectrum measurement](#)..... 74
- [How to analyze persistency in Real-Time Spectrum measurements](#)..... 75
- [How to configure the color mapping](#)..... 75
- [How to work with frequency mask triggers](#)..... 78

6.1 How to perform a basic Real-Time Spectrum measurement

The following step-by-step instructions demonstrate how to perform a basic Real-Time Spectrum measurement with the R&S FPL1-K41R Real-Time Spectrum measurements application.

1. Press [MODE] on the front panel and select the "Real-Time Spectrum" application.
2. Press [RUN CONT] to stop the default continuous measurement.
3. Select "Overview" to display the "Overview" for a Real-Time Spectrum measurement.
4. Select "Amplitude" to define the required reference level and configure the attenuation, if necessary.
5. Select "Frequency" to define the center frequency of the measurement.
6. Select "Bandwidth" to configure the FFT parameters.
 - "RBW": Define the resolution bandwidth in Hz
 - "Sweep Time": Define how long data is to be captured for one line in the spectrogram
7. Press [RUN SINGLE] to start a sweep with the defined settings.

When the sweep is finished, the "Spectrogram" displays all captured lines captured during the dwell time, and the "Real-Time Spectrum" displays the spectrum that starts with the trigger event (or the most recently captured spectrum for free-run measurements).

8. Scroll through the individual frames of the "Spectrogram":
 - a) Tap the "Spectrogram" window.
 - b) Press [SWEEP].
 - c) Select "Select Frame" and change the frame number (negative numbers from 0 downwards).

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

9. Optionally, export the trace data of the spectrogram to a file.

- a) Select "Analysis" in the "Overview".
- b) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace / Data 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".

6.2 How to analyze persistency in Real-Time Spectrum measurements

The following step-by-step instructions demonstrate how to analyze persistency in the R&S FPL1-K41R Real-Time Spectrum measurements application.

1. Configure the R&S FPL1-K41R Real-Time Spectrum measurements application to perform a Real-Time Spectrum measurement as described in [Section 6.1, "How to perform a basic Real-Time Spectrum measurement"](#), on page 74.
2. Select "Analysis" in the overview dialog and select "Persistence Config" to configure the persistency.
 - "Persistence": Define how long each measured value is considered in the density calculation.
 - Optionally, select "Color Mapping" to change the colors with which the density is represented in the "Persistence Spectrum". For details see [Section 6.3, "How to configure the color mapping"](#), on page 75.
 - Optionally, deactivate or change the intensity of the "Max Hold" trace that shows only the maximum density for all frequencies. Select "Reset" to start a new "Max Hold" trace.
3. Press [SWEEP] and select "Dwell Time Manual" to set the time for which persistence spectrum data should be measured, e.g. set it to 1 s.
4. Press [RUN SINGLE] to start a sweep with the defined persistency settings.

When the sweep is finished, the "Persistence Spectrum" displays the density of all measured values, and the "Real-Time Spectrum" displays the spectrum that starts with the trigger event (or the most recently captured spectrum for free-run measurements).

Now you can analyze the colors in the "Persistence Spectrum", which indicate the probability of a particular level in the spectrum.

6.3 How to configure the color mapping

The color display is highly configurable to adapt the spectrogram to your needs.

The settings for color mapping are defined in the "Color Mapping" dialog box. To display this dialog box, do one of the following:

- Select the color map in the window title bar of the "Spectrogram" result display.

To select a color scheme

You can select which colors are assigned to the measured values.

- In the "Color Mapping" dialog box, select the option for the color scheme to be used.

Editing the value range of the color map

The distribution of the measured values is displayed as a histogram in the "Color Mapping" dialog box. To cover the entire measurement value range, make sure the first and last bar of the histogram are included.

To ignore noise in a spectrogram, for example, exclude the lower power levels from the histogram.

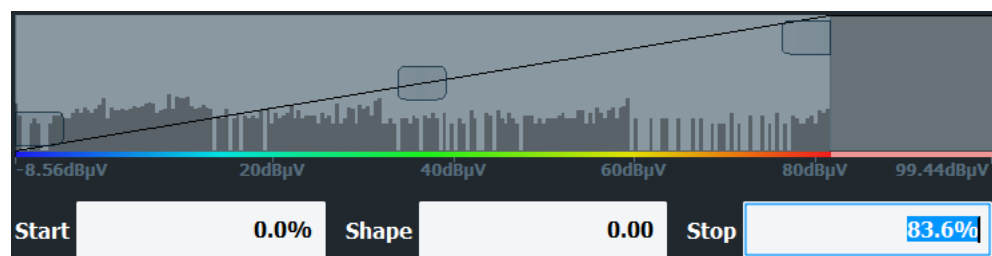


The value range of the color map must cover at least 10% of the value range on the horizontal axis of the diagram, that means, the difference between the start and stop values must be at least 10%.

The value range of the color map can be set numerically or graphically.

To set the value range graphically using the color range sliders

1. Select and drag the bottom color curve slider (indicated by a gray box at the left of the color curve pane) to the lowest value you want to include in the color mapping.
2. Select and drag the top color curve slider (indicated by a gray box at the right of the color curve pane) to the highest value you want to include in the color mapping.



To set the value range of the color map numerically

1. In the "Start" field, enter the percentage from the left border of the histogram that marks the beginning of the value range.
2. In the "Stop" field, enter the percentage from the right border of the histogram that marks the end of the value range.

Example:

The color map starts at -110 dBm and ends at -10 dBm (that is: a range of 100 dB). In order to suppress the noise, you only want the color map to start at -90 dBm. Thus, you enter *10%* in the "Start" field. The FPL shifts the start point 10% to the right, to -90 dBm.

**Adjusting the reference level and level range**

Since the color map is configured using percentages of the total value range, changing the reference level and level range of the measurement (and thus the power value range) also affects the color mapping in the spectrogram.

**Truncating persistence spectrum results**

By default, results that are smaller than the start value of the color map range are displayed in the color for the minimum value. Results that are larger than the stop value of the color map range are displayed in the color for the maximum value.

In order to hide results outside the value range of the color map, use the "Truncate" function (see "[Truncate](#)" on page 59).

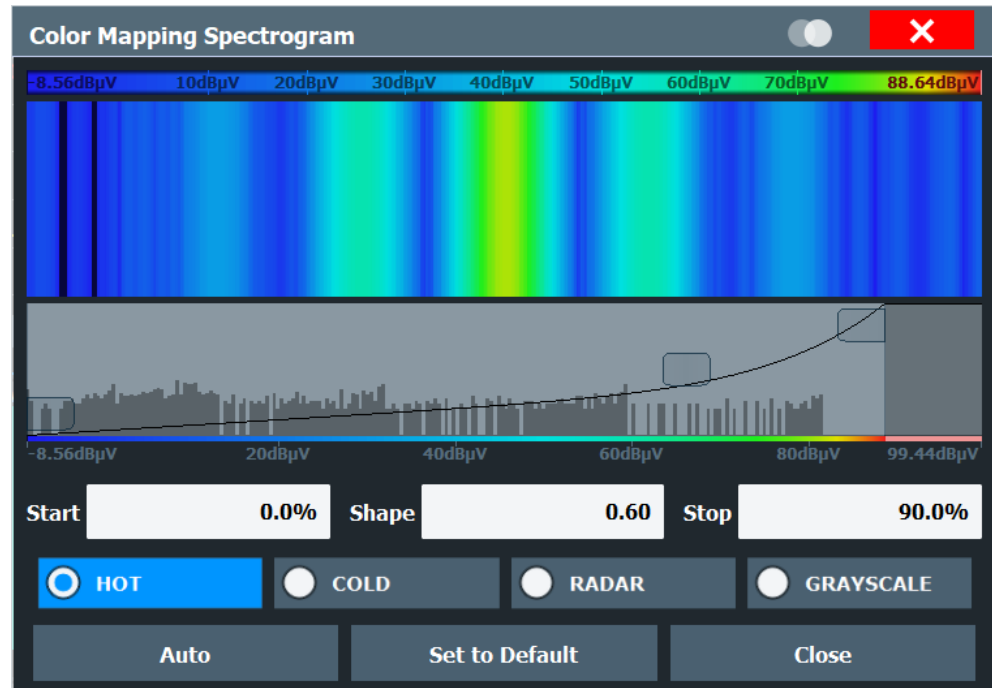
Editing the shape of the color curve

The color curve is a tool to shift the focus of the color distribution on the color map. By default, the color curve is linear, i.e. the colors on the color map are distributed evenly. If you shift the curve to the left or right, the distribution becomes non-linear. The slope of the color curve increases or decreases. One end of the color palette then covers a large number of results, while the other end distributes several colors over a relatively small result range.

The color curve shape can be set numerically or graphically.

To set the color curve shape graphically using the slider

- Select and drag the color curve shape slider (indicated by a gray box in the middle of the color curve) to the left or right. The area beneath the slider is focused, i.e. more colors are distributed there.



To set the color curve shape numerically

- In the "Shape" field, enter a value to change the shape of the curve:
 - A negative value (-1 to <0) focuses the lower values
 - 0 defines a linear distribution
 - A positive value (>0 to 1) focuses the higher values

6.4 How to work with frequency mask triggers

The Frequency Mask Trigger (FMT) is a mask in the frequency domain, which is checked with every calculated FFT. When a specific condition concerning this mask occurs during the measurement of the input signal, I/Q data capturing is triggered.

6.4.1 How to create a new frequency mask

The frequency mask is configured by a set of individual trace points which are connected to form a mask area. The frequency mask may have any shape, defined by up to 1001 points.

There are several ways to create a new mask:

- Automatically, according to the currently measured values
- Graphically, by adding and moving mask points on the touchscreen
- Numerically, by defining the x- and y-values of the mask points

You can combine the methods. For example, first you sketch the mask quickly on the touchscreen, and then modify the point coordinates with precise values. Or you create an upper mask automatically and then add a lower mask manually.

To create a mask automatically

1. Press [MEAS CONFIG] and select "Edit Frequency Mask".
A default (upper) mask is displayed in the preview area of the "Edit Frequency Mask" dialog box.
2. Select "Auto-Set Mask".
A mask in close proximity to the currently measured data is created.
3. If necessary, modify the mask or add a lower mask as described in ["To create a mask manually"](#) on page 79.

To create a mask manually

1. Press [MEAS CONFIG], then select "Edit Frequency Mask".
A default (upper) mask with 4 points is displayed in the preview area of the "Edit Frequency Mask" dialog box.
2. If you want to start from scratch press "New" to create a new default mask.
3. To define an upper mask, select the "Upper Mask" option.
To define a lower mask, select the "Lower Mask" option.
4. For each mask, tap the corner points of the mask in the preview area and drag them to the required destination, or enter the position and value of each mask point in the list of coordinates to the left of the preview area.
5. If necessary, insert additional mask points to design a more complex shape:
 - a) Tap an existing mask point in the preview area or in the list of coordinates before which you want to insert a new point.
 - b) Select "Insert".
An additional point is inserted in the mask in the preview area and in the list of coordinates.
 - c) Drag the new point to the required destination, or define its coordinates.
6. To shift the entire mask (upper and lower) vertically or horizontally, for example to consider a frequency or reference level offset in the input signal, select "Shift x" or "Shift y".
7. Repeat these steps until the required mask shape is displayed.

For upper masks, the display region above the defined mask points is defined as the frequency mask and filled with red color. For lower masks, the display region below the mask points is defined as the frequency mask and also filled in red.

8. Define how the frequency mask is to be evaluated, depending on whether the mask area represents the relevant or irrelevant value range. See ["Trigger conditions"](#) on page 18 for detailed descriptions of the possible conditions.
9. Optionally, store the frequency mask configuration for later use:
 - a) Provide a name and, optionally, a comment for the mask.
 - b) Select "Save Mask".
 - c) In the file selection dialog box, select the storage location for the file (default: `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask`).
By default, the mask name is used as the file name; however, it can be edited.
 - d) Select "Save".

The mask is stored in a file with the extension `.FMT` in the selected directory.

6.4.2 How to use a frequency mask trigger

1. Press [TRIG], then select "Frequency Mask" to use a mask as the trigger source.
2. Press [MEAS CONFIG], then select "Edit Frequency Mask".
3. Define which frequency mask is to be used as a trigger source:
 - a) Select "Load Mask" to select a stored frequency mask.
 - b) In the file selection dialog box, select the storage location of the file (default: `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\freqmask`) with the extension `.FMT`.
 - c) If necessary, modify the mask as described in ["To create a mask manually"](#) on page 79.
4. Make sure the checkbox next to "Upper Mask" or "Lower Mask" is selected for use in the measurement.

The next Real-Time Spectrum measurement will be triggered when the specified event concerning the frequency mask occurs.

7 Remote commands to perform Real-Time Spectrum measurements

The following commands are specific to performing measurements in the "Real-Time Spectrum" application in a remote environment.

It is assumed that the FPL has already been set up for remote control in a network as described in the FPL User Manual.



Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the FPL User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers

The following tasks specific to Real-Time measurements are described here:

• Introduction	81
• Common suffixes	86
• Activating the real-time spectrum application	86
• Configuring real-time measurements	90
• Capturing data and performing sweeps	132
• Retrieving results	136
• Analyzing results	144
• Querying the status registers	177
• Deprecated commands	180
• Programming examples: performing real-time measurements	181

7.1 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 FPL.



Remote command examples

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

7.1.1 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 FPL 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.

7.1.2 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`.

7.1.3 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.

7.1.4 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.

7.1.5 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`.

7.1.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters can have different forms of values.

• Numeric values	84
• Boolean	85
• Character data	85
• Character strings	86
• Block data	86

7.1.6.1 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.

7.1.6.2 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`

7.1.6.3 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 [Section 7.1.2, "Long and short form"](#), on page 82.

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`

7.1.6.4 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'
```

7.1.6.5 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.

7.2 Common suffixes

In the R&S FPL1-K41R Real-Time Spectrum measurements application, the following common suffixes are used in remote commands:

Table 7-1: Common suffixes used in remote commands in the R&S FPL1-K41R Real-Time Spectrum measurements application

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 6	Window (in the currently selected channel setup)
<t>	1 to 4	Trace
	1 to 8	Limit line By default, the suffixes 1 to 8 correspond to the lines REM1 to REM8. If they are used but do not yet exist, they are created automatically. If a name has been set via CALCulate:LIMit:NAME, you can access the corresponding line using its index.

7.3 Activating the real-time spectrum application

Real-Time measurements require a special application. A measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate.....	87
INSTrument:CREate[:NEW].....	87
INSTrument:CREate:REPLace.....	87
INSTrument:DELeTe.....	88
INSTrument:LIST?.....	88
INSTrument:REName.....	89
INSTrument[:SELeCt].....	89
SYSTem:PRESet:COMPatible.....	90
SYSTem:PRESet:CHANnel[:EXEC].....	90

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 'IQAnalyzer'
```

```
INST:CRE:DUPL
```

Duplicates the channel setup named 'IQAnalyzer' and creates a new channel setup named 'IQAnalyzer2'.

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 88.
<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. 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 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 88.
- <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 88).
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 'IQAnalyzer2', IQ, 'IQAnalyzer'`
Replaces the channel setup named "IQAnalyzer2" by a new channel setup of type "IQ Analyzer" named "IQAnalyzer".

Usage: Setting only

INSTrument:DELeTe <ChannelName>

Deletes a channel setup.

Setting parameters:

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

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 3 channel setups:
'ADEM', 'Analog Demod', 'IQ', 'IQ Analyzer', 'IQ', 'IQ Analyzer2'

Usage: Query only

Table 7-2: Available channel setup types and default channel setup names

Application	<ChannelType> Parameter	Default Channel setup Name*)
Spectrum	SANALYZER	Spectrum
AM/FM/PM Modulation Analysis	ADEM	Analog Demod
I/Q Analyzer	IQ	IQ Analyzer
Noise Figure Measurements	NOISE	Noise
Vector Signal Analysis (VSA)	DDEM	VSA

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 'IQAnalyzer2', 'IQAnalyzer3'`
Renames the channel setup with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SElect] <ChannelType>

Selects the application (channel type) for the current channel.

See also `INSTrument:CREate[:NEW]` on page 87.

Parameters:

- <ChannelType> **RTIM**
"Real-Time Spectrum" application

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

SYSTem:PRESet:COMPAtible <OpMode>

Defines the operating mode that is activated when you switch on the FPL or press [PRESET].

Parameters:

<OpMode>

SANalyzer

(Default:)

Defines Signal and Spectrum Analyzer operating mode as the presetting.

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:PRESet:CHAN:EXEC
```

Restores the factory default settings to the "Spectrum2" channel setup.

Usage:

Event

Manual operation: See ["Preset Channel setup"](#) on page 34

7.4 Configuring real-time measurements

- [Configuring input/output settings](#).....90
- [Configuring the vertical axis \(amplitude, scaling\)](#).....93
- [Defining the frequency and span](#)..... 99
- [Configuring bandwidth and sweep settings](#)..... 101
- [Triggering](#)..... 104
- [Configuring spectrograms](#)..... 112
- [Configuring the persistence spectrum](#)..... 115
- [Configuring color maps](#)..... 118
- [Adjusting settings automatically](#)..... 123
- [Configuring the result display](#)..... 125

7.4.1 Configuring input/output settings

The following commands are required to define input and output settings. Any settings related to data acquisition or data output are only available for the "Real-Time Spectrum" Application or the MSRT primary.

- [RF input](#).....91

7.4.1.1 RF input

INPut:ATTenuation:PROTection:RESet.....	91
INPut:CONNector.....	91
INPut:COUpling.....	91
INPut:FILTer:YIG[:STATe].....	92
INPut:IMPedance.....	92
INPut:SElect.....	92
INPut:FILTer:SAW.....	92
INPut:EATT:STATe.....	93
INPut:EATT.....	93

INPut:ATTenuation:PROTection:RESet

Resets the attenuator and reconnects the RF input with the input mixer for the FPL after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

The command works only if the overload condition has been eliminated first.

Example: `INP:ATT:PROT:RES`

INPut:CONNector <ConnType>

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

Parameters:

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

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

INPut:COUpling <CouplingType>

Selects the coupling type of the RF input.

Parameters:

<CouplingType> AC | DC
 AC
 AC coupling
 DC
 DC coupling
 *RST: AC

Example: `INP:COUP DC`

Manual operation: See ["Input Coupling"](#) on page 35

INPut:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Parameters:

<State> ON | OFF | 0 | 1

Example:

INP:FILT:YIG OFF

Deactivates the YIG-preselector.

Manual operation: See ["YIG-Preselector"](#) on page 36

INPut:IMPedance <Impedance>

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

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Default unit: OHM

Example:

INP:IMP 75

Manual operation: See ["Impedance"](#) on page 36

INPut:SElect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the FPL.

Parameters:

<Source>

RF

Radio Frequency ("RF INPUT" connector)

*RST: RF

Manual operation: See ["Radio Frequency State"](#) on page 35

INPut:FILTer:SAW <State>

Determines which IF path the FPL hardware uses.

Parameters:

<State>

AUTO | OFF

AUTO

The FPL determines which IF path to use automatically, depending on the used analysis bandwidth.

OFF

The wide IF path is always used.

*RST: I/Q Analyzer: AUTO; VSA: OFF

Example:

INP:FILT:SAW AUTO

Manual operation: See ["SAW filter"](#) on page 36

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on
 *RST: 0

Example: INP:EATT:STAT ON
 Switches the electronic attenuator into the signal path.

Manual operation: See ["Using Electronic Attenuation"](#) on page 41

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (INP:EATT:AUTO OFF, see [INPut:EATT:AUTO](#) on page 96).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation> attenuation in dB
 Range: see specifications document
 Increment: 1 dB
 *RST: 0 dB (OFF)
 Default unit: DB

Example: INP:EATT:AUTO OFF
 INP:EATT 10 dB

Manual operation: See ["Using Electronic Attenuation"](#) on page 41

7.4.2 Configuring the vertical axis (amplitude, scaling)

The following commands are required to configure the amplitude and vertical axis settings in a remote environment.

- [Amplitude settings](#).....94
- [Configuring the attenuation](#).....95
- [Configuring a preamplifier](#).....96
- [Scaling the Y-axis](#).....96

7.4.2.1 Amplitude settings

Useful commands for amplitude configuration described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 125

Remote commands exclusive to amplitude configuration:

<code>CALCulate<n>:MARKer<m>:FUNCTION:REFERENCE</code>	94
<code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel</code>	94
<code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet</code>	95

`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.

Manual operation: See "Reference Level = Marker Level" on page 72

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

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

With a reference level offset $\neq 0$, the value range of the reference level is modified by the offset.

Suffix:

<n> irrelevant

<w> subwindow
 Not supported by all applications

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.
 Range: see specifications document
 *RST: 0 dBm
 Default unit: DBM

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

Manual operation: See "Reference Level" on page 40

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

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

Suffix:

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

Parameters:

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

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

Manual operation: See ["Shifting the Display \(Offset\)"](#) on page 40

7.4.2.2 Configuring the attenuation

INPut:ATTenuation.....	95
INPut:EATT:AUTO.....	96
INPut:ATTenuation:AUTO.....	96

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>	Range: see specifications document
	Increment: 5 dB (with optional electr. attenuator: 1 dB)
	*RST: 10 dB (AUTO is set to ON)
	Default unit: DB

Example: INP:ATT 30dB
 Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Manual operation: See ["Attenuation Mode / Value"](#) on page 40

INPut:EATT:AUTO <State>

INPut:ATTenuation:AUTO <State>

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the FPL determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

For the FPL, these commands are identical.

Parameters:

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

Example: INP:ATT:AUTO ON
 Couples the attenuation to the reference level.

Manual operation: See "Attenuation Mode / Value" on page 40

7.4.2.3 Configuring a preamplifier

INPut:GAIN:STATe..... 96

INPut:GAIN:STATe <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

If activated, the input signal is amplified by 20 dB. The preamplifier is only active below 3 GHz (R&S FPL1003) or 7.5 GHz (R&S FPL1007).

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
 Switches the function off
ON | 1
 Switches the function on
 *RST: 0

Example: INP:GAIN:STAT ON
 Switches on 20 dB preamplification.

7.4.2.4 Scaling the Y-axis

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]..... 96
 DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE..... 97
 DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE..... 97
 DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition..... 98
 DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing..... 98

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

Parameters:

<Range>	Range: 1 dB to 200 dB *RST: 100 dB Default unit: HZ
---------	---

Example: `DISP:TRAC:Y 110dB`

Manual operation: See "Range" on page 42

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

Manual operation: See "Auto Scale Once" on page 42

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 FPL 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 corresponds 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

Manual operation: See ["Ref Level Position"](#) on page 42

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 %.

7.4.3 Defining the frequency and span

The commands required to configure the frequency and span settings in a remote environment are described here.

The tasks for manual operation are described in [Section 4.3, "Frequency and span settings"](#), on page 36.

[SENSe:]FREQuency:CENTer.....	99
[SENSe:]FREQuency:CENTer:STEP.....	99
[SENSe:]FREQuency:OFFSet.....	100
[SENSe:]FREQuency:SPAN.....	100
[SENSe:]FREQuency:STARt.....	100
[SENSe:]FREQuency:STOP.....	100
[SENSe:]FREQuency:SPAN:FULL.....	101

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

CW, pulsed and VCO measurements:

This command defines or queries (in case of automatic frequency search) the current signal frequency.

Transient measurement:

This command defines the center frequency of the transient measurement.

Parameters:

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

*RST: $f_{\max}/2$

Default unit: Hz

Example:

FREQ:CENT 100 MHz

FREQ:CENT:STEP 10 MHz

FREQ:CENT UP

Sets the center frequency to 110 MHz.

Manual operation: See ["Center Frequency"](#) on page 37

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

Defines the center frequency step size.

Parameters:

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

Range: 1 to $f_{\max}$

*RST: 0.1 x span

Default unit: Hz

Example: //Set the center frequency to 110 MHz.
 FREQ:CENT 100 MHz
 FREQ:CENT:STEP 10 MHz
 FREQ:CENT UP

Manual operation: See ["Center Frequency Stepsize"](#) on page 37

[SENSe:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

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

Parameters:

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

Example: FREQ:OFFS 1GHZ

Manual operation: See ["Frequency Offset"](#) on page 38

**[SENSe:]FREQuency:SPAN **

Defines the frequency span.

Manual operation: See ["Span"](#) on page 38
 See ["Last Span"](#) on page 38

[SENSe:]FREQuency:STARt <Frequency>

Defines the start frequency for a Real-Time measurement. If you set a start frequency that would exceed the maximum span, the FPL adjusts the stop frequency to stay within the maximum span.

Parameters:

<Frequency> 0 to (fmax - min span)
 *RST: 0
 Default unit: HZ

Example: FREQ:STAR 20MHz

Manual operation: See ["Start / Stop"](#) on page 38

[SENSe:]FREQuency:STOP <Frequency>

Defines the stop frequency for a Real-Time measurement. If you set a start frequency that would exceed the maximum span, the FPL adjusts the start frequency to stay within the maximum span.

Parameters:

<Frequency> min span to fmax
 *RST: fmax
 Default unit: HZ

Example: `FREQ:STOP 2000 MHz`

Manual operation: See ["Start / Stop"](#) on page 38

[SENSe:]FREQuency:SPAN:FULL

Restores the full span.

Manual operation: See ["Full Span"](#) on page 38

7.4.4 Configuring bandwidth and sweep settings

The commands required to configure the bandwidth, sweep and filter settings in a remote environment are described here.

The tasks for manual operation are described in [Section 4.7, "Bandwidth and sweep settings"](#), on page 49.

Useful commands for configuring sweeps described elsewhere:

- [\[SENSe:\]AVERage<n>:COUNT](#) on page 147

Remote commands exclusive to configuring bandwidth and sweeps:

[SENSe:]BANDwidth[:RESolution]	101
[SENSe:]BANDwidth[:RESolution]:RATio	102
[SENSe:]SWEep:COUNT	102
[SENSe:]SWEep:DTIME:AUTO	102
[SENSe:]SWEep:DTIME	103
[SENSe:]SWEep:FFT:WINDow:TYPE	103
[SENSe:]SWEep:TIME	104
[SENSe:]SWEep:TIME:AUTO	104
[SENSe:]SWEep:POINTs?	104

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

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

Parameters:

<Bandwidth> refer to specifications document
 Default unit: Hz

Example: `BAND 1 MHz`
 Sets the resolution bandwidth to 1 MHz

Manual operation: See ["RBW"](#) on page 50

[SENSe:]BANDwidth[:RESolution]:RATio <Ratio>

Defines the ratio between the resolution bandwidth (Hz) and the span (Hz).

Note that the ratio defined with this remote command (RBW/span) is reciprocal to that of the coupling ratio (span/RBW).

Changing this ratio also affects the FFT length, which in turn affects the time resolution of the FFT. Furthermore, the ratio also affects the RBW value according to:

$$RBW = \text{Span} / \text{Coupling ratio}$$

Parameters:

<Ratio> Range: 0.0001 to 1

Example: BAND:RAT 0.1

Example: [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185

Manual operation: See ["RBW"](#) on page 50

[SENSe:]SWEep:COUNT <SweepCount>

Defines the number of measurements that the application uses to average traces.

In continuous measurement mode, the application calculates the moving average over the average count.

In single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Example: SWE:COUN 64
Sets the number of measurements to 64.
INIT:CONT OFF
Switches to single measurement mode.
INIT;*WAI
Starts a measurement and waits for its end.

[SENSe:]SWEep:DTIME:AUTO <State>

Determines whether the dwell time is defined automatically or manually.

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example: SENS:SWE:DTIM:AUTO OFF
SENS:SWE:DTIM 1s

Manual operation: See ["Dwell Time"](#) on page 51

[SENSe:]SWEep:DTIME <Time>

Determines the amount of time used to sample a continuous stream of I/Q data. The stream is displayed as multiple rows in the spectrogram or waterfall diagrams (as opposed to the *sweep time*, which defines the time to capture a *single* row in the diagrams). Dwell time is never applied for triggered measurements. It is only applied in single sweep mode or when the Sequencer is in continuous mode.

The query returns the amount of time used to sample I/Q data in the current measurement.

Tip: the dwell time can also be defined automatically, see [\[SENSe:\]SWEep:DTIME: AUTO](#) on page 102.

Parameters:

<Time> numeric value
 Range: 30 ms to 3600 s
 *RST: 30 ms
 Default unit: s

Example:

```
SENS:SWE:DTIM:AUTO OFF
SENS:SWE:DTIM 1s
```

Manual operation: See ["Dwell Time"](#) on page 51

[SENSe:]SWEep:FFT:WINDow:TYPE <FFTWindow>

Selects the type of FFT window that you want to use in Real-Time mode.

Parameters:

<FFTWindow> **BLACkharris**
 FLATtop
 GAUSSian
 HAMMING
 HANNing
 KAISerbessel
 RECTangular
 *RST: BLACkharris

Example:

```
SWE:FFT:WIND:TYPE HANN
Selects the Hanning FFT window.
```

Example:

See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["FFT Window"](#) on page 50

[SENSe:]SWEep:TIME <Time>**Parameters:**

<Time> refer to specifications document
Default unit: S

Manual operation: See ["Sweep Time"](#) on page 50

[SENSe:]SWEep:TIME:AUTO <State>

Activates and deactivates automatic sweep time definition.

Parameters:

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

Example: SWE:TIME:AUTO ON
Activates automatic sweep time.

Manual operation: See ["Sweep Time"](#) on page 50

[SENSe:]SWEep:POINTS? <NoPoints>

Queries the number of sweep points

Parameters:

<NoPoints>

Example: SENS:SWE:POIN?
1001

Usage: Query only

7.4.5 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment.



*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

- [Configuring the triggering conditions](#).....105
- [Configuring a frequency mask trigger](#).....107

7.4.5.1 Configuring the triggering conditions

TRIGger:MODE.....	105
TRIGger[:SEQuence]:POSTtrigger[:TIME].....	105
TRIGger[:SEQuence]:PRETrigger[:TIME].....	106
TRIGger[:SEQuence]:SOURce.....	106

TRIGger:MODE <Mode>

Turns continuous triggering on and off.

Parameters:

<Mode>

CONTInuous

Continuous measurement

STOP

Measurement stops after the trigger event is done

MARK

A free-run measurement is performed; the trigger event is merely indicated in the results, but does not change the behavior of the measurement.

This setting is only available for FPL-B512R/-B800R.

*RST: CONTInuous

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Trigger mode \(Stop on Trigger\)"](#) on page 44

TRIGger[:SEQuence]:POSTtrigger[:TIME] <Time>

Defines the length of the posttrigger.

Parameters:

<Time>

Length of the posttrigger in seconds.

Note that the pre- and posttrigger combined may not be longer than 1 second.

Range: 0 s to 1 s

*RST: 60 ms

Default unit: S

Example: TRIG:POST 0.5s
Selects a posttrigger time of 0.5 seconds.

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Posttrigger capture time"](#) on page 44

TRIGger[:SEquence]:PRETrigger[:TIME] <Time>

Defines the length of the pretrigger.

Parameters:

<Time> Length of the pretrigger in seconds.
 Note that the pre- and posttrigger combined may not be longer than 1 second.
 Range: 0 s to 1 s
 *RST: 60 ms
 Default unit: S

Example: TRIG:PRE 0.5s
 Selects a pretrigger time of 0.5 seconds.

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Pretrigger capture time"](#) on page 44

TRIGger[: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.

Parameters:

<Source> **IMMediate**
 Free Run
 EXTernal
 Trigger signal from the "Trigger Input" connector.
 Trigger signal from the "Trigger In" connector.
 MASK
 Triggers when the measured signal violates the user-defined frequency mask.
 TDTR
 Triggers when the measured signal exceeds the defined power level in the **time domain**.
 *RST: IMMediate

Example: TRIG:SOUR EXT
 Selects the external trigger input as source of the trigger signal

Manual operation: See ["Trigger Source"](#) on page 43
 See ["Free Run"](#) on page 43
 See ["Frequency Mask"](#) on page 44
 See ["Activate"](#) on page 46

7.4.5.2 Configuring a frequency mask trigger

The Frequency Mask Trigger (FMT) is a mask in the frequency domain, which is checked with every calculated FFT. When a specific condition concerning this mask occurs during the measurement of the input signal, data capturing is triggered.

For details see [Section 3, "Real-time basics"](#), on page 13.

CALCulate<n>:MASK:COMMeNt	107
CALCulate<n>:MASK:DELeTe	107
CALCulate<n>:MASK:LOWer:SHIFt:X	108
CALCulate<n>:MASK:LOWer:SHIFt:Y	108
CALCulate<n>:MASK:LOWer:STATe	108
CALCulate<n>:MASK:LOWer[:DATA]	109
CALCulate<n>:MASK:MODE	109
CALCulate<n>:MASK:NAME	110
CALCulate<n>:MASK:SPAN	110
CALCulate<n>:MASK:UPPer:AUTO	110
CALCulate<n>:MASK:UPPer:SHIFt:X	110
CALCulate<n>:MASK:UPPer:SHIFt:Y	111
CALCulate<n>:MASK:UPPer:STATe	111
CALCulate<n>:MASK:UPPer[:DATA]	111
TRIGger[:SEQuence]:MASK:CONDition	112

CALCulate<n>:MASK:COMMeNt <Comment>

Defines a comment for the frequency mask that you have selected with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:

<n> [Window](#)

Parameters:

<Comment> String containing the comment for the frequency mask.

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Comment"](#) on page 47

CALCulate<n>:MASK:DELeTe

Suffix:

<n> 1..n

Manual operation: See ["Delete"](#) on page 46

CALCulate<n>:MASK:LOWer:SHIFt:X <Frequency>

Shifts the lower frequency mask horizontally by a specified distance. Positive values move the mask to the right, negative values shift the mask to the left.

Before making any changes to a frequency mask, you have to select one by name with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:

<n> [Window](#)

Parameters:

<Frequency> Defines the distance of the shift.
Default unit: Hz

Manual operation: See ["Shifting the mask position horizontally \(Shift x\)"](#) on page 47

CALCulate<n>:MASK:LOWer:SHIFt:Y <Level>

Shifts the lower frequency mask vertically by a specified distance. Positive values move the mask upwards, negative values shift the mask downwards.

Before making any changes to a frequency mask, you have to select one by name with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:

<n> [Window](#)

Parameters:

<Level> Defines the distance of the shift. The shift is relative to the current position.
Default unit: dB

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Shifting the mask vertically \(Shift y\)"](#) on page 47

CALCulate<n>:MASK:LOWer:STATe <State>

Turns the lower frequency mask on and off.

Before making any changes to a frequency mask, you have to select one by name with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:

<n> [Window](#)

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Selecting and deselecting upper and lower masks"](#) on page 48

CALCulate<n>:MASK:LOWer[:DATA] <Frequency>,<Level>,...

Defines the shape of the lower frequency mask.

Before making any changes to a frequency mask, you have to select one by name with [CALCulate<n>:MASK:NAME](#) on page 110.

The unit of the power levels depends on [CALCulate<n>:MASK:MODE](#) on page 109.

For R&S FPL1-K70, this command is query only.

[N] pairs of numerical values. [N] is the number of data points the mask consists of.

Each data point is defined by the frequency and the level. All values are separated by commas.

Note that the data points have to be inside the current span.

Suffix:

<n> [Window](#)

Parameters:

<Frequency> Frequency of the data point
Default unit: Hz

<Level> Level of the data point
Default unit: DBM

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Mask points"](#) on page 47
See ["Inserting points"](#) on page 47
See ["Deleting points"](#) on page 47

CALCulate<n>:MASK:MODE <Mode>

Defines the scaling of the level axis for frequency masks.

Suffix:

<n> [Window](#)

Parameters:

<Mode> **ABSolute**
absolute scaling of the level axis.
RELative
relative scaling of the level axis.
*RST: RELative

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Changing the y-axis scaling \(Y-Axis rel/abs\)"](#) on page 48

CALCulate<n>:MASK:NAME <Name>

Suffix:

<n> 1..n
[Window](#)

Parameters:

<Name> String containing the name of the mask.
Note that an empty string does not select a frequency mask.

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["New"](#) on page 46
See ["Save"](#) on page 46
See ["Load"](#) on page 46
See ["Name"](#) on page 47

**CALCulate<n>:MASK:SPAN **

Defines the frequency span of the frequency mask.

Suffix:

<n> [Window](#)

Example: CALC:MASK:SPAN 10 MHz
Defines a span of 10 MHz.

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

CALCulate<n>:MASK:UPPer:AUTO

Suffix:

<n> 1..n

Manual operation: See ["Defining a mask automatically \(Auto-Set Mask\)"](#) on page 48

CALCulate<n>:MASK:UPPer:SHIFt:X <Frequency>

Shifts the lower frequency mask horizontally by a specified distance. Positive values move the mask to the right, negative values shift the mask to the left.

You have to select a mask before you can use this command with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:<n> [Window](#)**Parameters:**

<Frequency> Defines the distance of the shift.
Default unit: HZ

Manual operation: See ["Shifting the mask position horizontally \(Shift x\)"](#) on page 47

CALCulate<n>:MASK:UPPer:SHIFt:Y <Level>

Shifts the upper frequency mask vertically by a specified distance. Positive values move the mask upwards, negative values shift the mask downwards.

You have to select a mask before you can use this command with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:<n> [Window](#)**Parameters:**

<Level> Defines the distance of the shift. The shift is relative to the current position.
Default unit: dB

Manual operation: See ["Shifting the mask vertically \(Shift y\)"](#) on page 47

CALCulate<n>:MASK:UPPer:STATe <State>

Turns the upper frequency mask on and off.

Before making any changes to a frequency mask, you have to select one by name with [CALCulate<n>:MASK:NAME](#) on page 110.

Suffix:<n> [Window](#)**Parameters:**

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Manual operation: See ["Selecting and deselecting upper and lower masks"](#) on page 48

CALCulate<n>:MASK:UPPer[:DATA] {<Frequency>,<Level>}

Activates and defines the shape of the upper frequency mask trigger mask.

You have to select a mask before you can use this command with [CALCulate<n>:MASK:NAME](#) on page 110.

[N] pairs of numerical values. [N] is the number of data points the mask consists of.

Each data point is defined by the frequency and the level. All values are separated by commas.

Suffix:

<n> [Window](#)

Parameters:

<Frequency> Frequency of the data point within the current span.
Default unit: Hz

<Level> Level of the data point. The unit of the power levels depends on [CALCulate<n>:MASK:MODE](#) on page 109.
Default unit: DBM

Example: See [Section 7.10.1, "Example 1: creating a frequency mask trigger"](#), on page 181.

Manual operation: See ["Mask points"](#) on page 47
See ["Inserting points"](#) on page 47
See ["Deleting points"](#) on page 47

TRIGger[:SEQUence]:MASK:CONDition <Condition>

Sets the condition that activates the frequency mask trigger.

Parameters:

<Condition> **ENTER**
Triggers on entering the frequency mask.
LEAVING
Triggers on leaving the frequency mask.
***RST:** ENTER

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Setting the trigger condition"](#) on page 48

7.4.6 Configuring spectrograms

The remote commands required for the individual settings available for spectrogram and waterfall displays are described here. For color mapping commands, see [Section 7.4.8, "Configuring color maps"](#), on page 118.

The suffix <n> for CALCulate determines the window and thus which display the command is applied to.

[CALCulate<n>:SGRam:CLEar\[:IMMediate\]](#)..... 113
[CALCulate<n>:SPECtrogram:CLEar\[:IMMediate\]](#)..... 113

CALCulate<n>:SGRam:FRAMe:SElect.....	113
CALCulate<n>:SPEctrogram:FRAMe:SElect.....	113
CALCulate<n>:SGRam:TSTamp:DATA?.....	113
CALCulate<n>:SPEctrogram:TSTamp:DATA?.....	113
CALCulate<n>:SGRam:TSTamp[:STATe].....	114
CALCulate<n>:SPEctrogram:TSTamp[:STATe].....	114

CALCulate<n>:SGRam:CLEar[:IMMediate]**CALCulate<n>:SPEctrogram:CLEar[:IMMediate]**

Resets the spectrogram and clears the history buffer.

Suffix:

<n> [Window](#)

Example:

```
//Reset the result display and clear the memory
CALC:SGR:CLE
```

Manual operation: See ["Clear Spectrogram"](#) on page 58

CALCulate<n>:SGRam:FRAMe:SElect <Frame>**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 at -25 s.
```

Manual operation: See ["Selecting a frame to display"](#) on page 51

CALCulate<n>:SGRam:TSTamp:DATA? <Frames>**CALCulate<n>:SPEctrogram:TSTamp:DATA? <Frames>**

Queries the starting time of the frames.

The return values consist of four values for each frame. If the "Spectrogram" is empty, the command returns '0,0,0,0'. The times are given as delta values, which simplifies evaluating relative results; however, you can also calculate the absolute date and time as displayed on the screen.

The frame results themselves are returned with `TRAC:DATA? SGR`

Suffix:

<n> [Window](#)

Query parameters:

<Frames>

CURRent

Returns the starting time of the current frame.

ALL

Returns the starting time for all frames. The results are sorted in descending order, beginning with the current frame.

Return values:

<Seconds>

Number of seconds that have passed since 01.01.1970 until the frame start

<Nanoseconds>

Number of nanoseconds that have passed *in addition to the* <Seconds> since 01.01.1970 until the frame start.

<Reserved>

The third value is reserved for future uses.

<Reserved>

The fourth value is reserved for future uses.

Example:

`CALC:SGR:TST:DATA? ALL`

Returns the starting times of all frames sorted in a descending order.

Usage:

Query only

Manual operation: See ["Time Stamp"](#) on page 68

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

CALCulate<n>:SPECTrogram:TSTamp[:STATe] <State>

Activates and deactivates the time stamp.

If the time stamp is active, some commands do not address frames as numbers, but as (relative) time values:

- [CALCulate<n>:DELTaMarker<m>:SPECTrogram:FRAMe](#) on page 172
- [CALCulate<n>:MARKer<m>:SPECTrogram:FRAMe](#) on page 167
- [CALCulate<n>:SPECTrogram:FRAMe:SElect](#) on page 113

Suffix:

<n> 1..n
[Window](#)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example: //Activates the time stamp
 CALC:SGR:TST ON

Manual operation: See ["Time Stamp"](#) on page 68

7.4.7 Configuring the persistence spectrum

You can customize the persistence spectrum in several ways. You can change the colors with which the densities are visualized, you can change the persistence of the data and change the style of the displayed results.



Compatibility with R&S FSVR

For compatibility with the R&S FSVR, the following commands required to configure the persistence spectrum also accept the optional `SUBWindow` keyword (`DISPlay:WINDow[:SUBWindow] . . .`). However, this keyword is ignored and has no effect on remote control.

<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:MAXHold:RESet</code>	115
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:MAXHold:INTensity</code>	115
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:MAXHold[:STATe]</code>	116
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:PERSistence:DURation</code>	116
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:PERSistence:GRANularity</code>	117
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:PERSistence[:STATe]</code>	117
<code>DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:SYMBol</code>	118

`DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:MAXHold:RESet`

Suffix:

<code><n></code>	1..n
<code><w></code>	1..n
<code><t></code>	1..n

Manual operation: See ["Resetting the Max Hold Function"](#) on page 56

`DISPlay:WINDow<n>[:SUBWindow<w>]:TRACe<t>:MAXHold:INTensity` `<Intensity>`

Defines the color intensity of the maxhold persistence spectrum.

Note: Setting the intensity to 0 has the same effect as deactivating the Maxhold function (see `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MAXHold[:STATe]` on page 116).

Suffix:<n> [Window](#)

<w> subwindow

<t> [Trace](#)**Parameters:**

<Intensity> Sets the color intensity of the maxhold trace.

Range: 0 to 254

Increment: 1

*RST: 100

Example:

DISP:WIND:TRAC:MAXH:INT 120

Sets the color intensity of the maxhold trace to 120.

Example:See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Intensity"](#) on page 56**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MAXHold[:STATe] <State>**

Switches the maxhold trace in the persistence spectrum on and off.

Note: Setting the intensity to 0 has the same effect as deactivating the Maxhold function (see [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:MAXHold:INTensity](#) on page 115).

Suffix:<n> [Window](#)

<w> subwindow

<t> [Trace](#)**Parameters:**

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Configuring the Max Hold Function"](#) on page 56**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence:DURation
<Persistence>**

Sets the duration of the persistence.

Setting the persistence to 0 turns it off and thus has the same effect as the command `DISP:WIND:TRAC:PERS OFF` (see `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence[:STATe]` on page 117).

Suffix:

<n> [Window](#)

<w> subwindow

<t> [Trace](#)

Parameters:

<Persistence> Persistence in seconds.

Range: 0 to 8

Increment: 0.001

*RST: 1 seconds

Default unit: seconds

Example: `DISP:WIND:TRAC:PERS:DUR 4.3`
Sets the persistence to 4.3 seconds.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Persistence"](#) on page 55

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence:GRANularity
<Granularity>

Defines the duration that data is captured to build one persistence spectrum.

Suffix:

<n> [Window](#)

<w> subwindow

<t> [Trace](#)

Parameters:

<Granularity> duration in seconds

*RST: 0.1s

Default unit: S

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Granularity"](#) on page 55

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence[:STATe]
<State>

Switches persistence in the persistence spectrum on and off.

Note: Setting the persistence to 0 turns it off and thus has the same effect as this command (see `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:PERSistence:DURation` on page 116).

Suffix:

<n> [Window](#)

<w> subwindow

<t> [Trace](#)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SYMBol <Style>

Sets the display style of the persistence spectrum.

Suffix:

<n> [Window](#)

<w> subwindow

<t> [Trace](#)

Parameters:

<Style> **DOTS**

Displays the data as dots. The result is a persistence spectrum made up out of dots.

VECTor

Interpolates the measurement points. The result is an uninterrupted persistence spectrum.

*RST: VECTor

Example:

`DISP:WIND:TRAC:SYMB DOTS`

Displays the persistence spectrum as dots.

Example:

See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

7.4.8 Configuring color maps

The color display used in spectrograms and persistence spectra is highly configurable to adapt the display to your needs.

For details see [Section 3.5.3, "Color maps"](#), on page 24.

| | |
|--|-----|
| DISPlay[:WINDow<n>]:PSPectrum:COLor:DEFault..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:LOWer..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:SHApe..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:TRUNcate..... | 120 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:UPPer..... | 120 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor[:STYLe]..... | 121 |
| CALCulate<n>:SPECtrogram:COLor..... | 121 |
| DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]..... | 121 |
| DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault..... | 122 |
| DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer..... | 122 |
| DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHApe..... | 122 |
| DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer..... | 122 |

DISPlay[:WINDow<n>]:PSPectrum:COLor:DEFault

Suffix:

<n> 1..n

Manual operation: See ["Set to Default"](#) on page 59

DISPlay[:WINDow<n>]:PSPectrum:COLor:LOWer <Percentage>

Sets the lower percentage boundary of the persistence spectrum.

Suffix:<n> [Window](#)**Parameters:**

<Percentage> Statistical frequency percentage.
 Range: 0 to 65,6
 *RST: 0
 Default unit: %

Example:

DISP:WIND:HIST:COL:LOW 10

Sets the start of the color map to 10%.

Example:See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Start / Stop"](#) on page 59

DISPlay[:WINDow<n>]:PSPectrum:COLor:SHApe <Shape>

Defines the shape and focus of the color curve for the persistence spectrum result display.

Suffix:<n> [Window](#)

Parameters:**<Shape>** Shape of the color curve.

Range: -1 to 1

*RST: 0

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Shape"](#) on page 59**DISPlay[:WINDow<n>]:PSPectrum:COLor:TRUNcate <State>**

Reduces the range of the color map of the persistence spectrum if there are no hits at the start or end of the value range.

Suffix:**<n>** [Window](#)**Parameters:****<State>** ON | OFF | 0 | 1**OFF | 0**

Switches the function off

ON | 1

Switches the function on

Example: DISP:WIND:PSP:COL:TRUN ON
Activates truncation of the color map.**Example:** See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Truncate"](#) on page 59**DISPlay[:WINDow<n>]:PSPectrum:COLor:UPPer <Percentage>**

Sets the upper percentage boundary of the persistence spectrum.

Suffix:**<n>** [Window](#)**Parameters:****<Percentage>** Statistical frequency percentage.

Range: 0.01 to 100

*RST: 100

Default unit: %

Example: DISP:WIND:HIST:COL:UPP 95
Sets the upper boundary of the color map to 95%.**Example:** See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.**Manual operation:** See ["Start / Stop"](#) on page 59

DISPlay[:WINDow<n>]:PSPectrum:COLor[:STYLE] <ColorScheme>

Sets the color scheme for the persistence spectrum.

Suffix:

<n> [Window](#)

Parameters:

<ColorScheme> **HOT**
 COLD
 RADar
 GRAYscale
 *RST: HOT

Example: DISP:WIND:HIST:COL GRAY
 Changes the color scheme of the persistence spectrum to black and white.

Example: See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See "[Hot/Cold/Radar/Grayscale](#)" on page 59

CALCulate<n>:SPECtrogram:COLor <ColorScheme>

DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLE] <ColorScheme>

Selects the color scheme.

Parameters:

<ColorScheme> **HOT**
 Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.
COLD
 Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.
RADar
 Uses a color range from black over green to light turquoise with shades of green in between.
GRAYscale
 Shows the results in shades of gray.
 *RST: HOT

Example: DISP:WIND:SPEC:COL GRAY
 Changes the color scheme of the spectrogram to black and white.

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Manual operation: See "[Hot/Cold/Radar/Grayscale](#)" on page 59

DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault

Restores the original color map.

Suffix:

<n> [Window](#)

Manual operation: See ["Set to Default"](#) on page 59

DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer <Percentage>

Defines the starting point of the color map.

Suffix:

<n> [Window](#)

Parameters:

<Percentage> Statistical frequency percentage.
Range: 0 to 66
*RST: 0
Default unit: %

Example: DISP:WIND:SGR:COL:LOW 10
Sets the start of the color map to 10%.

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Manual operation: See ["Start / Stop"](#) on page 59

DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPE <Shape>

Defines the shape and focus of the color curve for the spectrogram result display.

Suffix:

<n> [Window](#)

Parameters:

<Shape> Shape of the color curve.
Range: -1 to 1
*RST: 0

Example: See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Manual operation: See ["Shape"](#) on page 59

DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer <Percentage>

Defines the end point of the color map.

Suffix:

<n> [Window](#)

Parameters:

<Percentage> Statistical frequency percentage.
 Range: 0 to 66
 *RST: 0
 Default unit: %

Example:

DISP:WIND:SGR:COL:UPP 95
 Sets the start of the color map to 95%.

Example:

See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Manual operation:

See ["Start / Stop"](#) on page 59

7.4.9 Adjusting settings automatically

The following remote commands are required to adjust settings automatically in a remote environment. In MSRT mode, these commands are only available for the MSRT primary channel. The functions for manual operation are described in [Section 4.8, "Adjusting settings automatically"](#), on page 52.

| | |
|---|-----|
| [SENSe:]ADJust:CONFigure:LEVel:DURation..... | 123 |
| [SENSe:]ADJust:CONFigure:LEVel:DURation:MODE..... | 124 |
| [SENSe:]ADJust:CONFigure:HYSTeresis:LOWer..... | 124 |
| [SENSe:]ADJust:CONFigure:HYSTeresis:UPPer..... | 124 |
| [SENSe:]ADJust:LEVel..... | 125 |

[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the FPL performs a measurement on the current input data. This command defines the length of the measurement if [\[SENSe:\]ADJust:CONFigure:LEVel:DURation:MODE](#) is set to MANual.

Parameters:

<Duration> Numeric value in seconds
 Range: 0.001 to 16000.0
 *RST: 0.001
 Default unit: s

Example:

ADJ:CONF:DUR:MODE MAN
 Selects manual definition of the measurement length.
 ADJ:CONF:LEV:DUR 5ms
 Length of the measurement is 5 ms.

Manual operation:

See ["\(Meas Time Manual\)"](#) on page 53

[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the FPL performs a measurement on the current input data. This command selects the way the FPL determines the length of the measurement.

Parameters:

<Mode>

AUTO

The FPL determines the measurement length automatically according to the current input data.

MANual

The FPL uses the measurement length defined by [\[SENSe:\]ADJust:CONFigure:LEVel:DURation](#) on page 123.

*RST: AUTO

Manual operation: See ["Resetting the Automatic Measurement Time \(Meas Time Auto\)"](#) on page 52
See ["\(Meas Time Manual\)"](#) on page 53

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVel](#) on page 125 command, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB

*RST: +1 dB

Default unit: dB

Example:

SENS:ADJ:CONF:HYST:LOW 2

For an input signal level of currently 20 dBm, the reference level is only adjusted when the signal level falls below 18 dBm.

Manual operation: See ["Lower Level Hysteresis"](#) on page 53

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the [\[SENSe:\]ADJust:LEVel](#) on page 125 command, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold> Range: 0 dB to 200 dB
 *RST: +1 dB
 Default unit: dB

Example: SENS:ADJ:CONF:HYST:UPP 2

Example: For an input signal level of currently 20 dBm, the reference level is only adjusted when the signal level rises above 22 dBm.

Manual operation: See ["Upper Level Hysteresis"](#) on page 53

[SENSe:]ADJust:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The FPL is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Example: ADJ:LEV

Manual operation: See ["Setting the Reference Level Automatically \(Auto Level\)"](#) on page 40

7.4.10 Configuring the result display

The following remote commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in [Section 2.1, "Real-Time Spectrum result displays"](#), on page 8.

- [General window commands](#)..... 125
- [Working with windows in the display](#)..... 126

7.4.10.1 General window commands

The following commands are required to configure general window layout, independent of the application.

[DISPlay\[:WINDow<n>\]:SIZE](#)..... 125

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 129).

Suffix:<n> [Window](#)**Parameters:**

<Size>

LARGe

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

SMALI

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

*RST: [SMALI](#)**Example:**

DISP:WIND2:SIZE LARG

7.4.10.2 Working with windows in the display

The following commands are required to change the evaluation type and rearrange the screen layout for a channel setup 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 channel setup.

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

| | |
|---|-----|
| LAYout:ADD[:WINDow]?..... | 126 |
| LAYout:CATalog[:WINDow]?..... | 127 |
| LAYout:IDENtify[:WINDow]?..... | 127 |
| LAYout:MOVE[:WINDow]..... | 128 |
| LAYout:REMove[:WINDow]..... | 128 |
| LAYout:REPLace[:WINDow]..... | 129 |
| LAYout:SPLitter..... | 129 |
| LAYout:WINDow<n>:ADD?..... | 131 |
| LAYout:WINDow<n>:REMove..... | 131 |
| LAYout:WINDow<n>:REPLace..... | 132 |

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.

Example:

LAY:ADD? '1', LEFT, MTAB

Result:

'2'

Adds a new window named '2' with a marker table to the left of window 1.

Usage:

Query only

Manual operation:

See ["Spectrogram"](#) on page 9

See ["Marker Table"](#) on page 11

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>..

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.

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:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

Setting parameters:

<WindowName> String containing the name of an existing window that is to be moved.

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](#).

<WindowName> String containing the name of an existing window the selected window is placed next to or replaces.
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](#).

<Direction> LEFT | RIGHT | ABOVE | BELOW | REPLACE

Destination the selected window is moved to, relative to the reference window.

Example:

LAY:MOVE '4', '1', LEFT

Moves the window named '4' to the left of window 1.

Example:

LAY:MOVE '1', '3', REPL

Replaces the window named '3' by window 1. Window 3 is deleted.

Usage:

Setting 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 126 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.

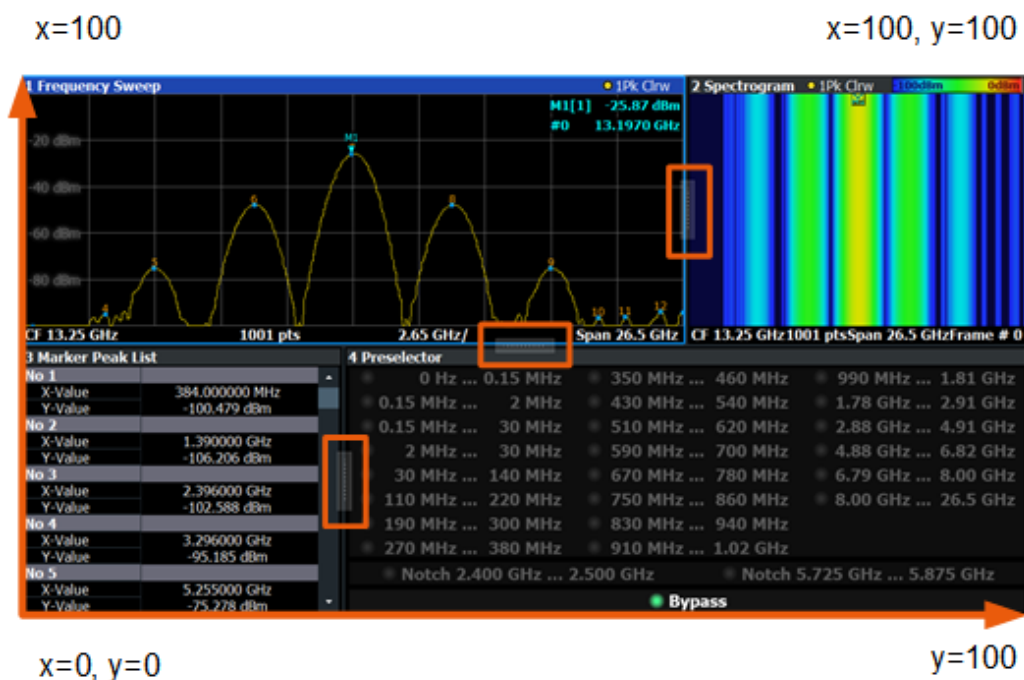


Figure 7-1: SmartGrid coordinates for remote control of the splitters

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 7-1.)
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 126 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>: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 126 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

7.5 Capturing data and performing sweeps

When you activate a "Real-Time Spectrum" measurement channel, a measurement is started immediately with the default settings. However, you can start and stop new measurements at any time.

| | |
|---|-----|
| ABORT | 132 |
| INITiate<n>:CONMeas | 133 |
| INITiate<n>:CONTinuous | 133 |
| INITiate<n>[:IMMediate] | 134 |
| INITiate:SEQuencer:ABORT | 134 |
| INITiate:SEQuencer:IMMediate | 134 |
| INITiate:SEQuencer:MODE | 135 |
| SYSTem:SEQuencer | 135 |

ABORT

Aborts the measurement in the current channel setup and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see [Remote control via SCPI](#).

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the FPL is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the FPL on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa:** `viClear()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR; :INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR; *WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONMeas

Restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

Suffix:
<n> irrelevant

Usage: Asynchronous command

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](#).

If the measurement mode is changed for a channel setup while the Sequencer is active (see [INITiate:SEQuencer:IMMediate](#) on page 134), the mode is only considered the next time the measurement in that channel setup is activated by the Sequencer.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

ON | 1

Continuous measurement

OFF | 0

Single measurement

*RST: 1 (some applications can differ)

Example:

INIT:CONT OFF

Switches the measurement mode to single measurement.

INIT:CONT ON

Switches the measurement mode to continuous measurement.

Manual operation: See ["Continuous Sweep / Run Cont"](#) on page 51

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see [Remote control via SCPI](#).

Suffix:

<n> irrelevant

Usage:

Asynchronous command

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using [INITiate:SEQuencer:IMMediate](#) on page 134.

Usage:

Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see [SYSTem:SEQuencer](#) on page 135).

Example:

```
SYST:SEQ ON
```

Activates the Sequencer.

```
INIT:SEQ:MODE SING
```

Sets single sequence mode so each active measurement is performed once.

```
INIT:SEQ:IMM
```

Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using *OPC, *OPC? or *WAI, use **SINGLE** Sequencer mode.

Parameters:

<Mode>

SINGLE

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTInuous

Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

```
*RST:      CONTInuous
```

SYSTem:SEQuencer <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

Parameters:

<State>

ON | OFF | 0 | 1

ON | 1

The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0

The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

```
*RST:      0
```

Example:

```

SYST:SEQ ON
Activates the Sequencer.
INIT:SEQ:MODE SING
Sets single Sequencer mode so each active measurement is
performed once.
INIT:SEQ:IMM
Starts the sequential measurements.
SYST:SEQ OFF

```

7.6 Retrieving results

The following commands are required to retrieve the results in a remote environment.

- [Retrieving marker results](#)..... 136
- [Retrieving trace results](#)..... 137
- [Measurement results for TRACe<n>\[:DATA\]?](#)..... 140
- [Exporting trace results](#)..... 141

7.6.1 Retrieving marker results

Useful commands for retrieving results described elsewhere:

- [CALCulate<n>:DELTamarker<m>:X](#) on page 153
- [CALCulate<n>:DELTamarker<m>:Y?](#) on page 153
- [CALCulate<n>:MARKer<m>:X](#) on page 150
- [CALCulate<n>:MARKer<m>:Y?](#) on page 151

Remote commands exclusive to retrieving marker results:

| | |
|---|-----|
| CALCulate<n>:DELTamarker<m>:X:RELative? | 136 |
| CALCulate<n>:DELTamarker<m>:Z | 137 |
| CALCulate<n>:MARKer<m>:Z? | 137 |

CALCulate<n>:DELTamarker<m>:X:RELative?

Queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example:

```

CALC:DELT3:X:REL?
Outputs the frequency of delta marker 3 relative to marker 1 or
relative to the reference position.

```

Usage: Query only

CALCulate<n>:DELTaMarker<m>:Z

Suffix:

<n> 1..n

<m> 1..n

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

Queries the z-axis value of the indicated marker in the persistence spectrum result display.

You can select whether to query the results of the persistence trace or the maxhold trace with [CALCulate<n>:DELTaMarker<m>:TRACe](#) on page 153.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Return values:

<Result> The return value is the percentage of hits on the marker position.

Usage: Query only

7.6.2 Retrieving trace results

The following remote commands are required to retrieve the trace results in a remote environment.

Useful commands for retrieving results described elsewhere:

- [CALCulate<n>:SPECTrogram:FRAMe:SElect](#) on page 113
- [CALCulate<n>:SPECTrogram:TSTamp:DATA?](#) on page 113

Remote commands exclusive to retrieving trace results:

| | |
|---|-----|
| FORMat[:DATA] | 137 |
| TRACe<n>[:DATA] | 138 |
| TRACe<n>[:DATA]:MEMory? | 139 |
| TRACe<n>[:DATA]:X? | 140 |

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

Selects the data format that is used for transmission of trace data from the FPL to the controlling computer.

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

Parameters:

<Format>

ASCII

ASCII format, separated by commas.

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

REAL

Floating-point numbers (according to IEEE 754) in the "definite length block format".

In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.

<BitLength>

Length in bits for floating-point results

16

16-bit floating-point numbers.

Compared to `REAL, 32` format, half as many numbers are returned.

32

32-bit floating-point numbers

For I/Q data, 8 bytes per sample are returned for this format setting.

64

64-bit floating-point numbers

Compared to `REAL, 32` format, twice as many numbers are returned.

Example:

`FORM REAL, 32`

TRACe<n>[:DATA]

Queries current trace data and measurement results.

The data format depends on `FORMat [:DATA]` on page 137.

For details, see [Section 7.6.3, "Measurement results for TRACe<n>\[:DATA\]?"](#), on page 140.

Suffix:

<n>

[Window](#)

Query parameters:

<ResultType>

Selects the type of result to be returned.

TRACE1 | ... | TRACE4

Returns the trace data for the corresponding trace.

The trace data consists of a list of measured power levels. The number of power levels in the list depends on the currently selected number of sweep points. The unit depends on the measurement and on the configured unit.

For the auto peak detector, the command returns positive peak values only. (To retrieve negative peak values, define a second trace with a negative peak detector.)

SPECTrogram | SGRam

Returns the results of the spectrogram result display.

For every frame in the spectrogram, the command returns the measured power levels, one for each sweep point. The number of frames depends on the size of the history depth. The power level depends on the configured unit. For spectrogram trace results, only `REAL, 32` format is supported

PSpectrum

Returns the result of the Clear/Write (trace 2) "Persistence Spectrum" result display.

For every sweep point in the "Persistence Spectrum", the command returns the probability of appearance values (in %) that have been determined.

HMAXhold

Returns the result of the Max Hold (trace 3) "Persistence Spectrum" result display.

For every sweep point in the "Persistence Spectrum", the command returns the probability of appearance values (in %) that have been determined.

Example:

`TRAC? TRACE3`

Queries the data of trace 3.

Manual operation:

See ["Real-Time Spectrum"](#) on page 8

See ["Spectrogram"](#) on page 9

See ["Persistence Spectrum"](#) on page 10

TRACe<n>[:DATA]:MEMory? <Trace>,<OffsSwPoint>,<NoOfSwPoints>

Queries the previously captured trace data for the specified trace from the memory. As an offset and number of sweep points to be retrieved can be specified, the trace data can be retrieved in smaller portions, making the command faster than the `TRAC:DATA?` command. This is useful if only specific parts of the trace data are of interest.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as `TRAC:DATA? TRACE1`.

For details on the returned values see the `TRAC:DATA? <TRACE...>` command.

Suffix:

<n>

[Window](#)

Query parameters:

| | |
|----------------|---|
| <Trace> | TRACE1 TRACE2 TRACE3 TRACE4 |
| <OffsSwPoint> | The offset in sweep points related to the start of the measurement at which data retrieval is to start. |
| <NoOfSwPoints> | Number of sweep points to be retrieved from the trace. |

Return values:

<SweepPointValues>

Example:

TRAC:DATA:MEM? TRACE1,25,100

Retrieves 100 sweep points from trace 1, starting at sweep point 25.

Usage:

Query only

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

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

Suffix:<n> [Window](#)**Query parameters:**

| | |
|---------------|---|
| <TraceNumber> | Trace number.
TRACE1 TRACE2 TRACE3 TRACE4 |
|---------------|---|

Return values:

<X-Values>

Example:

TRAC3:X? TRACE1

Returns the x-values for trace 1 in window 3.

Usage:

Query only

Manual operation:

See ["Real-Time Spectrum"](#) on page 8
 See ["Spectrogram"](#) on page 9
 See ["Persistence Spectrum"](#) on page 10

7.6.3 Measurement results for TRACe<n>[:DATA]?

The result type selected by [LAYout:ADD\[:WINDow\]?](#) and the data format defined by [FORMat\[:DATA\]](#) also affect the results of the trace data query (see [TRACe<n>\[:DATA\]](#) on page 138). Details on the returned trace data depending on the result type and data format are provided here.

| TRACe<n>[:DATA]?
parameter | Result type | Result Format |
|-------------------------------|---|---|
| TRACE1 ...
TRACE4 | "Persistence Spectrum"
(TRACE1 only)

"Real-Time Spectrum"

"Spectrogram" (TRACE1
only) | Depends on FORMat [: DATA] . By default, comma-separated floats in ASCII format. In Real-Time, traces are always 1001 points.

For Waterfall displays, TRACE1 returns the newest frame.

For the Persistence display, TRACE1 returns its TRACE1, which is also TRACE1 of the "Real-Time Spectrum". |
| SPECTrogram/SGRam | "Spectrogram" | Depends on FORMat [: DATA] . By default, comma-separated floats in ASCII format. REAL16 and 64 not supported.

Comma-separated list, formatted as 1001 x <frame_count>. No delimiter between frames. Frames are returned from newest frame (top of the spectrogram) to oldest (bottom of the spectrogram). |
| PSpectrum | "Persistence Spectrum" | Returns the data of the Clear/Write histogram, Trace 2.

Depends on FORMat [: DATA] . By default, 1001x600 comma-separated floats in ASCII format. REAL16 and 64 not supported.

Data is returned in Row-Major order, from top to bottom (i.e. the first 1001 values returned are the top row of the display, from left to right; the last 1001 values returned are the bottom row of the display). Each value is the probability of appearance (in %) for a specific pixel, as a percentage in range [0.0, 100.0]. |
| HMAXhold | "Persistence Spectrum" | Returns the data of the Max Hold histogram, Trace 3.

Depends on FORMat [: DATA] . By default, 1001x600 comma-separated floats in ASCII format. REAL16 and 64 not supported.

Data is returned in Row-Major order, from top to bottom (i.e. the first 1001 values returned are the top row of the display, from left to right; the last 1001 values returned are the bottom row of the display). Each value is the probability of appearance (in %) for a specific pixel, as a percentage in range [0.0, 100.0]. |

7.6.4 Exporting trace results

Trace results can be exported to a file.

For more commands concerning data and results storage see the FPL User Manual.

| | |
|--|-----|
| MMEMory:STORe<n>:PSpectrum | 142 |
| MMEMory:STORe<n>:SPECTrogram | 142 |
| MMEMory:STORe<n>:TRACe | 142 |
| FORMat:DEXPort:DSEParator | 143 |
| FORMat:DEXPort:HEADer | 143 |
| FORMat:DEXPort:TRACes | 143 |

MMEMory:STORe<n>:PSPectrum <FileName>

Exports persistence spectrum data to an ASCII file.

The file contains the most recently determined percentage value for each pixel in the persistence spectrum, that is, for 1001 frequency and 600 power values, followed by the 1001*600 maxhold percentages.

For details see [Table 8-2](#).

Note that, due to the large amount of data involved, the process of exporting the data can take a while.

Suffix:

<n> [Window](#)

Parameters:

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

Example:

MMEM:STOR:PSP 'C:\PersistentSpectrum'
Copies the persistent spectrum data to a file.

Example:

See [Section 7.10.3, "Example 3: analyzing persistency"](#), on page 185.

Manual operation: See ["Persistence Spectrum"](#) on page 10

MMEMory:STORe<n>:SPECtrogram <FileName>

Exports spectrogram data to an ASCII file.

The file contains the data for every frame in the history buffer. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Note that, depending on the size of the history buffer, the process of exporting the data can take a while.

Suffix:

<n> [Window](#)

Parameters:

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

Example:

MMEM:STOR:SGR 'Spectrogram'
Copies the spectrogram data to a file.

Example:

See [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Manual operation: See ["Spectrogram"](#) on page 9

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

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

Suffix:<n> [Window](#)**Parameters:**

<Trace> Number of the trace to be stored

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

Example:

MMEM:STOR1:TRAC 1, 'C:\TEST.ASC'

Stores trace 1 from window 1 in the file TEST.ASC.

Manual operation:See ["Real-Time Spectrum"](#) on page 8See ["Export Trace to ASCII File"](#) on page 63**FORMat:DEXPort:DSEParator** <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINT | COMMa

COMMa

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

POINT

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

*RST: *RST has no effect on the decimal separator.

Default is POINT.

Example:

FORM:DEXP:DSEP POIN

Sets the decimal point as separator.

Manual operation:See ["Decimal Separator"](#) on page 63**FORMat:DEXPort:HEADer** <State>

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation:See ["Include Instrument & Measurement Settings"](#) on page 63**FORMat:DEXPort:TRACes** <Selection>

Selects the data to be included in a data export file (see [MMEMory:STORe<n>:TRACe](#) on page 142).

Parameters:

<Selection> SINGLE | ALL

SINGle

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

ALL

Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.

The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See "Data to be exported" on page 62

7.7 Analyzing results

The following remote commands are required to configure general result analysis settings concerning the trace, markers, lines etc. in a remote environment.

More details are described for manual operation in [Section 5, "Analysis"](#), on page 54.

- [Configuring traces](#)..... 144
- [Working with markers remotely](#)..... 148
- [Zooming into the display](#)..... 175

7.7.1 Configuring traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing`
on page 98
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]`
on page 96
- [Section 7.6.4, "Exporting trace results"](#), on page 141

Remote commands exclusive to trace configuration

| | |
|---|-----|
| <code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE</code> | 145 |
| <code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONTinuous</code> | 145 |
| <code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]</code> | 146 |
| <code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing:APERture</code> | 146 |
| <code>DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing[:STATe]</code> | 147 |
| <code>[SENSe:]AVERage<n>:COUNT</code> | 147 |
| <code>[SENSe:]AVERage<n>[:STATe<t>]</code> | 147 |
| <code>[SENSe:][WINDow:]DETEctor<t>[:FUNCTION]</code> | 148 |
| <code>TRACe<n>:COPY</code> | 148 |

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

Selects the trace mode. If necessary, the selected trace is also activated.

For max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNT`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Suffix:

| | |
|-----|--|
| <n> | Window |
| <w> | subwindow
Not supported by all applications |
| <t> | Trace |

Parameters:

<Mode>

WRITE

(default:) Overwrite mode: the trace is overwritten by each sweep.

MAXHold

The maximum value is determined over several sweeps and displayed. The FPL saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold

The minimum value is determined from several measurements and displayed. The FPL saves the sweep result in the trace memory only if the new value is lower than the previous one.

BLANK

Hides the selected trace.

*RST: Trace 1: WRITE, Trace 2-6: BLANK

Example:

```
INIT:CONT OFF
```

Switching to single sweep mode.

```
SWE:COUN 16
```

Sets the number of measurements to 16.

```
DISP:TRAC3:MODE WRIT
```

Selects clear/write mode for trace 3.

```
INIT;*WAI
```

Starts the measurement and waits for the end of the measurement.

Manual operation: See "Mode" on page 61

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONTinuous <State>

Turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:<n> [Window](#)

<w> subwindow

<t> [Trace](#)**Parameters:**

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

DISP:WIND:TRAC3:MODE:HCON ON
Switches off the reset function.

DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>[:STATe] <State>

Turns a trace on and off.

The measurement continues in the background.

Suffix:<n> [Window](#)

<w> subwindow
Not supported by all applications

<t> [Trace](#)**Parameters:**

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

DISP:TRAC3 ON

Manual operation:

See "[Trace 1/Trace 2/Trace 3/Trace 4](#)" on page 61

See "[Trace 1/ Trace 2/ Trace 3/ Trace 4 \(Softkeys\)](#)" on page 62

**DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:SMOothing:APERture
<Aperture>**

Defines the degree (aperture) of the trace smoothing, if [DISPlay\[:WINDow<n>\]\[:SUBWIndow<w>\]:TRACe<t>:SMOothing\[:STATe\]](#) TRUE.

Suffix:<n> [Window](#)

<w> subwindow

<t> [Trace](#)

Parameters:

<Aperture> Range: 1 to 50
 *RST: 2
 Default unit: PCT

Example:

DISP3:TRAC2:SMO:APER 5
 Defines an aperture of 5% for trace 2 in window 3

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing[:STATe] <State>

Turns trace smoothing for a particular trace on and off.

If enabled, the trace is smoothed by the value specified using [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:SMOothing:APERture](#) on page 146.

Suffix:

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

Parameters:

<State> ON | OFF | 0 | 1
 OFF | 0
 Switches the function off
 ON | 1
 Switches the function on

Example:

DISP3:TRAC2:SMO ON
 Turns on trace smoothing for trace 2 in window 3

[SENSe:]AVERage<n>:COUNT <AverageCount>

Defines the number of measurements that the application uses to average traces.

In case of continuous sweep mode, the application calculates the moving average over the average count.

In case of single sweep mode, the application stops the measurement and calculates the average after the average count has been reached.

Suffix:

<n> irrelevant

[SENSe:]AVERage<n>[:STATe<t>] <State>

Turns averaging for a particular trace in a particular window on and off.

Suffix:

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

Parameters:

<State> ON | OFF | 1 | 0

[SENSe:][WINDow:]DETEctor<t>[:FUNction] <Detector>

Defines the trace detector to be used for trace analysis.

Parameters:

<Detector> **NEGative**
 Negative peak
 POSitive
 Positive peak
 SAMPlE
 First value detected per trace point
 AVERage
 Average
 *RST: POS

Example:

DET POS
 Sets the detector to "positive peak".

Manual operation: See ["Detector"](#) on page 61

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

Copies data from one trace to another.

Suffix:

<n> [Window](#)

Parameters:

<TraceNumber> **TRACE1 | TRACE2 | TRACE3 | TRACE4**
 The first parameter is the destination trace, the second parameter is the source.
 (Note the 'e' in the parameter is required!)

Example:

TRAC:COPY TRACE1, TRACE2
 Copies the data from trace 2 to trace 1.

7.7.2 Working with markers remotely

In the "Real-Time Spectrum" application, up to 16 markers or delta markers can be activated for each window simultaneously.

For more details see [Section 3.5.2, "Markers in the spectrogram"](#), on page 23.

- [Setting up individual markers](#)..... 149
- [General marker settings](#)..... 154
- [Configuring and performing a marker search](#)..... 157
- [Positioning the marker](#)..... 161
- [Marker search \(spectrograms\)](#)..... 166

7.7.2.1 Setting up individual markers

The following commands define the position of markers in the diagram.

| | |
|---|-----|
| CALCulate<n>:MARKer<m>:AOFF..... | 149 |
| CALCulate<n>:MARKer<m>[:STATe]..... | 149 |
| CALCulate<n>:MARKer<m>:TRACe..... | 150 |
| CALCulate<n>:MARKer<m>:X..... | 150 |
| CALCulate<n>:MARKer<m>:Y..... | 151 |
| CALCulate<n>:MARKer<m>:Y?..... | 151 |
| CALCulate<n>:DELTamarker<m>:AOFF..... | 151 |
| CALCulate<n>:DELTamarker<m>:LINK..... | 151 |
| CALCulate<n>:DELTamarker<m>:MODE..... | 152 |
| CALCulate<n>:DELTamarker<m>:MREFerence..... | 152 |
| CALCulate<n>:DELTamarker<m>[:STATe]..... | 152 |
| CALCulate<n>:DELTamarker<m>:TRACe..... | 153 |
| CALCulate<n>:DELTamarker<m>:X..... | 153 |
| CALCulate<n>:DELTamarker<m>:Y..... | 153 |
| CALCulate<n>:DELTamarker<m>:Y?..... | 153 |

CALCulate<n>:MARKer<m>:AOFF

Turns off all markers.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Example:

CALC:MARK:AOFF
Switches off all markers.

Manual operation: See ["All Markers Off"](#) on page 66

CALCulate<n>:MARKer<m>[:STATe] <State>

Turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example:

CALC:MARK3 ON
Switches on marker 3.

Manual operation: See ["Marker State"](#) on page 64
 See ["Marker Type"](#) on page 65
 See ["Select Marker"](#) on page 66

CALCulate<n>:MARKer<m>:TRACe <Trace>

Selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Trace> **1 to 4**

Trace number the marker is assigned to.

MAXHold

Marker is assigned to maxhold trace of persistent spectrum
 (only available in Persistent Spectrum window)

WRITe

Marker is assigned to clear/write trace of persistent spectrum
 (only available in Persistent Spectrum window)

Example: //Assign marker to trace 1
 CALC:MARK3:TRAC 1

Manual operation: See ["Assigning the Marker to a Trace"](#) on page 65

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.

Manual operation: See ["Marker Table"](#) on page 11
 See ["Marker Position X-value"](#) on page 65

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

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

Manual operation: See ["Marker Table"](#) on page 11

CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

Suffix:

<n> [Window](#)

<m> irrelevant

Example: `CALC:DELT:AOFF`
 Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:LINK <State>

Links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example: `CALC:DELT2:LINK ON`

CALCulate<n>:DELTamarker<m>:MODE <Mode>

Defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker. Note that this setting applies to *all* windows.

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see [CALCulate<n>:DELTamarker<m>:X](#) on page 153)!

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<Mode>

ABSolute

Delta marker position in absolute terms.

RELative

Delta marker position in relation to a reference marker.

*RST: RELative

Example:

CALC:DELT:MODE ABS

Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREFerence <Reference>

Selects a reference marker for a delta marker other than marker 1.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Reference>

Example:

CALC:DELT3:MREF 2

Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See ["Reference Marker"](#) on page 65

CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<State>

ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

CALC:DELT2 ON

Turns on delta marker 2.

Manual operation:See ["Marker State"](#) on page 64See ["Marker Type"](#) on page 65See ["Select Marker"](#) on page 66**CALCulate<n>:DELTamarker<m>:TRACe <Trace>**

Selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:<n> [Window](#)<m> [Marker](#)**Parameters:**

<Trace> Trace number the marker is assigned to.

Example:

CALC:DELT2:TRAC 2

Positions delta marker 2 on trace 2.

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

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:<n> [Window](#)<m> [Marker](#)**Example:**

CALC:DELT:X?

Outputs the absolute x-value of delta marker 1.

Manual operation:See ["Marker Position X-value"](#) on page 65**CALCulate<n>:DELTamarker<m>:Y <Position>****CALCulate<n>:DELTamarker<m>:Y?**

Queries the result at the position of the specified delta marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.
Default unit: DBM

Usage: Query only

7.7.2.2 General marker settings

The following commands control general marker functionality.

| | |
|---|-----|
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed[:STATe]..... | 154 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]..... | 155 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:X..... | 155 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:Y..... | 155 |
| CALCulate<n>:MARKer<m>:X:SSize..... | 156 |
| DISPlay[:WINDow<n>]:MINFo[:STATe]..... | 156 |
| DISPlay[:WINDow<n>]:MTABle..... | 156 |

CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed[:STATe] <State>

Activates or deactivates a marker that defines a fixed reference point for relative marker analysis.

If necessary, the command activates a marker and positions it on the peak power.

Subsequently, you can change the coordinates of the fixed reference independent of the marker. The fixed reference is independent of the trace and is applied to all active delta markers.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example:

```
CALC:DELT:FUNC:FIX ON
Switches on the measurement with fixed reference value for all
delta markers.
CALC:DELT:FUNC:FIX:RPO:X 128 MHZ
Sets the frequency reference to 128 MHz.
CALC:DELT:FUNC:FIX:RPO:Y 30 DBM
Sets the reference level to +30 dBm.
```

CALCulate<n>:DELTamarker<m>:FUNction:FIXed:RPOint:MAXimum[:PEAK]

Moves the fixed reference marker to the peak power.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Example:

`CALC:DELT:FUNC:FIX:RPO:MAX`

Sets the reference point level for delta markers to the peak of the selected trace.

CALCulate<n>:DELTamarker<m>:FUNction:FIXed:RPOint:X <RefPoint>

Defines the horizontal position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<RefPoint> Numeric value that defines the horizontal position of the reference.
For frequency domain measurements, it is a frequency in Hz.
For time domain measurements, it is a point in time in s.
*RST: Fixed Reference: OFF
Default unit: HZ

Example:

`CALC:DELT:FUNC:FIX:RPO:X 128 MHz`

Sets the frequency reference to 128 MHz.

CALCulate<n>:DELTamarker<m>:FUNction:FIXed:RPOint:Y <RefPointLevel>

Defines the vertical position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<RefPoint> Numeric value that defines the vertical position of the reference.
The unit and value range is variable.
*RST: Fixed Reference: OFF
Default unit: DBM

Example:

`CALC:DELT:FUNC:FIX:RPO:Y -10dBm`

Sets the reference point level for delta markers to -10 dBm.

CALCulate<n>:MARKer<m>:X:SSIZe <StepSize>

Selects the marker step size mode for *all* markers in *all* windows.

The step size defines the distance the marker moves when you move it with the rotary knob.

It therefore takes effect in manual operation only.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<StepSize>

STANdard

the marker moves from one pixel to the next

POINTs

the marker moves from one sweep point to the next

*RST: POINTs

Example:

CALC:MARK:X:SSIZ STAN

Sets the marker step size to one pixel.

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

Turns the marker information in all diagrams on and off.

Suffix:

<n> irrelevant

Parameters:

<State>

ON | 1

Displays the marker information in the diagrams.

OFF | 0

Hides the marker information in the diagrams.

*RST: 1

Example:

DISP:MINF OFF

Hides the marker information.

Manual operation: See "[Marker Info](#)" on page 68

DISPlay[:WINDow<n>]:MTABLe <DisplayMode>

Turns the marker table on and off.

Suffix:

<n> irrelevant

Parameters:

<DisplayMode>

ON | 1

Turns on the marker table.

OFF | 0

Turns off the marker table.

***RST:** AUTO**Example:**

DISP:MTAB ON

Activates the marker table.

Manual operation: See ["Marker Table Display"](#) on page 67**7.7.2.3 Configuring and performing a marker search**

The following commands control the marker search.

| | |
|--|-----|
| CALCulate<n>:MARKer<m>:LOEXclude..... | 157 |
| CALCulate<n>:MARKer<m>:MAXimum:AUTO..... | 157 |
| CALCulate<n>:MARKer<m>:MINimum:AUTO..... | 158 |
| CALCulate<n>:MARKer<m>:PEXCursion..... | 158 |
| CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]..... | 159 |
| CALCulate<n>:MARKer<m>:X:SLIMits:LEFT..... | 159 |
| CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT..... | 159 |
| CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]..... | 160 |
| CALCulate<n>:THReshold..... | 160 |
| CALCulate<n>:THReshold:STATe..... | 161 |

CALCulate<n>:MARKer<m>:LOEXclude <State>Turns the suppression of the local oscillator during automatic marker positioning on and off (for *all* markers in *all* windows).**Suffix:**

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

***RST:** 1**Example:**

CALC:MARK:LOEX ON

CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>

Turns an automatic marker peak search for a trace maximum on and off (using marker 1). The FPL performs the peak search after each sweep.

Suffix:<n> [Window](#)

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:`CALC:MARK:MAX:AUTO ON`

Activates the automatic peak search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MINimum:AUTO <State>

Turns an automatic marker peak search for a trace minimum on and off (using marker 1). The FPL performs the peak search after each sweep.

Suffix:<n> [Window](#)

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:`CALC:MARK:MIN:AUTO ON`

Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

Defines the peak excursion (for *all* markers in *all* windows).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<Excursion> The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized

*RST: 6.0 dB

Manual operation: See ["Peak Excursion"](#) on page 71

CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>

Turns marker search limits on and off for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

CALC:MARK:X:SLIM ON

Switches on search limitation.

CALCulate<n>:MARKer<m>:X:SLIMits:LEFT <SearchLimit>

Defines the left limit of the marker search range for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<SearchLimit> The value range depends on the frequency range or measurement time.

The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: left diagram border

Default unit: HZ

Example:

CALC:MARK:X:SLIM ON

Switches the search limit function on.

CALC:MARK:X:SLIM:LEFT 10MHz

Sets the left limit of the search range to 10 MHz.

CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT <SearchLimit>

Defines the right limit of the marker search range for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<Limit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: right diagram border

Default unit: HZ

Example:

CALC:MARK:X:SLIM ON

Switches the search limit function on.

CALC:MARK:X:SLIM:RIGH 20MHz

Sets the right limit of the search range to 20 MHz.

CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe] <State>

Adjusts the marker search range to the zoom area for *all* markers in *all* windows.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example:

CALC:MARK:X:SLIM:ZOOM ON

Switches the search limit function on.

CALC:MARK:X:SLIM:RIGH 20MHz

Sets the right limit of the search range to 20 MHz.

CALCulate<n>:THReshold <Level>

Defines a threshold level for the marker peak search (for *all* markers in *all* windows).

Note that you must enable the use of the threshold using [CALCulate<n>:THReshold:STATe](#) on page 161.

Suffix:

<n> irrelevant

Parameters:

<Level> Numeric value. The value range and unit are variable.

*RST: -120 dBm

Default unit: DBM

Example: `CALC:THR:STAT ON`

Example: `CALC:THR -82DBM`
Enables the search threshold and sets the threshold value to -82 dBm.

CALCulate<n>:THReshold:STATe <State>

Turns a threshold for the marker peak search on and off (for *all* markers in *all* windows).

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

Example: `CALC:THR:STAT ON`
Switches on the threshold line.

7.7.2.4 Positioning the marker

The following remote commands are required to position the marker on a trace.

- [Positioning markers](#)..... 161
- [Positioning delta markers](#)..... 164

Positioning markers

The following commands position markers on the trace.

| | |
|--|-----|
| CALCulate<n>:MARKer<m>:FUNCTion:CENTer | 161 |
| CALCulate<n>:MARKer<m>:MAXimum:LEFT | 162 |
| CALCulate<n>:MARKer<m>:MAXimum:NEXT | 162 |
| CALCulate<n>:MARKer<m>:MAXimum[:PEAK] | 162 |
| CALCulate<n>:MARKer<m>:MAXimum:RIGHT | 162 |
| CALCulate<n>:MARKer<m>:MINimum:LEFT | 163 |
| CALCulate<n>:MARKer<m>:MINimum:NEXT | 163 |
| CALCulate<n>:MARKer<m>:MINimum[:PEAK] | 163 |
| CALCulate<n>:MARKer<m>:MINimum:RIGHT | 163 |

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

Matches the center frequency to the frequency 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:CENT

Sets the center frequency to the frequency of marker 2.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:**See ["Search Mode for Next Peak in X Direction"](#) on page 69See ["Search Next Peak"](#) on page 71**CALCulate<n>:MARKer<m>:MAXimum:NEXT**

Moves a marker to the next positive peak.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:**See ["Search Mode for Next Peak in X Direction"](#) on page 69See ["Search Next Peak"](#) on page 71**CALCulate<n>:MARKer<m>:MAXimum[:PEAK]**

Moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:**See ["Marker Search Type"](#) on page 70See ["Peak Search"](#) on page 71**CALCulate<n>:MARKer<m>:MAXimum:RIGHT**

Moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in X Direction"](#) on page 69
See ["Search Next Peak"](#) on page 71

CALCulate<n>:MARKer<m>:MINimum:LEFT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in X Direction"](#) on page 69
See ["Search Next Minimum"](#) on page 72

CALCulate<n>:MARKer<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in X Direction"](#) on page 69
See ["Search Next Minimum"](#) on page 72

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

Moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70
See ["Search Minimum"](#) on page 72

CALCulate<n>:MARKer<m>:MINimum:RIGHT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in X Direction"](#) on page 69
 See ["Search Next Minimum"](#) on page 72

Positioning delta markers

The following commands position delta markers on the trace.

| | |
|--|-----|
| CALCulate<n>:DELTaMarker<m>:MAXimum:LEFT | 164 |
| CALCulate<n>:DELTaMarker<m>:MAXimum:NEXT | 164 |
| CALCulate<n>:DELTaMarker<m>:MAXimum[:PEAK] | 164 |
| CALCulate<n>:DELTaMarker<m>:MAXimum:RIGHT | 165 |
| CALCulate<n>:DELTaMarker<m>:MINimum:LEFT | 165 |
| CALCulate<n>:DELTaMarker<m>:MINimum:NEXT | 165 |
| CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK] | 165 |
| CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT | 166 |

CALCulate<n>:DELTaMarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)

Manual operation: See ["Search Next Peak"](#) on page 71

CALCulate<n>:DELTaMarker<m>:MAXimum:NEXT

Moves a marker to the next positive peak value.

Suffix:<n> 1..n
[Window](#)<m> 1..n
[Marker](#)

Manual operation: See ["Search Next Peak"](#) on page 71

CALCulate<n>:DELTaMarker<m>:MAXimum[:PEAK]

Moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Marker Search Type"](#) on page 70
See ["Peak Search"](#) on page 71

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT

Moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Search Next Peak"](#) on page 71

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Search Next Minimum"](#) on page 72

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Search Next Minimum"](#) on page 72

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

Moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70
See ["Search Minimum"](#) on page 72

CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Next Minimum"](#) on page 72

7.7.2.5 Marker search (spectrograms)

The following commands automatically define the marker and delta marker position in the spectrogram.



The usage of these markers is demonstrated in [Section 7.10.2, "Example 2: performing a basic real-time measurement"](#), on page 182.

Using markers

The following commands control spectrogram markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the markers.

- [CALCulate<n>:MARKer<m>:MAXimum:LEFT](#) on page 162
- [CALCulate<n>:MARKer<m>:MAXimum:NEXT](#) on page 162
- [CALCulate<n>:MARKer<m>:MAXimum\[:PEAK\]](#) on page 162
- [CALCulate<n>:MARKer<m>:MAXimum:RIGHT](#) on page 162
- [CALCulate<n>:MARKer<m>:MINimum:LEFT](#) on page 163
- [CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 163
- [CALCulate<n>:MARKer<m>:MINimum\[:PEAK\]](#) on page 163
- [CALCulate<n>:MARKer<m>:MINimum:RIGHT](#) on page 163

Remote commands exclusive to spectrogram markers

| | |
|--|-----|
| CALCulate<n>:MARKer<m>:SGRam:FRAME | 167 |
| CALCulate<n>:MARKer<m>:SPECtrogram:FRAME | 167 |
| CALCulate<n>:MARKer<m>:SGRam:SARea | 168 |
| CALCulate<n>:MARKer<m>:SPECtrogram:SARea | 168 |

| | |
|---|-----|
| CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:XY:MAXimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:XY:MINimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVE..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVE..... | 168 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELOW..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELOW..... | 169 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT..... | 169 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum[:PEAK]..... | 169 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVE..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVE..... | 169 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELOW..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELOW..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:NEXT..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum[:PEAK]..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:TRIGger..... | 171 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:TRIGger..... | 171 |

CALCulate<n>:MARKer<m>:SGRam:FRAME <Frame>

CALCulate<n>:MARKer<m>:SPECTrogram:FRAME <Frame> | <Time>

Positions a marker on a particular frame.

Suffix:

<n> [Window](#)

<m> [Marker](#)

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 (negative) distance to frame 0 in seconds.
 The range depends on the history depth.

Example:

CALC:MARK:SGR:FRAM -20

Sets the marker on the 20th frame before the present.

CALC:MARK2:SGR:FRAM -2s

Sets second marker on the frame 2 seconds ago.

Manual operation: See ["Frame"](#) on page 65

CALCulate<n>:MARKer<m>:SGRam:SARea <SearchArea>
CALCulate<n>:MARKer<m>:SPECTrogram:SARea <SearchArea>

Defines the marker search area for all spectrogram markers in the channel setup.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<SearchArea>

VISible

Performs a search within the visible frames.

Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory

Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See ["Marker Search Area"](#) on page 71

CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECTrogram:XY:MAXimum[:PEAK]

Moves a marker to the highest level of the spectrogram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECTrogram:XY:MINimum[:PEAK]

Moves a marker to the minimum level of the spectrogram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVE
CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVE

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELOW

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELOW

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT

Moves a marker vertically to the next lower peak level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum[:PEAK]

Moves a marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVE

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVE

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELOW

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELOW

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:NEXT

Moves a marker vertically to the next higher minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]

CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum[:PEAK]

Moves a marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level for all frequencies and moves the marker vertically to the minimum level.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:MARKer<m>:SGRam:Y:TRIGger

CALCulate<n>:MARKer<m>:SPECTrogram:Y:TRIGger

Positions a marker in the spectrogram on the most recent trigger event.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Using delta markers

The following commands control spectrogram delta markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the delta markers.

- [CALCulate<n>:DELTamarker<m>:MAXimum:LEFT](#) on page 164
- [CALCulate<n>:DELTamarker<m>:MAXimum:NEXT](#) on page 164
- [CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 164
- [CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT](#) on page 165
- [CALCulate<n>:DELTamarker<m>:MINimum:LEFT](#) on page 165
- [CALCulate<n>:DELTamarker<m>:MINimum:NEXT](#) on page 165
- [CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 165
- [CALCulate<n>:DELTamarker<m>:MINimum:RIGHT](#) on page 166

Remote commands exclusive to spectrogram markers

| | |
|---|-----|
| CALCulate<n>:DELTamarker<m>:SGRam:FRAMe | 172 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:FRAMe | 172 |
| CALCulate<n>:DELTamarker<m>:SGRam:SARea | 172 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:SARea | 172 |
| CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK] | 173 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MAXimum[:PEAK] | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK] | 173 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MINimum[:PEAK] | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe | 173 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVe | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELOW | 173 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:BELOW | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT | 174 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:NEXT | 174 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK] | 174 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum[:PEAK] | 174 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVe | 174 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:ABOVe | 174 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELOW | 174 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:BELOW | 174 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT | 175 |

| | |
|---|-----|
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:NEXT..... | 175 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]..... | 175 |
| CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum[:PEAK]..... | 175 |

CALCulate<n>:DELTamarker<m>:SGRam:FRAME <Frame>

CALCulate<n>:DELTamarker<m>:SPECTrogram:FRAME <Frame>

Positions a delta marker on a particular frame. The frame is relative to the position of marker 1.

The command is available for the spectrogram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Parameters:

<Frame> Selects a frame either by its frame number or time stamp.
 The frame number is available if the time stamp is off. The range depends on the history depth.
 The time stamp is available if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.
 Default unit: S

Example:

CALC:DELT4:SGR:FRAM -20

Sets fourth deltamarker 20 frames below marker 1.

CALC:DELT4:SGR:FRAM 2 s

Sets fourth deltamarker 2 seconds above the position of marker 1.

CALCulate<n>:DELTamarker<m>:SGRam:SAREa <SearchArea>

CALCulate<n>:DELTamarker<m>:SPECTrogram:SAREa <SearchArea>

Defines the marker search area for *all* spectrogram markers in the channel setup.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<SearchArea>

VISible

Performs a search within the visible frames.

Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory

Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "[Marker Search Area](#)" on page 71

CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MAXimum[:PEAK]

Moves a marker to the highest level of the spectrogram over all frequencies.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECTrogram:XY:MINimum[:PEAK]

Moves a delta marker to the minimum level of the spectrogram over all frequencies.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVE
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:ABOVE

Moves a marker vertically to the next higher level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELOW
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:BELOW

Moves a marker vertically to the next higher level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum:NEXT

Moves a delta marker vertically to the next higher level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MAXimum[:PEAK]

Moves a delta marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Marker Search Type"](#) on page 70

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVE
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:ABOVE

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:

<n> [Window](#)

<m> [Marker](#)

Manual operation: See ["Search Mode for Next Peak in Y Direction"](#) on page 69

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELOW
CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:BELOW

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Search Mode for Next Peak in Y Direction"](#) on page 69**CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT****CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum:NEXT**

Moves a delta marker vertically to the next minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Search Mode for Next Peak in Y Direction"](#) on page 69**CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]****CALCulate<n>:DELTamarker<m>:SPECTrogram:Y:MINimum[:PEAK]**

Moves a delta marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level in the whole spectrogram and moves the marker vertically to the minimum level.

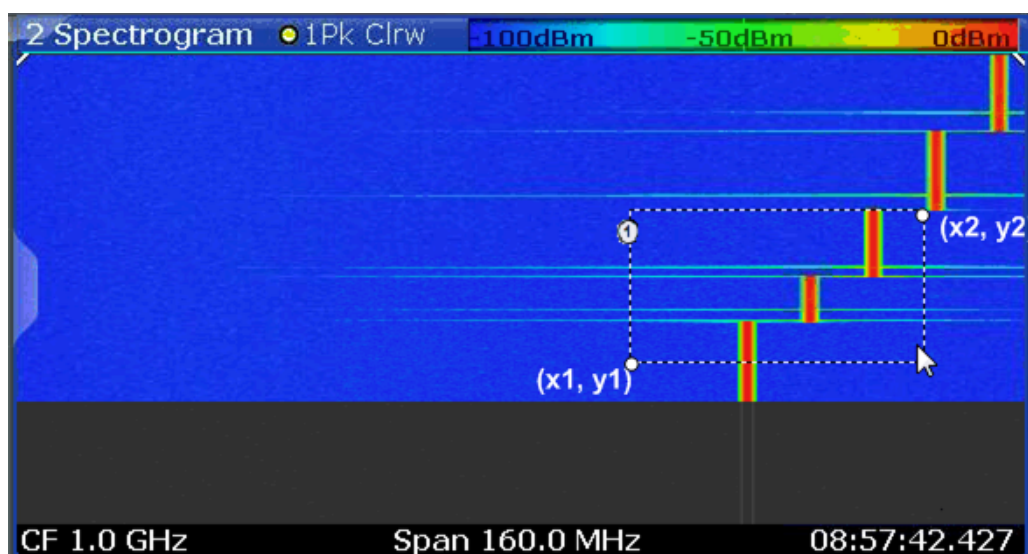
Suffix:<n> [Window](#)<m> [Marker](#)**Manual operation:** See ["Marker Search Type"](#) on page 70

7.7.3 Zooming into the display

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for the spectrogram.

To define a zoom area, you first have to turn on the zoom (see [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:ZOOM\[:STATe\]](#) on page 176).



1 = zoom area (e.g. $x1 = 1020$ MHz, $y1 = -80$ ms, $x2 = 1060$ MHz, $y2 = -40$ ms)

($x1, y1$) = zoom area start

($x2, y2$) = zoom area end

Suffix:

<n> [Window](#)

Parameters:

<x1> Starting frequency for the zoom area. Left side of zoom area.
Range: CF - Span/2 to CF + Span/2
Default unit: Hz

<y1> Oldest time for zoom area. Bottom side of zoom area.
Range: starting time of spectrogram to 0
Default unit: s

<x2> Ending frequency for the zoom area. Right side of zoom area.
Range: CF - Span/2 to CF + Span/2
Default unit: Hz

<y2> Most recent time for zoom area. Top side of zoom area.
Range: starting time of spectrogram to 0
Default unit: s

Example: `DISPlay:WINDow2:ZOOM:AREA 1020 MHz, -0.08 s, 1060 MHz, -0.040 s;`

Manual operation: See ["Single Zoom"](#) on page 73

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] <State>

Turns the zoom on and off.

Suffix:

<n> [Window](#)

| | |
|--------------------------|--|
| <w> | subwindow
Not supported by all applications |
| Parameters: | |
| <State> | ON OFF 0 1
OFF 0
Switches the function off
ON 1
Switches the function on |
| Example: | DISP:ZOOM ON
Activates the zoom mode. |
| Manual operation: | See "Single Zoom" on page 73
See "Restore Original Display" on page 73 |

7.8 Querying the status registers

The "Real-Time Spectrum" application uses the standard status registers of the FPL, as well as the `STATus:QUEStionable:TIME` register.

This register and the commands required to query its contents are described here.

For details on the common FPL status registers refer to the description of remote control basics in the FPL User Manual.



*RST does not influence the status registers.

- [STATus:QUEStionable:TIME register](#).....177
- [Commands to query the STATus:QUEStionable:TIME register](#).....178

7.8.1 STATus:QUEStionable:TIME register

The `STATus:QUEStionable:TIME` register contains information about possible time errors that may occur during operation of the FPL. A separate time register exists for each active channel.

You can read out the register with `STATus:QUEStionable:TIME:CONDition?` or `STATus:QUEStionable:TIME[:EVENT]?`

Table 7-3: Meaning of the bits used in the **STATus:QUEStionable:TIME** register

| Bit No. | Meaning |
|---------|---|
| 0 | Real-Time Data Loss
This bit is set if the FPL loses data during the measurement and measurements are no longer possible in Real-Time. |
| 1 to 14 | Unused |
| 15 | This bit is always 0. |

7.8.2 Commands to query the **STATus:QUEStionable:TIME** register

The following commands are required to query the contents of the **STATus:QUEStionable:TIME** register.

| | |
|---|-----|
| STATus:QUEStionable:TIME:CONDition? | 178 |
| STATus:QUEStionable:TIME:ENABle | 178 |
| STATus:QUEStionable:TIME:NTRansition | 179 |
| STATus:QUEStionable:TIME:PTRansition | 179 |
| STATus:QUEStionable:TIME[:EVENT]? | 179 |

STATus:QUEStionable:TIME:CONDition? [<ChannelName>]

These commands read out the **CONDition** section of the status register.

The commands do not delete the contents of the **CONDition** section.

Suffix:

<n> [Window](#)

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATus:QUEStionable:TIME:ENABle <SumBit>[, <ChannelName>]

These commands control the **ENABle** part of a register.

The **ENABle** part allows true conditions in the **EVENT** part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Suffix:

<n> [Window](#)

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:TIME:NTRansition <SumBit>[, <ChannelName>]

These commands control the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Suffix:

<n> [Window](#)

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:TIME:PTRansition <SumBit>[, <ChannelName>]

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

Suffix:

<n> [Window](#)

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUESTIONable:TIME[:EVENT]? [<ChannelName>]

These commands read out the EVENT section of the status register.

At the same time, the commands delete the contents of the EVENT section.

Suffix:

<n> [Window](#)

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

7.9 Deprecated commands

Note that these commands are maintained for compatibility with the R&S FSVR only. Use the specified commands for new remote control programs.



DISPlay:WINDow[:SUBWindow] commands

For compatibility with the R&S FSVR, the commands required to configure the persistence spectrum (see [Section 7.4.7, "Configuring the persistence spectrum"](#), on page 115) also accept the optional SUBWindow keyword (DISPlay:WINDow[:SUBWindow] . . .). However, this keyword is ignored and has no effect on remote control.

CALCulate<n>:FEED..... 180

CALCulate<n>:FEED <ResultDisplay>

This command selects the result display in Real-Time mode.

Note that this command is maintained for compatibility reasons only. Use the LAYout commands for new remote control programs (see [Section 7.4.10.2, "Working with windows in the display"](#), on page 126).

Suffix:

<n> Window

Parameters:

| | |
|-----------------|--|
| <ResultDisplay> | 'XFRequency:RFPower[:SPECtrum]' |
| | 'XFRequency[:SPECtrum]' |
| | Selects the Real-Time spectrum result display. |
| | 'XFRequency:RFPower:SGRam' |
| | 'XFRequency:SGRam' |
| | Selects the spectrogram result display. |
| | 'XFRequency:RFPower:PSPectrum' |
| | 'XFRequency:PSPectrum' |
| | Selects the persistence spectrum result display. |
| | 'XTIME:RFPower[:TDOMain]' |
| *RST: | SPECtrum |

Example:

CALC:FEED 'XFR:PSP'

Starts the persistence spectrum result display.

7.10 Programming examples: performing real-time measurements

The following programming examples demonstrate how to perform Real-Time measurements in a remote environment.



Some commands in the following examples may not be necessary as they reflect the default settings; however, they are included to demonstrate the command usage.

- [Example 1: creating a frequency mask trigger](#)..... 181
- [Example 2: performing a basic real-time measurement](#)..... 182
- [Example 3: analyzing persistency](#)..... 185

7.10.1 Example 1: creating a frequency mask trigger

In this example we will create a frequency mask trigger with an upper and lower mask. This trigger mask can be used in [Example 2: performing a basic real-time measurement](#).

```
//----- Configuring a frequency mask trigger -----
//Store trigger mask as 'C:\R_S\INSTR\freqmask\myFMTS\NewFreqMaskTrigger'
//Note the 'myFMTS' subdirectory must be created under 'C:\R_S\INSTR\freqmask'
//beforehand.
CALC:MASK:CDIR 'myFMTS'
CALC:MASK:NAME 'NewFreqMaskTrigger'
CALC:MASK:COMM 'Upper and lower frequency mask'

//----- Defining an upper frequency mask automatically -----
//Use relative scaling for the level axis
CALC:MASK:MODE REL
//Define a span of 20 MHz
CALC:MASK:SPAN 20000000
//Configure automatic upper mask according to measured spectrum
CALC:MASK:UPP:AUTO
//Query the mask points for the upper mask
CALC:MASK:UPP:DATA?
//Result: comma-separated list of value pairs (Frequency, level);
//one for each data point
//Example:
// -9.990009990E+006,-9.600020599E+001,-9.230769231E+006,-8.738758087E+001,
// -8.831168831E+006,-9.565835571E+001,-7.972027972E+006,-8.494093323E+001,
// ...
// +8.171828172E+006,-8.577051544E+001,+8.631368631E+006,-9.534964752E+001,
// +9.530469530E+006,-8.848562622E+001,+9.990009990E+006,-9.600020599E+001

//----- Configuring the lower frequency mask manually -----
//Configure lower mask 20 dB lower than upper mask;
//Use upper mask as basis, then shift all values by 20 dB
```

```

CALC:MASK:LOW:STAT ON
CALC:MASK:LOW:DATA -9.990009990E+006,-9.600020599E+001,-9.230769231E+006,-8.738758087E+001,
-8.831168831E+006,-9.565835571E+001,-7.972027972E+006,-8.494093323E+001,
-7.492507493E+006,-9.450020599E+001,-6.793206793E+006,-7.878201294E+001,
-6.693306693E+006,-7.925418091E+001,-6.213786214E+006,-9.578102112E+001,
-5.414585415E+006,-3.991313553E+001,-4.995004995E+006,-3.050031662E+001,
-4.575424575E+006,-3.975288010E+001,-3.776223776E+006,-9.574020386E+001,
-3.296703297E+006,-7.856089020E+001,-2.777222777E+006,-8.525804901E+001,
-2.497502498E+006,-9.450020599E+001,-1.878121878E+006,-8.315855408E+001,
-1.258741259E+006,-9.424127960E+001,-1.238761239E+006,-9.424189758E+001,
-1.058941058E+006,-8.987026215E+001,-4.995004995E+005,-9.452841949E+001,
-3.308057785E+006,-9.450020599E+001,+5.394605395E+005,-8.521303558E+001,
+1.238761239E+006,-9.425141144E+001,+1.258741259E+006,-9.425095367E+001,
+1.858141858E+006,-8.382637787E+001,+2.497502497E+006,-9.450020599E+001,
+2.817182817E+006,-8.492385864E+001,+3.356643357E+006,-8.088692474E+001,
+3.756243756E+006,-9.698367310E+001,+4.535464535E+006,-4.851605225E+001,
+4.995004995E+006,-3.950028992E+001,+5.454545455E+006,-4.873092270E+001,
+6.213786214E+006,-9.597808838E+001,+6.273726274E+006,-9.304232788E+001,
+6.773226773E+006,-8.045437622E+001,+7.492507493E+006,-9.450020599E+001,
+8.171828172E+006,-8.577051544E+001,+8.631368631E+006,-9.534964752E+001,
+9.530469530E+006,-8.848562622E+001,+9.990009990E+006,-9.600020599E+001
CALC:MASK:LOW:SHIFT:Y -20

```

7.10.2 Example 2: performing a basic real-time measurement

The first measurement example performs a basic Real-Time measurement in the frequency domain with the default display configuration (Real-Time spectrum and spectrogram). It uses a frequency mask trigger stored as

C:\R_S\INSTR\freqmask\myFMTS\NewFreqMaskTrigger, as described in [Example 1: creating a frequency mask trigger](#).



To perform a basic Real-Time measurement without a frequency mask trigger, simply remove the section Using a Frequency Mask Trigger in the following example.

```

//-----Preparing the instrument -----
//Reset the instrument
*RST

//----- Activating a Real-Time measurement channel -----
//Activate a Real-Time measurement channel named "Real-Time"
INST:CRE:NEW RTIM,'Real-Time'

//Stop the current measurement
INIT:CONT OFF

//----- Configuring the Measurement -----
//Define the center frequency
FREQ:CENT 100MHz

```

Programming examples: performing real-time measurements

```
//Set the span to 10 MHz on either side of the center frequency.
FREQ:SPAN 20MHz

//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0

//Couple the RBW to the span, with RBW/span = 0.000625
BAND:RAT 0.000625
//Use a Gaussian FFT window function
SWE:FFT:WIND:TYPE GAUS
//Collect data for 20 ms for each spectrum
SWE:TIME 0.02

//----- Using a Frequency Mask Trigger -----
//Configure the use of an existing frequency mask (from Example 4) as a trigger
TRIG:SOUR MASK
//Select the mask to use
CALC:MASK:CDIR 'myFMTS'
CALC:MASK:NAME 'NewFreqMaskTrigger'
//Trigger on entering the frequency mask
TRIG:MASK:COND ENT

//Define a pretrigger period of 10 ms, posttrigger = 0.5 s
TRIG:PRET 0.001
TRIG:POST 0.5
//Use rearming trigger mode to perform continuous measurements
TRIG:MODE CONT

//----- Configuring the result displays -----
//Clear the initial spectrogram results
CALC2:SPEC:CLE
//Store up to 1000 spectrogram frames
CALC2:SPEC:HDEP 1000

//----- Configuring spectrogram color mapping -----
//Use grayscale coloring
DISP:WIND2:SPEC:COL GRAY
//Configure a value range from 0.5% to 95%
DISP:WIND2:SPEC:COL:LOW 0.5
DISP:WIND2:SPEC:COL:UPP 95
//Change the shape of the color mapping function to distribute more colors among
//high values
DISP:WIND2:SPEC:COL:SHAP 0.35

//----- Performing the Measurement -----
//Initiate a new measurement
INIT:CONT ON
INIT:IMM
//Wait until some measurements have been performed.
INIT:CONT OFF
```

Programming examples: performing real-time measurements

```
//----- Retrieving Results -----
//Query the spectrogram results for the Real-Time measurement
CALC2:SPEC:TST:DATA? ALL
//Result: 4 values for each of the measured frames indicating the time passed
//since 01.01.1970 till the start of the frame, e.g.:
//1370524679,49559852,0,0,1370524679,18552034,0,0,
//1370524678,987161993,0,0,1370524678,971568114,0,0,
//...
//1370524670,79975615,0,0,1370524670,48813821,0,0
//First frame: 01.01.1970 + 1370524670 seconds
//Most recent frame: 01.01.1970 + 1370524679 seconds
//Measurement duration: 1370524679 s - 1370524670 s = 9 s

//Return the 1001 measured power levels for each of the measured frames
TRAC2:DATA? SPEC

//Store the spectrogram to a file
MMEM:STOR2:SPEC 'C:\temp\spectrogram'

//Query spectrum results for the most recent spectrum
CALC2:SPEC:FRAM:SEL 0
TRAC1:DATA:X? TRACE1
TRAC1:DATA? TRACE1

//Query spectrum results for the previous spectrum
CALC2:SPEC:TST OFF
//Use frame index instead of time stamp
CALC2:SPEC:FRAM:SEL -1
TRAC1:DATA:X? TRACE1
TRAC1:DATA? TRACE1
//Store these spectrum results to a file
MMEM:STOR1:TRAC 1,'C:\temp\FirstSpectrum'

//----- Analyzing the results using markers -----
//Set marker1 on the peak power in the most recent spectrum and query
//its position
CALC2:SPEC:FRAM:SEL 0
CALC2:MARK1 ON
CALC2:MARK1:X?
CALC2:MARK1:Y?

//Set marker2 on the peak power in frame -1 and query its position
CALC2:MARK2 ON
CALC2:MARK2:SGR:FRAM -1s
CALC2:MARK2:X?
CALC2:MARK2:Y?

//Set marker3 on peak power level in the entire spectrogram in memory and
//query its position
```

```

CALC2:MARK3 ON
CALC2:MARK:SPEC:SAR MEM
CALC2:MARK3:SPEC:XY:MAX
CALC2:MARK3:X?
CALC2:MARK3:Y?

//Move marker 3 to the next lower peak level for the same frequency
CALC2:MARK3:SPEC:Y:MAX:NEXT
CALC2:MARK3:X?
CALC2:MARK3:Y?

//Set marker4 on the most recent trigger event in the spectrogram and query
//its position
CALC2:MARK4 ON
CALC2:MARK4:SPEC:Y:TRIG
CALC2:MARK4:X?
CALC2:MARK4:Y?

```

7.10.3 Example 3: analyzing persistency

This measurement example performs a basic Real-Time measurement in the frequency domain with an additional persistence spectrum window. It uses a frequency mask trigger stored as

C:\R_S\INSTR\freqmask\myFMTS\NewFreqMaskTrigger, as described in [Example 1: creating a frequency mask trigger](#).



To perform a basic Real-Time measurement without a frequency mask trigger, simply remove the section Using a Frequency Mask Trigger in the following example.

```

//-----Preparing the instrument -----
//Reset the instrument
*RST

//----- Activating a Real-Time measurement channel -----
//Activate a Real-Time measurement channel named "Real-Time"
INST:CRE:NEW RTIM, 'Real-Time'

//Stop the current measurement
INIT:CONT OFF

//----- Configuring the Measurement -----
//Define the center frequency
FREQ:CEN 100MHz
//Set the span to 10 MHz on either side of the center frequency.
FREQ:SPAN 20MHz

//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0

```

Programming examples: performing real-time measurements

```
//Couple the RBW to the span, with RBW/span = 0.000625
BAND:RAT 0.000625
//Use a Gaussian FFT window function
SWE:FFT:WIND:TYPE GAUS
//Collect data for 20 ms for each spectrum
SWE:TIME 0.02

//----- Using a Frequency Mask Trigger -----
//Configure the use of an existing frequency mask (from Example 4) as a trigger
TRIG:SOUR MASK
//Select the mask to use
CALC:MASK:CDIR 'myFMTS'
CALC:MASK:NAME 'NewFreqMaskTrigger'
//Trigger on entering the frequency mask
TRIG:MASK:COND ENT

//Define a pretrigger period of 10 ms, posttrigger = 0.5 s
TRIG:PRET 0.001
TRIG:POST 0.5
//Use rearming trigger mode to perform continuous measurements
TRIG:MODE CONT

//----- Configuring the result displays -----
//Add a persistence spectrum result display
LAY:ADD? '1',RIGH,'XFrequency:PSpectrum'
//Result: '3'
//Clear the initial spectrogram results
CALC2:SPEC:CLE

//Configure vector-style trace for an uninterrupted (interpolated)
//persistence spectrum
DISP:WIND:TRAC:SYMB VECT

//Define a persistence duration of 1.2 s
DISP:WIND:TRAC:PERS:DUR 1.2
//Use the data captured in 120 ms for a single frame (persistence granularity)
DISP:WIND:TRAC:PERS:GRAN 0.12

//Activate the maxhold trace in the persistence spectrum display
DISP:WIND:TRAC:MAXH ON
//Define an intensity of 125 for the maxhold trace
DISP:WIND:TRAC:MAXH:INT 125
//Clear the maxhold trace
DISP:WIND:TRAC:MAXH:RES

//----- Configuring persistence color mapping -----
//Use greyscale coloring
DISP:WIND:PSP:COL GRAY
//Configure a value range from 0.5% to 95%
```

Programming examples: performing real-time measurements

```
DISP:WIND:PSP:COL:LOW 0.5
DISP:WIND:PSP:COL:UPP 95
//Reduce the range of the color map if no hits are found at the value range edges
DISP:WIND:PSP:COL:TRUN ON
//Change the shape of the color mapping function to distribute more colors among
//high values
DISP:WIND:PSP:COL:SHAP 0.35

//----- Performing the Measurement -----
//Initiate a new measurement and wait until some measurements have been performed.
INIT:CONT ON
INIT:IMM
INIT:CONT OFF

//----- Retrieving Results -----
//Query the persistence spectrum results
TRAC3:DATA? PSP
//Result: 1001*600 percentages, one for each pixel in the histogram

//Return the 1001 measured power levels for the most recent spectrum
TRAC3:DATA? TRACE1

//Return the 1001*600 maximum probabilities for the maxhold trace
TRAC3:DATA? HMAX

//Store the persistence spectrum to a file
MMEM:STOR3:PSP 'C:\temp\persistence'
```

8 Reference: ASCII file export format

Trace data (for example Real-Time spectrum, persistence spectrum, or spectrogram) can be exported to a file in ASCII format for further evaluation in other applications.

The file consists of the header containing important measurement parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see ["Decimal Separator"](#) on page 63).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section contains the measured data in two columns, which are also separated by a semicolon.

The file contents vary depending on the result type.

Table 8-1: ASCII file format for Spectrum trace export

| File contents | Description |
|----------------------------------|--|
| Header data | |
| Type;FPL; | Instrument model |
| Version;1.80; | Firmware version |
| Date;20.Jul 2013; | Date of data set storage |
| Mode;Real-Time; | Channel type |
| Preamplifier;OFF; | Preamplifier state |
| Transducer;OFF; | Transducer state |
| Center Freq;1000000000.000000;Hz | Center frequency |
| Freq Offset;0.000000;Hz | Frequency offset |
| Start;920000000.000000;Hz | Start frequency |
| Stop;1080000000.000000;Hz | Stop frequency |
| Span;160000000.000000;Hz | Measured span |
| Ref Level;0.000000;dBm | Reference level |
| Level Offset;0.000000;dB | Reference level offset |
| Rf Att;10.000000;dB | Input attenuation |
| EI Att;0.000000;dB | Electronic attenuation |
| RBW;800000.000000;Hz | Resolution bandwidth |
| SWT;0.030000;s | Sweep time |
| Sweep Count;0; | Number of sweeps |
| Window;1;"Real-Time Spectrum" | Window containing the exported results |
| Ref Position;100.000000; % | Reference level position in percent |

| File contents | Description |
|---|---|
| Level Range;100.000000;dB | Power level (y-axis) range |
| x-Axis;LIN; | x-axis scaling mode (linear, log.) |
| y-Axis;LOG; | y-axis scaling mode (linear, log.) |
| x-Unit;Hz; | x-axis unit |
| y-Unit;dBm; | y-axis unit |
| Data section | |
| Trace;1; | Trace number |
| Trace Mode;CLR/WRITE; | Trace mode |
| Detector;MAXPEAK; | Detector used for trace |
| Values; 1001; | Number of measured frequencies |
| 1317000000;-100.50020599365234;
13170160000;-100.16989898681641;
...;...; | Measured values: <frequency>, <power level> |

Table 8-2: ASCII file format for persistence spectrum trace export

| File contents | Description |
|----------------------------------|--------------------------|
| Header data | |
| Type;FPL; | Instrument model |
| Version;1.80; | Firmware version |
| Date;20.Jul 2013; | Date of data set storage |
| Mode;Real-Time; | Channel type |
| Preamplifier;OFF; | Preamplifier state |
| Transducer;OFF; | Transducer state |
| Center Freq;1000000000.000000;Hz | Center frequency |
| Freq Offset;0.000000;Hz | Frequency offset |
| Start;920000000.000000;Hz | Start frequency |
| Stop;1080000000.000000;Hz | Stop frequency |
| Span;160000000.000000;Hz | Measured span |
| Ref Level;0.000000;dBm | Reference level |
| Level Offset;0.000000;dB | Reference level offset |
| Rf Att;10.000000;dB | Input attenuation |
| EI Att;0.000000;dB | Electronic attenuation |
| RBW;800000.000000;Hz | Resolution bandwidth |
| SWT;0.030000;s | Sweep time |

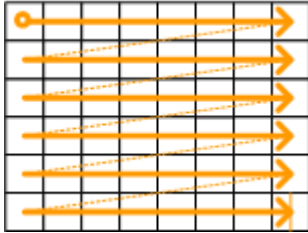
| File contents | Description |
|--|---|
| Sweep Count;0; | Number of sweeps |
| Trace Mode;CLR/WRITE;MAXHOLD; | Display mode of traces: 1. CLR/WRITE; 2.MAXHOLD |
| Detector;PERSISTENCE; | Detector used for trace (none for persistence) |
| Data section | |
| Values; 1001;600; | Number of measurement points for x-axis (frequency) and y-axis (power) |
| 920000000;920160000;920320000;920480000;
...
1079520000;1079680000;1079840000;1080000000 | 1001 frequency values used for histogram |
| -37.5;-37.583472454090149;
...
-87.416527545909844;-87.5 | 600 power levels used for histogram |
| CLR/WRITE | Introduction for persistence spectrum data |
| 0;0;0;
....
0.60534548759460449;0.37962344288825989 | 1000*600 most recently calculated probability of appearance value (in %) in histogram from top left to bottom right, that is, starting with the lowest frequency and highest power value and ending with the highest frequency and lowest power level
 |
| MAXHOLD | Introduction for MAXHOLD data |
| 0;0;0;
....
0.90801829099655151;0.56943517923355103 | 1000*600 maximum probability of appearance value (in %) for MAXHOLD trace from top left to bottom right, that is, starting with the lowest frequency and highest power value and ending with the highest frequency and lowest power level |

Table 8-3: ASCII file format for spectrogram trace export

| File contents | Description |
|--------------------|--------------------------|
| Header data | |
| Type;FPL; | Instrument model |
| Version;1.80; | Firmware version |
| Date;20.Jul 2013; | Date of data set storage |
| Mode;Real-Time; | Channel type |
| Preamplifier;OFF; | Preamplifier state |
| Transducer;OFF; | Transducer state |

| File contents | Description |
|--|--|
| Center Freq;1000000000.000000;Hz | Center frequency |
| Freq Offset;0.000000;Hz | Frequency offset |
| Start;920000000.000000;Hz | Start frequency |
| Stop;1080000000.000000;Hz | Stop frequency |
| Span;160000000.000000;Hz | Measured span |
| Ref Level;0.000000;dBm | Reference level |
| Level Offset;0.000000;dB | Reference level offset |
| Rf Att;10.000000;dB | Input attenuation |
| EI Att;0.000000;dB | Electronic attenuation |
| RBW;800000.000000;Hz | Resolution bandwidth |
| SWT;0.030000;s | Sweep time |
| Sweep Count;0; | Number of sweeps |
| Window;1;"Real-Time Spectrum" | Window containing the exported results |
| Ref Position;100.000000; % | Reference level position in percent |
| Level Range;100.000000;dB | Power level (y-axis) range |
| x-Axis;LIN; | x-axis scaling mode (linear, log.) |
| y-Axis;LOG; | y-axis scaling mode (linear, log.) |
| x-Unit;Hz; | x-axis unit |
| y-Unit;dBm; | y-axis unit |
| Data section | |
| Trace;1; | Trace number |
| Trace Mode;CLR/WRITE; | Trace mode |
| Detector;MAXPEAK; | Detector used for trace |
| Values; 1001; | Number of measured frequencies |
| Frames;130; | Number of exported frames |
| Data section for individual frame | |
| Frame;0; | Most recent frame number |
| Timestamp;29.Jul 13;08:51:19.355 | Timestamp of this frame |
| 10000;-10.3;-15.7
10130;-11.5;-16.9
10360;-12.0;-17.4
...;... | Measured values:
<frequency>; <power value1>; <power value2>;
<power value 2> only for AUTOPEAK detector; contains the minimum of the two measured values for each measurement point |
| Data section for individual frame | |
| Frame;-1; | Previous frame |

| File contents | Description |
|----------------------------------|-------------------------|
| Timestamp;29.Jul 13;08:51:19.278 | Timestamp of this frame |
| ... | |

List of commands (Real-Time)

| | |
|---|-----|
| [SENSe:]WINDow:DETEctor<t>[:FUNCTION]..... | 148 |
| [SENSe:]ADJust:CONFigure:HYSTeresis:LOWer..... | 124 |
| [SENSe:]ADJust:CONFigure:HYSTeresis:UPPer..... | 124 |
| [SENSe:]ADJust:CONFigure:LEVel:DURation..... | 123 |
| [SENSe:]ADJust:CONFigure:LEVel:DURation:MODE..... | 124 |
| [SENSe:]ADJust:LEVel..... | 125 |
| [SENSe:]AVERage<n>:COUNT..... | 147 |
| [SENSe:]AVERage<n>[:STATE<t>]..... | 147 |
| [SENSe:]BANDwidth[:RESolution]..... | 101 |
| [SENSe:]BANDwidth[:RESolution]:RATio..... | 102 |
| [SENSe:]FREQuency:CENTer..... | 99 |
| [SENSe:]FREQuency:CENTer:STEP..... | 99 |
| [SENSe:]FREQuency:OFFSet..... | 100 |
| [SENSe:]FREQuency:SPAN..... | 100 |
| [SENSe:]FREQuency:SPAN:FULL..... | 101 |
| [SENSe:]FREQuency:STARt..... | 100 |
| [SENSe:]FREQuency:STOP..... | 100 |
| [SENSe:]SWEep:COUNT..... | 102 |
| [SENSe:]SWEep:DTIME..... | 103 |
| [SENSe:]SWEep:DTIME:AUTO..... | 102 |
| [SENSe:]SWEep:FFT:WINDow:TYPE..... | 103 |
| [SENSe:]SWEep:POINts?..... | 104 |
| [SENSe:]SWEep:TIME..... | 104 |
| [SENSe:]SWEep:TIME:AUTO..... | 104 |
| ABORT..... | 132 |
| CALCulate<n>:DELTamarker<m>:AOFF..... | 151 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]..... | 155 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:X..... | 155 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed:RPOint:Y..... | 155 |
| CALCulate<n>:DELTamarker<m>:FUNCTION:FIXed[:STATE]..... | 154 |
| CALCulate<n>:DELTamarker<m>:LINK..... | 151 |
| CALCulate<n>:DELTamarker<m>:MAXimum:LEFT..... | 164 |
| CALCulate<n>:DELTamarker<m>:MAXimum:NEXT..... | 164 |
| CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT..... | 165 |
| CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]..... | 164 |
| CALCulate<n>:DELTamarker<m>:MINimum:LEFT..... | 165 |
| CALCulate<n>:DELTamarker<m>:MINimum:NEXT..... | 165 |
| CALCulate<n>:DELTamarker<m>:MINimum:RIGHT..... | 166 |
| CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]..... | 165 |
| CALCulate<n>:DELTamarker<m>:MODE..... | 152 |
| CALCulate<n>:DELTamarker<m>:MREFerence..... | 152 |
| CALCulate<n>:DELTamarker<m>:SGRam:FRAME..... | 172 |
| CALCulate<n>:DELTamarker<m>:SGRam:SARea..... | 172 |
| CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]..... | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]..... | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVE..... | 173 |
| CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELOW..... | 173 |

| | |
|--|-----|
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MAXimum:NEXT..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MAXimum[:PEAK]..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MINimum:ABOVe..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MINimum:BELOW..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MINimum:NEXT..... | 175 |
| CALCulate<n>:DELTaMarker<m>:SGRaM:Y:MINimum[:PEAK]..... | 175 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:FRAMe..... | 172 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:SARea..... | 172 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:XY:MAXimum[:PEAK]..... | 173 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:XY:MINimum[:PEAK]..... | 173 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MAXimum:ABOVe..... | 173 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MAXimum:BELOW..... | 173 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MAXimum:NEXT..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MAXimum[:PEAK]..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MINimum:ABOVe..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MINimum:BELOW..... | 174 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MINimum:NEXT..... | 175 |
| CALCulate<n>:DELTaMarker<m>:SPECtrogram:Y:MINimum[:PEAK]..... | 175 |
| CALCulate<n>:DELTaMarker<m>:TRACe..... | 153 |
| CALCulate<n>:DELTaMarker<m>:X..... | 153 |
| CALCulate<n>:DELTaMarker<m>:X:RELative?..... | 136 |
| CALCulate<n>:DELTaMarker<m>:Y..... | 153 |
| CALCulate<n>:DELTaMarker<m>:Y?..... | 153 |
| CALCulate<n>:DELTaMarker<m>:Z..... | 137 |
| CALCulate<n>:DELTaMarker<m>[:STATe]..... | 152 |
| CALCulate<n>:FEED..... | 180 |
| CALCulate<n>:MARKer<m>:AOFF..... | 149 |
| CALCulate<n>:MARKer<m>:FUNCTioN:CENTer..... | 161 |
| CALCulate<n>:MARKer<m>:FUNCTioN:REFerence..... | 94 |
| CALCulate<n>:MARKer<m>:LOEXclude..... | 157 |
| CALCulate<n>:MARKer<m>:MAXimum:AUTO..... | 157 |
| CALCulate<n>:MARKer<m>:MAXimum:LEFT..... | 162 |
| CALCulate<n>:MARKer<m>:MAXimum:NEXT..... | 162 |
| CALCulate<n>:MARKer<m>:MAXimum:RIGHT..... | 162 |
| CALCulate<n>:MARKer<m>:MAXimum[:PEAK]..... | 162 |
| CALCulate<n>:MARKer<m>:MINimum:AUTO..... | 158 |
| CALCulate<n>:MARKer<m>:MINimum:LEFT..... | 163 |
| CALCulate<n>:MARKer<m>:MINimum:NEXT..... | 163 |
| CALCulate<n>:MARKer<m>:MINimum:RIGHT..... | 163 |
| CALCulate<n>:MARKer<m>:MINimum[:PEAK]..... | 163 |
| CALCulate<n>:MARKer<m>:PEXCursion..... | 158 |
| CALCulate<n>:MARKer<m>:SGRaM:FRAMe..... | 167 |
| CALCulate<n>:MARKer<m>:SGRaM:SARea..... | 168 |
| CALCulate<n>:MARKer<m>:SGRaM:XY:MAXimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SGRaM:XY:MINimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SGRaM:Y:MAXimum:ABOVe..... | 168 |
| CALCulate<n>:MARKer<m>:SGRaM:Y:MAXimum:BELOW..... | 169 |
| CALCulate<n>:MARKer<m>:SGRaM:Y:MAXimum:NEXT..... | 169 |
| CALCulate<n>:MARKer<m>:SGRaM:Y:MAXimum[:PEAK]..... | 169 |
| CALCulate<n>:MARKer<m>:SGRaM:Y:MINimum:ABOVe..... | 169 |

| | |
|---|-----|
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELOW..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]..... | 170 |
| CALCulate<n>:MARKer<m>:SGRam:Y:TRIGger..... | 171 |
| CALCulate<n>:MARKer<m>:SPECTrogram:FRAMe..... | 167 |
| CALCulate<n>:MARKer<m>:SPECTrogram:SARea..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:XY:MAXimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:XY:MINimum[:PEAK]..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:ABOVe..... | 168 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:BELOW..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum:NEXT..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MAXimum[:PEAK]..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:ABOVe..... | 169 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:BELOW..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum:NEXT..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:MINimum[:PEAK]..... | 170 |
| CALCulate<n>:MARKer<m>:SPECTrogram:Y:TRIGger..... | 171 |
| CALCulate<n>:MARKer<m>:TRACe..... | 150 |
| CALCulate<n>:MARKer<m>:X..... | 150 |
| CALCulate<n>:MARKer<m>:X:SLIMits:LEFT..... | 159 |
| CALCulate<n>:MARKer<m>:X:SLIMits:RIGHT..... | 159 |
| CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]..... | 160 |
| CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]..... | 159 |
| CALCulate<n>:MARKer<m>:X:SSIZe..... | 156 |
| CALCulate<n>:MARKer<m>:Y..... | 151 |
| CALCulate<n>:MARKer<m>:Y?..... | 151 |
| CALCulate<n>:MARKer<m>:Z?..... | 137 |
| CALCulate<n>:MARKer<m>[:STATe]..... | 149 |
| CALCulate<n>:MASK:COMMeNt..... | 107 |
| CALCulate<n>:MASK:DELeTe..... | 107 |
| CALCulate<n>:MASK:LOWer:SHIFt:X..... | 108 |
| CALCulate<n>:MASK:LOWer:SHIFt:Y..... | 108 |
| CALCulate<n>:MASK:LOWer:STATe..... | 108 |
| CALCulate<n>:MASK:LOWer[:DATA]..... | 109 |
| CALCulate<n>:MASK:MODE..... | 109 |
| CALCulate<n>:MASK:NAME..... | 110 |
| CALCulate<n>:MASK:SPAN..... | 110 |
| CALCulate<n>:MASK:UPPer:AUTO..... | 110 |
| CALCulate<n>:MASK:UPPer:SHIFt:X..... | 110 |
| CALCulate<n>:MASK:UPPer:SHIFt:Y..... | 111 |
| CALCulate<n>:MASK:UPPer:STATe..... | 111 |
| CALCulate<n>:MASK:UPPer[:DATA]..... | 111 |
| CALCulate<n>:SGRam:CLear[:IMMeDiate]..... | 113 |
| CALCulate<n>:SGRam:FRAMe:SELeCt..... | 113 |
| CALCulate<n>:SGRam:TSTamp:DATA?..... | 113 |
| CALCulate<n>:SGRam:TSTamp[:STATe]..... | 114 |
| CALCulate<n>:SPECTrogram:CLear[:IMMeDiate]..... | 113 |
| CALCulate<n>:SPECTrogram:COLor..... | 121 |
| CALCulate<n>:SPECTrogram:FRAMe:SELeCt..... | 113 |
| CALCulate<n>:SPECTrogram:TSTamp:DATA?..... | 113 |

| | |
|--|-----|
| CALCulate<n>:SPECTrogram:TSTamp[:STATe]..... | 114 |
| CALCulate<n>:THReshold..... | 160 |
| CALCulate<n>:THReshold:STATe..... | 161 |
| DISPlay[:WINDow<n>]:MINFo[:STATe]..... | 156 |
| DISPlay[:WINDow<n>]:MTABLe..... | 156 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:DEFault..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:LOWer..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:SHApe..... | 119 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:TRUNcate..... | 120 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor:UPPer..... | 120 |
| DISPlay[:WINDow<n>]:PSPectrum:COLor[:STYLE]..... | 121 |
| DISPlay[:WINDow<n>]:SIZE..... | 125 |
| DISPlay[:WINDow<n>]:SPECTrogram:COLor:DEFault..... | 122 |
| DISPlay[:WINDow<n>]:SPECTrogram:COLor:LOWer..... | 122 |
| DISPlay[:WINDow<n>]:SPECTrogram:COLor:SHApe..... | 122 |
| DISPlay[:WINDow<n>]:SPECTrogram:COLor:UPPer..... | 122 |
| DISPlay[:WINDow<n>]:SPECTrogram:COLor[:STYLE]..... | 121 |
| DISPlay[:WINDow<n>]:ZOOM:AREA..... | 175 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MAXHold:INTensity..... | 115 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MAXHold:RESet..... | 115 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MAXHold[:STATe]..... | 116 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MODE..... | 145 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MODE:HCONtinuous..... | 145 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:PERSistence:DURation..... | 116 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:PERSistence:GRANularity..... | 117 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:PERSistence[:STATe]..... | 117 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:SMOothing:APERture..... | 146 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:SMOothing[:STATe]..... | 147 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:SYMBol..... | 118 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y:SPACing..... | 98 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]..... | 96 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:AUTO ONCE..... | 97 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:MODE..... | 97 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:RLEVel..... | 94 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:RLEVel:OFFSet..... | 95 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:RPOSition..... | 98 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>[:STATe]..... | 146 |
| DISPlay[:WINDow<n>][:SUBWIndow<w>]:ZOOM[:STATe]..... | 176 |
| FORMat:DEXPort:DSEParator..... | 143 |
| FORMat:DEXPort:HEADer..... | 143 |
| FORMat:DEXPort:TRACes..... | 143 |
| FORMat[:DATA]..... | 137 |
| INITiate:SEQuencer:ABORT..... | 134 |
| INITiate:SEQuencer:IMMediate..... | 134 |
| INITiate:SEQuencer:MODE..... | 135 |
| INITiate<n>:CONMeas..... | 133 |
| INITiate<n>:CONtinuous..... | 133 |
| INITiate<n>[:IMMediate]..... | 134 |
| INPut:ATTenuation..... | 95 |
| INPut:ATTenuation:AUTO..... | 96 |

| | |
|--|-----|
| INPut:ATTenuation:PROTection:RESet..... | 91 |
| INPut:CONNeCtor..... | 91 |
| INPut:COUPling..... | 91 |
| INPut:EATT..... | 93 |
| INPut:EATT:AUTO..... | 96 |
| INPut:EATT:STATe..... | 93 |
| INPut:FILTer:SAW..... | 92 |
| INPut:FILTer:YIG[:STATe]..... | 92 |
| INPut:GAIN:STATe..... | 96 |
| INPut:IMPedance..... | 92 |
| INPut:SElect..... | 92 |
| INSTRument:CREate:DUPLicate..... | 87 |
| INSTRument:CREate:REPLace..... | 87 |
| INSTRument:CREate[:NEW]..... | 87 |
| INSTRument:DELeTe..... | 88 |
| INSTRument:LIST?..... | 88 |
| INSTRument:REName..... | 89 |
| INSTRument[:SElect]..... | 89 |
| LAYout:ADD[:WINDow]?..... | 126 |
| LAYout:CATalog[:WINDow]?..... | 127 |
| LAYout:IDENtify[:WINDow]?..... | 127 |
| LAYout:MOVE[:WINDow]..... | 128 |
| LAYout:REMove[:WINDow]..... | 128 |
| LAYout:REPLace[:WINDow]..... | 129 |
| LAYout:SPLitter..... | 129 |
| LAYout:WINDow<n>:ADD?..... | 131 |
| LAYout:WINDow<n>:REMove..... | 131 |
| LAYout:WINDow<n>:REPLace..... | 132 |
| MMEMory:STORe<n>:PSPeCtrum..... | 142 |
| MMEMory:STORe<n>:SPeCtrogram..... | 142 |
| MMEMory:STORe<n>:TRACe..... | 142 |
| STATus:QUEStionable:TIME:CONDition?..... | 178 |
| STATus:QUEStionable:TIME:ENABLe..... | 178 |
| STATus:QUEStionable:TIME:NTRansition..... | 179 |
| STATus:QUEStionable:TIME:PTRansition..... | 179 |
| STATus:QUEStionable:TIME[:EVENT]?..... | 179 |
| SYSTem:PRESet:CHANnel[:EXEC]..... | 90 |
| SYSTem:PRESet:COMPAtible..... | 90 |
| SYSTem:SEQuencer..... | 135 |
| TRACe<n>:COPY..... | 148 |
| TRACe<n>[:DATA]..... | 138 |
| TRACe<n>[:DATA]:MEMory?..... | 139 |
| TRACe<n>[:DATA]:X?..... | 140 |
| TRIGger:MODE..... | 105 |
| TRIGger[:SEQuence]:MASK:CONDition..... | 112 |
| TRIGger[:SEQuence]:POSTtrigger[:TIME]..... | 105 |
| TRIGger[:SEQuence]:PRETrigger[:TIME]..... | 106 |
| TRIGger[:SEQuence]:SOURce..... | 106 |

Index

Symbols

*OPC 104

A

Aborting
Sweep 51
AC/DC coupling 35
Amplitude
Configuration 39
Settings 39
Analysis
Remote control 144
Settings 54
ASCII trace export 188
Attenuation
Auto 40
Electronic 41
Manual 40
Option 41
Protective (remote) 91
Auto level
Hysteresis 53
Reference level 40, 52
Softkey 40, 52
Auto scaling 42
Auto settings
Meastime Auto 52
Meastime Manual 53
Remote 123
Auto-Set Mask
Frequency masks 48

B

Bandwidth
Configuration (remote) 101
Configuration (Softkey) 49
Resolution 50

C

Capture finished
Status bit 177
Capture time
see also Measurement time 102, 103, 104
Center frequency 37
Softkey 37
Step size 37
Channel setup
Creating (remote) 87
Deleting (remote) 88
Duplicating (remote) 87
Querying (remote) 88
Renaming (remote) 89
Replacing (remote) 87
Closing
Channel setups (remote) 88
Windows (remote) 131
Color curve
Shape 24, 59
Spectrograms 24, 77

Color mapping
Color curve 59
Color range 59
Color scheme 59
Persistence spectrum 24, 58, 75
Settings 58
Settings (remote) 118
Softkey 56, 58
Spectrograms 24, 56, 58, 75, 76
Step by step 75
Value range 24
Waterfall 24, 58, 75
Color scheme
Spectrogram 24, 59
Compatibility
Commands 180
R&S FSVR 115, 180
Continuous sweep
Softkey 51
Conventions
SCPI commands 82
Copying
Channel setup (remote) 87
Coupling ratio
Real-Time 15
Span/RBW (remote) 102

D

Data acquisition
Performing (remote) 132
Status bit 177
Data format
Remote 143
Decimal separator
Trace export 63
Deleting
Frequency mask values 47
Delta markers 65
Defining 65
Detectors
FFT 15
Remote control 148
Trace 61
Diagram footer information 7
Display configuration 54
Display elements
Real-Time Spectrum application 6
Duplicating
Channel setup (remote) 87
Dwell time
vs. sweep time 15

E

Edit Frequency Mask
Softkey 44
Electronic input attenuation 40, 41
Entering
Trigger condition 48
Errors
IF OVLD 40

| | |
|-------------------------|--------|
| Evaluation methods | |
| Remote | 126 |
| Exclude LO | |
| Remote | 157 |
| Export format | |
| Traces | 188 |
| Exporting | |
| Measurement settings | 63 |
| Traces | 63 |
| Traces (remote) | 141 |
| F | |
| FFT | |
| Parameters | 15 |
| Sweep time | 15 |
| Window functions | 50 |
| File format | |
| Trace export | 188 |
| Filters | |
| YIG (remote) | 92 |
| Format | |
| Data (remote) | 143 |
| Frames | |
| Index | 23, 68 |
| Spectrogram marker | 65 |
| Time stamps | 23, 68 |
| Free Run | |
| Trigger | 43 |
| Frequency | |
| Configuration (Softkey) | 36 |
| Offset | 38 |
| Span | 38 |
| Start | 38 |
| Stop | 38 |
| Frequency mask trigger | |
| Availability | 19 |
| Basics | 16 |
| Conditions | 18 |
| Selecting | 44 |
| Settings | 45 |
| Settings (remote) | 107 |
| Step by step | 78 |
| Technical process | 19 |
| Frequency masks | |
| Activating | 46 |
| Comment | 47 |
| Creating | 46, 78 |
| Defining automatically | 48 |
| Deleting | 46 |
| Deleting values | 47 |
| Editing | 44 |
| Inserting values | 47 |
| Loading | 46 |
| Management | 46 |
| Name | 47 |
| Points | 47 |
| Saving | 46 |
| Scaling | 48 |
| Settings | 47 |
| Shifting horizontally | 47 |
| Shifting vertically | 47 |
| Trigger condition | 48 |
| Upper/lower | 18, 48 |
| Using | 80 |
| Frontend settings | |
| Remote | 90 |

| | |
|-----------|----|
| Full span | |
| Softkey | 38 |

G

| | |
|----------------------|----|
| Granularity | |
| Persistence spectrum | 55 |

H

| | |
|--------------------|----|
| Hardware settings | |
| Displayed | 6 |
| History | |
| Spectrum | 21 |
| Hysteresis | |
| Lower (Auto level) | 53 |
| Upper (Auto level) | 53 |

I

| | |
|-----------------------|----|
| Impedance | |
| Setting | 36 |
| Index | |
| Frames | 23 |
| Input | |
| Coupling | 35 |
| Overload (remote) | 91 |
| RF | 35 |
| Settings | 41 |
| Input settings | |
| Remote | 90 |
| Inserting | |
| Frequency mask values | 47 |
| Inside | |
| Trigger condition | 48 |
| Installation | 5 |
| Intensity | |
| Max Hold function | 56 |

K

| | |
|-------------|----|
| Keys | |
| MKR | 63 |
| MKR -> | 71 |
| Peak Search | 71 |
| RUN CONT | 51 |

L

| | |
|-------------------------|----|
| Last span | |
| Softkey | 38 |
| Leaving | |
| Trigger condition | 48 |
| Lower Level Hysteresis | 53 |
| Lower mask | |
| Activating/Deactivating | 46 |
| Frequency masks | 48 |

M

| | |
|--------------------|-----|
| Marker search area | |
| Remote control | 157 |
| Marker table | |
| Evaluation method | 11 |
| Marker to Trace | 65 |
| Markers | |
| Assigned trace | 65 |
| Basic settings | 63 |

- Configuration (remote control) 149
 - Configuration (softkey) 63, 66
 - Deactivating 66
 - Delta markers 65
 - Fixed reference (remote control) 154
 - Minimum 72
 - Minimum (remote control) 157, 161
 - Next minimum 72
 - Next minimum (remote control) 157, 161
 - Next peak 71
 - Next peak (remote control) 157, 161
 - Peak 71
 - Peak (remote control) 157, 161
 - Position 65
 - Positioning 71
 - Positioning (remote control) 149
 - Remote control 148
 - Retrieving results (remote) 136
 - Search (remote control) 157
 - Search area (softkey) 71
 - Search type (softkey) 70
 - Setting reference level 72
 - Setting up (remote control) 149
 - Spectrograms 23
 - Spectrograms (remote control) 166
 - State 64
 - Step size (remote control) 154
 - Table 67
 - Table (evaluation method) 11
 - Table (remote control) 154
 - Type 65
 - X-value 65
 - Mask points
 - Deleting 47
 - Frequency mask 47
 - Inserting 47
 - Max hold function
 - Persistence spectrum 30
 - Max Hold function
 - Configuring 56
 - Intensity 56
 - Persistence spectrum 56
 - Resetting 56
 - Maximizing
 - Windows (remote) 125
 - Measurement channel
 - Activating 86
 - Creating (remote) 89
 - Selecting (remote) 89
 - Measurement time
 - Auto settings 52, 53
 - Remote 102, 103, 104
 - Minimum 72
 - Marker positioning 72
 - Next 72
 - MKR
 - Key 63
 - MKR ->
 - Key 71
 - Moving density 27
 - Maximum 30
- N**
- Next Minimum 72
 - Marker positioning 72
- Next Mode X
 - Softkey 69
 - Next Mode Y
 - Softkey 69
 - Next Peak 71
 - Marker positioning 71
- O**
- Offset
 - Frequency 38
 - Reference level 40
 - Options
 - Electronic attenuation 41
 - Output
 - Settings (remote) 90
 - Outside
 - Trigger condition 48
 - Overload
 - RF input (remote) 91
 - Overview
 - Configuration 32
- P**
- Peak excursion 71
 - Peak list
 - Peak excursion 71
 - Peak search
 - Area (spectrograms) 71
 - Key 71
 - Mode 69
 - Mode (spectrograms) 68, 69
 - Type (spectrograms) 70
 - Peaks
 - Marker positioning 71
 - Next 71
 - Softkey 71
 - Performing
 - Real-Time measurement 74
 - Persistence
 - Basics 27
 - Duration 55
 - Granularity 28
 - Histogram 28
 - Persistence spectrum
 - Color mapping 24, 58, 75
 - Detector 28
 - Evaluation method 10
 - Granularity 55
 - Max Hold function 56
 - Max hold intensity 30
 - Max hold reset 30
 - Max hold trace 30
 - Persistence duration 55
 - Settings 54
 - Settings (remote) 115
 - Spectrogram 24
 - Vector style 29
 - Persistency
 - Real-Time analysis 75
 - Position
 - Frequency mask points 47
 - Posttrigger
 - Results, displaying 20
 - Time 44

| | |
|--------------------------------|--------|
| Presetting | |
| Channels | 34 |
| Pretrigger | |
| Results, displaying | 20 |
| Time | 44 |
| Probability of intercept (POI) | 15, 16 |
| Programming examples | |
| Statistics | 181 |
| Protection | |
| RF input (remote) | 91 |
| PVT waterfall | |
| Settings | 56 |
| R | |
| Range | 42 |
| Scaling | 42 |
| RBW | |
| Real-Time | 15 |
| Real-Time | |
| Persistence | 27 |
| Real-time bandwidth | 38 |
| Real-time measurements | |
| Result displays | 8 |
| Real-Time measurements | |
| Channel, activating | 86 |
| Configuration | 32 |
| Configuring (remote) | 90 |
| Remote control | 81 |
| Step by step | 74 |
| Real-Time Spectrum | |
| Application | 5 |
| Application, activating | 86 |
| Displayed frame | 51, 57 |
| Evaluation method | 8 |
| Ref Lvl = Mkr Lvl | 72 |
| Reference level | 40 |
| Auto level | 40, 52 |
| Offset | 40 |
| Position | 42 |
| Setting to marker | 72 |
| Unit | 40 |
| Value | 40 |
| Reference marker | 65 |
| Remote commands | |
| Basics on syntax | 81 |
| Boolean values | 85 |
| Capitalization | 82 |
| Character data | 85 |
| Data blocks | 86 |
| Numeric values | 84 |
| Optional keywords | 83 |
| Parameters | 84 |
| Strings | 86 |
| Suffixes | 83 |
| Resetting | |
| RF input protection | 91 |
| Resolution bandwidth | |
| Auto (Softkey) | 50 |
| Manual (Softkey) | 50 |
| Restoring | |
| Channel settings | 34 |
| Result displays | |
| Configuration | 54 |
| Marker table | 11 |
| Persistence spectrum | 10 |

| | |
|--------------------------------|---------------|
| Real-Time Spectrum | 8 |
| Spectrogram | 9 |
| Results | |
| Analyzing | 54 |
| ASCII export format | 188 |
| Data format (remote) | 143 |
| Markers (remote) | 136 |
| Retrieving (remote) | 136 |
| Traces (remote) | 137 |
| Traces, exporting (remote) | 141 |
| RF attenuation | |
| Auto | 40 |
| Manual | 40 |
| RF input | |
| Overload protection (remote) | 91 |
| Remote | 91 |
| RUN CONT | |
| Key | 51 |
| S | |
| Scaling | |
| Amplitude range, automatically | 42 |
| Configuration | 42 |
| Frequency masks | 48 |
| Y-axis (remote control) | 98 |
| Scrolling | |
| Spectrogram | 22 |
| Search Mode | |
| Spectrogram markers | 68 |
| Searching | |
| Configuration (softkey) | 68 |
| Select Frame | |
| Softkey | 51, 57 |
| Select Marker | 66 |
| Sequencer | |
| Activating (remote) | 134 |
| Remote | 133 |
| Sequences | |
| Aborting (remote) | 134 |
| Mode (remote) | 135 |
| Shift x | |
| Frequency masks | 47 |
| Shift y | |
| Frequency masks | 47 |
| Signal capturing | |
| Duration (remote) | 102, 103, 104 |
| Single zoom | 73 |
| Softkeys | |
| Activate | 46 |
| Amplitude Config | 39 |
| Auto Level | 40, 52 |
| Bandwidth Config | 49 |
| Center | 37 |
| Clear Spectrogram | 58 |
| Color Mapping | 56, 58 |
| Continuous Sweep | 51 |
| Continuous trigger | 20 |
| Delete mask | 46 |
| Edit Frequency Mask | 44, 45 |
| Free Run | 43 |
| Frequency Config | 36 |
| Frequency mask | 44 |
| Full Span | 38 |
| Last Span | 38 |
| Load (mask) | 46 |
| Lower Level Hysteresis | 53 |

| | | | |
|--------------------------------|----------------|------------------------------------|---------------|
| Marker Config | 63, 66 | Time stamps | 68 |
| Marker Search Area | 71 | Value range | 24, 76 |
| Marker Search Type | 70 | Spectrum | 21 |
| Marker to Trace | 65 | History | 21 |
| Meastime Auto | 52 | Start frequency | 38 |
| Meastime Manual | 53 | Softkey | 38 |
| Min | 72 | Statistics | 181 |
| New (mask) | 46 | Programming example | 181 |
| New mask | 47 | Status | 177 |
| Next Min | 72 | Capture finished | 177 |
| Next Mode X | 69 | Status registers | 178 |
| Next Mode Y | 69 | Querying | 177 |
| Next Peak | 71 | Querying (remote) | 91 |
| Norm/Delta | 65 | STAT:QUES:POW | 177 |
| Peak | 71 | STATus:OPERation | 177 |
| Posttrigger | 20 | STATus:QUESTionable:TIME | 177 |
| Pretrigger | 20 | Step size | 154 |
| Ref Level | 40 | Markers (remote control) | 38 |
| Ref Level Offset | 40 | Stop frequency | 86 |
| Res BW Auto | 50 | Softkey | 83 |
| Res BW Auto (remote) | 102 | Suffixes | 86 |
| Res BW Manual | 50 | Common | 83 |
| RF Atten Auto | 40 | Remote commands | 83 |
| RF Atten Manual | 40 | Sweep | 51 |
| Save (mask) | 46 | Aborting | 101 |
| Scale Config | 42 | Configuration (remote) | 49 |
| Search Config | 68 | Configuration (Softkey) | 132 |
| Select Frame | 51, 57 | Performing (remote) | 102, 103, 104 |
| Select Marker | 66 | Time (remote) | 50 |
| Span Manual | 38 | Sweep time | 15 |
| Start | 38 | Auto (Softkey) | 50 |
| Stop | 38 | FFT | 50 |
| Stop on trigger | 20 | Manual (Softkey) | 50 |
| Sweep Config | 49 | Spectrum | 50 |
| Sweep time Auto | 50 | | |
| Sweep time Manual | 50 | T | |
| Time Stamp | 68 | Time frames | 21, 51, 57 |
| Trace 1/2/3/4 | 62 | Selecting | 21 |
| Trace Config | 60 | Spectrograms | 21 |
| Trigger Config | 43 | Waterfalls | 21 |
| Upper Level Hysteresis | 53 | Time stamps | 23 |
| Span | 38 | Frames | 68 |
| FFT calculation | 36 | Softkey (Spectrogram) | 68 |
| FFT calculation (Remote) | 99 | Spectrograms | 62 |
| Manual | 38 | Configuration (Softkey) | 144 |
| Real-Time | 15 | Configuring (remote control) | 148 |
| Specifics for | 34 | Copying (remote control) | 61 |
| Configuration | 9 | Detector | 148 |
| Spectrogram | 22 | Detector (remote control) | 63 |
| Evaluation method | 21 | Export format | 63 |
| Scrolling | 21 | Exporting | 141 |
| Spectrograms | 21 | Exporting results (remote) | 61 |
| Basics | 21 | Mode | 145 |
| Clear | 58 | Mode (remote) | 137 |
| Clearing | 24, 59, 77 | Retrieving results (remote) | 61 |
| Color curve | 24, 56, 58, 75 | Selecting | 144 |
| Color mapping | 24, 59 | Settings (remote control) | 43 |
| Color scheme | 21 | External (remote) | 44 |
| History | 23 | Mode | 20 |
| Markers | 166 | Posttrigger | 20 |
| Markers (remote control) | 51, 57 | Pretrigger | 16 |
| Selecting frames | 56 | Real-Time measurements | 20, 44 |
| Settings | 112 | Rearming | |
| Settings (remote) | 21 | | |
| Time frames | 21 | | |
| Time stamp | | | |

| | |
|----------------------------|-----|
| Remote control | 104 |
| Stop measurement | 44 |
| Stop on trigger | 20 |
| Trigger condition | |
| Frequency masks | 48 |
| Trigger source | 43 |
| Configuration | 43 |
| Free Run | 43 |
| Frequency mask | 44 |
| Troubleshooting | |
| Input overload | 91 |
| Truncate | |
| Persistence Spectrum | 59 |

U

| | |
|-------------------------------|----|
| Units | |
| Reference level | 40 |
| Upper Level Hysteresis | 53 |
| Upper mask | |
| Activating/Deactivating | 46 |
| Frequency masks | 48 |

V

| | |
|----------------------------|----|
| Vector style | |
| Persistence spectrum | 29 |

W

| | |
|------------------------------------|------------|
| Waterfall | |
| Basics | 21 |
| Color mapping | 24, 58, 75 |
| Time frames | 21 |
| Window title bar information | 6 |
| Windows | |
| Adding (remote) | 126 |
| Closing (remote) | 131 |
| Configuring | 34 |
| Layout (remote) | 129 |
| Maximizing (remote) | 125 |
| Querying (remote) | 127 |
| Replacing (remote) | 129 |
| Splitting (remote) | 125 |
| Types (remote) | 126 |

X

| | |
|---------------|----|
| X-value | |
| Marker | 65 |

Y

| | |
|--|----|
| Y-axis | |
| Settings | 42 |
| YIG-preselector | |
| Activating/Deactivating | 36 |
| Activating/Deactivating (remote) | 92 |

Z

| | |
|----------------------------------|-----|
| Zooming | |
| Activating (remote) | 176 |
| Area (remote) | 175 |
| Functions | 73 |
| Remote | 175 |
| Restoring original display | 73 |
| Single mode | 73 |