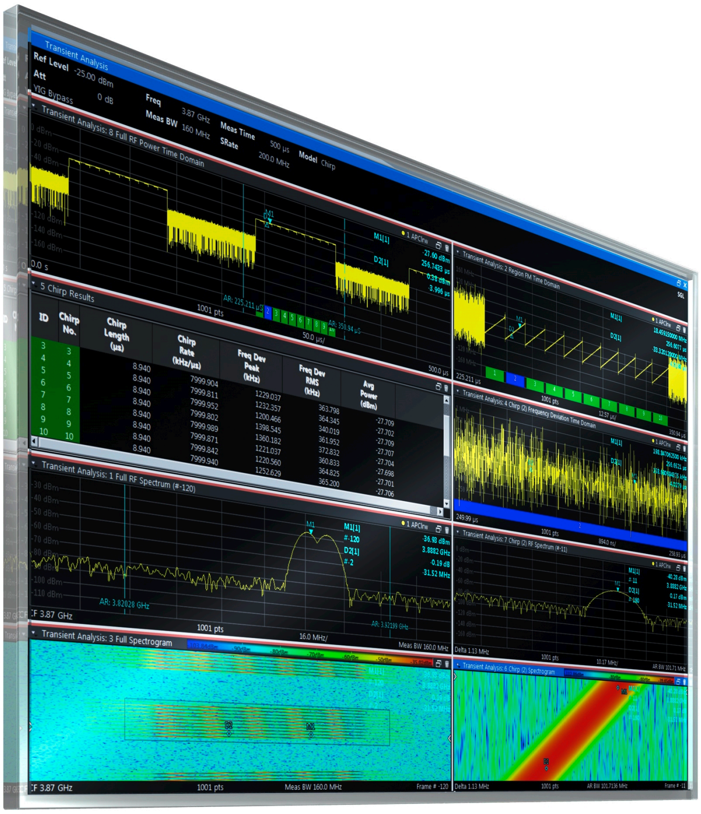
R&S®VSE-K60 Transient Analysis User Manual



1178376302
Version 09

ROHDE&SCHWARZ
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This manual applies to the following software, version 2.31 and later:

- R&S®VSE Enterprise Edition base software (1345.1105.06)
- R&S®VSE Basic Edition base software (1345.1011.06)

The following firmware options are described:

- R&S VSE-K60 Transient Analysis (1320.7868.02)
- R&S VSE-K60H Transient Hop Measurements (1320.7880.02)
- R&S VSE-K60C Transient Chirp Measurements (1320.7874.02)
- R&S VSE-K60P Transient Phase Noise Measurements (1345.2230.02)
- R&S VSE-KT60 Transient Analysis (1345.1905.02)
- R&S VSE-KT60H Transient Hop Measurements (1345.1886.02)
- R&S VSE-KT60C Transient Chirp Measurements (1345.1892.02)

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1178.3763.02 | Version 09 | R&S®VSE-K60

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

Contents

1 Documentation overview

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

www.rohde-schwarz.com/manual/VSE

Further documents are available at:

www.rohde-schwarz.com/product/VSE

1.1 User manuals and help

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

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

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

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

1.2 Data sheets and brochures

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

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

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

1.3 Release notes and open-source acknowledgment (OSA)

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

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

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

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

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

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

2 Welcome to the transient analysis application

The R&S VSE-K60 is a firmware application that adds functionality to detect transient signal effects to the R&S VSE.

The R&S VSE Transient Analysis application features:

- Analysis of transient effects
- Quick analysis even before measurement end due to online transfer of captured and measured I/Q data
- Easy analysis of user-defined regions within the captured data
- Analysis of frequency hopping or chirped FM signals (with additional Transient Analysis options)

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

Functions that are not discussed in this manual are the same as in the I/Q Analyzer application and are described in the R&S VSE User Manual. The latest version is available for download at the product homepage (http://www.rohde-schwarz.com/product/VSE.html).

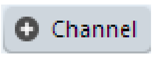
An application note discussing RF signal analysis and interference tests using the R&S VSE Transient Analysis application is available from the Rohde & Schwarz website:

1MA267: Automotive Radar Sensors - RF Signal Analysis and Inference Tests

2.1 Starting the transient analysis application

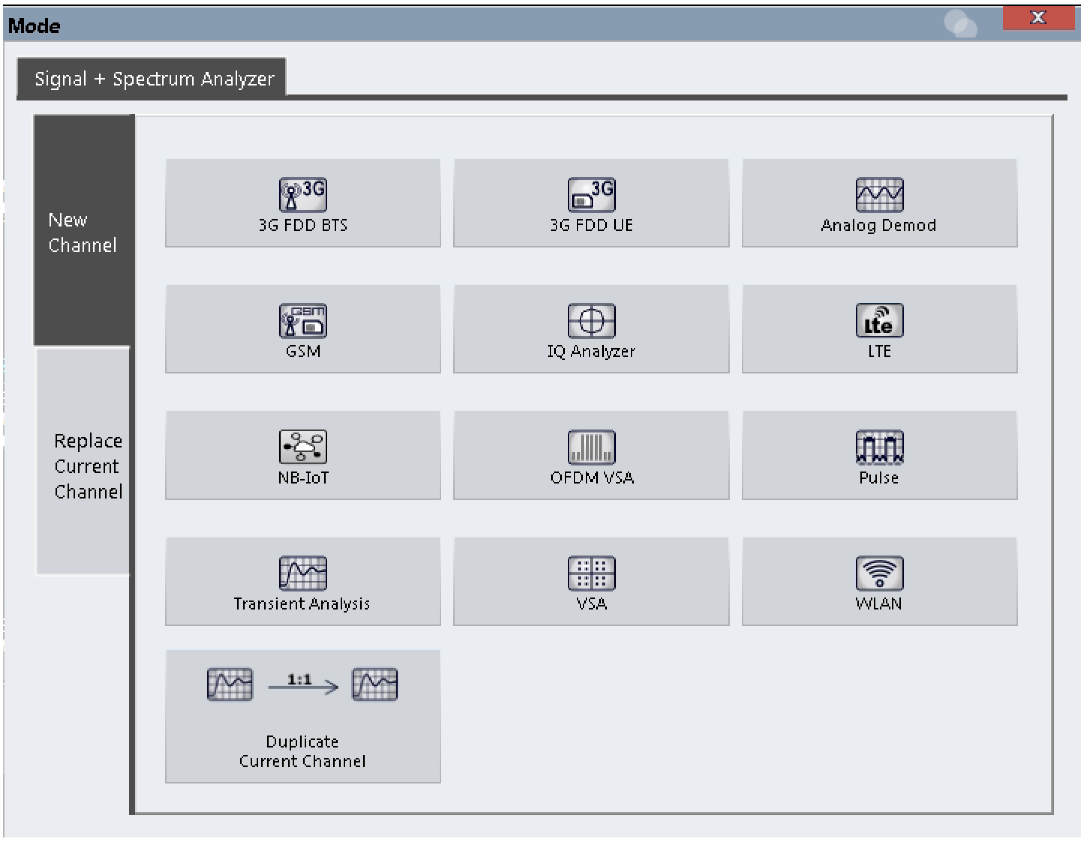
Transient Analysis requires a separate application on the R&S VSE. It is activated by creating a new measurement channel in Transient Analysis mode.

To activate the Transient Analysis application

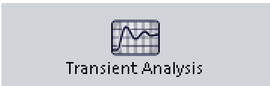
1. 

   Select the "Add Channel" function in the Sequence tool window.

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



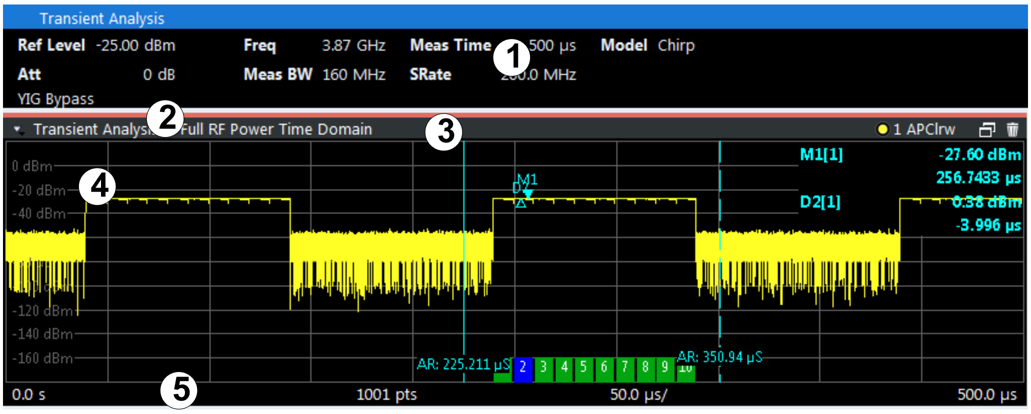
2. Select the "Transient Analysis" item.



The R&S VSE opens a new measurement channel for the R&S VSE Transient Analysis application.

2.2 Understanding the display information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Channel bar for firmware and measurement settings
2 = Color coding for windows of same channel
3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information

Channel bar information

In the R&S VSE Transient Analysis application, the R&S VSE shows the following settings:

Table 2-1: Information displayed in the channel bar in the Transient Analysis application

Ref Level	Reference level
Att	RF attenuation
Freq	Center frequency for the RF signal
Meas BW	Measurement bandwidth
Meas Time	Measurement time (data acquisition time)
Sample Rate	Sample rate
Model	Signal model (hop, chirp or none)

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 (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S VSE Base Software User Manual.

Window title bar information

For each diagram, the header provides the following information:

Figure 2-1: Window title bar information in the R&S VSE Transient Analysis application

0 = Color coding for windows of same channel
1 = Window number
2 = Window type
3 = Trace color
4 = Trace number
5 = Detector mode
6 = Trace mode
6 = Dock/undock window function
7 = Close window function

Diagram footer information

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

Time domain:

- Start and stop time of data acquisition
- Number of data points
- Time displayed per division

Frequency domain:

- Center frequency
- Number of data points
- Bandwidth displayed per division
- Measurement bandwidth

Spectrogram:

- Center frequency
- Number of data points
- Measurement bandwidth
- Selected frame number

Status bar information

The software status, errors and warnings and any irregularities in the software are indicated in the status bar at the bottom of the R&S VSE window.

3 About transient analysis

Transient analysis refers to signal effects which may appear briefly or change rapidly in time or frequency. Typical examples are spurious emissions or modulated signals using frequency-hopping techniques. Such signals often require analysis of a large bandwidth, if possible without gaps.

Ideally, such signals are analyzed in real-time mode, which employs special hardware in order to capture and process data simultaneously, and seamlessly. However, if a real-time analyzer is not available, the Transient Analysis application is a good choice.

Similarly to real-time mode, but without the special hardware, this application captures data and asynchronously - before data acquisition is completed - starts analyzing the available input and displays first results. Especially for large bandwidths or long measurement times, analysis becomes much more efficient and the complete measurement task can be sped up significantly. Although gaps may occur between successive measurements with large bandwidths, the results from each individual measurement are complete without gaps.

Thus, the Transient Analysis application supports you in analyzing time- and frequency-variant signals with large bandwidths.

4 Measurement basics

Some background knowledge on basic terms and principles used in analysis of transient signals is provided here for a better understanding of the required configuration settings.

4.1 Data acquisition

The R&S VSE Transient Analysis application measures the power of the signal input over time. How much data is captured depends on the measurement bandwidth and the measurement time. These two values are interdependant and allow you to define the data to be measured using different methods:

- By defining a bandwidth around the specified center frequency to be measured at a specified sample rate
- By defining a time length during which a specified number of samples are measured at the specified center frequency

4.2 Signal processing

The R&S VSE Transient Analysis application measures the power of the signal input over time. In order to convert the time domain signal to a frequency spectrum, an FFT (Fast Fourier Transformation) is performed which converts a vector of input values into a discrete spectrum of frequencies.

The application calculates multiple FFTs per capture, by dividing one capture into several overlapping FFT frames. This is especially useful in conjunction with window functions since it enables a gap-free frequency analysis of the signal.

Using overlapping FFT frames leads to more individual results and improves detection of transient signal effects. However, it also extends the duration of the calculation. The size of the FFT frame depends on the number of input signal values (record length), the overlap factor, and the time resolution (time span used for each FFT calculation).

FFT window functions

Each FFT frame is multiplied with a specific window function after sampling in the time domain. Windowing helps minimize the discontinuities at the end of the measured signal interval and thus reduces the effect of spectral leakage, increasing the frequency resolution.

Additional filters can be applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Asynchronous data processing

During a measurement in the R&S VSE Transient Analysis application, the data is captured and stored in the capture buffer until the defined measurement time has expired. As soon as a minimum amount of data is available, the first FFT calculation is performed. As soon as the required number of (overlapping) FFT results is available, the detector function is applied to the data and the first frame is displayed in the Spectrogram (and any other active result displays).

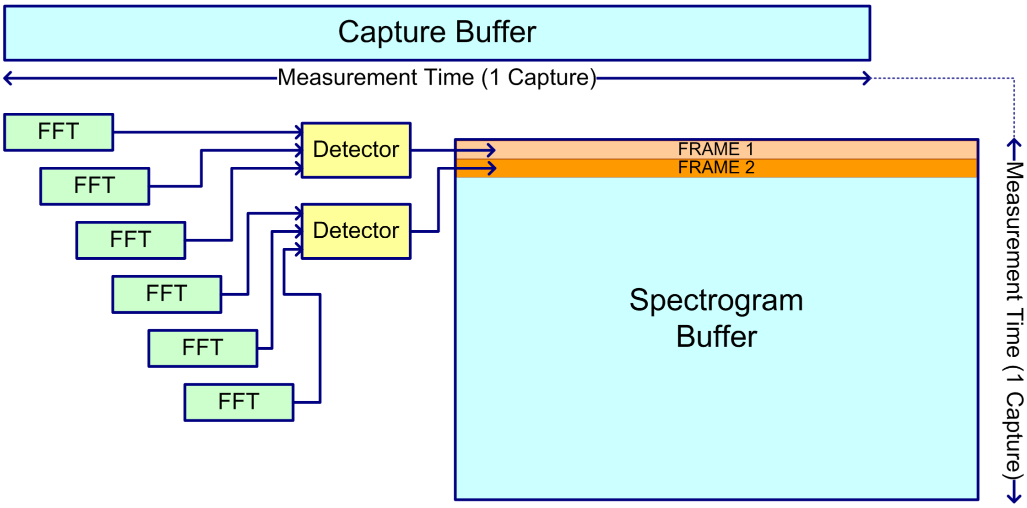


Figure 4-1: Signal processing: calculating one spectrogram frame

Shortly after the measurement time is over, the final results are displayed and the measurement is complete. Due to this asynchronous processing, initial analysis results are available very quickly. At the same time, the data is captured over the full bandwidth entirely without gaps. The following figure illustrates how the capture and result display processes are performed asynchronously.

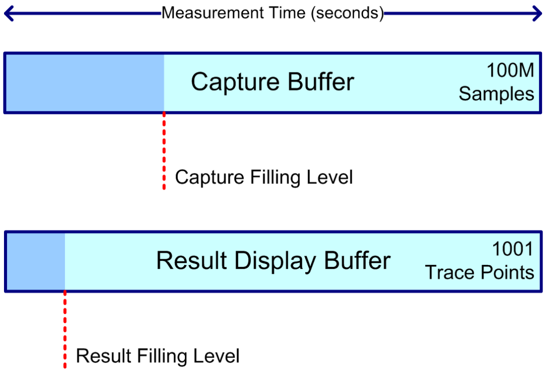


Figure 4-2: Asynchronous data processing

Multiple spectrograms

However, after each data acquisition, a short delay occurs before the next acquisition can be carried out. Thus, for measurements for which several spectrograms are required and the capturing process is repeated several times (defined by the "frame count"), a short gap in the results between spectrograms can be detected.

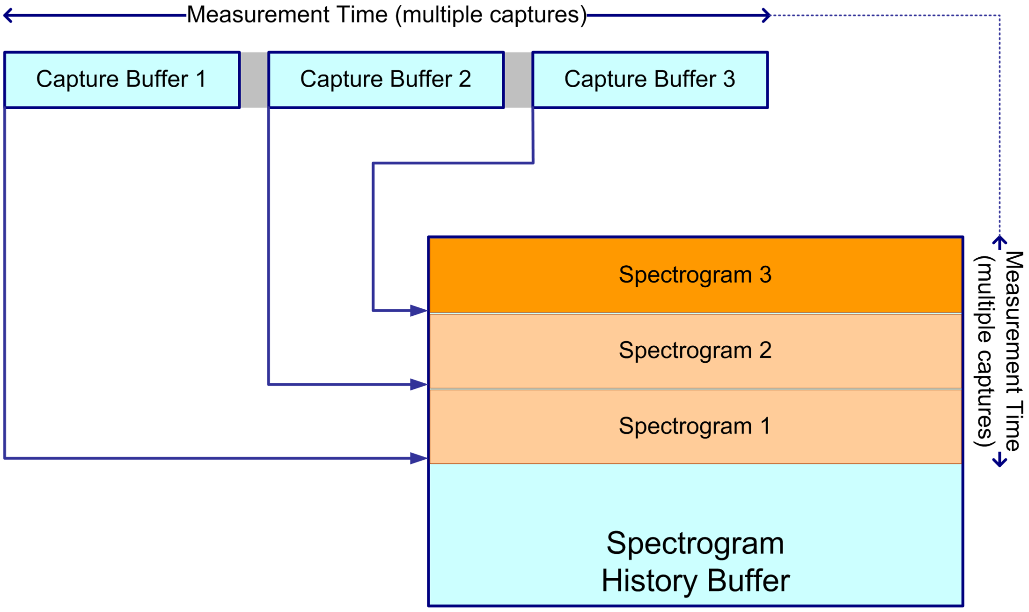


Figure 4-3: Signal processing: calculating several spectrograms

Resolution bandwidth

The resolution bandwidth (RBW) has an effect on how the spectrum is measured and displayed. It determines the frequency resolution of the measured spectrum and is directly coupled to the selected analysis bandwidth (ABW). The ABW can be the full measurement bandwidth, the bandwidth of the analysis region, or the length of the result range, depending on the evaluation basis of the result display (see Chapter 4.4, "Basis of evaluation", on page 24). If the ABW is changed, the resolution bandwidth is automatically adjusted. Which coupling ratios are available depends on the selected FFT Window.

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 required measurement time.

The resolution bandwidth parameters can be defined in the bandwidth configuration, see Chapter 6.6, "Bandwidth settings", on page 107.

Time resolution

The time resolution determines the size of the bins used for each FFT calculation. The shorter the time span used for each FFT, the shorter the resulting span, and thus the higher the resolution in the spectrum becomes. The time resolution to be used for R&S VSE can be defined manually or automatically according to the data acquisition settings.

4.3 Signal models

If the additional firmware options R&S VSE-K60H or -K60C are installed, the R&S VSE Transient Analysis application supports different signal models for which similar parameters are characteristic.

4.3.1 Frequency hopping

Some digital data transmission standards employ a *frequency-hopping* technique, in which a carrier signal is rapidly switched among many frequency channels. Discrete frequencies and continuous modulation are characteristic of this signal model.

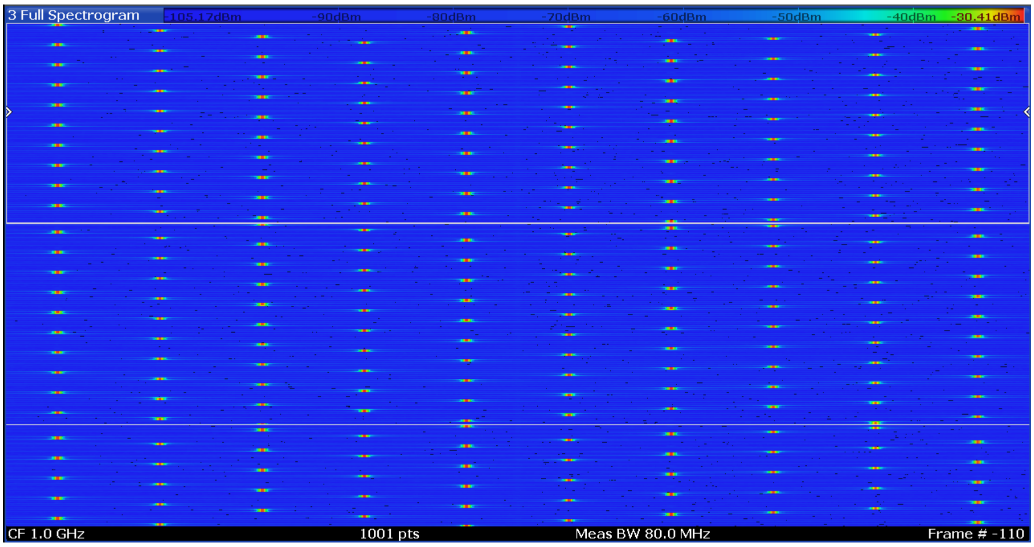


Figure 4-4: Typical spectrogram of a frequency-hopping signal

Analyzing such signals includes the following challenges:

- Detecting the currently used carrier frequency and a possible offset
- Determining the duration the signal stays at one frequency and the time it takes to switch to another
- Measuring the average power level
- Demodulating the signal correctly

The R&S VSE Transient Analysis application (with the additional R&S VSE-K60H option installed) can automatically detect frequency hops in a measured signal and determine characteristic hop parameters. Both pulsed and continuous wave hopping signals can be analyzed.

Assuming a frequency-hopping signal model, the frequency bands in which the carrier can be expected are usually known in advance. Therefore, you can configure conditions that must apply to the measured signal in order to detect a frequency hop and distinguish it from random spurs or frequency distortions. Such conditions can be a frequency tolerance around a defined nominal value, for instance, or a minimum or maximum dwell time in which the frequency remains steady.

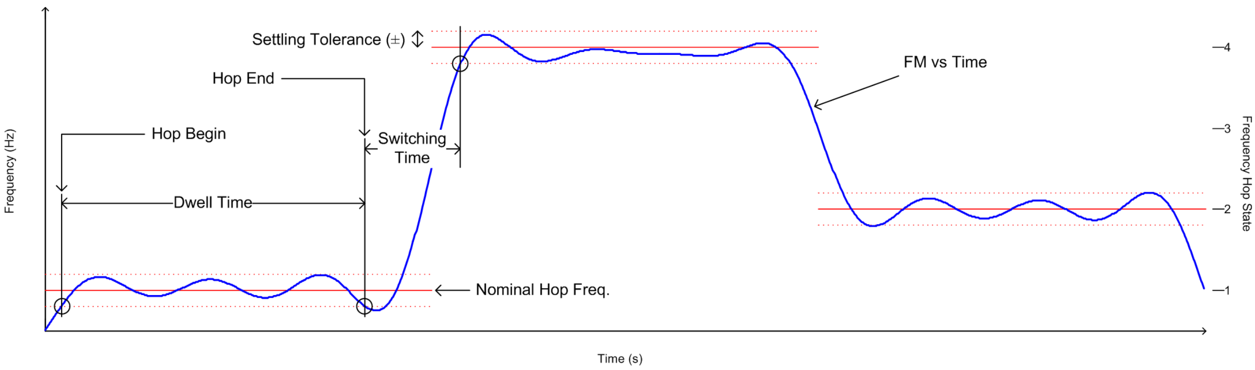


Figure 4-5: Parameters required to detect hops

Nominal Frequency Values (Hop States)

The (nominal) frequency values the carrier is expected to "hop" to are defined in advance. Each such level is considered to be a *hop state*. The hop states are defined as frequency offsets from the center frequency. A tolerance span can be defined to compensate for settling effects. As long as the deviation remains within the tolerance above or below the nominal frequency, the hop state is detected.

The nominal frequency levels are numbered consecutively in the "Hop States" table (see Chapter 6.2.2, "Signal states", on page 83), starting at 0. The state index of the corresponding nominal frequency level is assigned to each detected hop in the measured signal results.

Dwell Time Conditions

The dwell time is the time the signal remains in the tolerance area of a nominal hop frequency, or in other words: the duration of a hop from beginning to end. In a default measurement, useful dwell times for the current measurement are determined automatically. However, you can define minimum or maximum dwell times, or both, manually, in order to detect only specific hops, for example.

4.3.2 Frequency chirping

Frequency chirping is similar to hopping, however, instead of switching to discrete frequencies, the frequency varies with time at a particular *chirp rate*. Transient analysis with the R&S VSE application (and the additional R&S VSE-K60C option) is restricted to the commonly used *linear* FM chirp signals. In this case, the nominal chirp switches to discrete values, referred to as the *chirp states*.

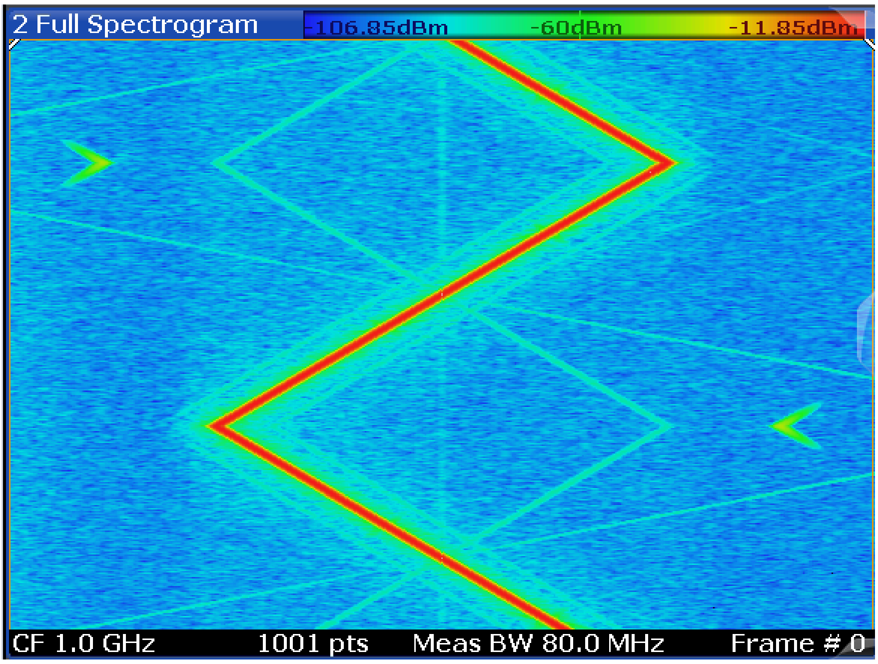


Figure 4-6: Typical spectrogram of a chirped signal

The R&S VSE Transient Analysis application can automatically detect chirps in a measured signal and determine characteristic chirp parameters. Both pulsed and continuous wave chirp signals can be analyzed.

Obviously, if you consider the chirps rather than the individual frequencies, the measured data from chirped signals is very similar to hopped signals, and thus the analysis tasks and the characteristic parameters are very similar, as well.

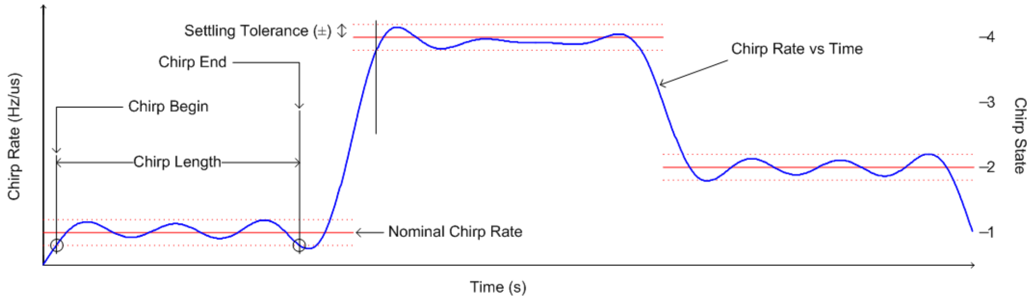


Figure 4-7: Parameters required to detect chirps

In the R&S VSE Transient Analysis application, for a chirp signal, the derivation of the captured signal data is calculated before further analysis. From there, processing is identical for both signal models.

4.3.3 Automatic vs. manual hop/chirp state detection

By default, the R&S VSE Transient Analysis application automatically detects the existing hop/chirp states in a pre-measurement. For an initial overview of the signal at hand this detection is usually sufficient. For more accurate results, particularly if the input signal is known in advance, the nominal frequency or chirp values can be defined manually.

4.4 Basis of evaluation

Depending on the measurement task, not all of the measured data in the capture buffer may be of interest. In some cases it may be useful to restrict analysis to a specific user-definable region, or to a selected individual chirp or hop. This makes analysis more efficient and the display clearer.

Automatic detection of hops or chirps, for example, is always based on a restricted analysis region. Numeric results for characteristic parameters, as well as statistical results, are also calculated on this restricted basis.

For graphical displays, selecting an individual hop or chirp allows you to analyze or compare characteristic values in detail.

Which evaluation basis is available for which result display is indicated in Table 5-1.

Detected hops/chirps are indicated by green bars along the x-axis in graphical result displays. The selected hop/chirp (see "Select Hop / Select Chirp" on page 125) is indicated by a blue bar. The hop/chirp index as displayed in the result tables is indicated at the bottom of each bar.

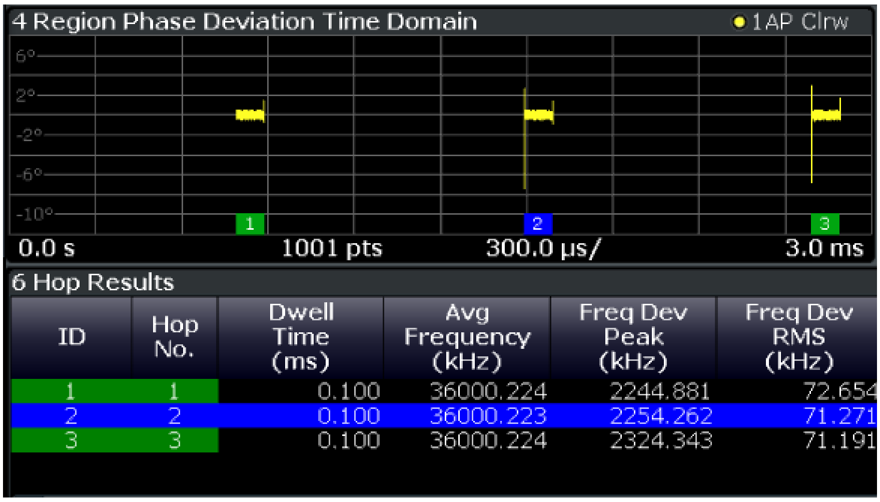


Figure 4-8: Example of detected hops with hop index in graphical result display and result table

4.5 Analysis region

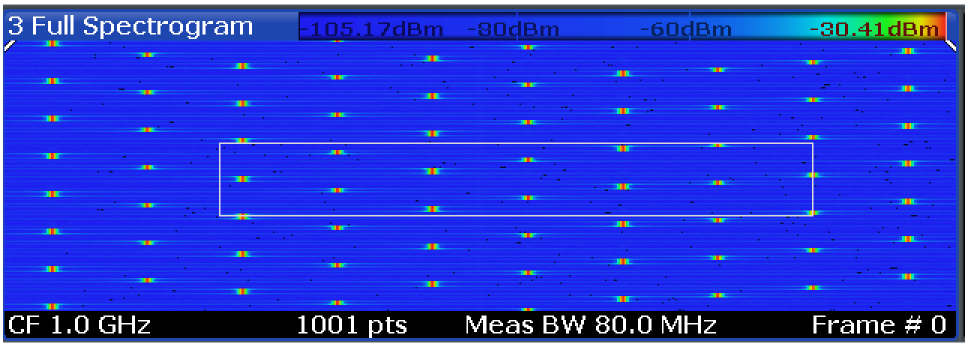
The *analysis region* determines which of the captured data is analyzed and displayed on the screen. By default, the entire capture buffer data is defined as the analysis region. However, you can select a specific frequency and time region which is of interest for analysis. The results can then be restricted to this region (see Chapter 7.2, "Evaluation basis", on page 125).

Note, however, that only *one* analysis region can be defined. All result displays that are restricted to the analysis region thus have the same data basis.

Numeric results (displayed in the result or statistics tables) are always calculated based on the analysis region.

For graphical result displays based on the analysis region, the x-axis range corresponds to the analysis region length (see "Time Gate Length" on page 107).

The analysis region is indicated by a colored frame in the Full Spectrogram display, and by vertical blue lines in result displays based on the full capture buffer.



The colors used to indicate the analysis range in spectrograms are configurable, see "Modifying Analysis Region and Sweep Separator Colors" on page 132.

Defining the analysis region

There are different methods of defining the analysis region:

- absolute definition: by defining an absolute frequency span and an absolute time gate
  The frequency span is defined by an offset from the center frequency and an analysis bandwidth.
  The time gate is defined by a starting point after measurement begin and the gate length.
- Relative definition: by linking the analysis region to the full capture buffer and defining a percentage of the full bandwidth and measurement time
  The specified frequency offset or time gate start are also considered for relative values.
- Graphically: The analysis region is indicated by a dotted frame in the Spectrogram display and by vertical lines in the full spectrum display. Its size and position can be moved by tapping and dragging the frame on the touchscreen.
  Furthermore, the data zoom and shift functions allow you to change the size and position of the analysis region from any graphical result display (see Chapter 4.6, "Zooming and shifting results", on page 28).

The absolute and relative methods can be combined, for example by defining an absolute frequency span and a relative time gate.

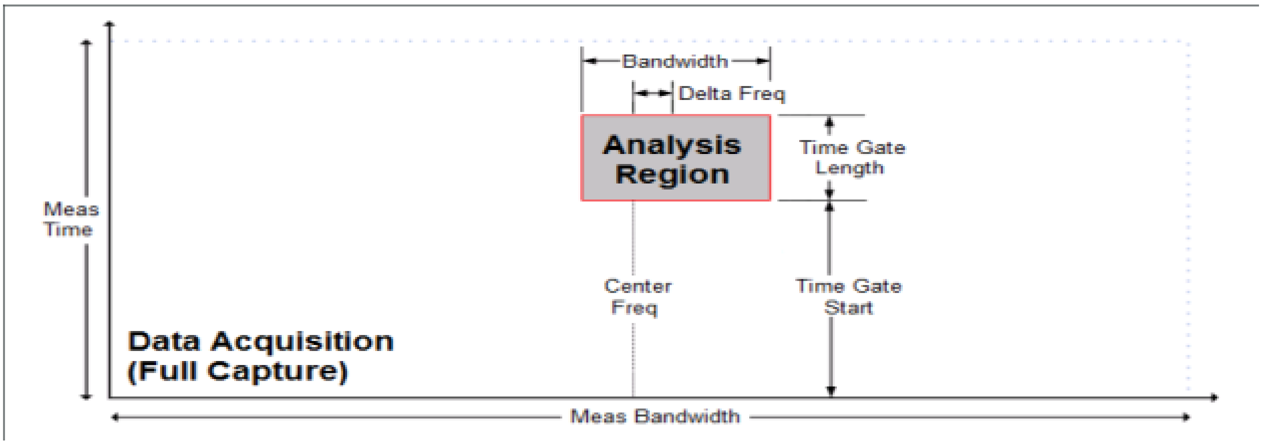


Figure 4-9: Visualization of absolute analysis region parameters

Processing data in the analysis region - data zoom

In result displays restricted to the analysis region, only the data measured for the specified frequency range and within the defined time gate is considered. Furthermore, the analysis region data is taken only from the latest data acquisition, that is, only data that is still in the capture buffer is analyzed.

Restricting the results to an analysis region has the same effect as a data zoom: the results are recalculated for a restricted data base. The data in the capture buffer is filtered by the defined time gate; the measured data within that time span then passes a bandpass filter, so only the frequency range of interest is analyzed. Depending on the selected result display, the data is then demodulated, if necessary, and distributed among the trace points using a detector. The time span displayed per division of the diagram is much smaller compared to the initial full data analysis. Thus, the results of the analysis range become more precise.

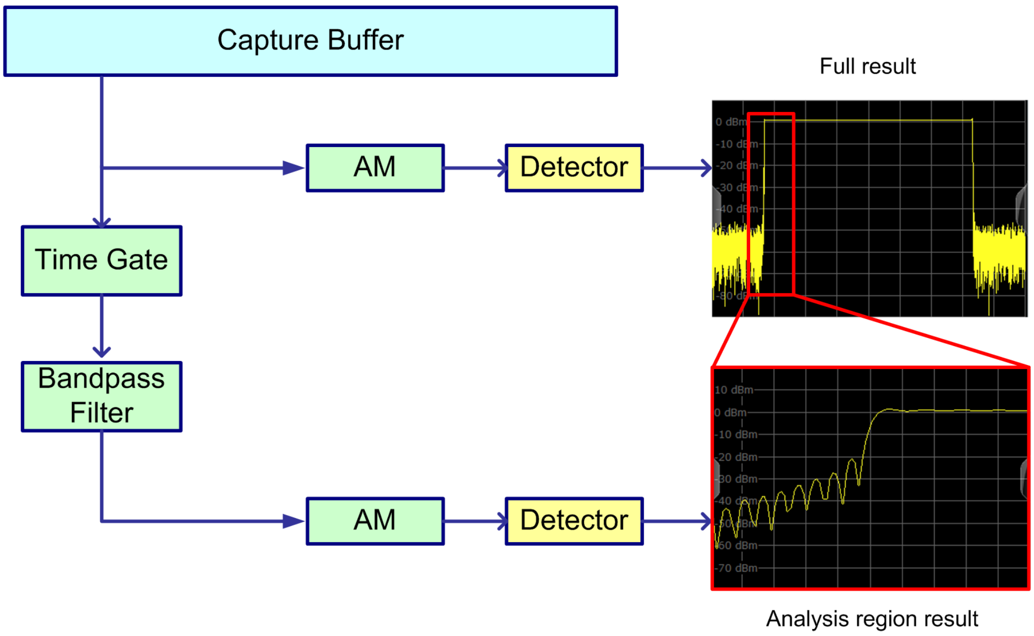


Figure 4-10: Data zoom - full result vs. analysis region result

4.6 Zooming and shifting results

As described above (Processing data in the analysis region - data zoom), restricting the results to an analysis region has the same effect as a data zoom: the results are recalculated for a restricted data base.

This is exactly what the "Data Zoom" ( ) function in the toolbar does: it changes the size of the analysis region and re-evaluates the new data base. Thus, if the analysis region is reduced, less data is displayed in the same area of the screen, thus enlarging the display of the selected data. If the analysis region is enlarged, more data is displayed.

The "Data Shift" ( ) function, on the other hand, does not change the size of the analysis region, but the position. Thus you can scroll through the signal and analyze several hops/chirps after another, for example.

The effects of a data zoom or shift are reflected in the Analysis Region settings of the "Data Acquisition" dialog box.

Similarly, when the data zoom and shift functions are applied to a hop/chirp-based result display, the size or position of the result range are changed (see Chapter 7.1.1, "Result range", on page 116).

This means that *ALL* result displays based on the analysis region or hop/chirp result range are re-evaluated after a data zoom or shift function is applied in any window. This includes result tables, which may take some time to re-calculate. Close the result tables during a data shift/zoom to improve the screen update speed.

Use the data zoom or shift functions in the full spectrum or spectrogram displays and analyze the data sequentially or hop-by-hop / chirp-by-chirp in the other result displays!

4.7 Measurement range

In order to calculate frequency, phase or power results in frequency hopping or chirped signals more accurately, it may be useful not to take the entire dwell time of the hop (or length of the chirp) into consideration, but only a certain range within the dwell time/ length. Thus, it is possible to eliminate settling effects, for instance. For other measurements, the settling time may be of particular interest.

For such cases, a *measurement range* can be defined for frequency, phase and power results, in relation to specific hop or chirp characteristics.

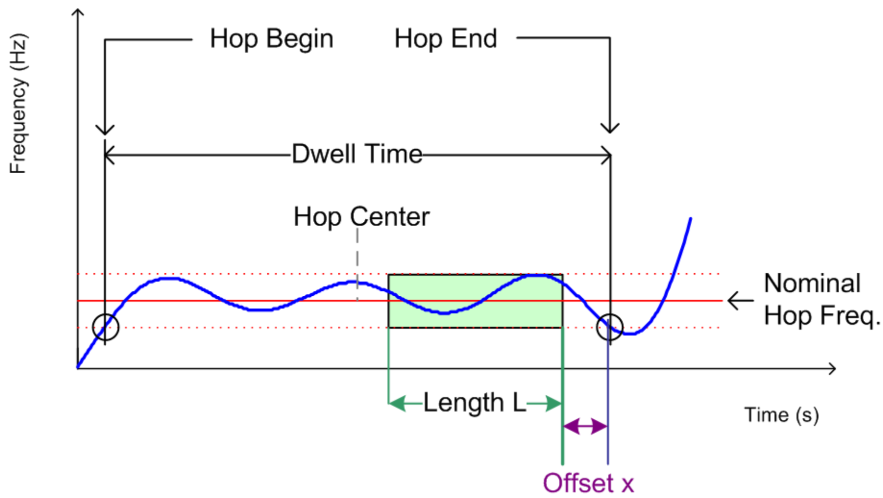


Figure 4-11: Dwell time parameters for hopped signals

Similarly, for chirped signals, a measurement range can be defined for the corresponding parameters.

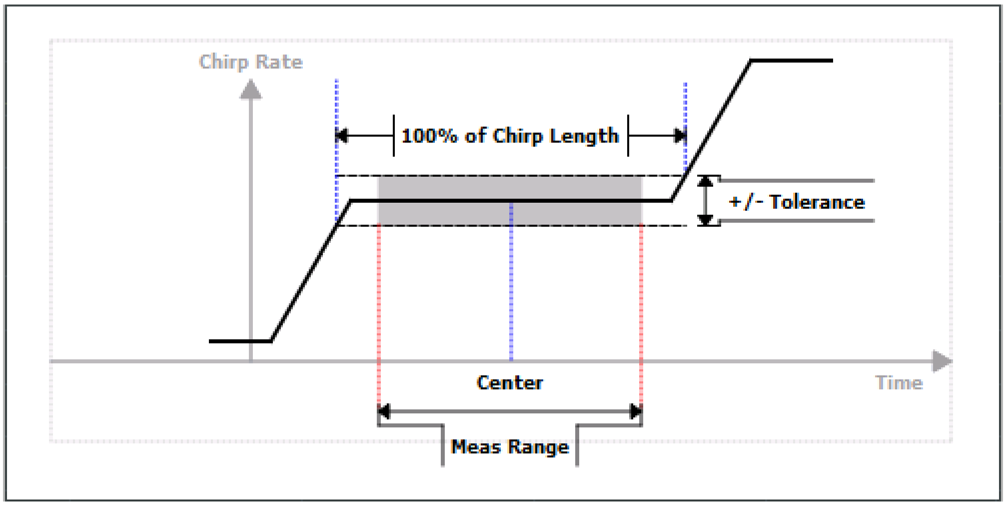


Figure 4-12: Measurement range parameters for chirped signals

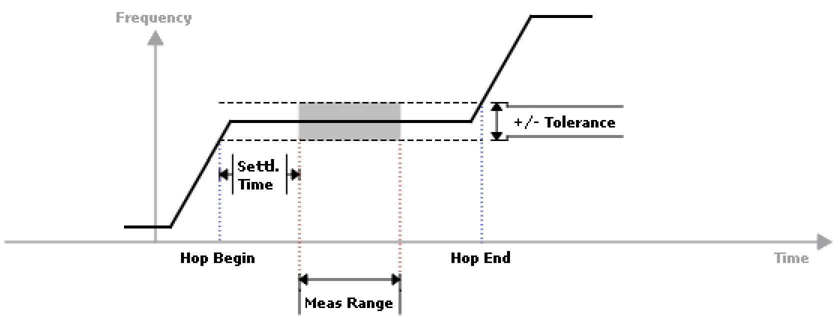
Each range is defined by a reference point, an offset, and the range length. The reference point can be either the center or either edge of the hop/chirp, or a point defined by an offset to one of these characteristic points. The range is then centered around this reference point.

Example:

In Figure 4-11, the indicated measurement range could be defined by the following parameters, for example:

- "Reference": *Hop End*
- "Offset": *-x*
- "Alignment": *right*
- "Length": *L*

For frequency/phase deviation and power measurements, the measurement range can also be aligned to the end of the FM or PM settling time.



Measurement range vs result range

While the measurement range defines which part of the hop/chirp is used for individual calculations, the **result range** determines which part is **displayed** on the screen in the form of AM, FM or PM vs. time traces (see also Chapter 7.1.1, "Result range", on page 116).

4.8 Trace evaluation

Traces in graphical result displays based on the defined result range (see Chapter 7.1.1, "Result range", on page 116) can be configured, for example to perform statistical evaluations over the selected hop/chirp or all hops/chirps.

You can configure up to 6 individual traces for the following result displays (see Chapter 5.3, "Evaluation methods for transient analysis", on page 65):

- RF Power Time Domain
- FM Time Domain
- Frequency Deviation Time Domain
- PM Time Domain
- PM Time Domain (Wrapped)
- Chirp Rate Time Domain

Find out more about trace evaluation:

4.8.1 Mapping samples to measurement points with the trace detector

A trace displays the values measured at the measurement points. The number of samples taken during a measurement is much larger than the number of measurement points that are displayed in the measurement trace.

Obviously, a data reduction must be performed to determine which of the samples are displayed for each measurement point. This is the trace detector's task.

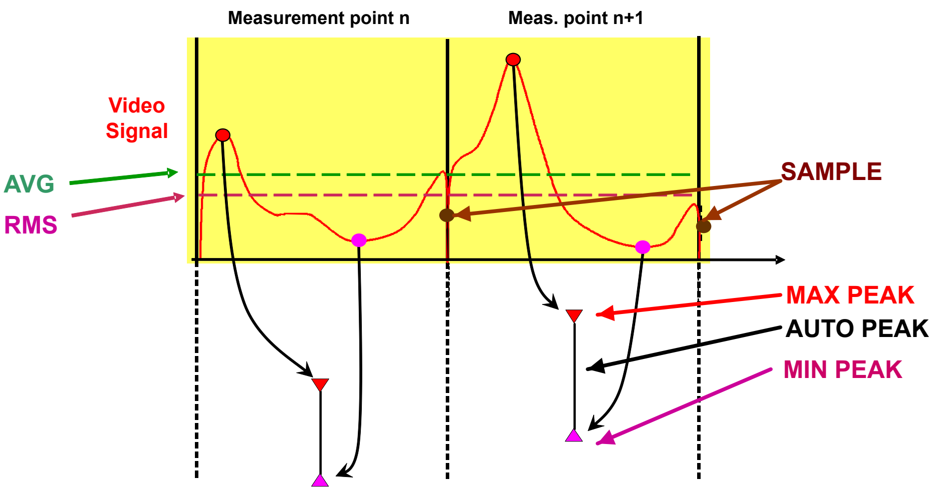
The trace detector can analyze the measured data using various methods:

The detector activated for the specific trace is indicated in the corresponding trace information by an abbreviation.

Table 4-1: Detector types

Detector	Abbrev.	Description
Positive Peak	Pk	Determines the largest of all positive peak values of the levels measured at the individual frequencies which are displayed in one sample point
Negative Peak	Mi	Determines the smallest of all negative peak values of the levels measured at the individual frequencies which are displayed in one sample point
Auto Peak	Ap	Combines the peak detectors; determines the maximum and the minimum value of the levels measured at the individual frequencies which are displayed in one sample point
RMS	Rm	Calculates the root mean square of all samples contained in a measurement point. The RMS detector supplies the power of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal). Correction factors as needed for other detectors to measure the power of the different signal classes are not required.
Average	Av	Calculates the linear average of all samples contained in a measurement point. To this effect, R&S VSE 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). For logarithmic display the logarithm is formed from the average value. For linear display the average value is displayed. Each measurement point thus corresponds to the average of the measured values summed up in the measurement 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	Sa	Selects the last measured value of the levels measured at the individual frequencies which are displayed in one sample point; all other measured values for the frequency range are ignored

The result obtained from the selected detector for a measurement point is displayed as the value at this x-axis point in the trace.



The trace detector for the individual traces can be selected manually by the user or set automatically by the R&S VSE.

The detectors of the R&S VSE are implemented as pure digital devices. All detectors work in parallel in the background, which means that the measurement speed is independent of the detector combination used for different traces.

Auto detector

If the R&S VSE is set to define the appropriate detector automatically, the detector is set depending on the selected trace mode:

Trace mode	Detector
Clear Write	Auto Peak
Max Hold	Positive Peak
Min Hold	Negative Peak
Average	Sample Peak
View	–
Blank	–

4.8.2 Analyzing several traces - trace mode

If several measurements are performed one after the other, or continuous measurements are performed, the trace mode determines how the data for subsequent traces is processed. After each measurement, the trace mode determines whether:

- The data is frozen (View)
- The data is hidden (Blank)
- The data is replaced by new values (Clear Write)
- The data is replaced selectively (Max Hold, Min Hold, Average)

Each time the trace mode is changed, the selected trace memory is cleared.

The trace mode also determines the detector type if the detector is set automatically, see Chapter 4.8.1, "Mapping samples to measurement points with the trace detector", on page 31.

The R&S VSE offers the following trace modes:

Table 4-2: Overview of available trace modes

Trace Mode	Description
Blank	Hides the selected trace.
Clear Write	Overwrite mode: the trace is overwritten by each measurement. This is the default setting. All available detectors can be selected.

Trace Mode	Description
Max Hold	The maximum value is determined over several measurements and displayed. The R&S VSE saves the measurement result in the trace memory only if the new value is greater than the previous one. This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each measurement until all signal components are detected in a kind of envelope.
Min Hold	The minimum value is determined from several measurements and displayed. The R&S VSE saves the measurement result in the trace memory only if the new value is lower than the previous one. This mode is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed, whereas a CW signal is recognized by its constant level.
Average	The average is formed over several measurements and displayed. The Capture Count determines the number of averaging procedures. (See also Chapter 4.8.3, "Trace statistics", on page 34.)
View	The current contents of the trace memory are frozen and displayed.

If a trace is frozen ("View" mode), the instrument settings, apart from level range and reference level (see below), can be changed without impact on the displayed trace. The fact that the displayed trace no longer matches the current instrument setting is indicated by the icon on the tab label.

If the level range or reference level is changed, the R&S VSE automatically adapts the trace data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

4.8.3 Trace statistics

Each trace represents an analysis of the data measured in one result range. As described in Chapter 4.8.2, "Analyzing several traces - trace mode", on page 33, statistical evaluations can be performed over several traces, that is, result ranges. Which ranges and how many are evaluated depends on the configuration settings.

Selected hop/chirp vs all hops/chirps

The Capture Count determines how many measurements are evaluated.

For each measurement, in turn, either the selected hop/chirp only (that is: one result range), or all detected hops/chirps (that is: possibly several result ranges) can be included in the statistical evaluation.

Thus, the overall number of averaging steps depends on the Capture Count and the statistical evaluation mode.

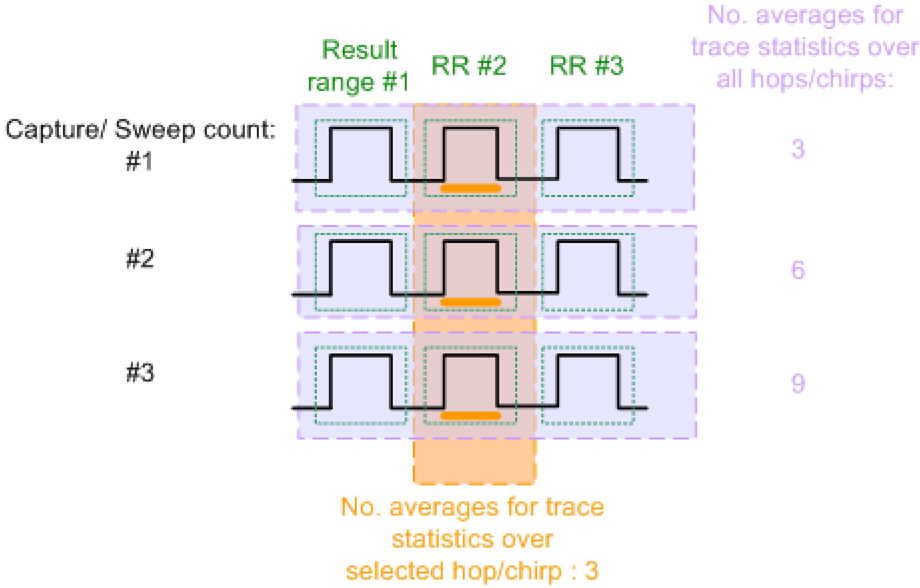
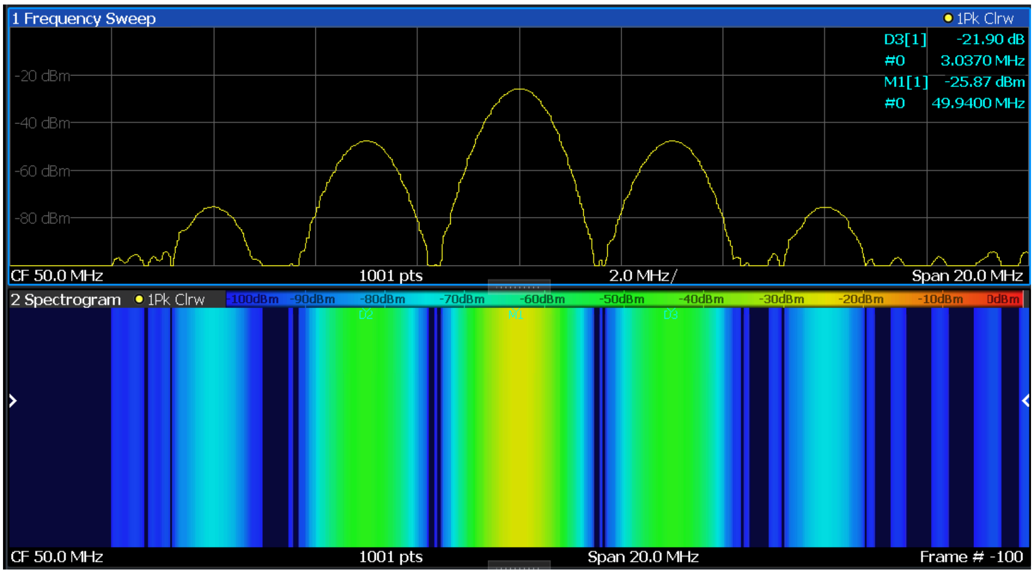


Figure 4-13: Trace statistics - number of averaging steps

4.9 Working with spectrograms

A spectrogram shows how the spectral density of a signal varies over time. The x-axis shows the frequency, the y-axis shows the time. A third dimension, the power level, is indicated by different colors. Thus you can see how the strength of the signal varies over time for different frequencies.

Example:



In this example, you see the spectrogram for the calibration signal of the R&S VSE, compared to the standard spectrum display. Since the signal does not change over time, the color of the frequency levels does not change over time, i.e. vertically. The legend above the spectrogram display describes the power levels the colors represent.

Result display

The spectrogram result can consist of the following elements:

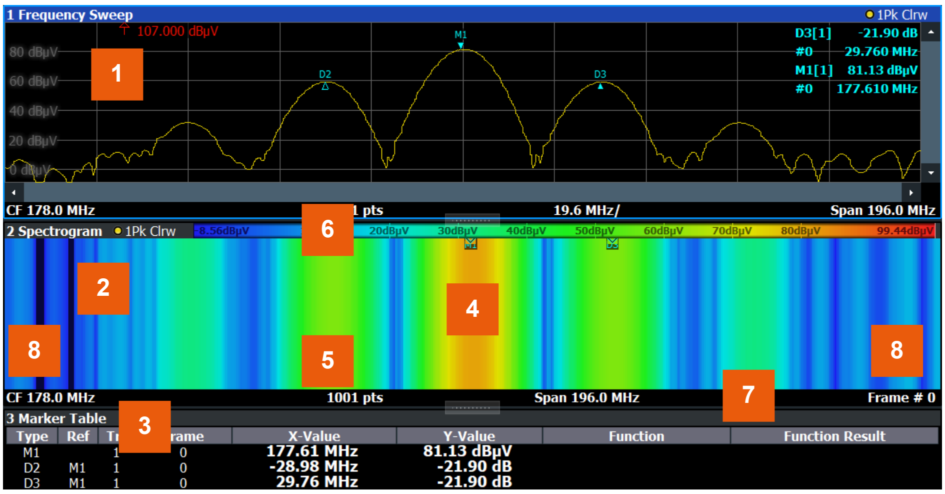


Figure 4-14: Screen layout of the spectrogram result display

1 = Spectrum result display
2 = Spectrogram result display
3 = Marker list
4 = Marker

5 = Delta marker
6 = Color map
7 = Timestamp / frame number
8 = Current frame indicator

Remote commands:

Activating and configuring spectrograms:

Storing results:

`MMEMory:STORe<n>:SPECtrogram` on page 452

4.9.1 Time frames

The time information in the spectrogram is displayed vertically, along the y-axis. Each line (or trace) of the y-axis represents one or more captured measurement and is called a **time frame** or simply "frame". As with standard spectrum traces, several measured values are combined in one measurement point using the selected detector.

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 measurement, 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 measurements unless they are cleared manually.

The frames for each individual sweep are separated by colored lines.

The scaling of the time axis (y-axis) is not configurable. However, you can enlarge the spectrogram display by maximizing the window using "Split/Maximize" .

Alternatively, use a spectrogram based on the analysis region and decrease the size of the region to zoom into the data of interest. (See also Chapter 4.6, "Zooming and shifting results", on page 28.)

Tracking absolute time - timestamps

Alternatively to the frame count, the absolute time (that is: a *timestamp*) at which a frame was captured can be displayed. While the measurement is running, the timestamp shows the system time. In single measurement mode or if the measurement is stopped, the timestamp shows the time and date at the end of the measurement.Thus, the individual frames can be identified by their timestamp or their frame count.

When active, the timestamp replaces the display of the frame number in the diagram footer (see Figure 4-14).

Displaying individual frames

The current frame number is indicated in the diagram footer, or alternatively a time-stamp, if activated. The current 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 spectrum diagram of a previous frame by changing the current frame number.

4.9.2 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 result display, the markers and their frequency and level values (1) are displayed as usual. Additionally, the frame number is displayed to indicate the position of the marker in time (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. If no frame number is specified, the marker is positioned on the currently selected frame. All markers are visible that are positioned on a visible frame. Special search functions are provided for spectrogram markers.

In the spectrum result display, only the markers positioned on the currently selected frame are visible. In "Continuous Sweep" mode, this means that 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.

4.9.3 Color maps

Spectrograms assign power levels to different colors to visualize them. The legend above the spectrogram display describes the power levels the colors represent.

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 R&S VSE.

The Color Scheme

For each color scheme, you can select the suitable color used to display the analysis region frame and sweep separator lines, see "Modifying Analysis Region and Sweep Separator Colors" on page 132.

- **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. However, 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.

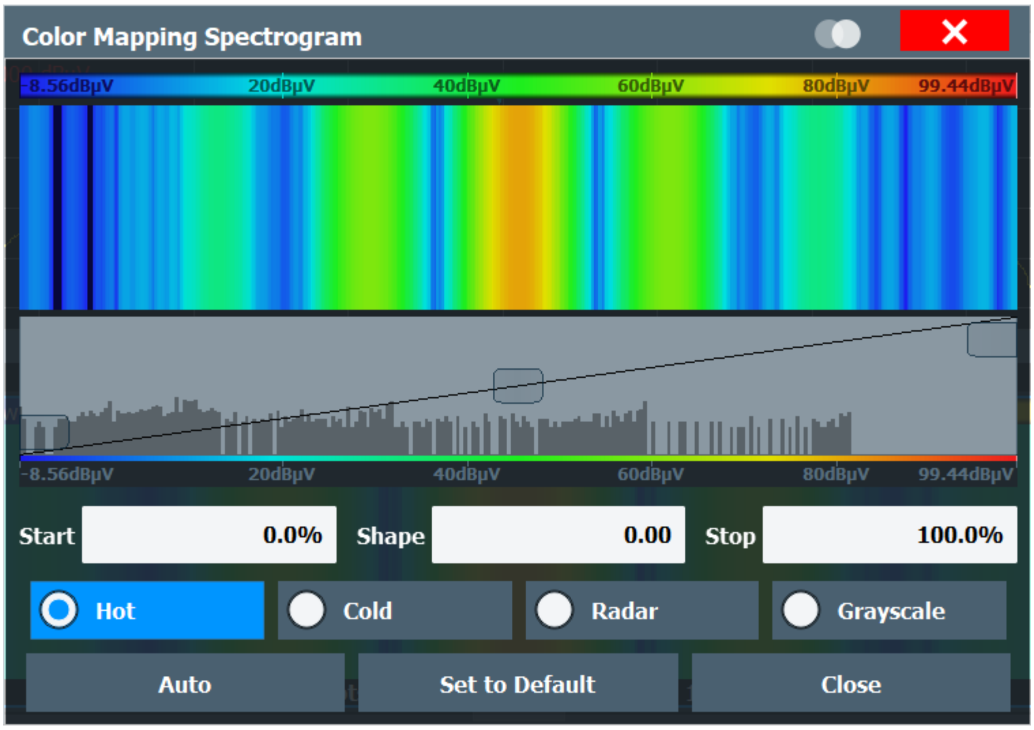


Figure 4-15: Spectrogram with (default) linear color curve shape = 0

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.

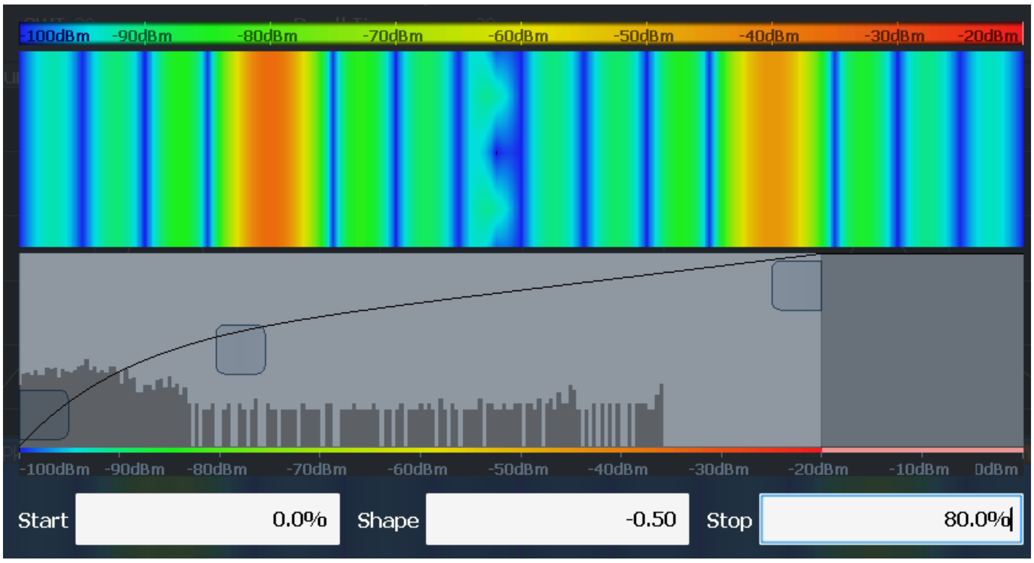


Figure 4-16: Spectrogram with non-linear color curve (shape = -0.5)

5 Measurement results

The data that was measured by the R&S VSE can be evaluated using various different methods.

Basis of evaluation

For some displays you can define whether the results are calculated for:

- the entire capture buffer
- the selected analysis region
- a selected individual chirp or hop (for options R&S VSE-K60C/-K60H)

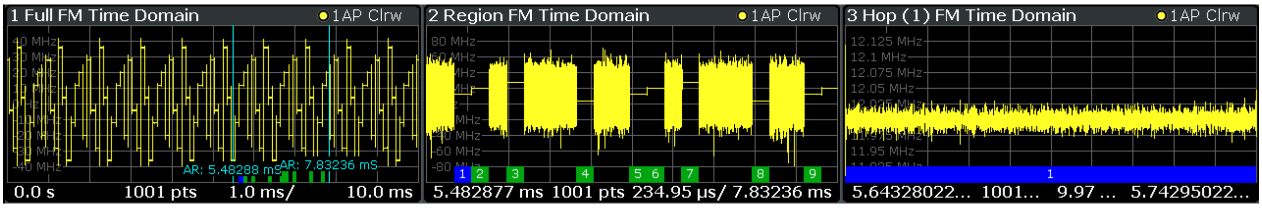


Figure 5-1: Example for different data sources for the same result display (FM Time Domain)

The data source for each result display is selected in the [MEAS] menu. It is indicated in the description of the individual result displays.

The analysis region is indicated by a colored frame in the Full Spectrogram display, and by vertical blue lines in result displays based on the full capture buffer. For details on the analysis region see Chapter 4.5, "Analysis region", on page 25.

For hop/chirp-based result displays, the current hop/chirp index as displayed in the result tables is indicated at the bottom of the hop/chirp bar.

Measurement range vs result range

The **measurement range** defines which part of a hop/chirp is used for calculation (for example for frequency estimation), whereas the **result range** determines which data is **displayed** on the screen in the form of AM, FM or PM vs. time traces.

Exporting Table Results to an ASCII File

Measurement result tables can be exported to an ASCII file for further evaluation in other (external) applications.

For step-by-step instructions on how to export a table, see Chapter 8.2, "How to export table data", on page 158.

5.1 Hop parameters

If the R&S VSE-K60H option is installed, various hop parameters can be determined during transient analysis.

The hop parameters to be measured are based primarily on the IEEE 181 Standard 181-2003. For detailed descriptions refer to the standard documentation ("IEEE Standard on Transitions, hops, and Related Waveforms", from the IEEE Instrumentation and Measurement (I&M) Society, 7 July 2003).

The following graphic illustrates the main hop parameters and characteristic values. (For a definition of the values used to determine the measured hop parameters see Chapter 4.3.1, "Frequency hopping", on page 21.)

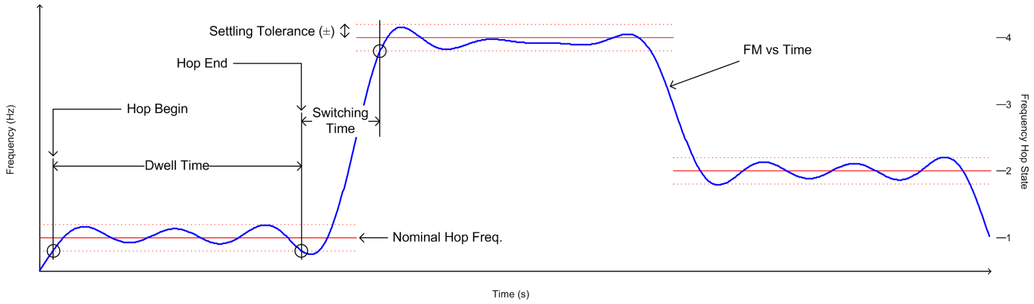


Figure 5-2: Definition of the main hop parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 7.1.2, "Table configuration", on page 118) or apply the required SCPI parameter to the remote command (see Chapter 11.5.5.2, "Hop results", on page 287 and Chapter 11.6.1, "Retrieving information on detected hops", on page 386).

Settling Parameters

Settling refers to the time it takes the FM or PM signal to remain within a specified tolerance around the nominal frequency.

Settling parameters are calculated from the FM or PM deviation considering the given FM or PM settling tolerance.

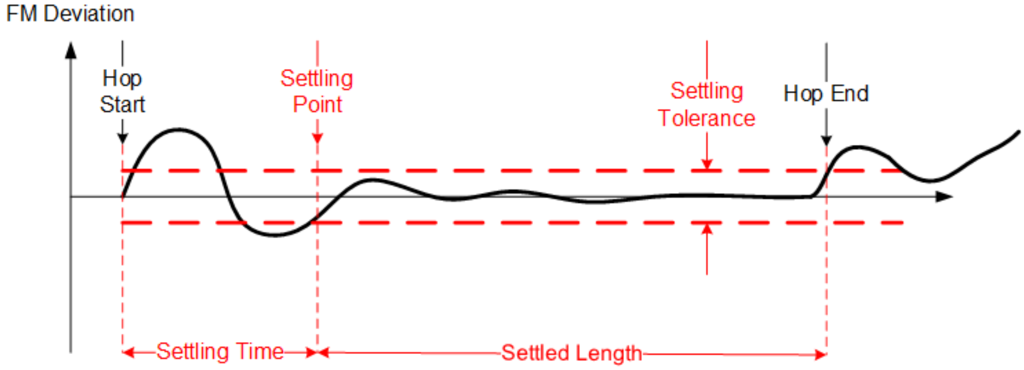


Figure 5-3: Settling parameters for hopped signals

Hop ID and Hop number

Each individual hop can be identified by a timestamp which corresponds to the absolute time the beginning of the hop was detected. In addition, each hop is provided with a consecutive number, which starts at 1 for each new measurement. This is useful to distinguish hops in a measurement quickly.

Remote command:

`[SENSe:]HOP:ID?` on page 401

`[SENSe:]HOP:NUMBer?` on page 407

State parameters
Hop state parameters

Remote command:
`CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe]` on page 295

State Index ← State parameters
The nominal frequency levels are numbered consecutively in the "Hop States" table (see Chapter 6.2.2, "Signal states", on page 83), starting at 0. The state of a detected hop is defined as the index of the corresponding nominal frequency.

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:STATe:INDex` on page 296
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 389
`[SENSe:]HOP:STATe[:INDex]?` on page 410

Timing parameters
Hop timing parameters

Remote command:
`CALCulate<n>:HOPDetection:TABLe:TIMing:ALL[:STATe]` on page 297

Hop Begin ← Timing parameters
The relative time (in ms) from the capture start at which the signal first enters the tolerance area of a nominal hop (within the analysis region). The tolerance area is defined by the settling tolerance above and below the defined nominal hop frequencies.

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:TIMing:BEGin` on page 297
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 389
`[SENSe:]HOP:TIMing:BEGin?` on page 412

Dwell Time ← Timing parameters
The duration of a hop from begin to end, that is, the time the signal remains in the tolerance area of a nominal hop frequency.

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:TIMing:DWELl` on page 297
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:TIMing:DWELl? on page 413

Switching Time ← Timing parameters
The time the signal requires to "hop" from one level to the next. It is defined as the time between a hop end and the following hop begin. The first switching time result can only be determined after the first hop has been detected.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:TIMing:SWITching on page 297
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:TIMing:SWITching? on page 414

Frequency parameters
Hop frequency parameters

Remote command:
CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe] on page 295

State Frequency (Nominal) ← Frequency parameters
Nominal frequency of the hop state as defined in "Hop States" table.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:STATe:STAFrequency on page 296
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:STATe:STAFrequency? on page 411

Average Frequency ← Frequency parameters
Average frequency measured within the frequency measurement range of the hop (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm on page 292
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FREQuency:FREQuency? on page 398

Hop State Deviation ← Frequency parameters
Deviation of the hop frequency from the nominal hop state frequency

$$fdev_{state} = \hat{f}_{avg} - f_{nom}$$

Where
- $\hat{f}_{avg}$: Average hop frequency estimate obtained from the frequency meas range of a hop
- f_{nom}: Nominal hop frequency corresponding to a detected or predefined hop state

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FREQuency:FMERror on page 292
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FREQuency:FMERror? on page 397

Relative Frequency (Hop-to-Hop) ← Frequency parameters
Relative difference in frequency between two hops.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FREQuency:RELFrequency on page 292
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FREQuency:RELFrequency? on page 400

Frequency Deviation (Peak) ← Frequency parameters
Maximum of Frequency Deviation vs Time trace

All hop frequency deviation table values are calculated from the time domain result:

$$fdev(k) = f_{meas}(k) - f_{ideal}(k)$$

for hop start ≤ k ≤ hop start + dwell time

where:

$f_{meas}(k)$: instantaneous frequency of the measured signal

$f_{ideal}(k)$: ideal frequency trajectory obtained from weighted linear regression of the instantaneous signal phase $\varphi_{meas}(k)$ within the frequency measurement range (see Chapter 6.7, "Hop / chirp measurement settings", on page 109)

The peak deviation is thus defined as:

$$fdev_{peak} = max(|fdev(k)|)$$

for k∈ {frequency meas range}

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FREQuency:MAXFm on page 292
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FREQuency:MAXFm? on page 399

Frequency Deviation (RMS) ← Frequency parameters
RMS of Frequency Deviation vs Time trace

$$fdev_{RMS} = \sqrt{\frac{1}{frequency\ meas\ range} \sum_k fdev^2(k)}$$

for k∈ {frequency meas range}

(fdev is defined in "Frequency Deviation (Peak)" on page 48)

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:FREQuency:RMSFm` on page 292
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 389
`[SENSe:]HOP:FREQuency:RMSFm?` on page 401

Frequency Deviation (Average) ← Frequency parameters
Average of Frequency Deviation vs Time trace

$$fdev_{avg} = \frac{1}{frequency\ meas\ range} \sum_k fdev(k)$$

for k∈ {frequency meas range}

(fdev is defined in "Frequency Deviation (Peak)" on page 48)

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm` on page 292
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 389
`[SENSe:]HOP:FREQuency:AVGFm?` on page 394

Phase parameters
Hop phase parameters

All hop phase deviation table values are calculated from the time domain result:

$$\varphi dev(k) = \varphi_{meas}(k) - \varphi_{ideal}(k)$$

for hop start ≤ k ≤ hop start + dwell time

where:

$\varphi_{meas}(k)$: instantaneous phase of the measured signal

$\varphi_{ideal}(k)$: ideal phase trajectory obtained from weighted linear regression of $\varphi_{meas}(k)$ within the frequency meas range

Note: Coherent phase deviation measurement.
For coherent hops, the phase deviation can also be calculated based on a common reference phase trajectory, instead of the ideal phase trajectory of a single hop. The common reference phase trajectory is calculated from the first detected hop assigned to a nominal frequency (hop state). This trajectory is then used for the phase deviation calculation of all subsequent hops of the same hop state. For each different hop state, a separate reference phase trajectory is calculated.

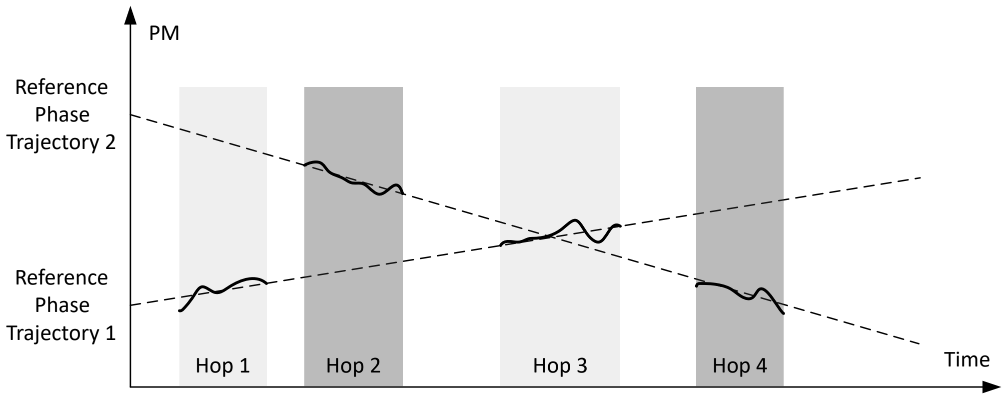


Figure 5-4: Coherent hops (1,3 and 2,4) with common reference phase trajectories

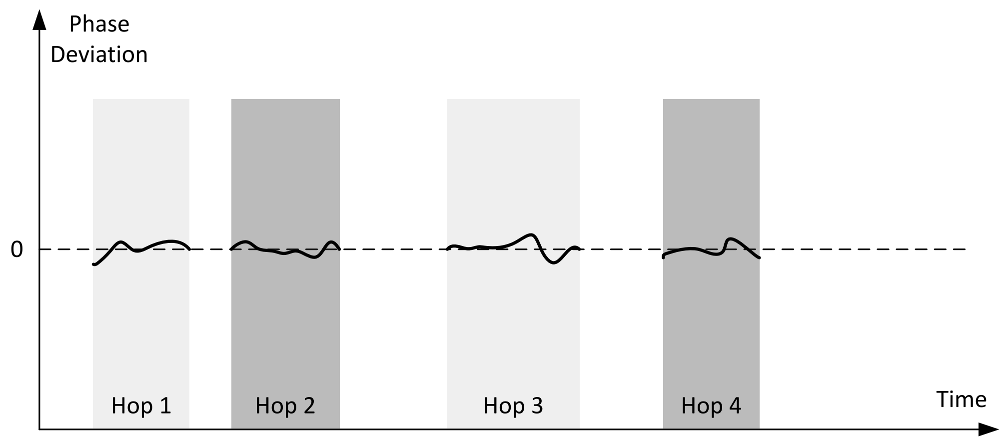


Figure 5-5: Results of a coherent phase deviation measurement

This function is only available for the R&S VSE-K60H option.

Coherent phase deviation measurement is enabled in the "Hop Measurement" settings, see "Coherent Phase Deviation Measurement" on page 110.

Remote command:
`CALCulate<n>:HOPDetection:TABLe:PHASe:ALL[:STATe]` on page 292

Phase Deviation (Peak) ← Phase parameters
Maximum of Phase Deviation vs Time trace

The deviation is calculated within the phase measurement range of the hop (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

$\varphi dev_{peak} = max(|\varphi dev(k)|)$

for k∊ {frequency meas range}

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:PHASe:MAXPm` on page 293
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PHASe:MAXPm? on page 402

Phase Deviation (RMS) ← Phase parameters
RMS of Phase Deviation vs Time trace

$$\varphi dev_{RMS} = \sqrt{\frac{1}{frequency\ meas\ range} \sum_{k} \varphi dev^{2}(k)}$$

for k∊ {frequency meas range}

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:PHASe:RMSPm on page 293
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PHASe:RMSPm? on page 403

Phase Deviation (Average) ← Phase parameters
Average of Phase Deviation vs Time trace

$$\varphi dev_{avg} = \frac{1}{frequency\ meas\ range} \sum_{k} \varphi dev(k)$$

for k∊ {frequency meas range}

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:PHASe:AVGPm on page 293
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PHASe:AVGPm? on page 402

Power parameters
Hop power parameters

Remote command:
CALCulate<n>:HOPDetection:TABLe:POWer:ALL[:STATe] on page 294

Minimum Power ← Power parameters
Minimum power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range settings (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:MINPower on page 295
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:POWer:MINPower? on page 409

Maximum Power ← Power parameters
Maximum power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range settings (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:MAXPower on page 295
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:POWer:MAXPower? on page 408

Average Power ← Power parameters
Average power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range settings (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:AVEPower on page 295
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:POWer:AVEPower? on page 407

Power Ripple ← Power parameters
The power ripple is defined as the ratio of maximum to minimum power inside the power measurement range of the detected hop (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:PWRRipple on page 295
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:POWer:MINPower? on page 409

FM settling parameters
FM settling parameters describe the hop when it has settled at the nominal frequency. For details see Figure 5-3.

Remote command:
CALCulate<n>:HOPDetection:TABLe:FMSettling:ALL[:STATe] on page 290

FM settling point ← FM settling parameters
The FM settling point is the point where FM deviation does not exceed the FM settling tolerance anymore. Since the signal can pass through the tolerance area several times while it settles, the actual settling point is determined starting at the center of the hop. From there, the signal is analyzed backwards until it first leaves the tolerance area. That is defined as the settling point. One FM settling point is calculated per detected hop. The FM settling point is provided in seconds (time stamp).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSPoint on page 291
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FMSettling:FMSPoint? on page 395

FM settling time ← FM settling parameters
The FM settling time refers to the time interval between the detected hop start and the FM settling point. The FM settling time is determined once per detected hop. The FM settling time is provided in seconds.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSTime on page 291
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FMSettling:FMSTime? on page 396

FM settled length ← FM settling parameters
The FM settled length refers to the duration the signal remains settled around a particular nominal frequency. It is determined as the time interval starting from the FM settling point until the point where the deviation exceeds the settling tolerance (hop end). The FM settled length is given in seconds.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSLength on page 291
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:FMSettling:FMSLength? on page 394

PM settling parameters
PM settling parameters describe when the hop has reached its nominal phase value. For details see Figure 5-3.

Remote command:
CALCulate<n>:HOPDetection:TABLe:PMSettling:ALL[:STATe] on page 293

PM settling point ← PM settling parameters
The PM settling point is the point where FM deviation does not exceed the PM settling tolerance anymore. Since the signal can pass through the tolerance area several times while it settles, the actual settling point is determined starting at the center of the hop. From there, the signal is analyzed backwards until it first leaves the tolerance area. That is defined as the settling point. One PM settling point is calculated per detected hop. The PM settling point is provided in seconds (time stamp).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSPoint on page 294
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PMSettling:PMSPoint? on page 405

PM settling time ← PM settling parameters
The PM settling time refers to the time interval between the detected hop start and the PM settling point. The PM settling time is determined once per detected hop. The PM settling time is provided in seconds.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSTime on page 294
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PMSettling:PMSTime? on page 406

PM settled length ← PM settling parameters
The PM settled length refers to the duration the signal remains settled around a particular nominal frequency. It is determined as the time interval starting from the PM settling point until the point where the deviation exceeds the settling tolerance (hop end). The PM settled length is given in seconds.

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSLength on page 294
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 389
[SENSe:]HOP:PMSettling:PMSLength? on page 404

5.2 Chirp parameters

If the additional option R&S VSE-K60C is installed, various chirp parameters can be determined during transient analysis.

The chirp parameters to be measured are very similar to the hop parameters; however, some values are based on the chirp rather than a frequency, so the resulting unit is Hz/µs.

The following graphic illustrates the main chirp parameters and characteristic values. (For a definition of the values used to determine the measured chirp parameters see Chapter 4.3.2, "Frequency chirping", on page 23.)

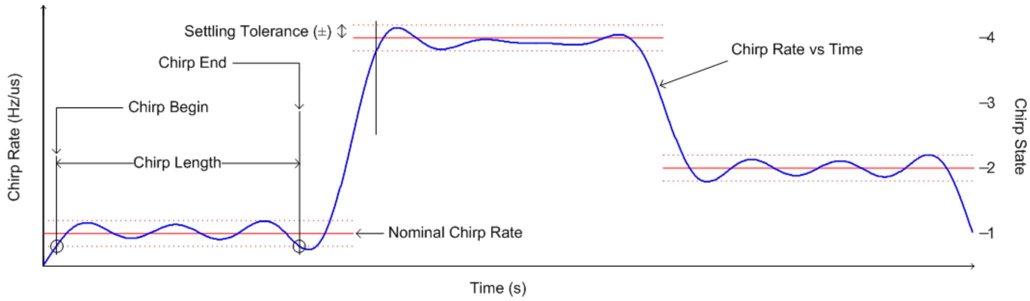


Figure 5-6: Definition of the main chirp parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 7.1.2, "Table configuration", on page 118) or apply the required SCPI parameter to the remote command (see Chapter 11.5.5.1, "Chirp results", on page 278 and Chapter 11.6.2, "Retrieving information on detected chirps", on page 414).

Settling Parameters

Settling refers to the time it takes the FM or PM signal to remain within a specified tolerance around the nominal frequency.

Settling parameters are calculated from the FM or PM deviation considering the given FM or PM settling tolerance.

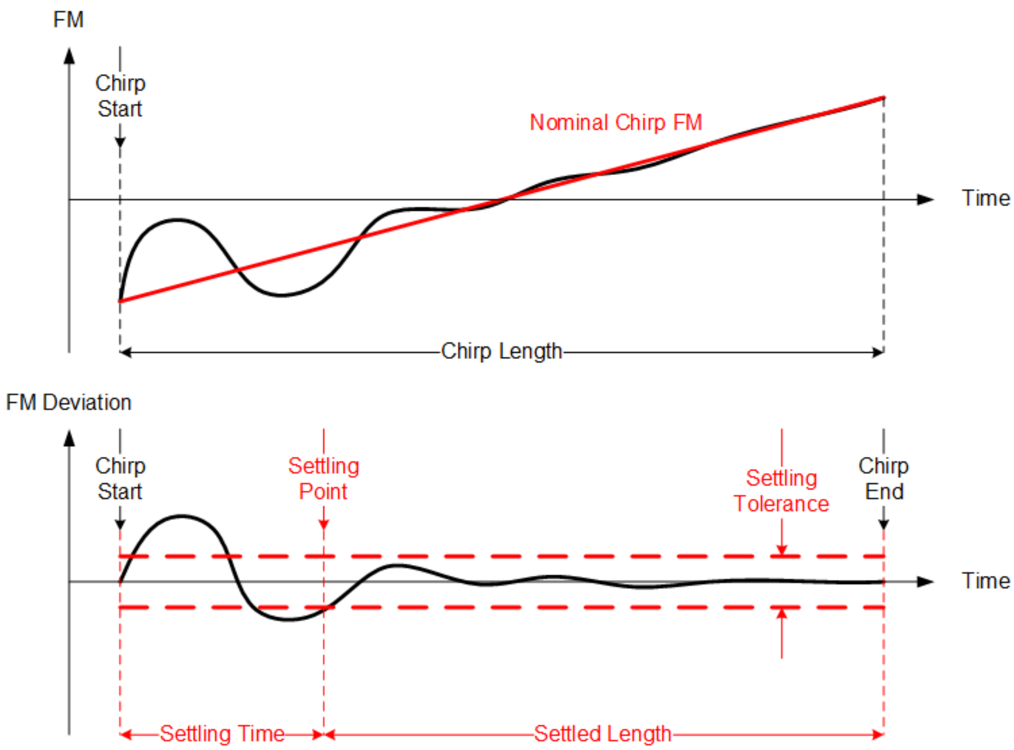


Figure 5-7: Settling parameters for chirped signals

Non-linearity parameters

Non-linearity parameters describe the deviation of the chirped signal frequency in relation to the nominal frequency. The integrated non-linearity defines the deviation in reference to the chirp bandwidth.

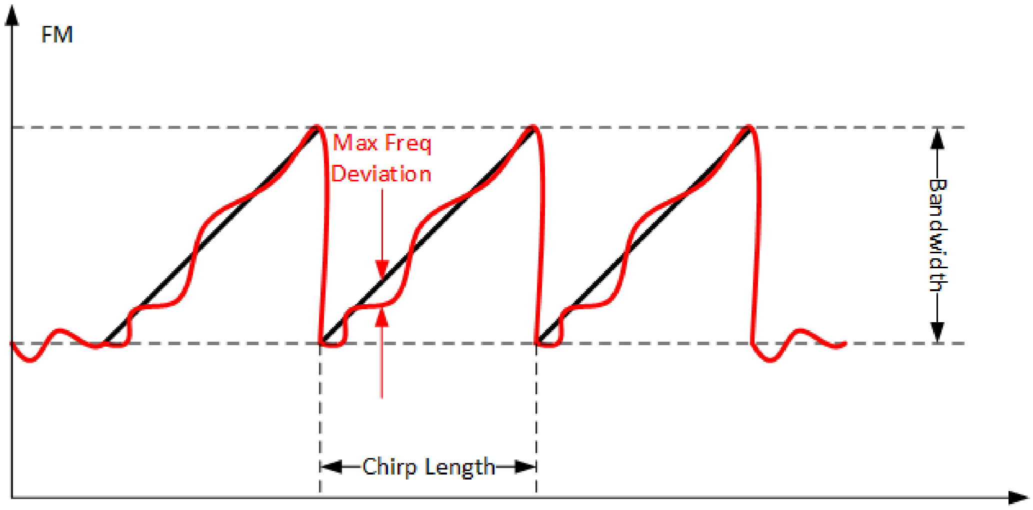


Figure 5-8: Non-linearity parameters for chirped signals

Chirp ID and Chirp number

Each individual chirp can be identified by a timestamp which corresponds to the absolute time the beginning of the chirp was detected. In addition, each chirp is provided with a consecutive number, which starts at 1 for each new measurement. This is useful to distinguish chirps in a measurement quickly.

Remote commands:

`[SENSe:]CHIRp:ID?` on page 434

`[SENSe:]CHIRp:NUMBer?` on page 434

State parameters
Chirp state parameters

Remote command:
`CALCulate<n>:CHRDetection:TABLe:STATe:ALL[:STATe]` on page 286

State Index ← State parameters
The nominal chirps are numbered consecutively in the "Chirp States" table (see Chapter 6.2.2, "Signal states", on page 83), starting at 0. The state of a detected chirp is defined as the index of the corresponding nominal chirp frequency.

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:STATe:INDex` on page 286
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:STATe?` on page 444

Timing parameters
Chirp timing parameters

Remote command:
`CALCulate<n>:CHRDetection:TABLe:TIMing:ALL[:STATe]` on page 287

Chirp Begin ← Timing parameters
Time offset from the analysis region start at which the signal first enters the tolerance area of a nominal chirp. The tolerance area is defined by the settling tolerance above and below the defined nominal chirps.

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:TIMing:BEGin on page 287
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:TIMing:BEGin? on page 445

Chirp Length ← Timing parameters
The duration of a chirp from begin to end, that is, the time the signal remains in the tolerance area of a nominal chirp.

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:TIMing:LENGth on page 287
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:TIMing:LENGth? on page 446

Chirp Rate ← Timing parameters
Derivative of the FM vs time trace within the frequency measurement range (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:TIMing:RATE on page 287
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:TIMing:RATE? on page 446

Switching Time ← Timing parameters
Chirp switching time parameters.

Remote command:
[SENSe:]CHIRp:TIMing:SWITching? on page 447

Frequency parameters
Chirp frequency parameters.

Remote command:
CALCulate<n>:CHRDetection:TABLe:FREQuency:ALL[:STATe] on page 282

Chirp State Deviation ← Frequency parameters
Deviation of the detected chirp rate from the nominal chirp state (in kHz/us).

$$df\,dev_{state} = \widehat{\mathbf{df}_{\mathbf{avg}}} - \mathbf{df}_{nom}$$

- $\widehat{df_{avg}}$: Average chirp rate estimate obtained from the frequency meas range of a chirp
- df_{nom}: Nominal chirp rate corresponding to detected chirp state

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:CHERror on page 282
Results:

CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:CHERror? on page 428

Average Frequency ← Frequency parameters
Average frequency measured within the frequency measurement range of the chirp (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:FREQuency on page 282
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:FREQuency? on page 429

Frequency Deviation (Peak) ← Frequency parameters
Maximum of Frequency Deviation vs Time trace.

All chirp frequency deviation table values are calculated from the time domain result:

$$fdev(k) = f_{meas}(k) - f_{ideal}(k)$$

For chirp start ≤ k ≤ chirp start + chirp length

Where:

$f_{meas}(k)$: instantaneous frequency of the measured signal

$f_{ideal}(k)$: ideal frequency trajectory obtained from weighted quadratic regression of the instantaneous signal phase φ_{meas} (k) within the frequency measurement range (see Chapter 6.7, "Hop / chirp measurement settings", on page 109)

The peak deviation is thus defined as:

$$fdev_{peak} = max(|fdev(k)|)$$

for k∊ {frequency meas range}

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXFm on page 282
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:MAXFm? on page 430

Frequency Deviation (RMS) ← Frequency parameters

$$fdev_{RMS} = \sqrt{\frac{1}{frequency\ meas\ range} \sum_k fdev^2(k)}$$

for k∊ {frequency meas range}

(fdev is defined in "Frequency Deviation (Peak)" on page 59)

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSFm on page 282
Results:

`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:FREQuency:RMSFm?` on page 431

Frequency Deviation (Average) ← Frequency parameters

$$fdev_{avg} = \frac{1}{frequency\ meas\ range} \sum_k fdev(k)$$

for k∈ {frequency meas range}

(fdev is defined in "Frequency Deviation (Peak)" on page 59)

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGFm` on page 282
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:FREQuency:AVGFm?` on page 423

Frequency Overshoot ← Frequency parameters
Chirp frequency overshoot parameters.

Remote command:
`[SENSe:]CHIRp:FREQuency:OVERshoot?` on page 433

Frequency Undershoot ← Frequency parameters
Chirp frequency undershoot parameters.

Remote command:
`[SENSe:]CHIRp:FREQuency:UNDershoot?` on page 433

Phase parameters
Chirp phase parameters

All chirp phase deviation table values are calculated from the time domain result:

$$\varphi dev(k) = \varphi_{meas}(k) - \varphi_{ideal}(k)$$

for chirp start ≤ k ≤ chirp start + chirp length

where:

$\varphi_{meas}(k)$: instantaneous phase of the measured signal

$\varphi_{ideal}(k)$: ideal phase trajectory obtained from weighted linear regression of $\varphi_{meas}(k)$ within the frequency meas range

Remote command:
`CALCulate<n>:CHRDetection:TABLe:PHASe:ALL[:STATe]` on page 283

Phase Deviation (Peak) ← Phase parameters
Maximum of Phase Deviation vs Time trace.

The deviation is calculated within the phase measurement range of the hop (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

$$\varphi dev_{peak} = max(|\varphi dev(k)|)$$

for k∈ {frequency meas range}

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PHASe:MAXPm on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PHASe:MAXPm? on page 435

Phase Deviation (RMS) ← Phase parameters
RMS of Phase Deviation vs Time trace

$$\varphi dev_{RMS} = \sqrt{\frac{1}{frequency\ meas\ range} \sum_k \varphi dev^2(k)}$$

for k∈ {frequency meas range}

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PHASe:RMSPm on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PHASe:RMSPm? on page 436

Phase Deviation (Average) ← Phase parameters
Average of Phase Deviation vs Time trace

$$\varphi dev_{avg} = \frac{1}{frequency\ meas\ range} \sum_k \varphi dev(k)$$

for k∈ {frequency meas range}

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PHASe:AVGPm on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PHASe:AVGPm? on page 434

Phase Overshoot ← Phase parameters
Chirp phase overshoot parameters.

Remote command:
[SENSe:]CHIRp:PHASe:OVERshoot? on page 437

Phase Undershoot ← Phase parameters
Chirp phase undershoot parameters.

Remote command:
[SENSe:]CHIRp:PHASe:UNDershoot? on page 437

Power parameters
Chirp power parameters

Remote command:
CALCulate<n>:CHRDetection:TABLe:POWer:ALL[:STATe] on page 285

Minimum Power ← Power parameters
Minimum power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range settings (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:MINPower` on page 286
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:POWer:MINPower?` on page 443

Maximum Power ← Power parameters
Maximum power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range settings (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:MAXPower` on page 285
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:POWer:MAXPower?` on page 442

Average Power ← Power parameters
Average power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:AVEPower` on page 285
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:POWer:AVEPower?` on page 441

Power Ripple ← Power parameters
The power ripple is defined as the ratio of maximum to minimum power inside the power measurement range of the detected hop (see Chapter 6.7, "Hop / chirp measurement settings", on page 109).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:PWRRipple` on page 286
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:POWer:PWRRipple?` on page 443

Frequency non-linearity parameters
Non-linearity parameters describe the deviation of the chirped signal frequency. For details see Figure 5-8.

Bandwidth ← Frequency non-linearity parameters
The bandwidth describes the frequency range occupied by the chirp.

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:BWIDth on page 282
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:BWIDth? on page 427

Frequency INL (Peak) ← Frequency non-linearity parameters
The maximum frequency integrated non-linearity (INL) indicates the maximum deviation of the measured chirp from the nominal chirp, in relation to the chirp bandwidth.

$$fINL_{max} = \frac{fdev_{max}}{BW}$$

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXNonlinear on page 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:MAXNonlinear? on page 431

Frequency INL (RMS) ← Frequency non-linearity parameters
The RMS of the frequency integrated non-linearity (INL) indicates the RMS deviation of the measured chirp from the nominal chirp, in relation to the chirp bandwidth.

$$fINL_{rms} = \frac{fdev_{rms}}{BW}$$

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSNonlinear on page 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:RMSNonlinear? on page 432

Frequency INL (Average) ← Frequency non-linearity parameters
The average integrated non-linearity (INL) indicates the average deviation of the measured chirp from the nominal chirp, in relation to the chirp bandwidth.

$$fINL_{avg} = \frac{fdev_{avg}}{BW}$$

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGNonlinear on page 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:FREQuency:AVGNonlinear? on page 427

FM settling parameters
FM settling parameters describe the chirp when it has reached its nominal frequency value. For details see Figure 5-7.

Remote command:
`CALCulate<n>:CHRDetection:TABLe:FMSettling:ALL[:STATe]` on page 280

FM settling point ← FM settling parameters
The FM settling point is the point where FM deviation does not exceed the FM settling tolerance anymore. Since the signal can pass through the tolerance area several times while it settles, the actual settling point is determined starting at the center of the chirp. From there, the signal is analyzed backwards until it first leaves the tolerance area. That is defined as the settling point. One FM settling point is calculated per detected chirp. The FM settling point is provided in seconds (time stamp).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSPoint` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:FMSettling:FMSPoint?` on page 424

FM settling time ← FM settling parameters
The FM settling time refers to the time interval between the detected chirp start and the FM settling point. The FM settling time is determined once per detected chirp. The FM settling time is provided in seconds.

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSTime` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:FMSettling:FMSTime?` on page 425

FM settled length ← FM settling parameters
The FM settled length refers to the duration the signal remains settled around a particular nominal frequency. It is determined as the time interval starting from the FM settling point until the point where the deviation exceeds the settling tolerance (chirp end). The FM settled length is given in seconds.

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSLength` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 418
`[SENSe:]CHIRp:FMSettling:FMSLength?` on page 423

PM settling parameters
PM settling parameters describe the chirp when it has reached its nominal phase value. For details see Figure 5-7.

Remote command:
`CALCulate<n>:CHRDetection:TABLe:PMSettling:ALL[:STATe]` on page 284

PM settling point ← PM settling parameters
The PM settling point is the point where FM deviation does not exceed the PM settling tolerance anymore. Since the signal can pass through the tolerance area several times while it settles, the actual settling point is determined starting at the center of the chirp. From there, the signal is analyzed backwards until it first leaves the tolerance area. That is defined as the settling point. One PM settling point is calculated per detected chirp. The PM settling point is provided in seconds (time stamp).

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSPoint on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PMSettling:PMSPoint? on page 439

PM settling time ← PM settling parameters
The PM settling time refers to the time interval between the detected chirp start and the PM settling point. The PM settling time is determined once per detected chirp. The PM settling time is provided in seconds.

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSTime on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PMSettling:PMSTime? on page 440

PM settled length ← PM settling parameters
The PM settled length refers to the duration the signal remains settled around a particular nominal frequency. It is determined as the time interval starting from the PM settling point until the point where the deviation exceeds the settling tolerance (chirp end). The PM settled length is given in seconds.

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSLength on page 284
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 418
[SENSe:]CHIRp:PMSettling:PMSLength? on page 438

5.3 Evaluation methods for transient analysis

Access: "Overview" > "Display Config"

The data that was measured by the R&S VSE can be evaluated using various different methods, depending on the measurement task.

Table 5-1: Available evaluation methods and evaluation basis

Measurement task	Evaluation	Evaluation basis
Frequency domain analysis	RF Spectrum	Full capture buffer Analysis region Individual hop / chirp[1)]
Time domain analysis	RF Power Time Domain PM Time Domain FM Time Domain PM Time Domain (Wrapped) Chirp Rate Time Domain I/Q Time Domain	Full capture buffer Analysis region Individual hop / chirp[1)]
Joint time / frequency analysis	Spectrogram	Full capture buffer Analysis region Individual hop / chirp [1)]
Demodulation quality analysis	Frequency Deviation Time Domain[1)] Phase Deviation Time Domain[1)]	Analysis region Individual hop / chirp
Signal characteristics	Hop/Chirp Results Table[1)] Hop/Chirp Statistics Table[1)] Parameter Distribution Parameter Trend	Analysis region
Online I/Q data transfer analysis	RF Spectrum Spectrogram RF Power Time Domain PM Time Domain FM Time Domain PM Time Domain (Wrapped)	Full capture buffer
Phase noise measurements [2)]	Phase Noise Frequency Deviation Spectrogram Frequency Deviation Spectrum Phase Deviation Spectrum Phase Deviation Spectrogram	Individual hop / chirp
[1)] requires additional option R&S VSE-K60C/-K60H [2)] requires additional option R&S VSE-K60P		

By default, the Transient Analysis results are displayed in the following windows:

- RF Spectrum (full capture buffer)
- FM Time Domain (analysis region)
- Spectrogram (full capture buffer)
- RF Power Time Domain (analysis region)

If the additional options R&S VSE-K60C/-K60H are installed, the default result displays are:

- RF Spectrum (full capture buffer)
- FM Time Domain (analysis region)
- Spectrogram (full capture buffer)
- Frequency Deviation Time Domain (hop/chirp)
- Hop/Chirp Result Table (analysis region)

The following evaluation methods are available for Transient Analysis:

RF Spectrum

The RF Spectrum diagram displays the measured power levels for the detected hops/ chirps. 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 "Select Frame" on page 131) or the marker position in the spectrogram (see "Frame (for Spectrograms only)" on page 140).

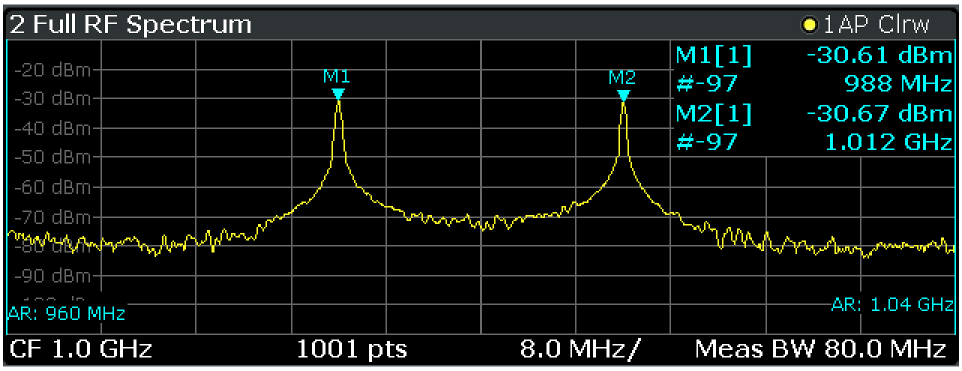


Figure 5-9: RF Spectrum result display

Thus, the RF Spectrum is useful to analyze the input signal measured at a specific time in more detail.

Detected hops/chirps are indicated by green bars along the x-axis in graphical result displays. The selected hop/chirp (see "Select Hop / Select Chirp" on page 125) is indicated by a blue bar. The hop/chirp index as displayed in the Hop/Chirp Results Table is indicated at the bottom of each bar.

In the RF Spectrum for the full capture buffer, the analysis region (AR) is indicated by vertical blue lines.

Remote command:
`LAY:ADD? '1',RIGH, RFSP`, see `LAYout:ADD[:WINDow]?` on page 266

Spectrogram

The spectrogram is a way of displaying multiple consecutive spectra over time. The power, or more exactly the power level, which is usually displayed over frequency, is displayed over frequency and time. Thus, joint analysis in the time and frequency domain is possible.

Graphically, time and frequency represent the vertical and horizontal axes of the diagram. Each coordinate (frequency f, time t) of the diagram is filled with a color representing the level for the respective frequency and time.

At the beginning of a measurement, the diagram is empty. As the measurement advances, the graph is filled line by line from top to bottom. 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. However, older frames that have disappeared from the visible display area can be returned to view by selecting a particular frame or timestamp.

The frames for each individual sweep are separated by colored lines.

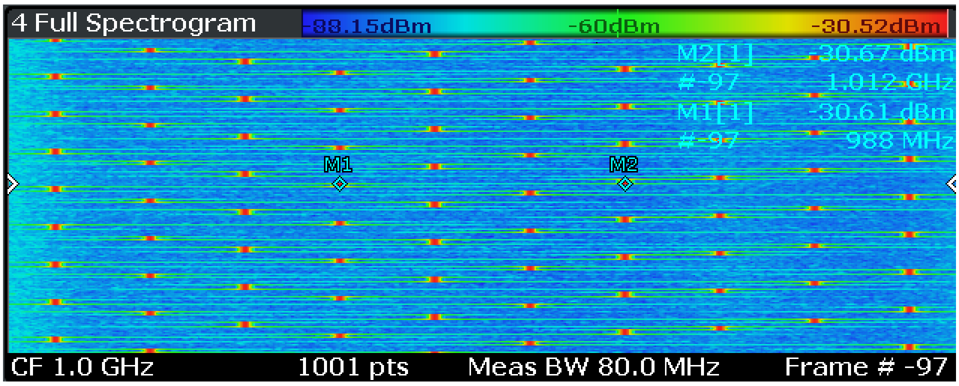


Figure 5-10: Spectrogram of a frequency hopper

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.

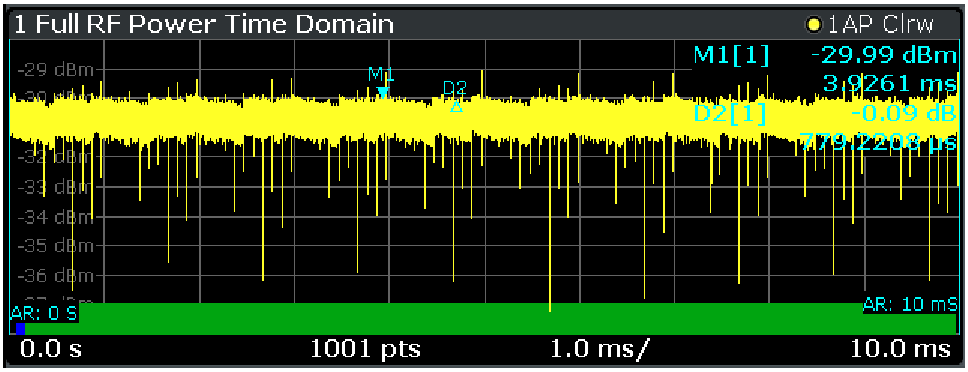
For more information on working with spectrograms see Chapter 4.9, "Working with spectrograms", on page 35.

Remote command:

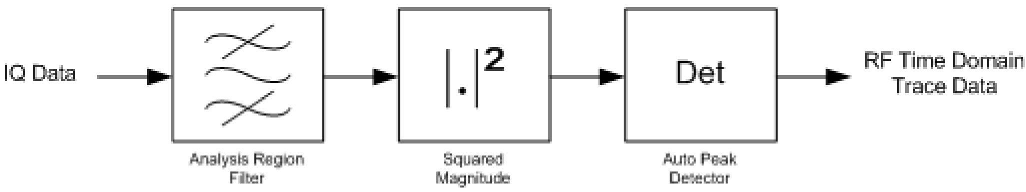
`LAY:ADD? '1',RIGH, SGR`, see `LAYout:ADD[:WINDow]?` on page 266

RF Power Time Domain

Displays the RF power (in dBm) versus time.



The RF Power Time Domain trace is determined as follows:

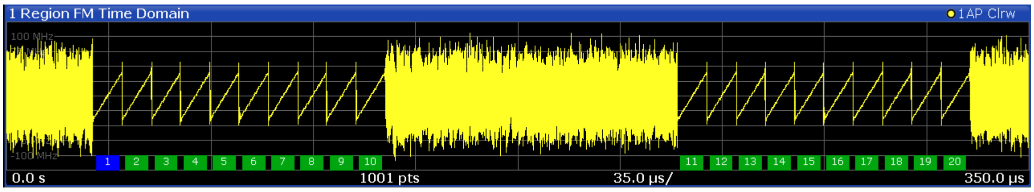


Remote command:

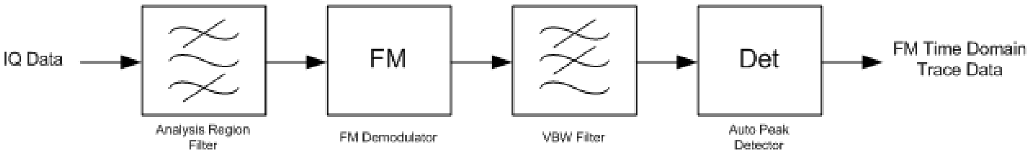
`LAY:ADD? '1',RIGH,RFPT`, see `LAYout:ADD[:WINDow]?` on page 266)

FM Time Domain

Displays the frequency of the demodulated FM signal versus time.



The FM time domain trace is determined as follows:

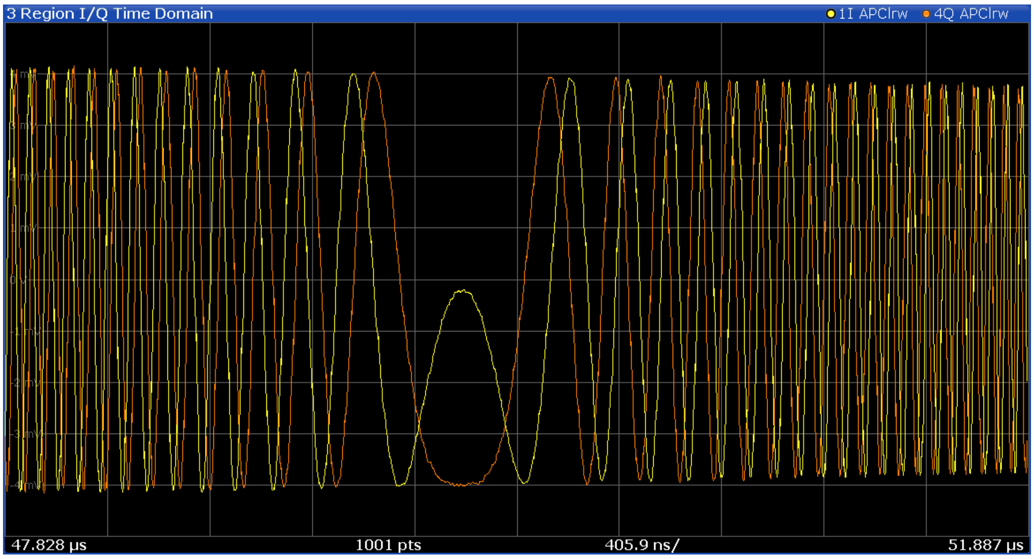


Remote command:

`LAY:ADD? '1',RIGH,FMT`, see `LAYout:ADD[:WINDow]?` on page 266)

I/Q Time Domain

Displays the magnitude of the I and Q components of the demodulated FM signal versus time as separate traces in one diagram.



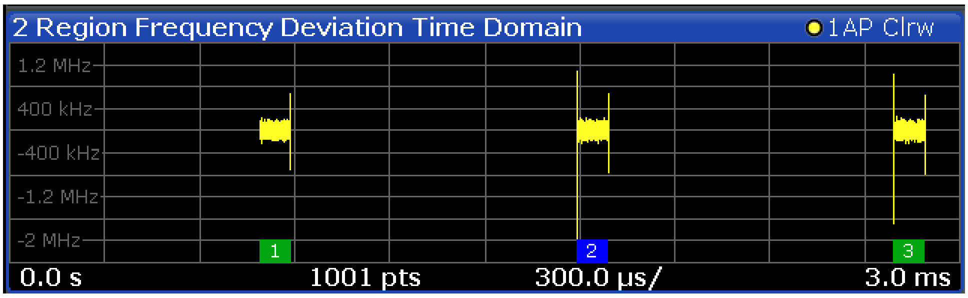
Remote command:

`LAY:ADD:WIND '2',RIGH,IQT` see `LAYout:ADD[:WINDow]?` on page 266

Frequency Deviation Time Domain

Displays the frequency error of the demodulated FM signal versus time.

This display requires additional option R&S VSE-K60C/-K60H.



Note: The frequency error is calculated for complete hops/chirps only. Thus, where no (complete) hops/chirps are available, gaps will occur in the error display.

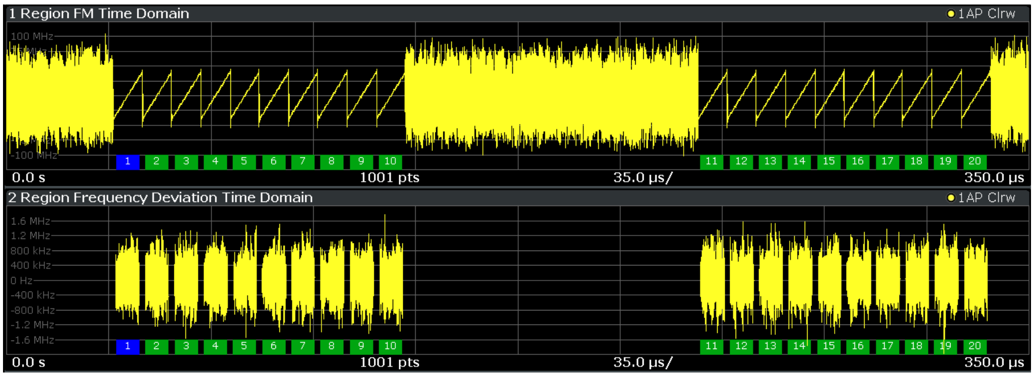


Figure 5-11: Frequency Deviation Time Domain display with gaps where no (complete) chirps are detected

The Frequency Deviation for the analysis region in the hop model is calculated as follows:

$$FMerr(k) = FM(k) - \hat{f}_{avg}$$

hop start ≤ k ≤ hop start + dwell time

Where

- $\hat{f}_{avg}$: Average frequency estimate obtained from the frequency meas range of a hop

In the chirp model it is calculated as:

$$FMerr(k) = FM(k) - d\hat{f}_{avg}(k - \frac{chirp\ length}{2}) - \hat{f}_{avg}$$

chirp start ≤ k ≤ chirp start + chirp length

Where

- $\widehat{df}_{avg}$: Average chirp rate estimate obtained from the frequency meas range of a chirp
- $\hat{f}_{avg}$: Average frequency estimate w.r.t. the chirp center obtained from the frequency meas range of a chirp

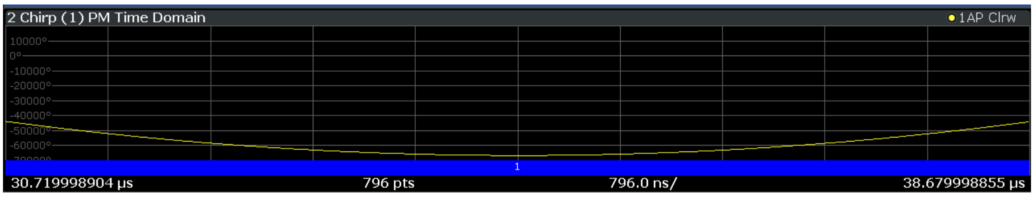
For an individual hop/chirp, *k ∈ Result Range*

Remote command:

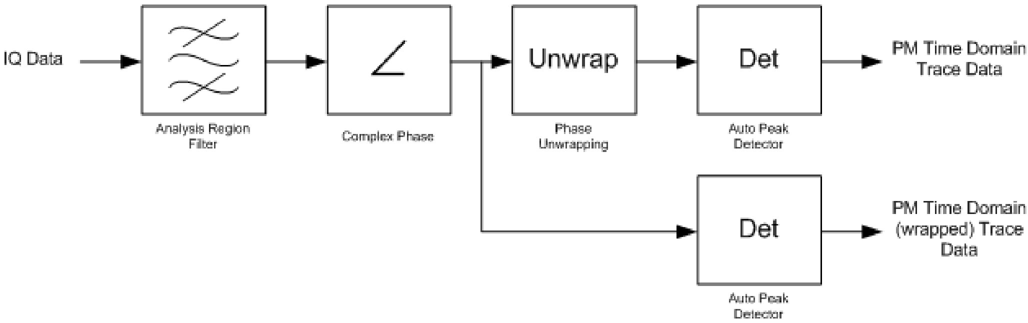
`LAY:ADD? '1',RIGH,FDEV`, see `LAYout:ADD[:WINDow]?` on page 266

PM Time Domain

Displays the phase deviations of the demodulated PM signal (in rad or °) versus time.



The PM time domain trace is determined as follows:

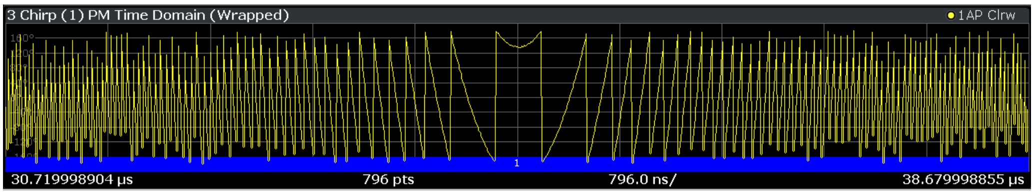


Remote command:

LAY:ADD? '1',RIGH,PMT, see LAYout:ADD[:WINDow]? on page 266)

PM Time Domain (Wrapped)

Displays the phase deviations of the *wrapped* demodulated PM signal (in rad or °) versus time.



Remote command:

LAY:ADD? '1',RIGH,PMWR, see LAYout:ADD[:WINDow]? on page 266

Phase Deviation Time Domain

Displays the phase error of the demodulated PM signal (in rad or °) versus time.

This display requires additional option R&S VSE-K60C/-K60H.

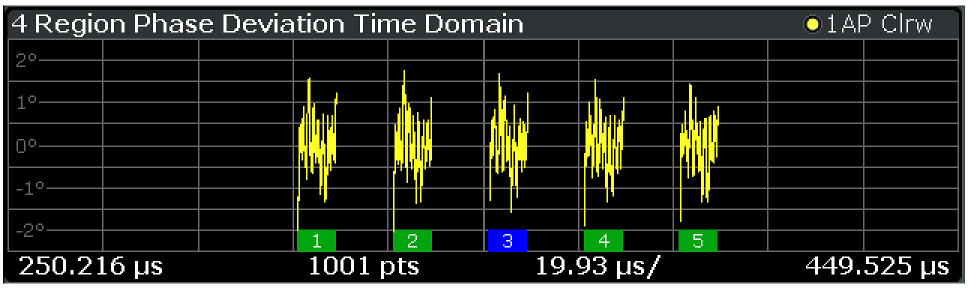


Figure 5-12: Phase deviation per chirp over time

Note: Similar to frequency deviation, the phase error is calculated for complete hops/chirps only. Thus, where no (complete) hops/chirps are available, gaps will occur in the error display.

The phase deviation **in the hop model** is calculated as follows:

With hop state deviation compensation:

$$\varphi dev(t) = PM(t) - \widehat{f_{avg}}t - \widehat{\varphi 0}$$

Without hop state deviation compensation:

$$\varphi dev(t) = PM(t) - f_{nom}t - \widehat{\varphi 0}$$

Where:
- $\widehat{f_{avg}}$: Average frequency estimate obtained from the frequency meas range of a hop
- f_{nom}: Nominal hop frequency corresponding to detected hop state
- $\widehat{\varphi 0}$: Phase offset estimate obtained from the frequency meas range of a hop
- *t* ∊ *Result range* (for individual hop)
  hop start ≤ *t* ≤ *hop start* + *dwell time* (for analysis range)

In the chirp model it is calculated as:

With chirp state deviation compensation:

$$\varphi dev(t) = PM(t) - \widehat{df_{avg}}(t - \frac{chirp\ length}{2})^2 - \widehat{f_{avg}}(t - \frac{chirp\ length}{2}) - \widehat{\varphi 0}$$

Without chirp state deviation compensation:

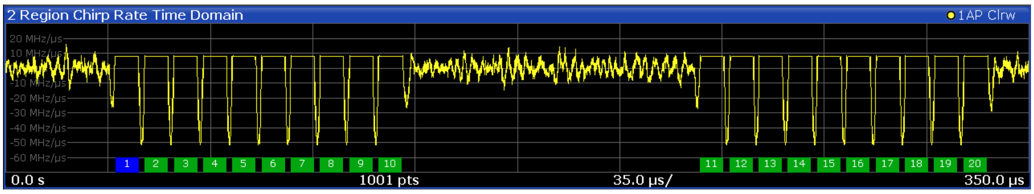
$$\varphi dev(t) = PM(t) - df_{nom}(t - \frac{chirp\ length}{2})^2 - \widehat{f_{avg}}(t - \frac{chirp\ length}{2}) - \widehat{\varphi 0}$$

Where:
- $\widehat{df_{avg}}$: Average chirp rate estimate obtained from the frequency meas range of a chirp
- df_{nom}: Nominal chirp rate corresponding to detected chirp state
- $\widehat{f_{avg}}$: Average frequency estimate based on the chirp center obtained from the frequency meas range of a chirp
- $\widehat{\varphi 0}$: Phase offset estimate obtained from the frequency meas range of a chirp
- *t* ∊ *Result range* (for individual chirp)
  chirp start ≤ *t* ≤ *chirp start* + *chirp length* (for analysis range)

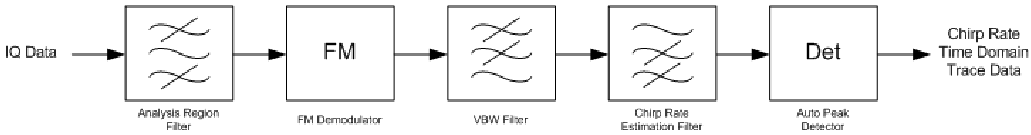
Remote command:
`LAY:ADD? '1',RIGH,PDEV`, see `LAYout:ADD[:WINDow]?` on page 266

Chirp Rate Time Domain

Displays the chirp rate versus time. This display requires additional option R&S VSE-K60C/-K60H.



The chirp rate time domain trace is determined as follows:



Remote command:
`LAY:ADD? '1',RIGH,CRT`, see `LAYout:ADD[:WINDow]?` on page 266

Hop/Chirp Results Table

Displays the automatically detected hop/chirp parameters in a table of results. This display requires additional option R&S VSE-K60C/-K60H.

Which parameters are displayed depends on the "Result Configuration" (see Chapter 7.1.2, "Table configuration", on page 118). The currently selected hop/chirp is highlighted blue. The remaining hops/chirps contained in the current capture buffer are highlighted green.

5 Hop Results

ID	Hop No.	State Index	Hop Begin (ms)	Dwell Time (ms)	Switching Time (ms)	State Frequency (kHz)	Avg Frequency (kHz)	Hop State Deviation (kHz)	Relative Frequency (kHz)	Freq Dev Peak (kHz)
1	1	0	5.438	0.100	0.100	-4000.033	-4000.000	0.033	...	93.877
2	2	1	5.738	0.100	0.200	4000.133	3999.999	-0.134	8000.000	91.121
3	3	3	5.938	0.100	0.100	-11999.915	-12000.000	-0.085	-15999.999	104.041
4	4	2	6.038	0.100	0.000	11999.897	12000.000	0.104	24000.000	89.876
5	5	4	6.138	0.100	0.000	19999.827	20000.000	0.173	8000.000	129.434
6	6	5	6.238	0.100	0.000	-20000.024	-20000.000	0.023	-40000.001	117.177

Figure 5-13: Hop Results Table

For details on the individual parameters see Chapter 5.1, "Hop parameters", on page 44 or Chapter 5.2, "Chirp parameters", on page 54.

Remote command:
`LAY:ADD:WIND '2',RIGH,RTAB` see `LAYout:ADD[:WINDow]?` on page 266
Results:
`CALCulate<n>:CHRDetection:TABLe:TOTal?` on page 422 / `CALCulate<n>:CHRDetection:TOTal?` on page 422
`CALCulate<n>:HOPDetection:TABLe:TOTal?` on page 393 / `CALCulate<n>:HOPDetection:TOTal?` on page 393

Hop/Chirp Statistics Table

Displays statistical values (minimum, maximum, average, standard deviation) for the measured hop/chirp parameters in a table of results. This display requires additional option R&S VSE-K60C/-K60H.

Both the current capture buffer data and the cumulated captured data from a series of measurements are evaluated. The statistics computed only from hops/chirps within the current capture buffer are highlighted green. For reference, the measured parameters from the Select Hop / Select Chirp are also shown, highlighted blue. The displayed parameters are the same as in the Hop/Chirp Results Table and can be configured in the "Result Configuration" (see Chapter 7.1.2, "Table configuration", on page 118).

2 Hop Statistics

Statistic	State Index	Hop Begin (ms)	Dwell Time (µs)	Switching Time (ns)	State Frequency (MHz)	Avg Frequency (MHz)	Hop State Deviation (kHz)	Relative Frequency (MHz)	Freq Dev Peak (kHz)
Selected	9	0.056	99.930	50.000	3.992	4.000	8.428	...	2409.827
Average	4	4.256	99.967	32.941	-0.142	-0.141	0.674	0.190	2359.054
Std. Dev.	2	2.468131	0.019397	19.989493	22.953792	22.948780	6.572411	36.459741	317.525893
Maximum	9	8.456	100.000	80.000	36.006	36.000	8.432	64.000	3127.913
Minimum	0	0.056	99.910	10.000	-36.003	-36.000	-8.902	-40.000	1807.365
Average	4	4.939	99.493	32.067	0.061	0.062	0.497	0.098	2373.978
Std. Dev.	2	2.850073	5.610992	19.666186	22.995292	22.989849	7.226803	36.550840	309.108072
Maximum	9	9.899	100.000	120.000	36.008	36.000	11.123	64.000	3540.204
Minimum	0	0.013	4.150	10.000	-36.005	-36.000	-13.500	-40.000	1616.558

Figure 5-14: Hop Statistics Table

For details on the individual parameters see Chapter 5.1, "Hop parameters", on page 44 or Chapter 5.2, "Chirp parameters", on page 54.

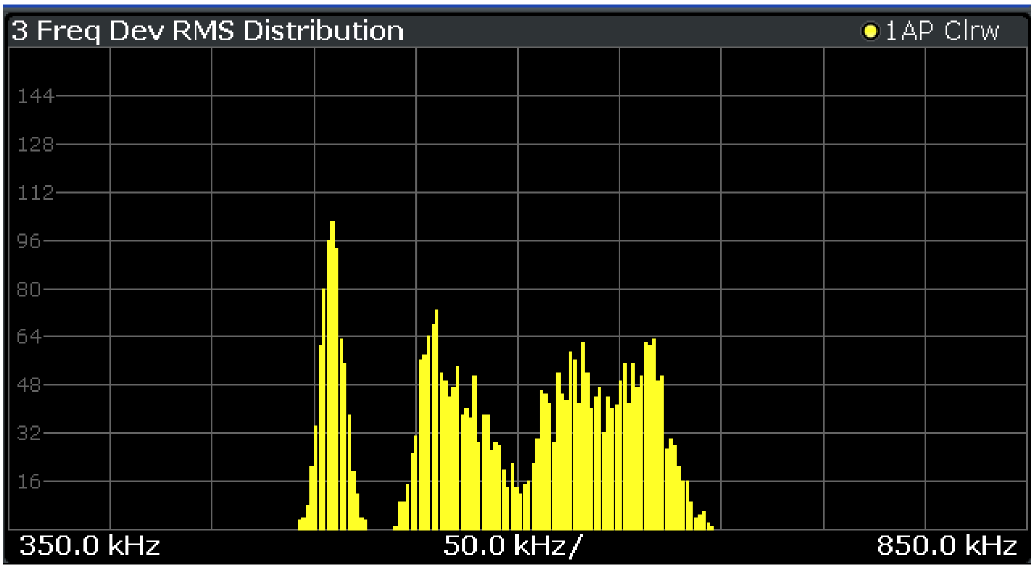
Remote command:

`LAY:ADD:WIND '2',RIGH,STAB` see `LAYout:ADD[:WINDow]?` on page 266

Parameter Distribution

Plots a histogram of a particular parameter, i.e. all measured parameter values from the current capture vs hop/chirp count or occurrence in %. Thus you can determine how often a particular parameter value occurs. For each parameter distribution window you can configure a different parameter to be displayed.

This evaluation method allows you to distinguish transient and stable effects in a specific parameter, such as a spurious frequency deviation or a fluctuation in power over several hops.



Note that averaging is not possible for parameter distribution traces.

Remote command:

`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 266

`CALCulate<n>:DISTribution:X?` on page 307

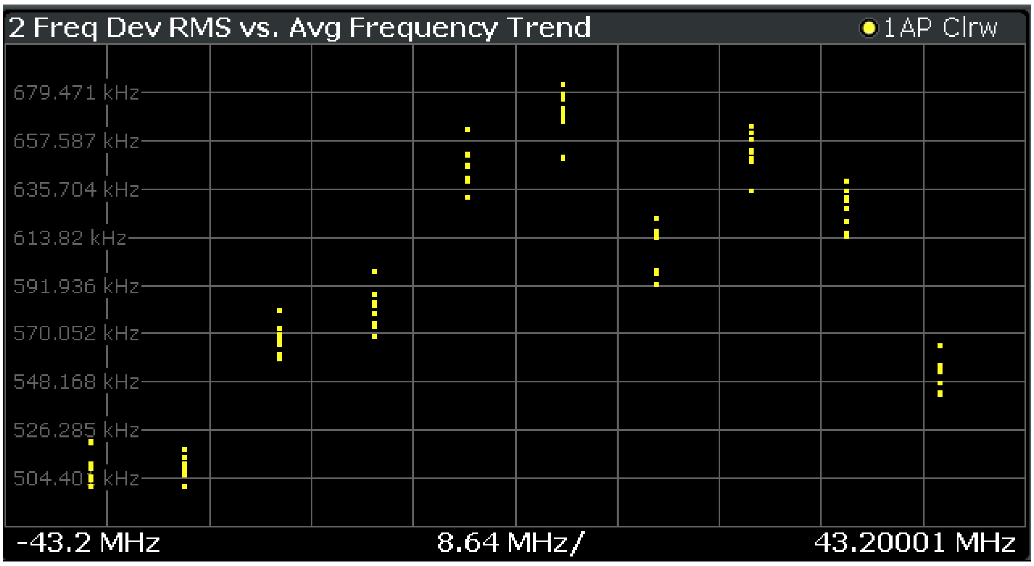
`CALCulate<n>:DISTribution:Y?` on page 308

Chapter 11.5.6, "Configuring parameter distribution displays", on page 298

Parameter Trend

Plots all measured parameter values from the current capture vs another parameter or the hop/chirp state index. This evaluation allows you to determine trends in a specific parameter, such as a frequency deviation or a fluctuation in power over several hops.

For each parameter trend window you can configure a different parameter to be displayed for both the x-axis and the y-axis, making this a very powerful and flexible analysis tool. Note, however, that the same parameter may not be selected on the x-axis and y-axis.



Note that averaging is not possible for parameter trend traces.

Remote command:

`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 266

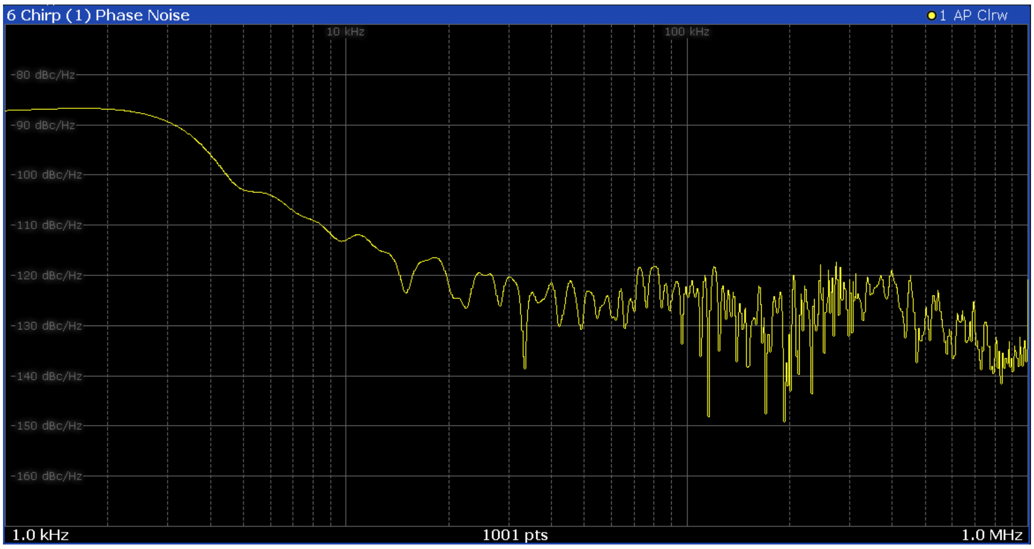
`CALCulate<n>:TRENd:X?` on page 309

`CALCulate<n>:TRENd:Y?` on page 309

Chapter 11.5.7, "Configuring parameter trends", on page 308

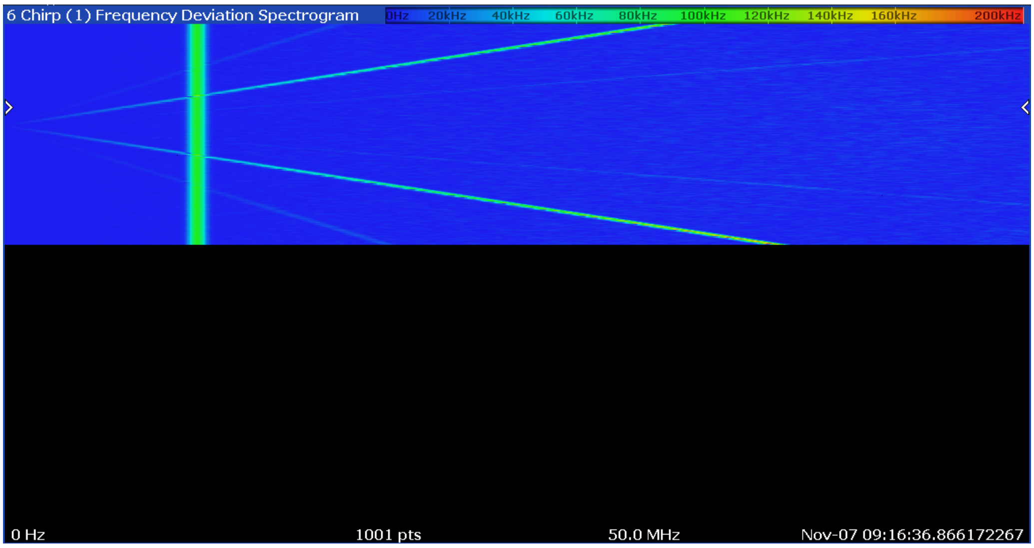
Phase Noise

The phase noise diagram shows the power level of the phase noise over a variable frequency offset from the carrier frequency. It is only available with option R&S VSE-K60P installed.



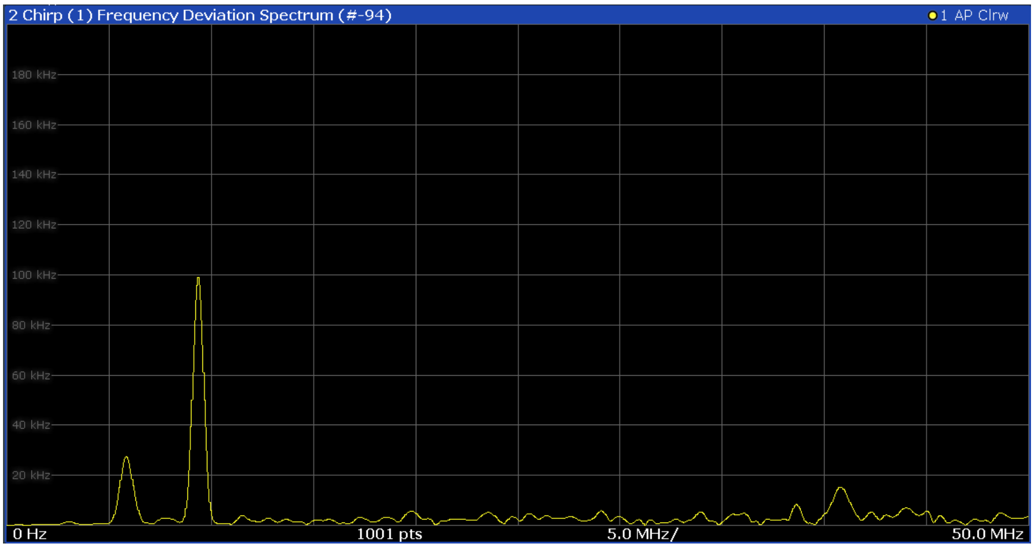
Remote command:
`LAY:ADD:WIND '2',RIGH,PNO` see `LAYout:ADD[:WINDow]?` on page 266

Frequency Deviation Spectrogram
Shows a spectrogram view of the frequency deviation. It is only available with option R&S VSE-K60P installed.



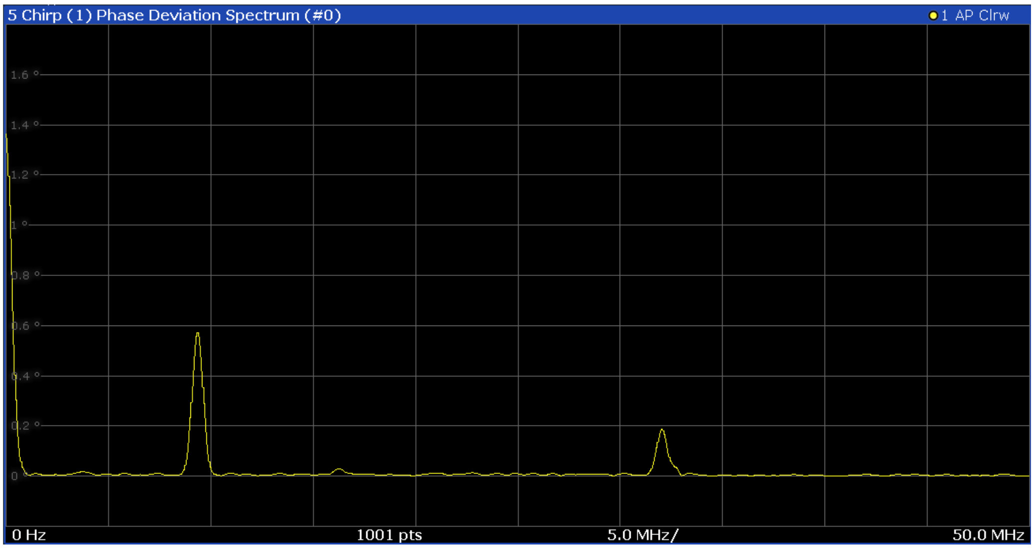
Remote command:
`LAY:ADD:WIND '2',RIGH,FDSG` see `LAYout:ADD[:WINDow]?` on page 266

Frequency Deviation Spectrum
Shows a spectrum view of the frequency deviation. It is only available with option R&S VSE-K60P installed.



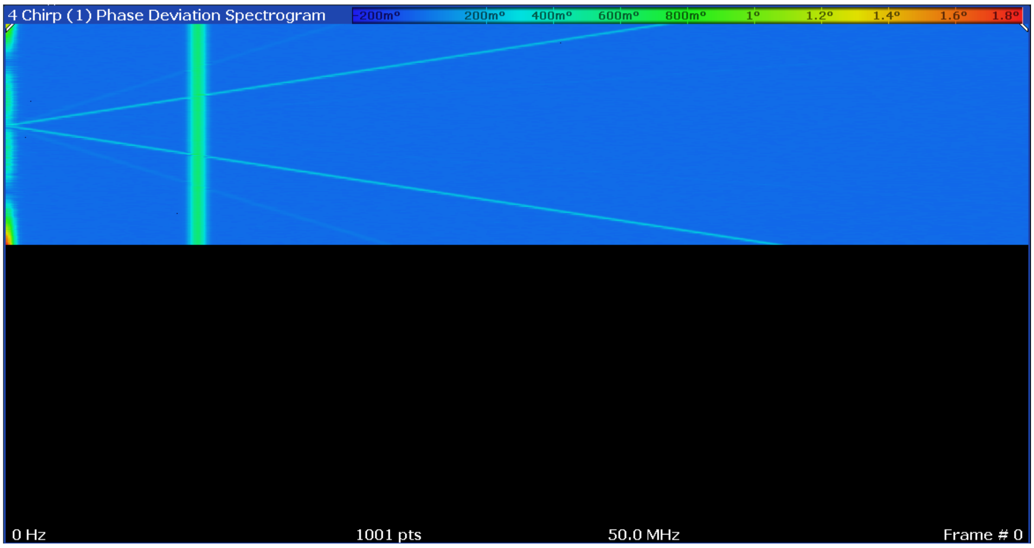
Remote command:
`LAY:ADD:WIND '2',RIGH,FDSP` see `LAYout:ADD[:WINDow]?` on page 266

Phase Deviation Spectrum
Shows a spectrum view of the phase deviation. It is only available with option R&S VSE-K60P installed.



Remote command:
`LAY:ADD:WIND '2',RIGH,PDSG` see `LAYout:ADD[:WINDow]?` on page 266

Phase Deviation Spectrogram
Shows a spectrogram view of the phase deviation. It is only available with option R&S VSE-K60P installed.



Remote command:
`LAY:ADD:WIND '2',RIGH,PDSP` see `LAYout:ADD[:WINDow]?` on page 266

Marker Table

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

This table is displayed automatically if configured accordingly.


3 Marker Table

Wnd	Type	Ref	X-Value	Y-Value
1	M1		0.256	0.00 dB
1	D2	M1	415.512	-1.94 dB
1	D3	M1	489.512	-1.95 dB
1	D4	M1	266.512	-2.00 dB

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 266
Results:
`CALCulate<n>:MARKer<m>:X` on page 363
`CALCulate<n>:MARKer<m>:Y?` on page 364

6 Configuration

Transient Analysis requires a special application on the R&S VSE.

Transient Analysis measurements require a special application on the R&S VSE.

Multiple access paths to functionality

The easiest way to configure a measurement channel is via the "Overview" dialog box, which is displayed when you select the "Overview" icon from the main toolbar or the "Meas Setup" > "Overview" menu item.

Alternatively, you can access the individual dialog boxes from the corresponding menu items, or via tools in the toolbars, if available.

In this documentation, only the most convenient method of accessing the dialog boxes is indicated - usually via the "Overview". For an overview of all available menu items and toolbar icons see Chapter A.2, "Transient analysis measurements menus", on page 466.

General R&S VSE functions

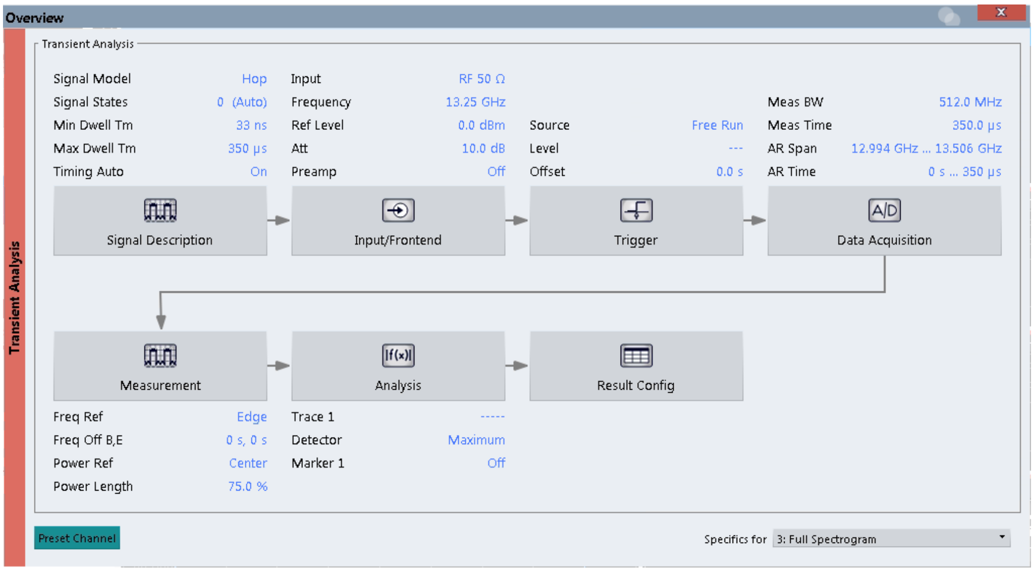
The application-independent functions for general tasks on the R&S VSE are also available for Transient Analysis measurements and are described in the R&S VSE Base Software User Manual. In particular, this comprises the following functionality:

- Controlling Instruments and Capturing I/Q Data
- Data Management
- General Software Preferences and Information

6.1 Configuration overview

Access: "Meas Setup" > "Overview"

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



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".

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

1. Signal Description
   See Chapter 6.2, "Signal description", on page 82.
2. Input and frontend settings
   See Chapter 6.3, "Input and frontend settings", on page 88
3. Triggering
   See Chapter 6.4, "Trigger settings", on page 101
4. Data acquisition
   See Chapter 6.5, "Data acquisition and analysis region", on page 105
5. Measurement settings
   See Chapter 6.7, "Hop / chirp measurement settings", on page 109
6. Analysis
   See Chapter 7, "Analysis", on page 116
7. Result configuration
   See Chapter 7.1, "Result configuration", on page 116

To configure settings

► Select any button to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) or in the diagram footer of a graphical result display to change a specific setting.

For step-by-step instructions on configuring a measurement for Transient Analysis, see Chapter 8, "How to perform transient analysis", on page 150.

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 177

Specifics for
The channel 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 "Specifics 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.

6.2 Signal description

Access: "Overview" > "Signal Description"

The "Signal Description" settings provide information on the expected signal which can improve measurement and analysis.

6.2.1 Signal model

Access: "Overview" > "Signal Description" > "Signal Model" tab

The signal model defines which type of signal to expect (if known), thus determining the analysis method. These settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.

Hop Model / Chirp Model
Defines which type of signal to expect (if known), thus determining the analysis method.

These settings are only available if the additional options R&S VSE-K60C/-K60H are installed.

For more information see Chapter 4.3, "Signal models", on page 21.

"Hop Model"	Signals "hop" between random carrier frequencies in short intervals
"Chirp Model"	The carrier frequency is either increased or decreased linearly over time.

Remote command:
[SENSe:]SIGNal:MODel on page 232

6.2.2 Signal states

Access: "Overview" > "Signal Description" > "Signal States" tab

The (nominal) frequencies or chirps the signal is expected to switch to are defined in advance in the "Signal State" table. Each possible frequency/chirp is considered to be a *hop state*/*chirp state*.These settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.

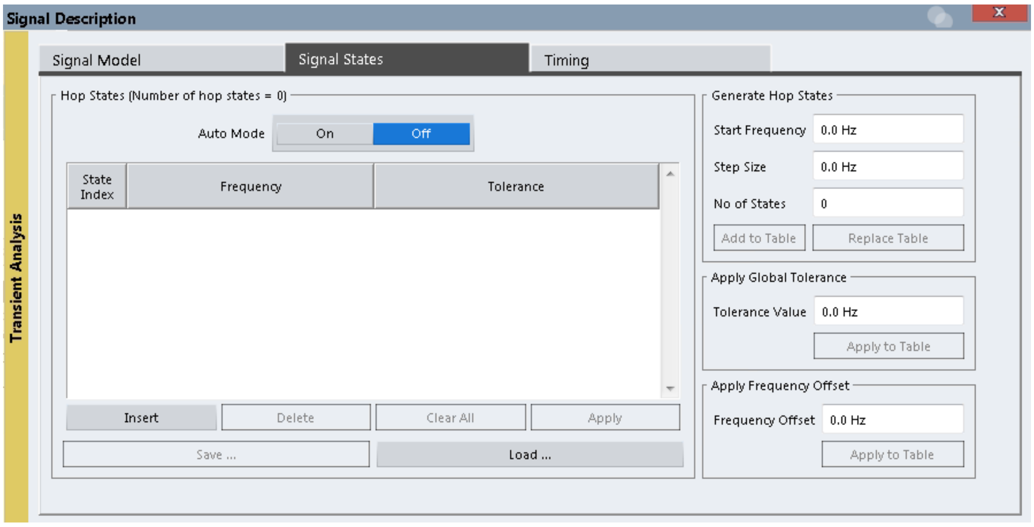


Figure 6-1: Hop States configuration dialog with additional settings

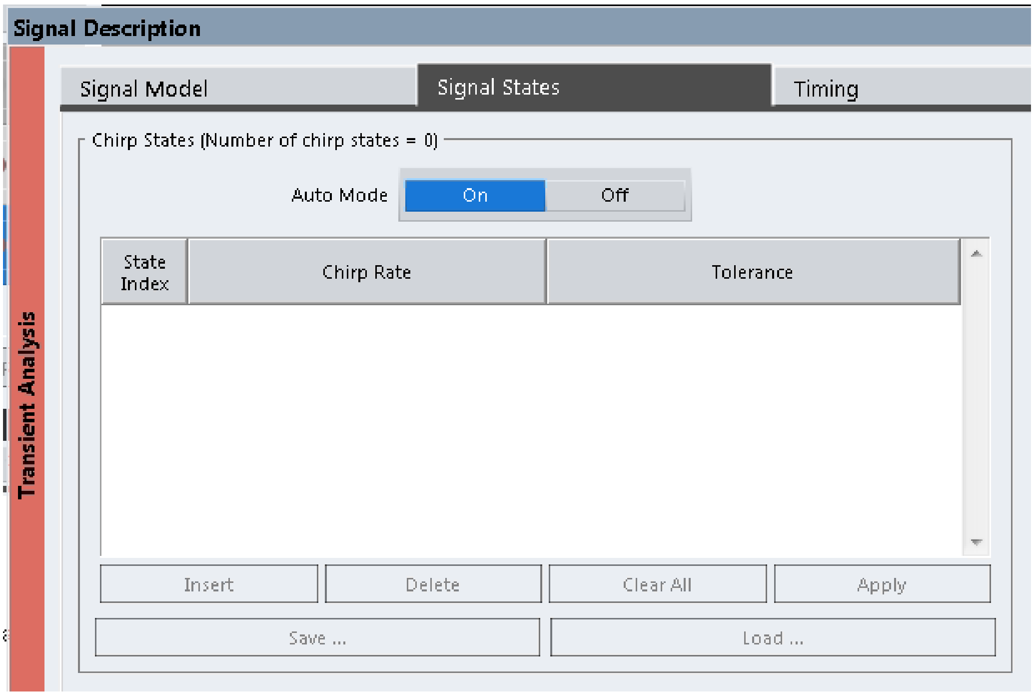


Figure 6-2: Chirp States configuration dialog

For details on the individual parameters see Chapter 4.3.1, "Frequency hopping", on page 21.

Hop / Chirp Settings
By default, the R&S VSE Transient Analysis application performs an automatic hop/ chirp detection according to the measured data. For an initial overview of the signal at hand this detection is usually sufficient. For more accurate results, particularly if the input signal is known in advance, the signal states can be adapted as required.

For details see Chapter 4.3.3, "Automatic vs. manual hop/chirp state detection", on page 24.

Remote command:
`CALCulate<n>:CHRDetection:STATes:AUTO` on page 234
`CALCulate<n>:HOPDetection:STATes:AUTO` on page 238

Chirp Detection
Selects the chirp detection mode.

The parameters that can be defined in the chirp state detection table depend on the chirp settings and the chirp detection mode:

	Chirp Settings "Auto"	Chirp Settings "Manual"
Chirp Detection "On"	All parameters are set automatically.	Manual setting of: • Chirp Rate • Tolerance
Chirp Detection "Off"	Manual setting of: • Chirp start • Chirp length	Manual setting of: • Chirp start • Chirp length • Start frequency • Stop frequency

Remote command:
`CALCulate<n>:CHRDetection:DETection` on page 236

Hop / Chirp State Index
The nominal frequency levels are numbered consecutively in the "Hop States"/"Chirp States" table, starting at 0. A maximum of 1000 states can be defined. The state index of the corresponding nominal frequency level is assigned to each detected hop/chirp in the measured signal.

Remote command:
`CALCulate<n>:HOPDetection:STATes:NUMBer?` on page 239
`CALCulate<n>:CHRDetection:STATes:NUMBer?` on page 235
`CALCulate<n>:HOPDetection:STATes:TABLe:NSTates?` on page 240

Frequency Offset / Chirp Rate
The hop states are defined as frequency offsets from the center frequency. Hops are only detected at these frequencies.

Chirp states are defined as a (linear) chirp rate. Chirps are only detected at these chirp rates.

Remote command:
`CALCulate<n>:CHRDetection:STATes[:DATA]` on page 234
`CALCulate<n>:HOPDetection:STATes[:DATA]` on page 238

Tolerance
A tolerance span can be defined to compensate for settling effects in the signal after switching the frequency. As long as the deviation remains within the tolerance above or below the nominal frequency, the signal state is detected.

Remote command:
`CALCulate<n>:CHRDetection:STATes[:DATA]` on page 234
`CALCulate<n>:HOPDetection:STATes[:DATA]` on page 238

Inserting a signal state
Inserts an additional signal state before the currently selected state.

Deleting a signal state
Deletes the currently selected signal state.

Clearing the signal state table
Deletes all signal states in the signal state table.

Applying changes to the signal state table
Applies the changes to the current signal state table configuration.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:SAVE` on page 241
`CALCulate<n>:CHRDetection:STATes:TABLe:SAVE` on page 236

Saving the signal state table to a file
Saves the current signal state table configuration to a file for later use.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:SAVE` on page 241
`CALCulate<n>:CHRDetection:STATes:TABLe:SAVE` on page 236

Loading a signal state table from a file
Loads the selected signal state table configuration from a file.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:LOAD` on page 239
`CALCulate<n>:CHRDetection:STATes:TABLe:LOAD` on page 236

Generating a series of hop states
For hop signals, additional settings are available which allow you to generate several regularly spaced hop states very easily and quickly.

These settings are displayed or hidden when you select "More/Less" in the "Signal States" tab of the "Signal Description" dialog box for hop signals.

Start Frequency ← Generating a series of hop states
The frequency at which the first hop state will be generated.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:STARt?` on page 241

Step Size ← Generating a series of hop states
The distance between two hop states.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:STEP?` on page 241

No of States ← Generating a series of hop states
Number of hop states to be generated. A maximum of 1000 states can be defined in one table.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:NSTates?` on page 240

Add to Table ← Generating a series of hop states
Adds the defined number of hop states, starting at the Start Frequency, with the defined Step Size and a tolerance of 1/2 the Step Size to the existing states in the Hop States table.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:ADD` on page 239

Replace Table ← Generating a series of hop states
Replaces any existing states in the "Hop States" table by the defined number of hop states, starting at the Start Frequency, with the defined Step Size and a tolerance of 1/2 the Step Size.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:REPLace` on page 240

Applying a global tolerance value ← Generating a series of hop states
Applies a global Tolerance value to all hop states in the table at once. By default, a tolerance of 1/2 the Step Size is applied when a series of states is generated.

To edit the tolerance value for an *individual* hop state, select the value directly in the "Hop States" table and enter the new value.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:TOLerance` on page 241

Applying a global frequency offset ← Generating a series of hop states
Applies a global Frequency Offset value to all hop states in the table at once.

To edit the frequency offset for an *individual* hop state, select the value directly in the "Hop States" table and enter the new value.

Remote command:
`CALCulate<n>:HOPDetection:STATes:TABLe:OFFSet` on page 240

6.2.3 Timing

Access: "Overview" > "Signal Description" > "Timing" tab

The dwell time is the time the signal remains in the tolerance area of a nominal hop frequency, that is, the duration of a hop from beginning to end. A hop/chirp is only detected if its dwell time lies within the defined minimum and maximum values.

Auto Mode

If "Auto Mode" is enabled (default), useful dwell time/chirp length limits for the current measurement are defined automatically.

Otherwise, the manually defined Min Dwell Time / Max Dwell Time values apply.

Remote command:

`CALCulate<n>:CHRDetection:LENGth:AUTO` on page 233

`CALCulate<n>:HOPDetection:DWELl:AUTO` on page 237

Min Dwell Time / Max Dwell Time

If "Auto Mode" is disabled, you can define minimum or maximum dwell times, or both, manually, in order to detect only specific hops, for example.

Remote command:

`CALCulate<n>:CHRDetection:LENGth:MAXimum` on page 233

`CALCulate<n>:CHRDetection:LENGth:MINimum` on page 234

`CALCulate<n>:HOPDetection:DWELl:MAXimum` on page 237

`CALCulate<n>:HOPDetection:DWELl:MINimum` on page 238

6.3 Input and frontend settings

Access: "Overview" > "Input/Frontend"

The R&S VSE can evaluate signals from different input sources and provide various types of output (such as noise or trigger signals).

The frequency and amplitude settings represent the "frontend" of the measurement setup.

6.3.1 Input source settings

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

Or: "Input & Output" > "Input Source"

The R&S VSE can control the input sources of the connected instruments.

6.3.1.1 Radio frequency input

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

Or: "Input & Output" > "Input Source" > "Radio Frequency"

The default input source for the connected instrument is "Radio Frequency". Depending on the connected instrument, different input parameters are available.

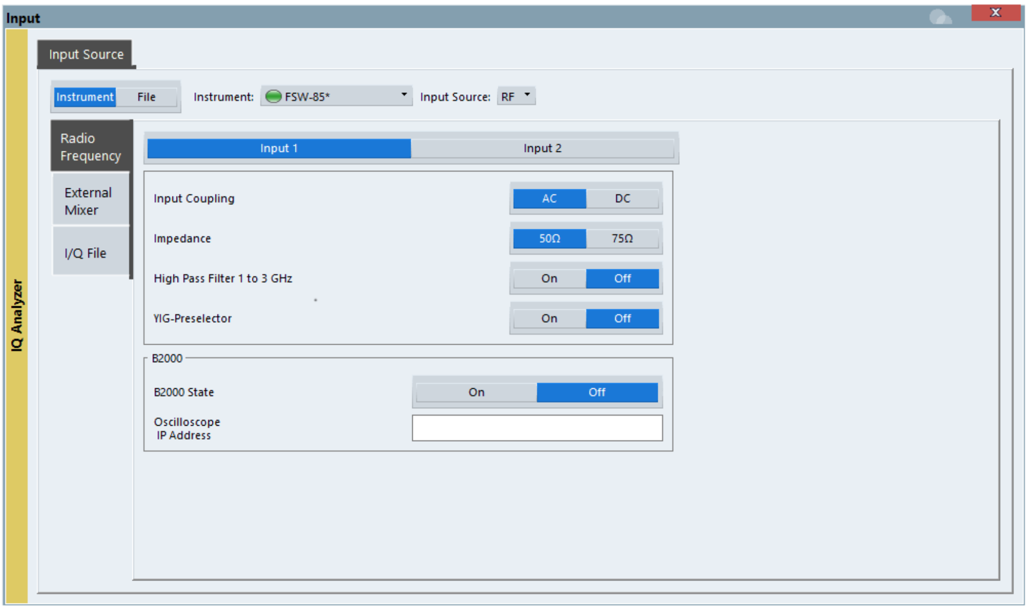


Figure 6-3: RF input source settings for an R&S FSW with B2000 option

If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE Transient Analysis application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.

For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

Input Type (Instrument / File)

Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 185
`INPut:SELect` on page 184

Instrument

Specifies a configured instrument to be used for input.

Input 1 / Input 2

For instruments with two input connectors, you must define which input source is used for each measurement channel.

If an external frontend is active, select the connector the external frontend is connected to. You cannot use the other RF input connector simultaneously for the same channel. However, you can configure the use of the other RF input connector for another active channel at the same time.

"Input 1"	R&S FSW85: 1.00 mm RF input connector for frequencies up to 85 GHz (90 GHz with option R&S FSW-B90G)
"Input2"	R&S FSW85: 1.85 mm RF input connector for frequencies up to 67 GHz

Remote command:
`INPut:TYPE` on page 184

Input Coupling

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

The RF input of the connected instrument 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 data sheet.

Remote command:
`INPut<ip>:COUPling<ant>` on page 179

Impedance

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

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

Remote command:
`INPut<ip>:IMPedance<ant>` on page 181

Direct Path

Enables or disables the use of the direct path for small frequencies.

In spectrum analyzers, passive analog mixers are used for the first conversion of the input signal. In such mixers, the LO signal is coupled into the IF path due to its limited isolation. The coupled LO signal becomes visible at the RF frequency 0 Hz. This effect is referred to as LO feedthrough.

To avoid the LO feedthrough the spectrum analyzer provides an alternative signal path to the A/D converter, referred to as the *direct path*. By default, the direct path is selected automatically for RF frequencies close to zero. However, this behavior can be disabled. If "Direct Path" is set to "Off" , the spectrum analyzer always uses the analog mixer path.

"Auto"	(Default) The direct path is used automatically for frequencies close to zero.
"Off"	The analog mixer path is always used.

Remote command:
`INPut<ip>:DPATh` on page 180

High Pass Filter 1 to 3 GHz

Activates an additional internal highpass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

For some connected instruments, this function requires an additional hardware option on the instrument.

Note: For RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Remote command:
`INPut<ip>:FILTer:HPASs[:STATe]` on page 180

YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires an additional option on the connected instrument.

An internal YIG-preselector at the input of the connected instrument ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the connected instrument, which can lead to image-frequency display.

Note: Note that the YIG-preselector is active only higher frequencies, depending on the connected instrument. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

To use the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

To use the optional 54 GHz frequency extension (R&S FSV3-B54G), the YIG-preselector must be disabled.

Remote command:
`INPut<ip>:FILTer:YIG[:STATe]` on page 181

Capture Mode

Determines how data from an oscilloscope is input to the R&S VSE software.

This function is only available for a connected R&S oscilloscope with a firmware version 3.0.1.1 or higher (for other versions and instruments the input is always I/Q data).

"I/Q" The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.
For data imports with small bandwidths, importing data in this format is quicker. However, the maximum record length is restricted by the R&S oscilloscope. (Memory options on the R&S oscilloscope are not available for I/Q data.)

"Waveform" The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.
For data imports with large bandwidths, this format is more convenient as it allows for longer record lengths if appropriate memory options are available on the R&S oscilloscope.

"Auto" Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement, oscilloscope baseband input).

Remote command:
`INPut<ip>:RF:CAPMode` on page 182

B2000 State

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: The R&S VSE software supports input from a connected R&S FSW with a B2000 option installed. However, the R&S FSW interface to the oscilloscope must be

set up and aligned directly on the instrument before the R&S VSE software can start analyzing the input.
The analysis bandwidth is defined in the data acquisition settings of the application as usual. Note that the maximum bandwidth cannot be restricted manually as for other bandwidth extension options.

Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

Remote command:
`SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe]` on page 186

Oscilloscope Sample Rate
Determines the sample rate used by the connected oscilloscope.

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

"10 GHz"	Default for waveform Capture Mode (not available for I/Q Capture Mode); provides maximum record length
"20 GHz"	Achieves a higher decimation gain, but reduces the record length by half. Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet). For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used in waveform Capture Mode
"40 GHz"	Provides a maximum sample rate. Only available for I/Q Capture Mode, and only for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet)

Remote command:
Input source R&S FSW via oscilloscope:
`SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe` on page 187
Input source oscilloscope waveform mode:
`INPut<ip>:RF:CAPMode:WAVeform:SRATe` on page 183
Input source oscilloscope I/Q mode:
`INPut<ip>:RF:CAPMode:IQ:SRATe` on page 183

Oscilloscope Splitter Mode
Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&S FSW and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the R&S FSW I/Q Analyzer and I/Q Input user manual.

Remote command:
`SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe]` on page 187

Oscilloscope IP Address
When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an R&S FSW as the connected instrument, the entire measurement, as well as both instruments, are controlled by the R&S VSE software. Thus, the instruments must be connected via LAN, and the TCPIP address of the oscilloscope must be defined in the R&S VSE software.

For tips on how to determine the computer name or TCPIP address, see the oscilloscope's user documentation.

Remote command:
`SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip` on page 186

Preselector State

Turns the preselector on and off.

When you turn on the preselector, you can configure the characteristics of the preselector and add the preamplifier into the signal path.

When you turn off the preselector, the signal bypasses the preselector and the preamplifier, and is fed into the input mixer directly.

Remote command:
`INPut<ip>:PRESelection[:STATe]` on page 182

Preselector Mode

Selects the preselection filters to be applied to the measurement.

"Auto" Automatically applies all available bandpass filters in a measurement. Available with the optional preamplifier.

"Auto Wide" Automatically applies the wideband filters consecutively:

- Lowpass 40 MHz
- Bandpass 30 MHz to 2250 MHz
- Bandpass 2 GHz to 8 GHz
- Bandpass 8 GHz to 26.5 GHz

Available with the optional preselector.

"Auto Narrow" Automatically applies the most suitable narrowband preselection filters in a measurement, depending on the bandwidth you have selected.
For measurement frequencies up to 30 MHz, the connected instrument uses combinations of lowpass and highpass filters. For higher frequencies, the connected instrument uses bandpass filters.
Available with the optional preselector.

"Manual" Applies the filter settings you have defined manually.

Remote command:
`INPut<ip>:PRESelection:SET` on page 182

10 dB Minimum Attenuation

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

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

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

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

Remote command:
`INPut:ATTenuation:PROTection:RESet` on page 179

6.3.1.2 I/Q file input

Access: "Overview" > "Input/Frontend" > "Input Source" > "I/Q File"

Or: "Input & Output" > "Input Source" > "I/Q File"

Loading a file via drag&drop

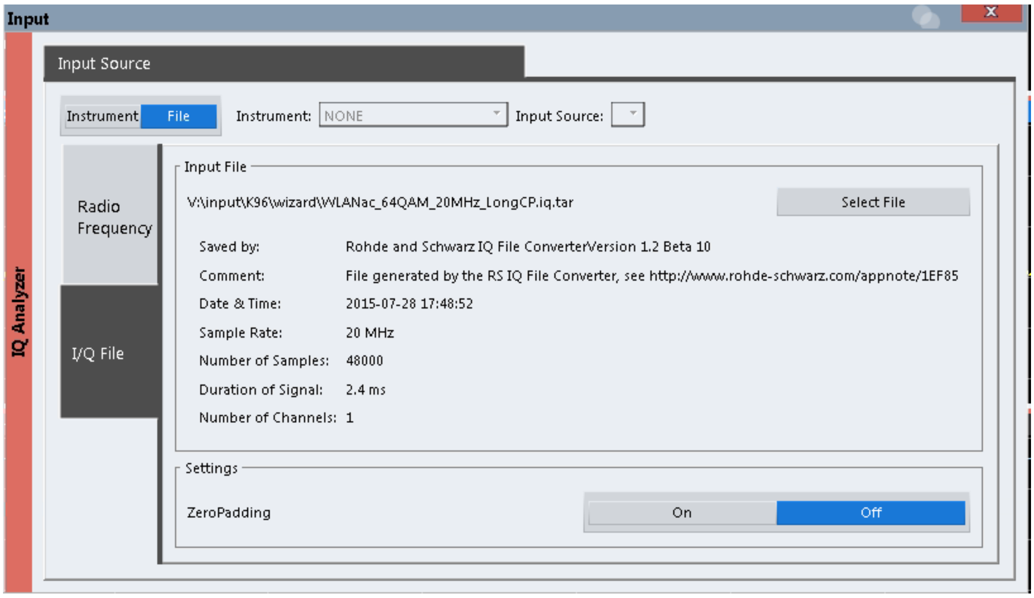
You can load a file simply by selecting it in a file explorer and dragging it to the R&S VSE software. Drop it into the "Measurement Group Setup" window or the channel bar for any channel. The channel is automatically configured for file input, if necessary. If the file contains all essential information, the file input is immediately displayed in the channel. Otherwise, the "Recall I/Q Recording" dialog box is opened for the selected file so you can enter the missing information.

If the file contains data from multiple channels (e.g. from LTE measurements), it can be loaded to individual input sources, if the application supports them.

For details see the R&S VSE Base Software User Manual.

The "Input Source" settings defined in the "Input" dialog box are identical to those configured for a specific channel in the "Measurement Group Setup" window.

(See "Controlling Instruments and Capturing Data" in the R&S VSE User Manual).



If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE Transient Analysis application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.

For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

Encrypted .wv files can also be imported. Note, however, that traces resulting from encrypted file input cannot be exported or stored in a saveset.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 185
`INPut:SELect` on page 184

Input File
Specifies the I/Q data file to be used for input.

Select "Select File" to open the "Load I/Q File" dialog box.

(See "Data Management - Loading the I/Q Data File" in the R&S VSE base software user manual).

Zero Padding
Enables or disables zero padding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

If enabled, the required number of samples are inserted as zeros at the beginning and end of the file. The entire input data is analyzed. However, the additional zeros can effect the determined spectrum of the I/Q data. If zero padding is enabled, a status message is displayed.

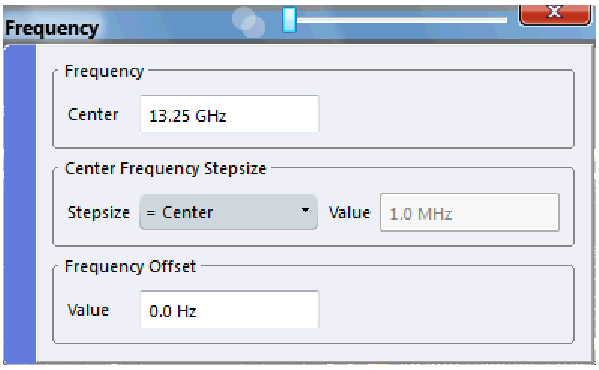
If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

Note: You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:
`INPut<ip>:FILE:ZPADing` on page 180

6.3.2 Frequency settings

Access: "Overview" > "Input/Frontend" > "Frequency" tab



Center Frequency

Defines the center frequency of the signal in Hertz.

$0\ \text{Hz} \leq f_{center} \leq f_{max}$

Note: For file input, you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the sample rate of the file data.

$$CF_{shift_{max}} = CF_{file} \pm \frac{SR_{file}}{2}$$

If the file does not provide the center frequency, it is assumed to be 0 Hz.

To ensure that the input data remains within the valid analysis bandwidth, define the center frequency and the analysis bandwidth for the measurement such that the following applies:

$$CF + \frac{ABW_{channel}}{2} > CF_{file} + \frac{ABW_{file}}{2}$$

$$CF - \frac{ABW_{channel}}{2} > CF_{file} - \frac{ABW_{file}}{2}$$

Remote command:
[SENSe<ip>:]FREQuency:CENTer on page 211

Center Frequency Stepsize

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

When you use the mouse wheel, the center frequency changes in steps of only 1/10 of the span.

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

"= 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 212

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.

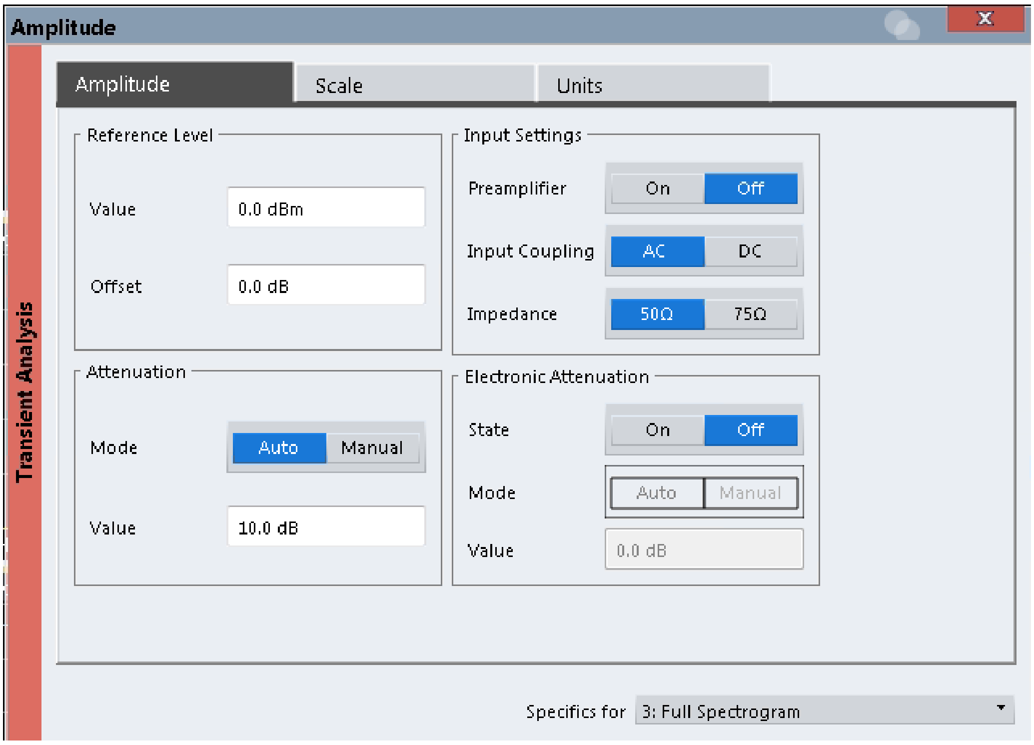
The allowed values range from -1 THz to 1 THz. The default setting is 0 Hz.

Remote command:
[SENSe<ip>:]FREQuency:OFFSet on page 212

6.3.3 Amplitude settings

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

Amplitude settings affect the signal power or error levels.



Note that amplitude settings are not window-specific, as opposed to the scaling and unit settings.

Reference Level

Defines the expected maximum input signal level. Signal levels above this value are possibly not measured correctly, which is indicated by the "IF Overload" status display.

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" 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 connected instrument 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<ant>` on page 217

Shifting the Display (Offset) ← Reference Level

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

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

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

Note, however, that the *internal* reference level (used to adjust the hardware settings to the expected signal) ignores any "Reference Level Offset" . Thus, it is important to keep in mind the actual power level the R&S VSE 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<ant>:OFFSet` on page 218

RF Attenuation

Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation

Defines the attenuation applied to the RF input of the R&S VSE.

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 1 dB steps (down to 0 dB). Other entries are rounded to the next integer value. The range is specified in the data sheet. 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<ip>:ATTenuation` on page 218
`INPut<ip>:ATTenuation:AUTO` on page 218

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the connected instrument, 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: Note that restrictions can apply concerning which frequencies electronic attenuation is available for, depending on which instrument is connected to the R&S VSE software. Check your instrument documentation for details.
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.

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 221
`INPut:EATT:AUTO` on page 220
`INPut:EATT` on page 220

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

For information on other input settings see Chapter 6.3.1.1, "Radio frequency input", on page 89.

Preamplifier ← Input Settings
If the (optional) internal preamplifier hardware is installed on the connected instrument, a preamplifier can be activated for the RF input signal.

You can use a preamplifier to analyze signals from DUTs with low output power.

Note: If an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

"Off" Deactivates the preamplifier.

"15 dB" The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

Remote command:
INPut<ip>:GAIN<ant>:STATe on page 219
INPut<ip>:GAIN<ant>[:VALue] on page 219

Impedance ← Input Settings
For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50 Ω or 75 Ω.

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

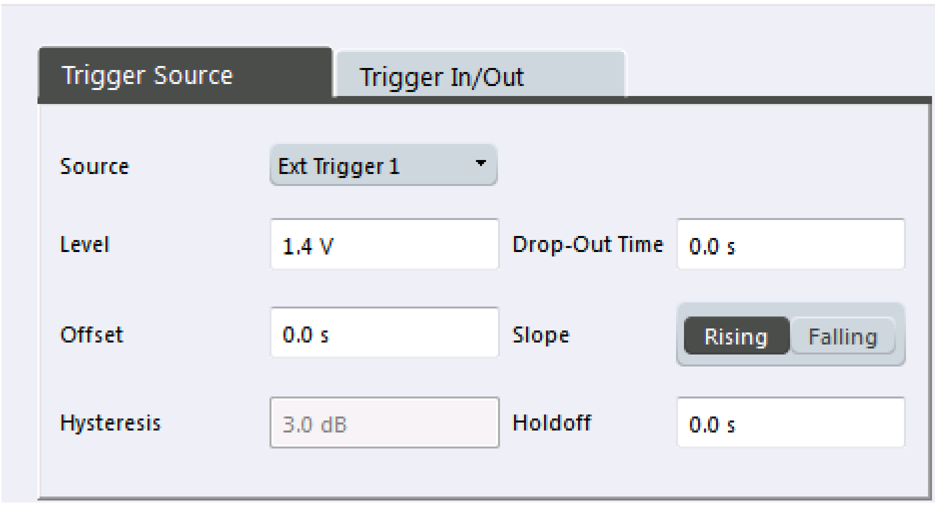
Remote command:
INPut<ip>:IMPedance<ant> on page 181

6.4 Trigger settings

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

Trigger settings determine when the input signal is measured. Note that gating is not available for hop measurements.

When using time domain displays, the position of the trigger signal relative to the trace is indicated by a vertical red line in the diagram.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the connected instrument are configured in a separate tab of the dialog box.

For details see R&S VSE Base Software User Manual.

For step-by-step instructions on configuring triggered measurements, see the R&S VSE User Manual.

Trigger Settings
The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Settings
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.

Note: When triggering is activated, the squelch function is automatically disabled.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 226

Free Run ← Trigger Source ← Trigger Settings
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 226

External Trigger 1/2/3/4 ← Trigger Source ← Trigger Settings
Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

Note: If the optional 2 GHz bandwidth extension (B2000) is active, only External Channel 3 is supported.

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

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

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

Remote command:
See TRIGger[:SEQuence]:SOURce on page 226

External Channel 3 ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the "Ch3" input connector on the oscilloscope meets or exceeds the specified trigger level.

Note: In previous firmware versions, the external trigger was connected to the *"Ch2"* input on the oscilloscope. As of firmware version R&S VSE 2.30, the *"Ch3"* input on the oscilloscope must be used!

Note: Since the external trigger uses a second channel on the oscilloscope, the maximum memory size, and thus record length, available for the input channel 1 may be reduced by half. For details, see the oscilloscope's data sheet and documentation.

Remote command:
`TRIG:SOUR EXT`, see TRIGger[:SEQuence]:SOURce on page 226

IF Power ← Trigger Source ← Trigger Settings
The R&S VSE starts capturing data as soon as the trigger level is exceeded around the third intermediate frequency.

(The third IF represents the center frequency.)

This trigger source is only available for RF input.

The available trigger levels depend on the RF attenuation and preamplification. A reference level offset, if defined, is also considered.

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, the IF power trigger corresponds to a "width" trigger on the oscilloscope, with a negative polarity and the range "longer". Thus, data acquisition starts when both of the following conditions apply to the signal fed into the CH1 input connector on the oscilloscope:

- The power level has remained below the specified trigger level for a duration longer than the drop-out time.
- The power level then rises above the specified trigger level.

For details on available trigger levels and trigger bandwidths, see the data sheet.

Remote command:
`TRIG:SOUR IFP`, see TRIGger[:SEQuence]:SOURce on page 226

I/Q Power ← Trigger Source ← Trigger Settings
Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see TRIGger[:SEQuence]:SOURce on page 226

RF Power ← Trigger Source ← Trigger Settings
Defines triggering of the measurement via signals which are outside the displayed measurement range.

For this purpose, the software uses a level detector at the first intermediate frequency.

The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels, see the instrument's data sheet.

Note: If the input signal contains frequencies outside of this range (e.g. for fullspan measurements), the measurement can be aborted. A message indicating the allowed input frequencies is displayed in the status bar.

A "Trigger Offset" , "Trigger Polarity" and "Trigger Holdoff" (to improve the trigger stability) can be defined for the RF trigger, but no "Hysteresis" .

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 226

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

For details on supported trigger levels, see the instrument data sheet.

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 223

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 222

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

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

(If supported by the connected instrument.)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 222

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

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, only rising slopes can be detected.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 225

Hysteresis ← Trigger Settings
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Setting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, the hysteresis refers to the robust width trigger.

This setting is only available for "IF Power" or "Magnitude (Offline)" trigger sources.

The range of the value depends on the connected instrument.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 222
`TRIGger[:SEQuence]:MAPower:HYSTeresis` on page 225

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

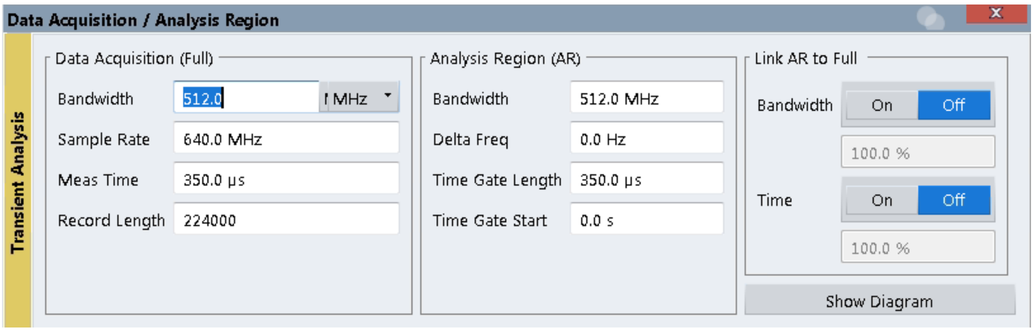
Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 222
`TRIGger[:SEQuence]:MAPower:HOLDoff` on page 224

6.5 Data acquisition and analysis region

Access: "Overview" > "Data Acquisition"

You must define how much and how data is captured from the input signal, and which part of the captured data is to be analyzed.

For details see Chapter 4.1, "Data acquisition", on page 18.



Measurement Bandwidth
The measurement bandwidth and Sample Rate are interdependent and define the range of data to be captured. For information on supported sample rates and band-widths see the data sheet.

Remote command:
[SENSe:]BWIDth:DEMod on page 229
[SENSe:]FREQuency:SPAN on page 229

Sample Rate
The Measurement Bandwidth and sample rate are interdependent and define the range of data to be captured. For information on supported sample rates and bandwidths see the data sheet.

Remote command:
[SENSe:]SRATe on page 230

Measurement Time
The measurement time and Record Length are interdependent and define the amount of data to be captured.

The maximum measurement time in the R&S VSE Transient Analysis application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the R&S VSE.

Remote command:
[SENSe:]MTIMe on page 229

Record Length
The Measurement Time and record length are interdependent and define the amount of data to be captured.

The maximum record length in the R&S VSE Transient Analysis application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the record length (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the R&S VSE.

Remote command:
[SENSe:]RLENgth on page 230

Analysis Region
The analysis region determines which data is displayed on the screen (see also Chapter 4.5, "Analysis region", on page 25).

The region is defined by a frequency span and a time gate for which the results are displayed. The time and frequency spans can be defined either as absolute values or relative to the full capture buffer.

Both methods can be combined, for example by defining an absolute frequency span and a relative time gate.

Analysis Bandwidth ← Analysis Region
Defines the absolute width of the frequency span for the analysis region. It is centered around the point defined by the Delta Frequency.

Remote command:
CALCulate<n>:AR:FREQuency:BANDwidth on page 259

Delta Frequency ← Analysis Region
Defines the center of the frequency span for the analysis region. It is defined as an offset from the center frequency.

Remote command:
`CALCulate<n>:AR:FREQuency:DELTa` on page 259

Time Gate Length ← Analysis Region
Defines the absolute length of the time gate, that is, the duration (or height) of the analysis region.

Remote command:
`CALCulate<n>:AR:TIME:LENGth` on page 260

Time Gate Start ← Analysis Region
Defines the starting point of the time span for the analysis region. The starting point is defined as a time offset from the capture start time.

Remote command:
`CALCulate<n>:AR:TIME:STARt` on page 261

Linked analysis bandwidth ← Analysis Region
If activated, the width of the frequency span for the analysis region is defined as a percentage of the full capture buffer. It is centered around the point defined by the Delta Frequency.

Remote command:
`CALCulate<n>:AR:FREQuency:PERCent` on page 260
`CALCulate<n>:AR:FREQuency:PERCent:STATe` on page 260

Linked analysis time span ← Analysis Region
If activated, the length of the time gate, that is, the duration (or height) of the analysis region, is defined as a percentage of the full measurement time. The time gate start is the start of the capture buffer plus an offset defined by the Time Gate Start.

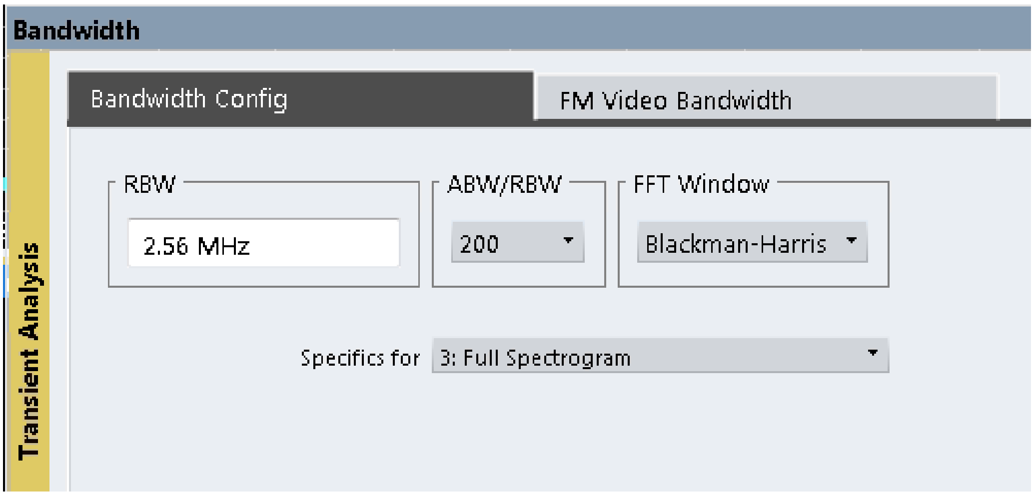
Remote command:
`CALCulate<n>:AR:TIME:PERCent` on page 261
`CALCulate<n>:AR:TIME:PERCent:STATe` on page 261

Visualizing the Analysis Region Parameters (Show Diagram) ← Analysis Region
If enabled, the "Data Acquisition / Analysis Region" dialog box shows a visualization of the parameters that define the analysis region (as shown in Figure 4-9).

6.6 Bandwidth settings

Access: "Meas Setup" > "Bandwidth"

Some of these settings are also available in the "Data acquisition and analysis region" dialog box.



RBW

Defines the resolution bandwidth. Numeric input is always rounded to the nearest possible bandwidth.

The resolution bandwidth is coupled to the selected span (see "ABW / RBW" on page 108).

For more information see "Resolution bandwidth" on page 20.

Remote command:
`[SENSe:]BANDwidth[:WINDow<n>]:RESolution` on page 232

ABW / RBW

The resolution bandwidth is coupled to the selected analysis bandwidth (ABW). The ABW can be the full measurement bandwidth, the bandwidth of the analysis region, or the length of the result range, depending on the evaluation basis of the result display. If the ABW is changed, the resolution bandwidth is automatically adjusted. This setting defines the coupling ratio. Which coupling ratios are available depends on the selected FFT Window.

For more information see "Resolution bandwidth" on page 20.

Remote command:
`[SENSe:]BANDwidth[:WINDow<n>]:RATio` on page 231

FFT Window

In the Transient Analysis application you can select one of several FFT window types.

The following window types are available:
- Blackman-Harris
- Flattop
- Gauss
- Rectangular
- Hanning
- Hamming

- Chebyshev

Remote command:
[SENSe:]SWEep:FFT:WINDow:TYPE on page 359

6.7 Hop / chirp measurement settings

Access: "Overview" > "Measurement"

For some frequency, phase or power calculations, it may be useful not to take the entire dwell time of the hop or length of the chirp into consideration, but only a certain range within the dwell time/length. Thus, it is possible to eliminate settling effects, for instance. For other measurements, the settling time may be of particular interest.

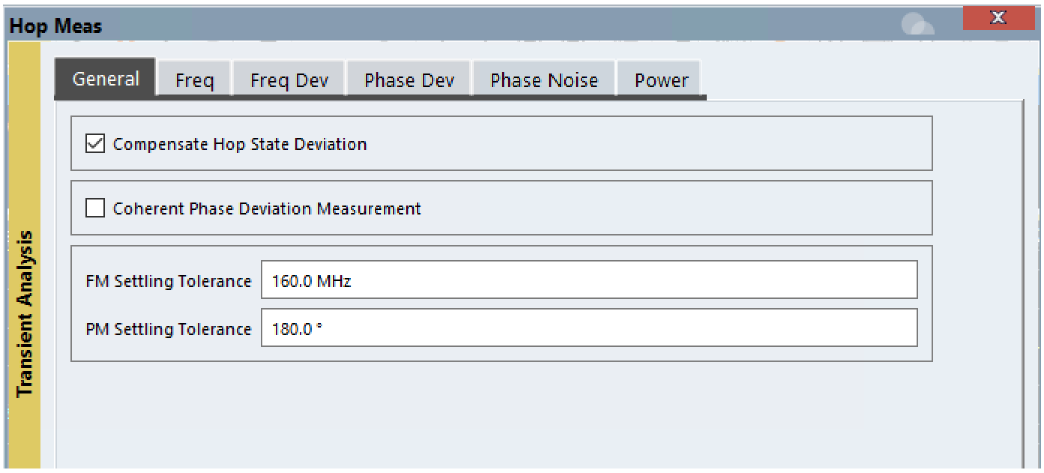
For such cases, a *measurement range* can be defined for power and frequency/phase results, in relation to specific hop or chirp characteristics.

These settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.

6.7.1 General hop/chirp measurement settings

Access: "Overview" > "Measurement" > "General"

The following settings are available for all measurements.



Compensate Hop State Deviation/Compensate Chirp Rate Deviation
Determines the behavior of the measurement when calculating deviation to the signal model.

Generally, the nominal value as defined in the state table is compensated when calculating the measurement results.

If activated (default), the measured deviation to the nominal value for hop frequency (hop model) or chirp rate (chirp model) is compensated *in addition to the nominal value*. If your goal is to see the smallest deviation from a best-fit of the model parameters, then you can leave this option activated.

However, if you need to determine the deviation from a specific user-defined model parameter value, then de-activate this option. In this case, *only the nominal value* is compensated.

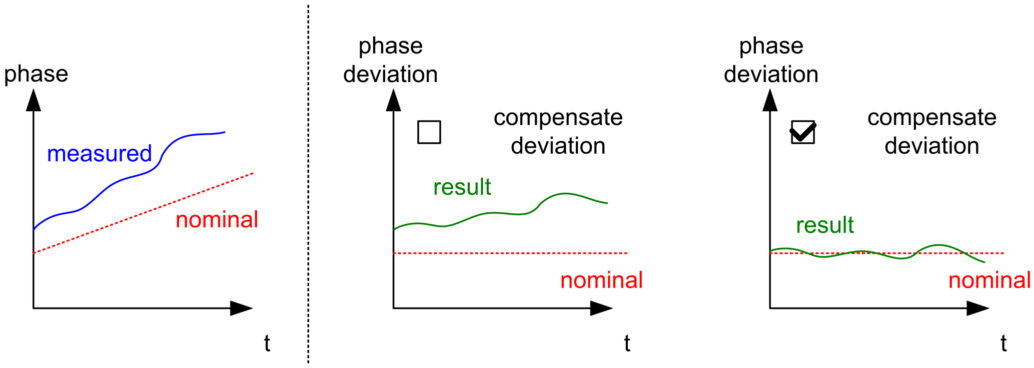


Figure 6-4: Results without and with measured deviation compensation

Remote command:
`CALCulate<n>:HOPDetection:COMPensation[:STATe]` on page 250
`CALCulate<n>:CHRDetection:COMPensation[:STATe]` on page 243

Coherent Phase Deviation Measurement
For coherent hops, the phase deviation can also be calculated based on a common reference phase trajectory, instead of the ideal phase trajectory of a single hop. The common reference phase trajectory is calculated from the first detected hop assigned to a nominal frequency (hop state). This trajectory is then used for the phase deviation calculation of all subsequent hops of the same hop state. For each different hop state, a separate reference phase trajectory is calculated.

If disabled, the reference phase for the deviation measurement is determined for each hop individually.

This function is only available for the R&S VSE-K60H option.

For details see "Coherent phase deviation measurement" on page 49.

Remote command:
`CALCulate<n>:HOPDetection:PCOHerent[:STATe]` on page 254

FM Settling Tolerance
Defines the allowed deviation from the detected FM signal model state where the hop or chirp is considered as "settled". One global FM settling tolerance is defined (in Hertz) for all hops or chirps.

Remote command:
`CALCulate<n>:HOPDetection:FMTolerance` on page 252
`CALCulate<n>:CHRDetection:FMTolerance` on page 245

PM Settling Tolerance
Defines the allowed deviation from the detected PM signal model state where the hop or chirp is considered as "settled". One global PM settling tolerance is defined (in degrees) for all hops or chirps.

Remote command:
`CALCulate<n>:HOPDetection:PMTolerance` on page 256
`CALCulate<n>:CHRDetection:PMTolerance` on page 248

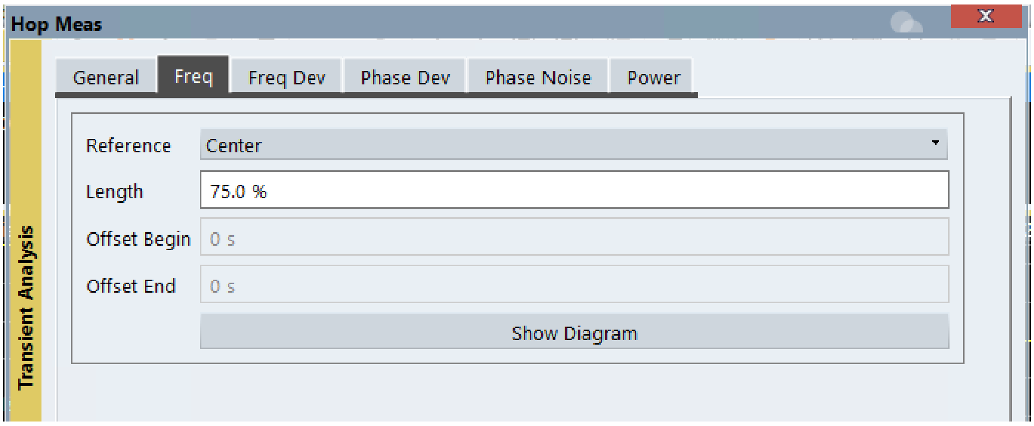
6.7.2 Specific measurement settings

Access: "Overview" > "Measurement" > "Freq"/ "Freq Dev"/ "Phase Dev"/ "Power"

The "Frequency/Phase" settings determine which part of the hop/chirp is used to calculate the average frequency/phase in one hop/chirp.

The "Power" settings determine which part of the hop/chirp is used to calculate the average power in one hop/chirp.

For details on the measurement range parameters see Chapter 4.7, "Measurement range", on page 29.



Reference
Defines the reference point for positioning the frequency/phase/power measurement range. The Offset Begin / Offset End is given with respect to this value.

"Edge"	The measurement range is defined in reference to the rising or falling edge.
"Center"	The measurement range is defined in reference to the center of the hop/chirp.
"FM Settling"	The measurement range starts at the FM settling point (see "FM settling point" on page 52).

Remote command:
CALCulate<n>:CHRDetection:FREQuency:REFerence on page 246
CALCulate<n>:CHRDetection:FDEViation:REFerence on page 244
CALCulate<n>:CHRDetection:PDEViation:REFerence on page 248
CALCulate<n>:CHRDetection:POWer:REFerence on page 250
CALCulate<n>:CHRDetection:PNOise:REFerence on page 214
CALCulate<n>:HOPDetection:FREQuency:REFerence on page 254
CALCulate<n>:HOPDetection:FDEViation:REFerence on page 252
CALCulate<n>:HOPDetection:PDEViation:REFerence on page 256
CALCulate<n>:HOPDetection:POWer:REFerence on page 257
CALCulate<n>:HOPDetection:PNOise:REFerence on page 214

Length

Defines the length or duration of the frequency/phase/power measurement range.

Remote command:
CALCulate<n>:CHRDetection:FREQuency:LENGth on page 245
CALCulate<n>:CHRDetection:FDEViation:LENGth on page 243
CALCulate<n>:CHRDetection:PDEViation:LENGth on page 247
CALCulate<n>:CHRDetection:POWer:LENGth on page 249
CALCulate<n>:CHRDetection:PNOise:LENGth on page 215
CALCulate<n>:HOPDetection:FREQuency:LENGth on page 253
CALCulate<n>:HOPDetection:FDEViation:LENGth on page 251
CALCulate<n>:HOPDetection:PDEViation:LENGth on page 255
CALCulate<n>:HOPDetection:POWer:LENGth on page 257
CALCulate<n>:HOPDetection:PNOise:LENGth on page 215

Offset Begin / Offset End

The offset in seconds from the beginning or end of the Reference.

Remote command:
CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin on page 245
CALCulate<n>:CHRDetection:FREQuency:OFFSet:END on page 246
CALCulate<n>:CHRDetection:FDEViation:OFFSet:BEGin on page 243
CALCulate<n>:CHRDetection:FDEViation:OFFSet:END on page 244
CALCulate<n>:CHRDetection:PDEViation:OFFSet:BEGin on page 247
CALCulate<n>:CHRDetection:PDEViation:OFFSet:END on page 247
CALCulate<n>:CHRDetection:POWer:OFFSet:BEGin on page 249
CALCulate<n>:CHRDetection:POWer:OFFSet:END on page 249
CALCulate<n>:CHRDetection:PNOise:OFFSet:BEGin on page 215
CALCulate<n>:CHRDetection:PNOise:OFFSet:END on page 216
CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin on page 253
CALCulate<n>:HOPDetection:FREQuency:OFFSet:END on page 253
CALCulate<n>:HOPDetection:FDEViation:OFFSet:BEGin on page 251
CALCulate<n>:HOPDetection:FDEViation:OFFSet:END on page 251
CALCulate<n>:HOPDetection:PDEViation:OFFSet:BEGin on page 255
CALCulate<n>:HOPDetection:PDEViation:OFFSet:END on page 255
CALCulate<n>:HOPDetection:POWer:OFFSet:BEGin on page 257
CALCulate<n>:HOPDetection:POWer:OFFSet:END on page 257

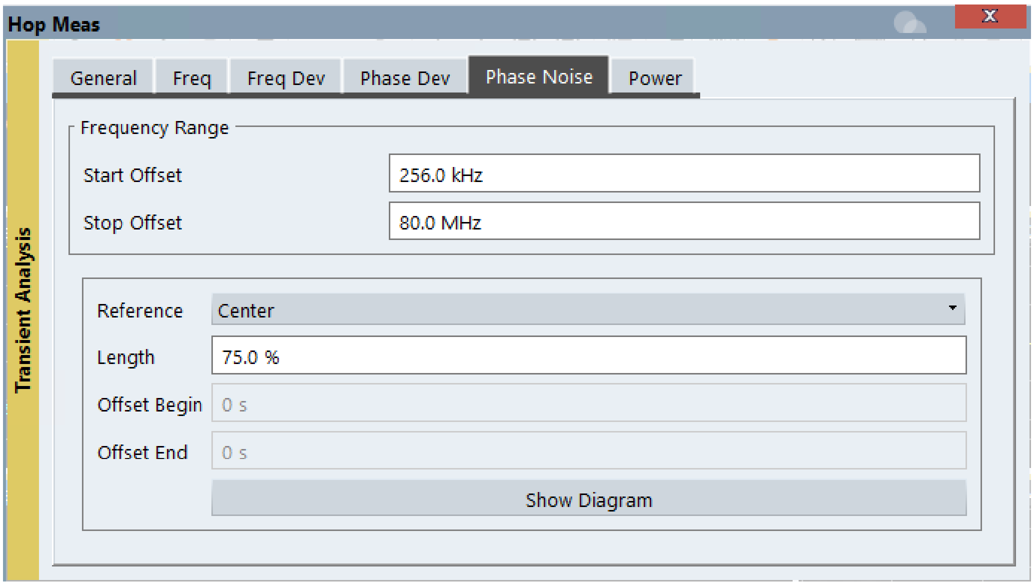
CALCulate<n>:HOPDetection:PNOise:OFFSet:BEGin on page 216
CALCulate<n>:HOPDetection:PNOise:OFFSet:END on page 216

Show Diagram / Hide Diagram
Hides or displays an illustration of the currently selected measurement range settings.

6.7.3 Phase noise measurement settings (R&S VSE-K60P)

Access: "Overview" > "Measurement" > "Phase Noise"

The following settings are available if option R&S VSE-K60P is installed.



Start / Stop Offset
Defines the frequency offsets that make up the measurement range.

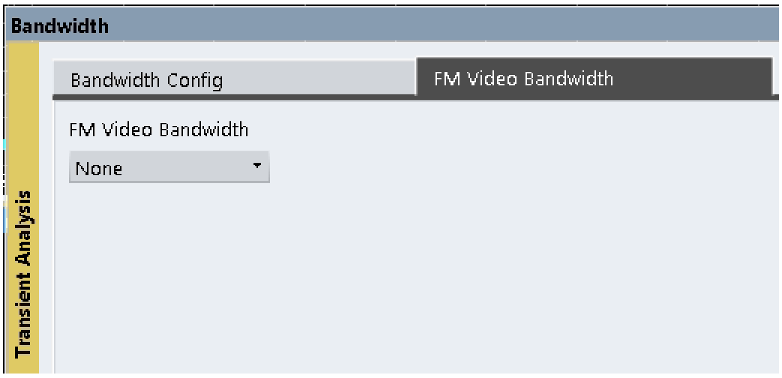
Note that the maximum offset you can select depends on the hardware you are using.

Remote command:
Start Offset
CALCulate<n>:CHRDetection:PNOise:FREQuency:STARt on page 213
CALCulate<n>:HOPDetection:PNOise:FREQuency:STARt on page 213
Stop Offset
CALCulate<n>:CHRDetection:PNOise:FREQuency:STOP on page 213
CALCulate<n>:HOPDetection:PNOise:FREQuency:STOP on page 213

6.8 FM video bandwidth

Access: "Meas Setup" > "Bandwidth" > "FM Video BW"

A video filter applied during demodulation can filter out unwanted signals.



FM Video Bandwidth
Additional filters applied after demodulation help filter out unwanted signals, or correct pre-emphasized input signals.

- Relative low pass filters:
  Relative filters (3 dB) can be selected in % of the analysis (demodulation) bandwidth. The filters are designed as 5th-order Butterworth filters (30 dB/octave) and active for all demodulation bandwidths.
- "None" deactivates the FM video bandwidth (default).

Remote command:
`[SENSe:]DEMod:FMVF:TYPE` on page 258

6.9 Adjusting settings automatically

Access: "Auto Set" toolbar

Some settings can be adjusted by the R&S VSE 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)
To determine the required reference level, a level measurement is performed on the connected instrument.

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.

When using the optional 2 GHz bandwidth extension (B2000) or the optional oscilloscope baseband input, the level measurement is performed on the connected oscilloscope. For B2000, y-axis scaling on the oscilloscope is limited to a minimum of 5 mV per division.

Remote command:
[SENSe<ip>:]ADJust:LEVel on page 262

7 Analysis

Access: "Overview" > "Analysis"

General result analysis settings concerning the trace, markers, windows etc. can be configured via the "Analysis" button in the "Overview". They are identical to the analysis functions in the base unit except for the special window functions.

7.1 Result configuration

Access: "Overview" > "Result Config"

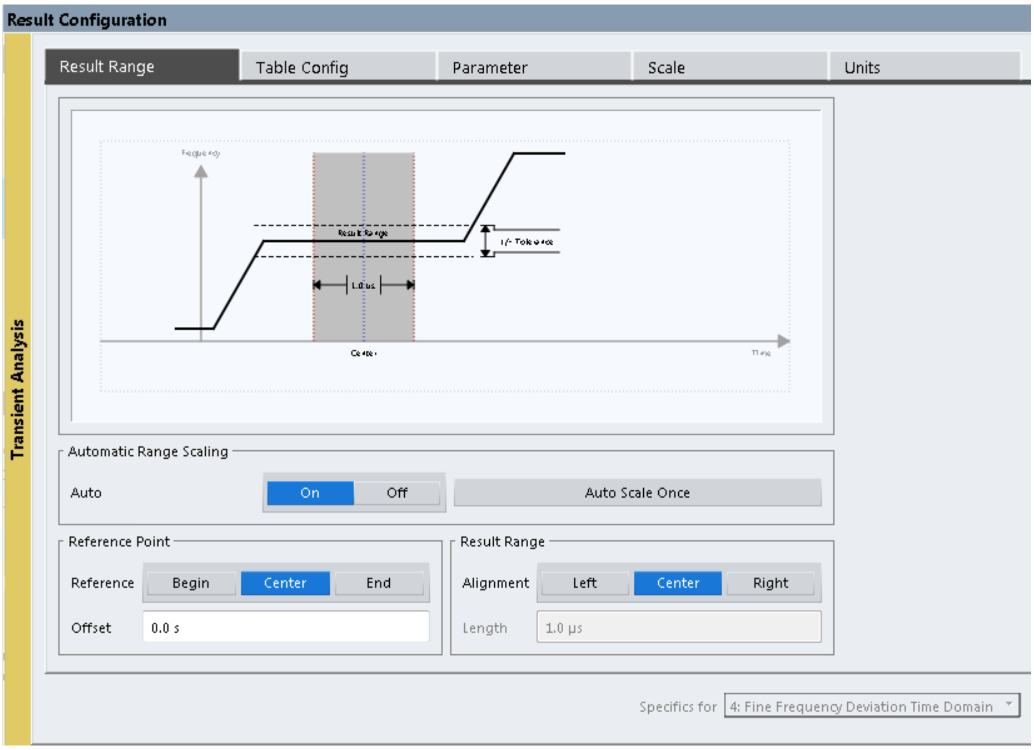
Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specifics for " on page 82).

7.1.1 Result range

Access: "Overview" > "Result Config" > "Result Range" tab

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 43). This range applies to the hop/chirp magnitude, frequency and phase vs time displays.

These settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.



The range is defined by a reference point, alignment and the range length.

Automatic Range Scaling

Defines whether the result range length is determined automatically according to the width of the selected hop/chirp (see "Select Hop / Select Chirp" on page 125).

"OFF" Switches automatic range scaling off

"ON" Switches automatic range scaling on

Remote command:
`CALCulate<n>:RESult:RANGe:AUTO` on page 276

Result Range Reference Point

Defines the reference point for positioning the result range. The Offset is given with respect to this value.

"Rise" The result range is defined in reference to the rising edge.

"Center" The result range is defined in reference to the center of the hop/chirp top.

"Fall" The result range is defined in reference to the falling edge.

Remote command:
`CALCulate<n>:RESult:REFerence` on page 276

Offset
The offset in seconds from the hop/chirp edge or center at which the result range reference point occurs.

Remote command:
`CALCulate<n>:RESult:OFFSet` on page 275

Alignment
Defines the alignment of the result range in relation to the selected Result Range Reference Point.

"Left"	The result range starts at the hop/chirp center or selected edge.
"Center"	The result range is centered around the hop/chirp center or selected edge.
"Right"	The result range ends at the hop/chirp center or selected edge.

Remote command:
`CALCulate<n>:RESult:ALIGnment` on page 274

Length
Defines the length or duration of the result range.

Remote command:
`CALCulate<n>:RESult:LENGth` on page 275

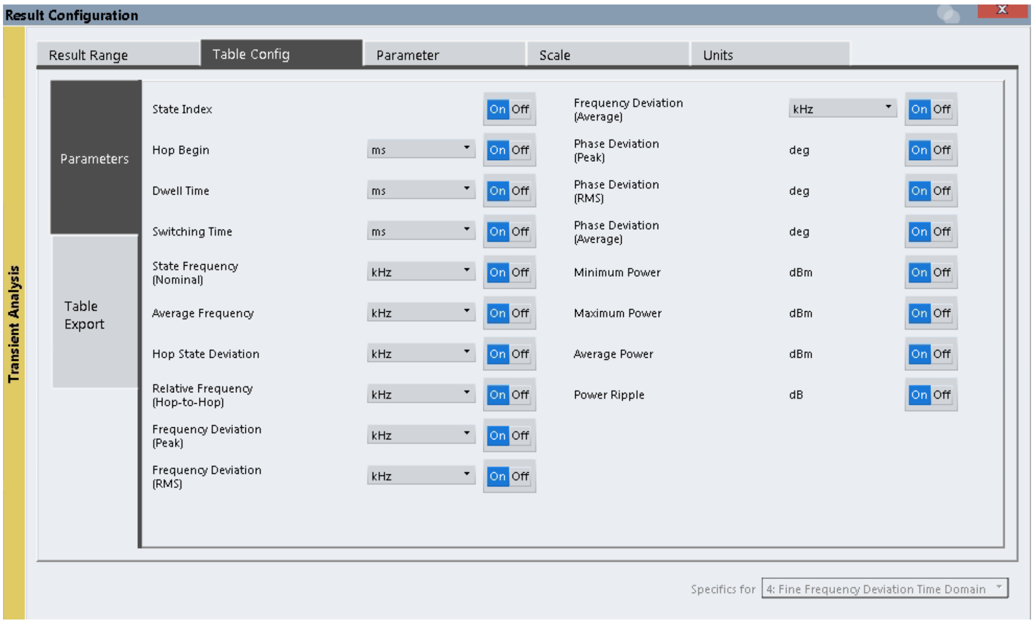
7.1.2 Table configuration

Access: "Overview" > "Result Config" > "Table Config" tab > "Parameters" tab

During each measurement, a large number of statistical and characteristic values are determined. The "Hop/Chirp Statistics" and "Hop/Chirp Results" tables display an overview of the parameters selected here. Note that the table configuration applies to both result tables, it is not window-specific.

These settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.

Table export settings are described in "Table Export Configuration" on page 137.



Select the parameters to be included in the table, and the required unit scaling, if available.

For a description of the individual parameters see Chapter 5.1, "Hop parameters", on page 44/ Chapter 5.2, "Chirp parameters", on page 54.

Remote command:

`CALCulate<n>:CHRDetection:TABLe:COLumn` on page 278

`CALCulate<n>:HOPDetection:TABLe:COLumn` on page 288

7.1.3 Parameter configuration for result displays

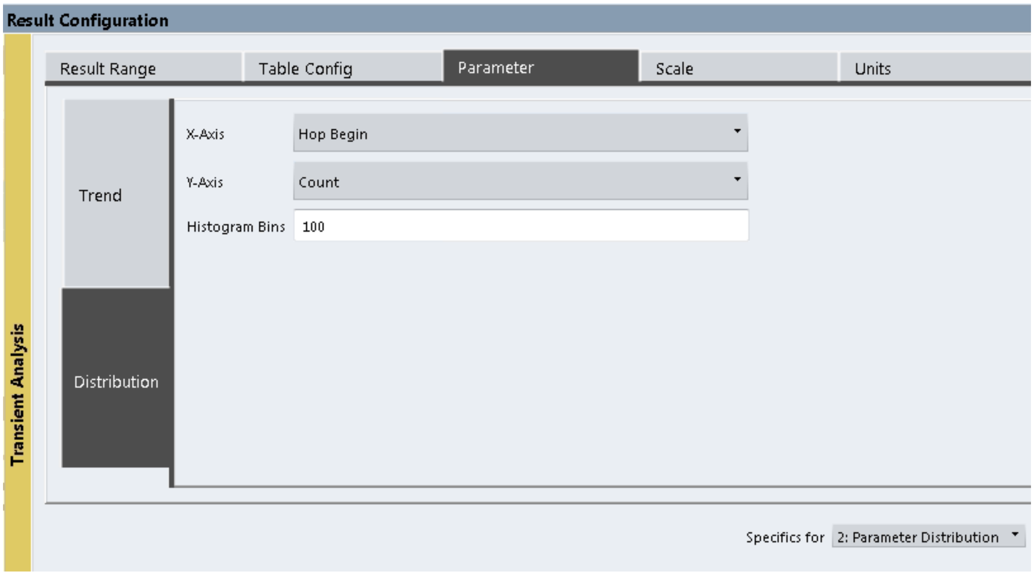
Access: "Overview" > "Result Config" > "Parameter" tab

For parameter trend or distribution displays you can define which parameters are to be evaluated in each window.

7.1.3.1 Parameter distribution configuration

Access: "Overview" > "Result Config" > "Parameter" tab > "Distribution" tab

The parameter distribution evaluations allow you to visualize the number of occurrences for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.



Note that this tab is only available for windows with a Parameter Distribution evaluation.

X-Axis

Defines the parameter for which the values are displayed on the x-axis. For a description of the parameters see Chapter 5.1, "Hop parameters", on page 44/ Chapter 5.2, "Chirp parameters", on page 54.

Remote command:
`CALCulate<n>:DISTribution:X?` on page 307

Y-Axis

Defines the scaling of the y-axis.

"Count"	Number of hops/chirps in which the value occurred.
"Occurrence"	Number of occurrences in percent of all measured values.

Remote command:
`CALCulate<n>:DISTribution:Y?` on page 308

Histogram Bins

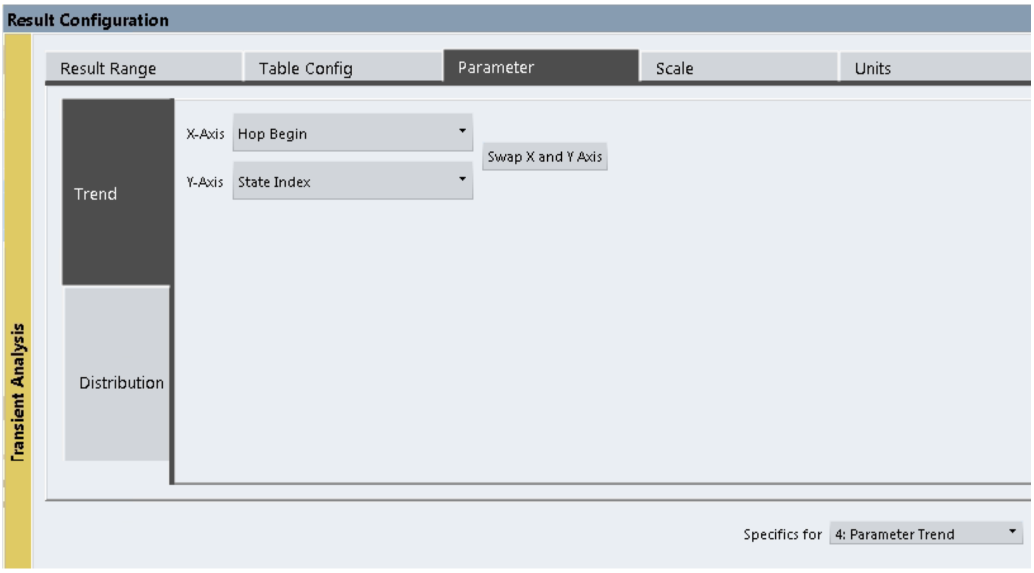
Number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Remote command:
`CALCulate<n>:DISTribution:NBINs` on page 307

7.1.3.2 Parameter trend configuration

Access: "Overview" > "Result Config" > "Parameter" tab > "Trend" tab

The parameter trend result displays allow you to visualize changes in a specific parameter for all measured hops/chirps within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed on the x-axis and which on the y-axis.



Note that this tab is only available for windows with a Parameter Trend evaluation.

X-Axis
Defines the parameter for the trend which is displayed on the x-axis. For a description of the parameters see Chapter 5.1, "Hop parameters", on page 44/ Chapter 5.2, "Chirp parameters", on page 54.

Remote command:
`CALCulate<n>:TRENd:X?` on page 309

Y-Axis
Defines the parameter for the trend which is displayed on the y-axis. For a description of the parameters see Chapter 5.1, "Hop parameters", on page 44/ Chapter 5.2, "Chirp parameters", on page 54.

Remote command:
`CALCulate<n>:TRENd:Y?` on page 309

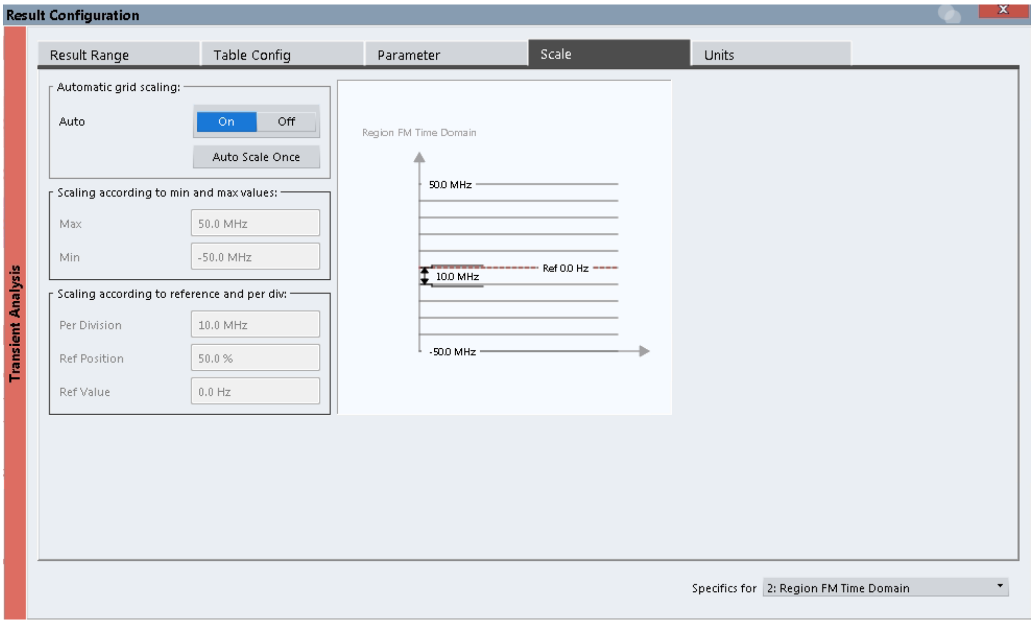
Swap X and Y Axis
Swaps the parameters on the x-axis and y-axis in a Parameter Trend result display.

Remote command:
`CALCulate<n>:TRENd:SWAP:XY` on page 308

7.1.4 Y-Axis scaling

Access: "Overview" > "Result Config" > "Scale" tab

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These settings are described here.



Automatic Grid Scaling

The y-axis is scaled automatically according to the current measurement settings and results (continuously).

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once " on page 122 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 348

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.

This function is only available for RF measurements.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 348

Absolute Scaling (Min/Max Values)
Define the scaling using absolute minimum and maximum values.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 348
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 348

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 349

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 349

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 350

Spectrogram y-scaling
For spectrograms, the displayed y-levels are defined as a range below the reference level.

Range ← Spectrogram y-scaling
Defines the full value span in dB that can be displayed by the color map. Note that the span actually used for the color map definition may be restricted (see "Start / Stop " on page 136).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 347

Ref Level Position ← Spectrogram y-scaling
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.

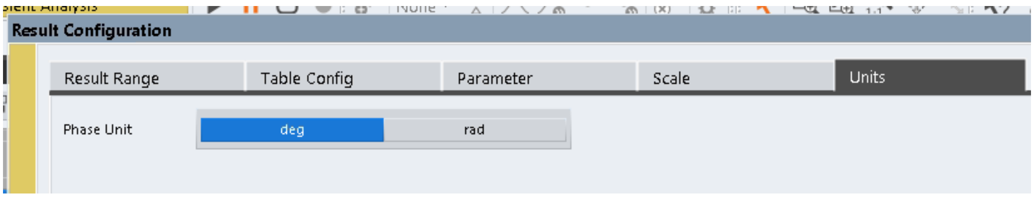
For spectrograms, this value defines the position of the reference level value within the span covered by the color map. In this case, the value is given in %, where 0 % corresponds to the maximum (right end) and 100 % to the minimum (left end) of the color map.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 349

7.1.5 Units

Access: "Overview" > "Result Config" > "Units" tab

The unit for phase display is configurable. This setting is described here.



Phase Unit
Defines the unit in which phases are displayed (degree or rad).

Remote command:
`CALCulate<n>:UNIT:ANGLe` on page 347

7.2 Evaluation basis

Depending on the measurement task, not all of the measured data in the capture buffer may be of interest. In some cases it may be useful to restrict analysis to a specific user-definable region, or to a selected individual chirp rate or hop.

Which evaluation basis is available for which result display is indicated in Table 5-1.

Some of these settings are only available if at least one of the additional options R&S VSE-K60C/-K60H are installed.

Full Capture / Region Analysis / Hop / Chirp
For some result displays you can select the basis used for analysis:

- The full capture buffer
- The selected Analysis Region
- An individual selected hop / chirp (only available if at least one of the additional options R&S VSE-K60C/-K60H are installed, see "Select Hop / Select Chirp" on page 125)
  The currently selected hop / chirp is highlighted blue in the "Result Table" and "Statistic Table" displays.
  As soon as a new hop / chirp is selected, all hop/chirp-specific displays are automatically updated.

Remote command:
`DISPlay[:WINDow<n>]:EVALuate` on page 273

Select Hop / Select Chirp
Defines the individual hop or chirp from the current capture buffer for which results are calculated and displayed.

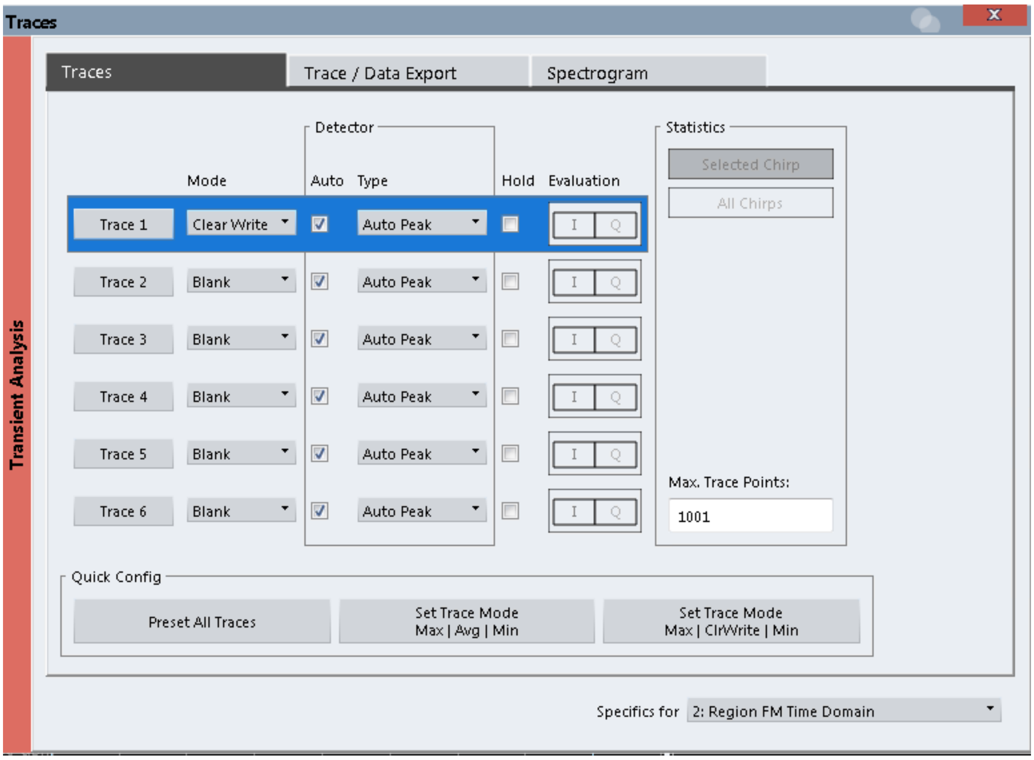
Remote command:
`CALCulate<n>:CHRDetection:SELected` on page 277
`CALCulate<n>:HOPDetection:SELected` on page 277

7.3 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 6 traces may be displayed.

Trace data can also be exported to an ASCII file for further analysis. For details see Chapter 7.4, "Trace / data export configuration", on page 129.



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6

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 352

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 R&S VSE 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 351

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:

"Auto" Selects the optimum detector for the selected trace and filter mode. This is the default setting.

"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, R&S VSE 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

Remote command:
`[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO` on page 353

Hold
If activated, traces in "Min Hold" , "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous
on page 352

Evaluation
Defines which signal component (I/Q) is evaluated in which trace for the I/Q Time Domain result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Remote command:
CALCulate<n>:TRACe<t>[:VALue] on page 350

Statistical Evaluation
If the trace modes "Average", "Max Hold" or "Min Hold" are set, you can define how many hops or chirp rates are included in the statistical evaluation.

For details see Chapter 4.8.3, "Trace statistics", on page 34.

Selected Hop/Selected Chirp vs All Hops/All Chirps ← Statistical Evaluation
Defines which hops/chirps are included in the statistical evaluation.

"Selected hop/ chirp"	Only the selected hop/chirp from each sweep (capture) is included in the statistical evaluation.
"All Hops/ Chirps"	All measured hops/chirps from each sweep (capture) are included in the statistical evaluation.

Remote command:
[SENSe:]STATistic<n>:TYPE on page 354

Capture Count ← Statistical Evaluation
Defines the number of measurements to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one measurement is performed.

Remote command:
[SENSe:]SWEep:COUNt on page 354

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see Chapter 7.1.1, "Result range", on page 116) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

For details see also Chapter 4.8.1, "Mapping samples to measurement points with the trace detector", on page 31.

Restricting this value can improve performance during statistical evaluation of large result range lengths.

Remote command:
[SENSe:]MEASure:POINts on page 353

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 352

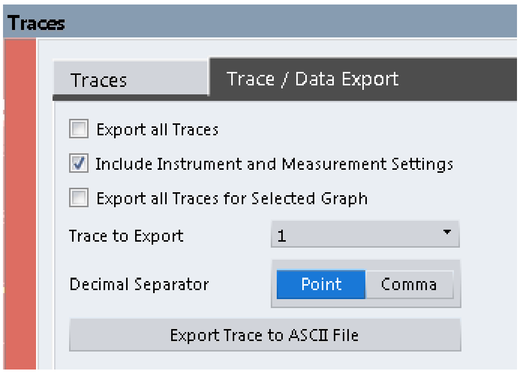
7.4 Trace / data export configuration

Traces resulting from encrypted file input cannot be exported.

The R&S VSE provides various evaluation methods for the results of the performed measurements. However, if you want to evaluate the data with other, external applications, you can export the measurement data to a standard format file (ASCII or CSV).

The standard data management functions that are available for all R&S VSE applications are not described here, e.g. saving or loading instrument settings, or exporting the I/Q data in other formats.

See the R&S VSE base software user manual for a description of the standard functions.



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

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

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

Remote command:
`FORMat:DEXPort:TRACes` on page 452

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 451

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

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

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

Remote command:
`FORMat:DEXPort:DSEParator` on page 451

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.

Note: Traces resulting from encrypted file input cannot be exported.

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 453

7.5 Spectrogram settings

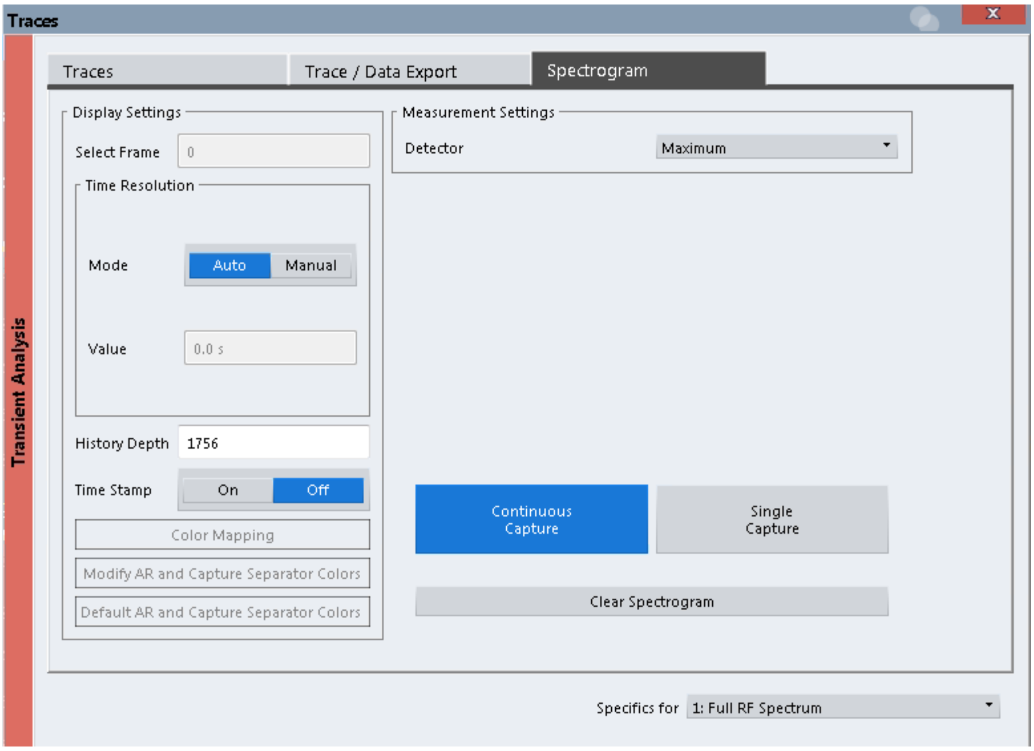
Access: [MEAS CONFIG] > "Spectrogram Config"

The individual settings available for spectrogram display are described here. For settings on color mapping, see Chapter 7.5.2, "Color map settings", on page 135.

7.5.1 General spectrogram settings

Access: [MEAS CONFIG] > "Spectrogram Config"

This section describes general settings for spectrogram display.



The FFT analysis used to create the spectrogram is configurable, in order to improve detection of transient signal effects or minimize the duration of the calculation. For details on FFT calculation see Chapter 4.2, "Signal processing", on page 18.

Select Frame

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

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

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

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

For more information, see Chapter 4, "Measurement basics", on page 18.

Remote command:
`CALCulate<n>:SGRam:FRAMe:SELect` on page 355

Time Resolution
The time resolution determines the size of the bins used for each FFT calculation. The shorter the time span used for each FFT, the shorter the resulting span, and thus the higher the resolution in the spectrum becomes.

In "Auto" mode, the optimal resolution is determined automatically according to the data acquisition settings.

In "Manual" mode, you must define the time resolution in seconds.

Remote command:
`CALCulate<n>:SGRam:TRESolution:AUTO` on page 356
`CALCulate<n>:SGRam:TRESolution` on page 356

History Depth
Sets the number of frames that the R&S VSE stores in its memory.

If the memory is full, the R&S VSE deletes the oldest frames stored in the memory and replaces them with the new data.

Remote command:
`CALCulate<n>:SGRam:HDEPth` on page 356

Time Stamp
Activates and deactivates the timestamp. The timestamp shows the system time while the measurement is running. In single sweep mode or if the measurement is stopped, the timestamp shows the time and date of the end of the measurement.

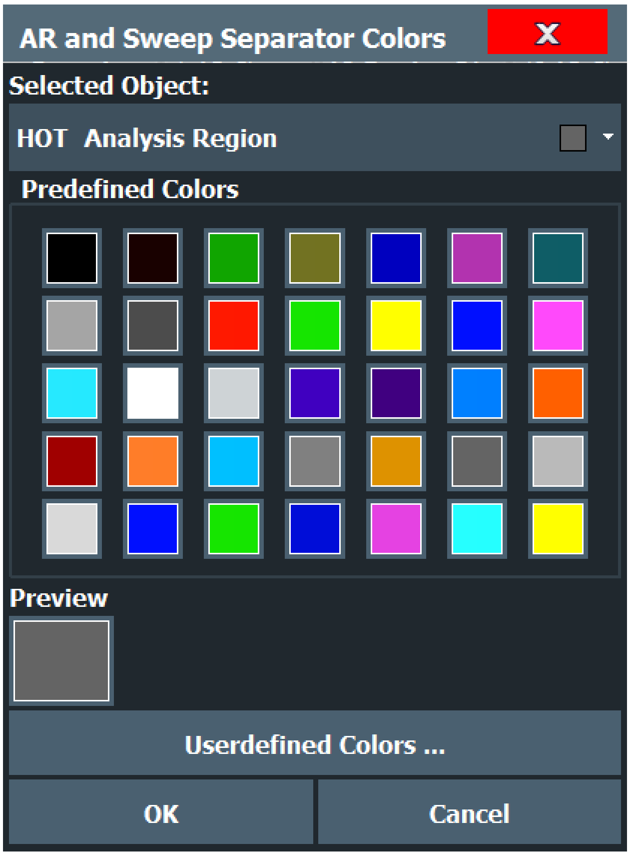
When active, the timestamp replaces the display of the frame number.

Remote command:
`CALCulate<n>:SGRam:TSTamp[:STATe]` on page 357
`CALCulate<n>:SGRam:TSTamp:DATA?` on page 357

Color Mapping
Opens the "Color Mapping" dialog.

Modifying Analysis Region and Sweep Separator Colors
For each color scheme (see "Hot /Cold /Radar /Grayscale " on page 136) you can configure the colors used to indicate the analysis range and sweep separator lines in spectrograms.

For details on the analysis range and sweep separator lines see Chapter 4.5, "Analysis region", on page 25 and Chapter 4.9.1, "Time frames", on page 37.



Selecting the Object ← Modifying Analysis Region and Sweep Separator Colors
Selects the object for which the color is to be defined. Colors can be defined for each combination of:

Color scheme + analysis region

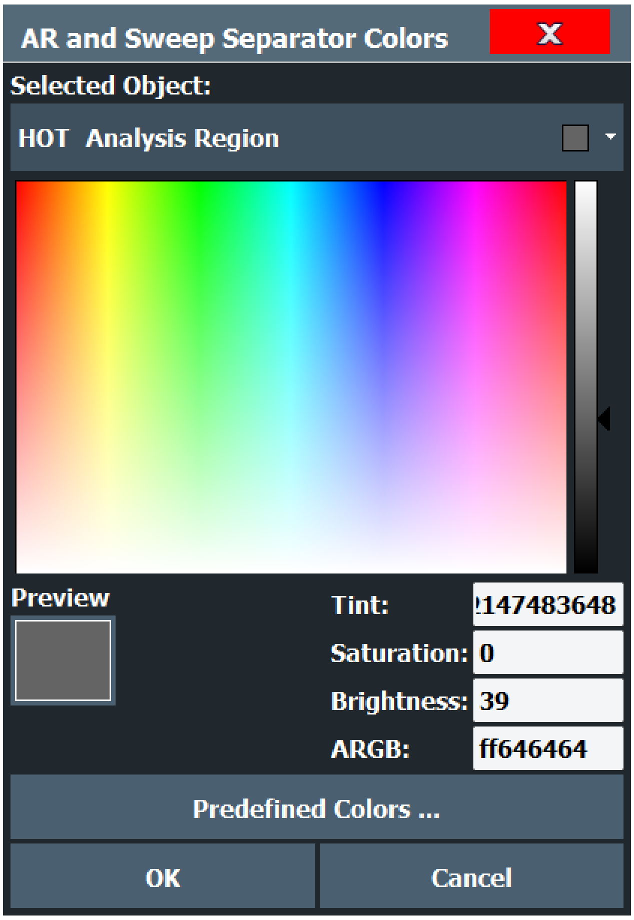
Color scheme + sweep separator

Preview ← Modifying Analysis Region and Sweep Separator Colors
Indicates the currently selected color that will be used for the selected object.

Predefined Colors ← Modifying Analysis Region and Sweep Separator Colors
Displays the available colors from the predefined color set that can be used for the selected object.

Defining User-specific Colors ← Modifying Analysis Region and Sweep Separator Colors
In addition to the colors in the predefined color set you can configure a user-specific color to be used for the selected object.

When you select "Userdefined Colors", the set of predefined colors is replaced by a color palette and color configuration settings.



The color palette allows you to select the color directly. The color settings allow you to define values for tint, saturation and brightness.

Restoring Default AR and Sweep Separator Colors
Restores the default colors used to indicate the analysis range and sweep separator lines in spectrograms.

Detector
Defines the detector used to combine overlapping FFT frames for the spectrogram result display.

"Sum"	Calculates the sum of all values in one sample point
"Average"	Calculates the linear average of all values in one sample point
"RMS"	Calculates the RMS of all values in one sample point
"Maximum"	Determines the largest of all values in one sample point
"Minimum"	Determines the minimum of all values in one sample point
"Sample"	Selects the last measured value for each sample point

Remote command:
`[SENSe:][WINDow<n>:]SGRam|SPECtrogram:DETector:FUNCtion` on page 358

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>:SGRam:CLEar` on page 355

Clear All Spectrograms

Resets all spectrogram result displays and clears the history buffers.

This function is only available if a spectrogram is selected.

Remote command:
`CALCulate<n>:SGRam:CLEar` on page 355

7.5.2 Color map settings

Access: "Overview" > "Analysis" > "Traces" > "Color Mapping"

or: "Trace" > "Spectrogram" > "Color Mapping"

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.

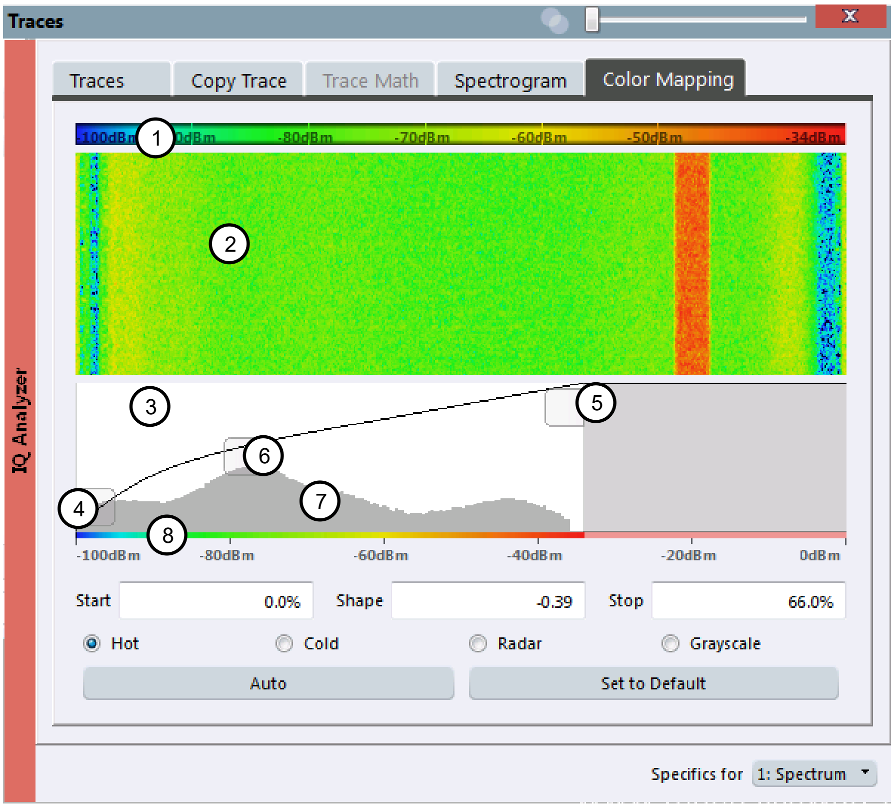


Figure 7-1: Color Mapping dialog box

1 = Color map: shows the current color distribution
2 = Preview pane: shows a preview of the spectrogram 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 spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer` on page 360
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer` on page 360

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
">0 to 1"	More colors are distributed among the higher values

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe` on page 360

Hot /Cold /Radar /Grayscale
Sets the color scheme for the spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]` on page 361

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

Set to Default
Sets the color mapping to the default settings.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault` on page 359

Close
Saves the changes and closes the dialog box.

7.6 Export functions

Access: "Save" > "Export"

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

See the R&S VSE User Manual for a description of the standard functions.

Export table to ASCII File
Opens a file selection dialog box and saves the selected result table in ASCII format (**.DAT**) to the specified file and directory.

Remote command:
MMEMory:STORe<n>:TABLe on page 453

Table Export Configuration
Access: "Overview" > "Result Config" > "Table Config" tab > "Table Export" tab

Or: "Save/Recall" > "Export"

The settings are window-specific and only available for result tables.

Columns to Export ← Table Export Configuration
Defines which of the result table columns are to be included in the export file.

"Visible" Only the currently visible columns in the result display are exported.

"All" All columns, including currently hidden ones, for the result display are exported.

Remote command:
MMEMory:STORe<n>:TABLe on page 453

Decimal Separator ← Table Export Configuration
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 451

Export table to ASCII File ← Table Export Configuration
Opens a file selection dialog box and saves the selected result table in ASCII format (**.DAT**) to the specified file and directory.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 453

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.

Note: Traces resulting from encrypted file input cannot be exported.

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 453

Trace Export Configuration
Opens the "Traces" dialog box to configure the trace and data export settings. See Chapter 7.4, "Trace / data export configuration", on page 129.

7.7 Marker settings

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

7.7.1 Individual marker setup

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

Or: "Marker" > "Marker"

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

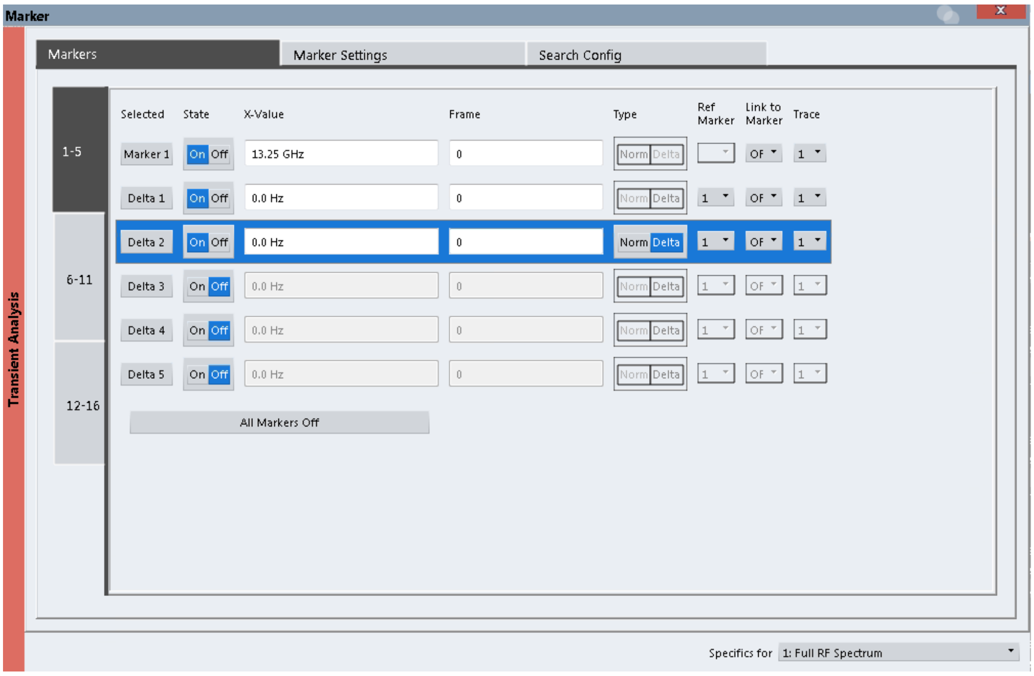


Figure 7-2: Marker settings for spectrogram display

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.

Place New Marker

Activates the next currently unused marker and sets it to the peak value of the current trace in the current window.

If a spectrogram is active, an edit field is displayed for the frame number (≤ 0) in which the marker is to be placed.

Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16

To activate a marker, select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker" > "Select Marker" menu. Enter the marker position ("X-value") in the edit dialog box.

To deactivate a marker, select the marker name in the marker selection list in the toolbar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off" .

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 362
`CALCulate<n>:MARKer<m>:X` on page 363
`CALCulate<n>:MARKer<m>:Y?` on page 364
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 366
`CALCulate<n>:DELTamarker<m>:X` on page 366
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 367
`CALCulate<n>:DELTamarker<m>:Y?` on page 367

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 362
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 366

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 363
`CALCulate<n>:DELTamarker<m>:X` on page 366

Frame (for Spectrograms only)
Spectrogram frame number the marker is assigned to. The most recently swept frame is number 0, all previous frames have negative numbers.

Remote command:
`CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 374

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 362
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 366

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 365

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 362
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 365
`CALCulate<n>:DELTamarker<m>:LINK` on page 364

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.

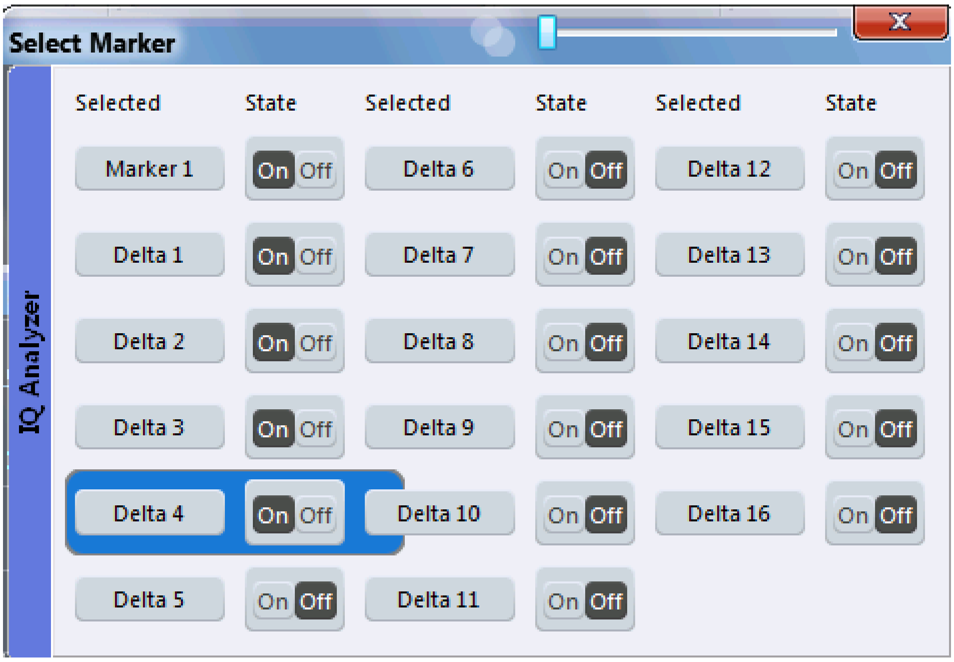
If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 363

Select Marker

M1

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 362
CALCulate<n>:DELTamarker<m>[:STATe] on page 366

All Markers Off

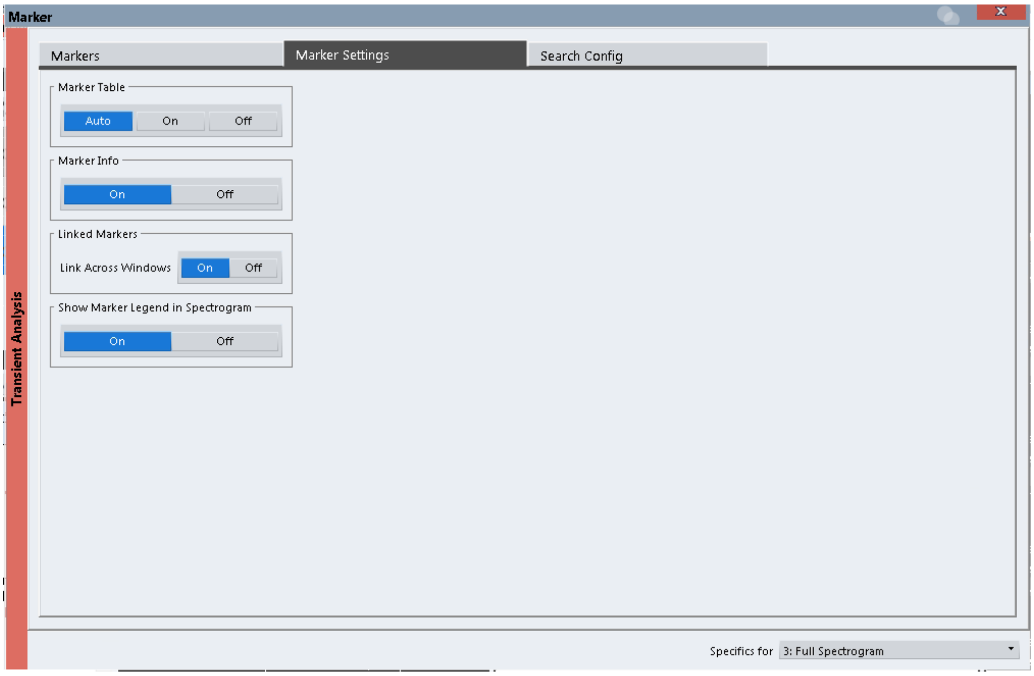
Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 362

7.7.2 General marker settings

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

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



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.

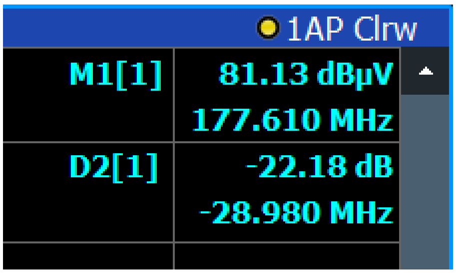
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"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 368

Marker Info

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



Remote command:
DISPlay[:WINDow<n>]:MINFo[:STATe] on page 368

Linked Markers
If enabled, the markers in all Transient Analysis diagrams - regardless of the x-axis unit - are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same position in time. Linking is also possible across spectrogram and spectrum displays.

Remote command:
CALCulate<n>:MARKer<m>:LINK on page 369

Show Marker Legend in Spectrogram
Hides or shows marker information within the spectrogram diagram area (as opposed to the separate marker table, see also "Marker Table Display " on page 143). This setting only takes effect if a marker is active.

7.7.3 Marker search settings and positioning functions

Several functions are available to set the marker to a specific position very quickly and easily, or to use the current marker position to define another characteristic value. In order to determine the required marker position, searches may be performed. The search results can be influenced by special settings.

Most marker positioning functions and the search settings are available in the [MKR ->] menu.

Search settings are also available via [Marker] or in the vertical "Marker Config" tab of the "Analysis" dialog box (horizontal "Search Settings" tab).

7.7.3.1 Marker search settings

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

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.

Depending on the type of result display, different settings are available.

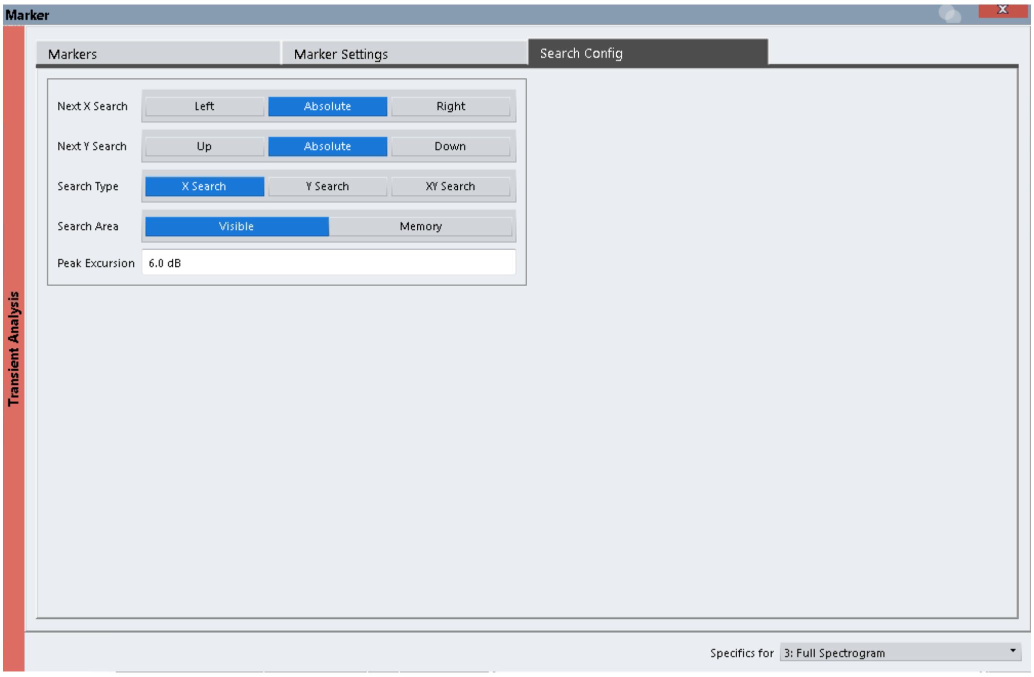


Figure 7-3: Marker search settings for spectrogram

Search Mode for Next Peak in X-Direction
Selects the search mode for the next peak.

For spectrograms:

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:
Chapter 11.5.12.4, "Positioning the marker", on page 369

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 function is available for spectrograms only.

"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 376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe on page 380
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow on page 376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow on page 380
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT on page 376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT on page 380
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe on page 377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe on page 381
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow on page 377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow on page 381
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT on page 377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT on page 382

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 frequency position.

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

Remote command:
Defined by the search function, see Chapter 11.5.12.5, "Marker search (spectrograms)", on page 373

Marker Search Area

Defines which frames the search is performed in.

This function is available for spectrograms only.

"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 375
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea on page 379

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 369

7.7.3.2 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. These functions are available as softkeys in the menu, which is displayed when you press the key.

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 370
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 372

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 371
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 373

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 371
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 373

7.8 Zoom functions

Access: "Zoom" icons in toolbar

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] on page 383
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA on page 382

Multi-Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]
on page 385
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA
on page 384

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:
Single zoom:
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] on page 383
Multiple zoom:
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]
on page 385 (for each multiple zoom window)

Data shift (Pan)

Shifts the data to be evaluated in the result display (analysis region or hop/chirp) and re-evaluates the new data. *ALL* result displays based on the same data (analysis region or hop/chirp) are updated.

Currently, this function is only available in the Transient Analysis application.

Tip: Result tables are also re-evaluated for each data shift, which can take some time. Close the result tables during a data shift/zoom to improve the screen update speed.

For more information, see Chapter 4.6, "Zooming and shifting results", on page 28.

Data Zoom

Decreases the amount of data to be evaluated in the result display (analysis region or hop/chirp) and re-evaluates the new data, thus enlarging the display of the remaining data.

ALL result displays based on the same data (analysis region or hop/chirp) are updated.

Currently, this function is only available in the Transient Analysis application.

Tip: result tables are also re-evaluated for each data zoom, which can take some time. Close the result tables during a data shift/zoom to improve the screen update speed.

For more information, see Chapter 4.6, "Zooming and shifting results", on page 28.

8 How to perform transient analysis

The following step-by-step instructions demonstrate how to analyze transient signal effects with the R&S VSE Transient Analysis application.

To perform a basic transient analysis measurement

1. Open a new channel or replace an existing one and select the "Transient Analysis" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a Transient Analysis measurement.
3. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
4. Select the "Data Acquisition" button to define the "Data Acquisition (Full)" and "Analysis Region (AR)" parameters for the input signal:
   - "(Full) Measurement Bandwidth": the amount of signal bandwidth to be captured
   - "(Full) Measurement Time": how long the input signal is to be captured
   - "(AR) Bandwidth": the amount of signal bandwidth to be analyzed
   - "(AR) Delta Frequency": the offset from the center frequency
   - "(AR) Time Gate Length"": the absolute length of the time gate
   - "(AR) Time Gate Start"": the starting point of the time span for analysis

   Optionally, you can link the size of the analysis region to the size of the full capture buffer.
5. If necessary, filter out unwanted signals using an FM video filter (in the "BW" settings).
6. Select the "Add Window" icon from the toolbar to add further result displays for the Transient Analysis channel.
7. Select "Meas Setup > Overview" to display the "Overview".
8. Select the "Result Config" button and configure the data basis for evaluation and display.
   - In the "Scale" and "Units" tabs, configure the value range for the y-axis in the individual result displays. (See Chapter 7.1.4, "Y-Axis scaling", on page 122.)
9. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the "Capture" function to stop the continuous measurement mode and start a defined number of measurements.
10. Select "Meas Setup > Selected Pulse" and select a specific pulse to be evaluated.

    The result displays are updated to show the results for the selected pulse.
11. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the displays.

- Configure a trace to display the average over a series of sweeps (on the "Traces" tab, see Chapter 7.3, "Trace settings", on page 125).
- Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.7, "Marker settings", on page 138).
- Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.5, "Spectrogram settings", on page 130).

To detect hops in a transient measurement

This procedure requires the additional option R&S VSE-K60H to be installed.

1. Open a new channel or replace an existing one and select the "Transient Analysis" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a Transient Analysis measurement.
3. Select the "Signal Description" button and configure the expected signal characteristics.
   - In the "Signal Model" tab, select the "Hop" signal model.
   - In the "Signal States" tab, define the known hop states and the conditions for detection (see Chapter 6.2.2, "Signal states", on page 83).

   To generate multiple regularly-spaced hop states easily, do the following:

   a) In the "Signal States" tab, select "More".
   b) Define the "Start Frequency" for the first hop state.
   c) Define the "Step Size" between two hop states.
   d) Define the number of hop states to be generated in the "No of Steps" field.
   e) Select "Add to Table" to add the generated states to the existing table, or select "Replace Table" to overwrite the existing table.
   f) Optionally, define a "Tolerance Value" or "Frequency Offset" (or both) to all hop states and select "Apply to Table" to adapt the hop state settings.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
5. Select the "Data Acquisition" button to define the Data Acquisition (Full) and Analysis Region (AR) parameters for the input signal:
   - "(Full) Measurement Bandwidth": the amount of signal bandwidth to be captured
   - "(Full) Measurement Time": how long the input signal is to be captured
   - "(AR) Bandwidth": the amount of signal bandwidth to be analyzed
   - "(AR) Delta Frequency": the offset from the center frequency
   - "(AR) Time Gate Length"": the absolute length of the time gate
   - "(AR) Time Gate Start"": the starting point of the time span for analysis

   Optionally, you can link the size of the analysis region to the size of the full capture buffer.

6. Select the "Measurement" button and in the "Frequency/Phase" and "Power" tabs, define which parts of the hop will be considered when calculating frequency, phase and power parameters.
7. If necessary, filter out unwanted signals using an FM video filter (in the "BW" settings).
8. Select the "Result Config" button and configure the data basis for evaluation and display.
   - In the "Result Range" tab, define the area of the hop to be analyzed in the result display. Define the area by a reference point, a length, and its alignment in relation to the hop's center or edges. (See Chapter 7.1.1, "Result range", on page 116.)
   - In the "Table Config" tab, define which parameters are to be displayed in the hop result tables.
   - In the "Parameters" tab, define parameters for which a trend or distribution is to be displayed
   - In the "Scale" and "Units" tabs, configure the value range for the y-axis in the individual result displays. (See Chapter 7.1.4, "Y-Axis scaling", on page 122.)
9. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the displays.
   - Configure a trace to display the average over a series of sweeps or calculate hop statistics (on the "Traces" tab, see Chapter 7.3, "Trace settings", on page 125).
   - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.7, "Marker settings", on page 138).
   - Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.5, "Spectrogram settings", on page 130).

To detect chirps in a transient measurement

This procedure requires the additional option R&S VSE-K60C to be installed.

1. Open a new channel or replace an existing one and select the "Transient Analysis" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a Transient Analysis measurement.
3. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
4. Select the "Data Acquisition" button and define the bandwidth parameters for the input signal:
   - In the "Data Acquisition" area, define:
     – "Measurement Bandwidth": the amount of signal bandwidth to be captured
     – "Measurement Time": how long the input signal is to be captured

- In the "Analysis Region" area, define the frequency range and time gate (within the captured data) which is to be analyzed, that is, which hops are to be detected. (See Analysis Region.)
  Optionally, you can link the size of the analysis region to the size of the full capture buffer.

5. Select the "Signal Description" button and configure the expected signal characteristics.
   - In the "Signal Model" tab, select the "Chirp" signal model.
   - In the "Signal States" tab, define the known chirp states and the conditions for detection. (See Chapter 6.2.2, "Signal states", on page 83)
6. Select the "Measurement" button and in the "Frequency/Phase" and "Power" subtabs, define which parts of the chirp will be considered when calculating frequency, phase and power parameters.
7. If necessary, filter out unwanted signals using an FM video filter (in the "BW" settings).
8. Select the "Result Config" button and configure the data basis for evaluation and display.
   - In the "Result Range" tab, define the area of the chirp to be analyzed in the result display. Define the area by a reference point, a length, and its alignment in relation to the chirp's center or edges. (See Chapter 7.1.1, "Result range", on page 116.)
   - In the "Table Config" tab, define which parameters are to be displayed in the chirp result tables.
   - In the "Parameters" tab, define parameters for which a trend or distribution is to be displayed
   - In the "Scale" and "Units" tabs, configure the value range for the y-axis in the individual result displays. (See Chapter 7.1.4, "Y-Axis scaling", on page 122.)
9. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the displays.
   - Configure a trace to display the average over a series of sweeps or calculate chirp statistics (on the "Traces" tab, see Chapter 7.3, "Trace settings", on page 125).
   - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.7, "Marker settings", on page 138).
   - Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.5, "Spectrogram settings", on page 130).

8.1 How to display and configure a spectrogram

Step-by-step instructions on how to display and configure a spectrogram are provided here.

For details on individual functions and settings see Chapter 7.5, "Spectrogram settings", on page 130. The remote commands required to perform these tasks are described in Chapter 11.5.10, "Configuring spectrograms", on page 355.

The following tasks are described here:

- "To display a spectrogram" on page 154
- "To remove the spectrogram display" on page 154
- "To set a marker in the spectrogram" on page 155
- "To configure a spectrogram" on page 155
- "To select a color scheme" on page 156
- "To set the value range graphically using the color range sliders" on page 156
- "To set the value range of the color map numerically" on page 156
- "To set the color curve shape graphically using the slider" on page 157
- "To set the color curve shape numerically" on page 157

To display a spectrogram

1. Select a Magnitude or Spectrum result display.
2. From the "Trace" menu, select "Spectrogram".

   The Spectrogram is automatically displayed as a subwindow of the selected result display, where each subwindow is the same size.
3. To enlarge the Spectrogram to the full window size, select "State: Full".
4. To clear an existing spectrogram display, select "Clear Spectrogram".
5. Close the dialog box.

   The spectrogram is updated continuously with each new capture.

To display the Spectrum or Magnitude diagram for a specific time frame:

1. Stop the continuous measurement or wait until the single capture is completed.
2. Select the frame number in the diagram footer of the Spectrogram.
3. Enter the required frame number in the edit dialog box.
   Note that the most recent sweep is frame number 0, all previous frames have negative numbers.

To remove the spectrogram display

1. Select the result display that contains the Spectrogram subwindow.
2. From the "Trace" menu, select "Spectrogram".

3. Select "State: Off"

   The Spectrogram subwindow is closed, and the original result display is restored in full window size.

To set a marker in the spectrogram

1. While a spectrogram is displayed, select the "Place Next Marker" icon in the "Marker" toolbar.
2. Select a "Marker" softkey.
3. Enter the frequency or time (x-value) of the marker or delta marker.
4. Enter the frame number for which the marker is to be set, for example *0* for the current frame, or *-2* for the second to last frame. Note that the frame number is always 0 or a negative value!
   The marker is only visible in the spectrum diagram if it is defined for the currently selected frame. In the spectrogram result display all markers are visible that are positioned on a visible frame.

To configure a spectrogram

1. Configure the spectrogram frames:
   a) From the Meas Setup menu, select "Capture".
   b) In the "Capture Count" field, define how many captures are to be analyzed to create a single frame.
   c) In the "Frame Count" field, define how many frames are to be plotted during a single measurement.
   d) To include frames from previous measurements in the analysis of the new frame (for "Max Hold", "Min Hold" and "Average" trace modes only), select "Continue Frame" = "ON".
2. Define how many frames are to be stored in total:
   a) From the "Trace" menu, select "Spectrogram".
   b) In the "History Depth" field, enter the maximum number of frames to store.
3. If necessary, adapt the color mapping for the spectrogram to a different value range or color scheme as described in Chapter 8.1.1, "How to configure the color mapping", on page 155.

8.1.1 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.
- From the "Trace" menu, select "Spectrogram" , then select "Color Mapping" , or switch to the "Color Mapping" tab directly.

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.

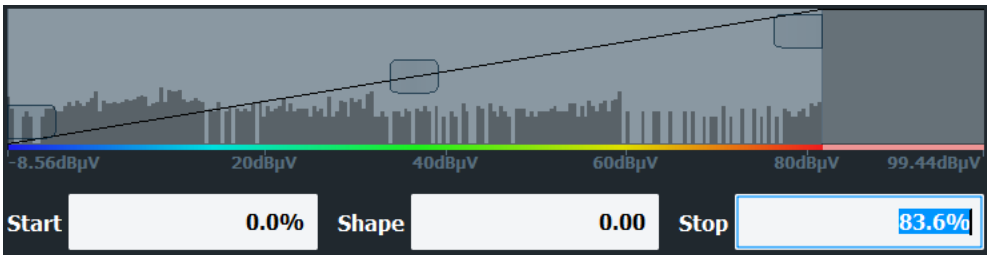
To ignore noise in a spectrogram, for example, exclude the lower power levels from the histogram.

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 R&S VSE 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.

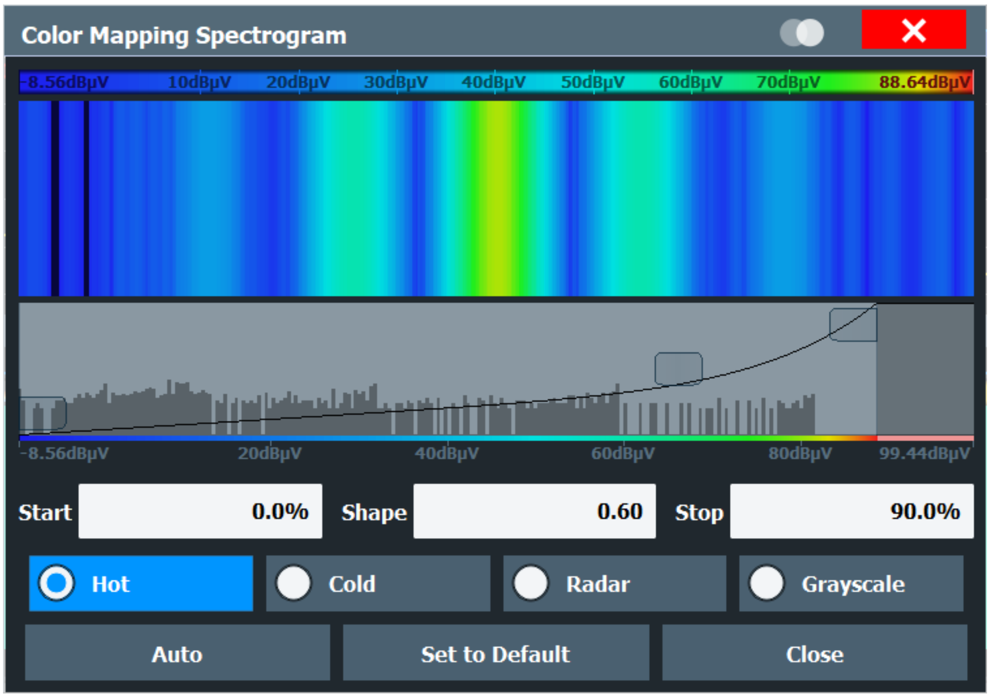
Editing the shape of the color curve

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

8.2 How to export table data

The measured result table data can be exported to an ASCII file. For each parameter, the measured values are output.

For details on the storage format, see Chapter B, "Reference: ASCII file export format", on page 473.

Table data can be exported either from the "Result Configuration" dialog box, or from the "Save/Recall" menu.

To export from the "Save/Recall" menu

1. Select an active result table whose data you want to export.
2. Select the "Save" icon in the toolbar.
3. Select "Export".
4. If necessary, change the decimal separator used in the ASCII export file.
5. Select "ASCII Table Export".
6. In the file selection dialog box, select the storage location and file name for the export file.
7. Select "Save" to close the dialog box and export the table data to the file.

To export from the "Result configuration" dialog box

1. Press "Overview".
2. Select "Result Config".
3. Select the window that contains the result table in the "Specifics for" selection box.
4. Select the "Table Config" tab.
5. Select the vertical "Table Export" tab.
6. Select whether you want to export all columns or only the currently visible columns of the table.
7. If necessary, change the decimal separator used in the ASCII export file.
8. Select "Export Table to ASCII File".
9. In the file selection dialog box, select the storage location and file name for the export file.
10. Select "Save" to close the dialog box and export the table data to the file.

9 Measurement examples

The following measurement examples demonstrate some basic functions and measurement tasks, assuming the additional options R&S VSE-K60C/-K60H are installed.

9.1 Example: hopped FM signal

A practical example for a basic transient analysis measurement is provided here. It demonstrates how to identify a hopped signal, how to detect hops, and how to analyze an individual hop.

The measurement is performed using the following devices:

- A signal analyzer with bandwidth extension option B160
- A vector signal generator, e.g. R&S SMBV100A
- The R&S VSE software with the application firmware R&S VSE-K60: Transient Analysis+ K60H (Hopped Transient Analysis)

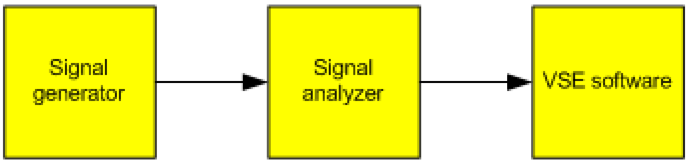


Figure 9-1: Test setup

Signal generator settings (e.g. R&S SMBV100A):

Frequency:	4 GHz
Level:	-30 dBm
Channels	CW-Hopping channel: 0 dB DC carrier: +20 dB
Hops	20.0 / 20.2 / 20.4 / 20.6 / 20.8 / 21.0 MHz
Dwell time	200 µs
Sample rate	100 MHz

Settings in the R&S VSE Transient Analysis application

To identify a hopped FM signal

1. Preset the R&S VSE.
2. Open a new channel or replace an existing one and select the "Transient Analysis" application.

3. Set the center frequency to *4 GHz*.
4. Set the reference level to *-30 dBm*.
5. Select the signal model *Hop*.
6. From the "Meas Setup" menu, select "Data Acquisition".
7. Set the measurement time to *5 ms*.
8. Set the measurement bandwidth to *160 MHz*.
9. The RF Spectrum and Full Spectrogram displays are dominated by the DC carrier. Define an analysis region to extract the hopped FM signal. Make sure that a sufficient number of hops are inside the analysis region. A second spectrogram showing the analysis region helps with fine-tuning.

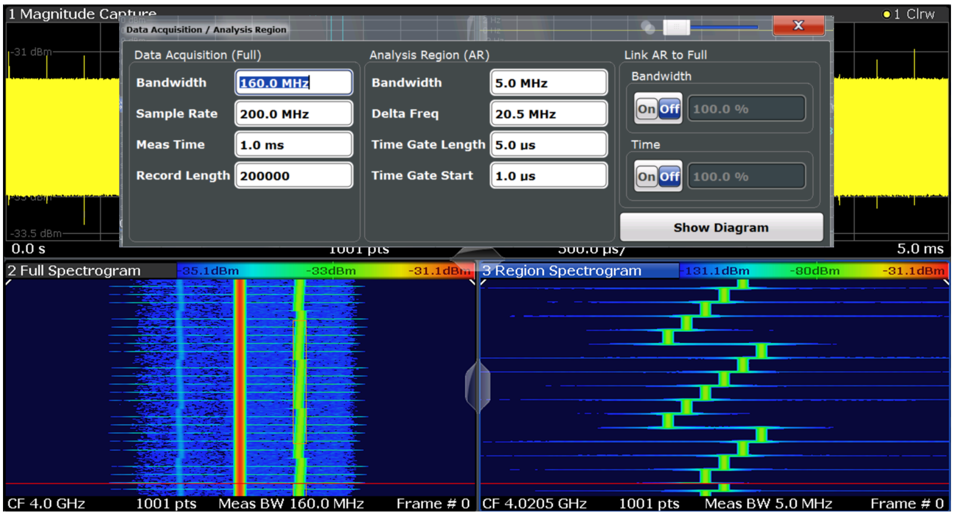


Figure 9-2: Configuring an analysis region for a hopped FM signal

   a) Select the "Add Window" icon from the toolbar to add a second spectrogram display to the right of the existing one.
   b) Select "Meas Setup > Analysis Region" to restrict the spectrogram display to the analysis region.
   By default, the analysis region corresponds to the entire capture buffer.
10. Select "Data Acquisition".
   a) Define the starting point of the analysis region as an offset from the center frequency ("Delta Freq").
   b) Define the width of the analysis region as a "Bandwidth". Be sure to include several hops in the frequency range.
   c) Define the starting point and the length of the time gate. Again, be sure to include several hops in the time gate.
11. Since the signal model is set to "Hop" and the "Auto Mode" for detection is on, the hops are detected automatically. The detected hop states are listed in the order of

their occurrence in the "Signal States" table. From the "Meas Setup" menu, select "Signal Description" to check them.

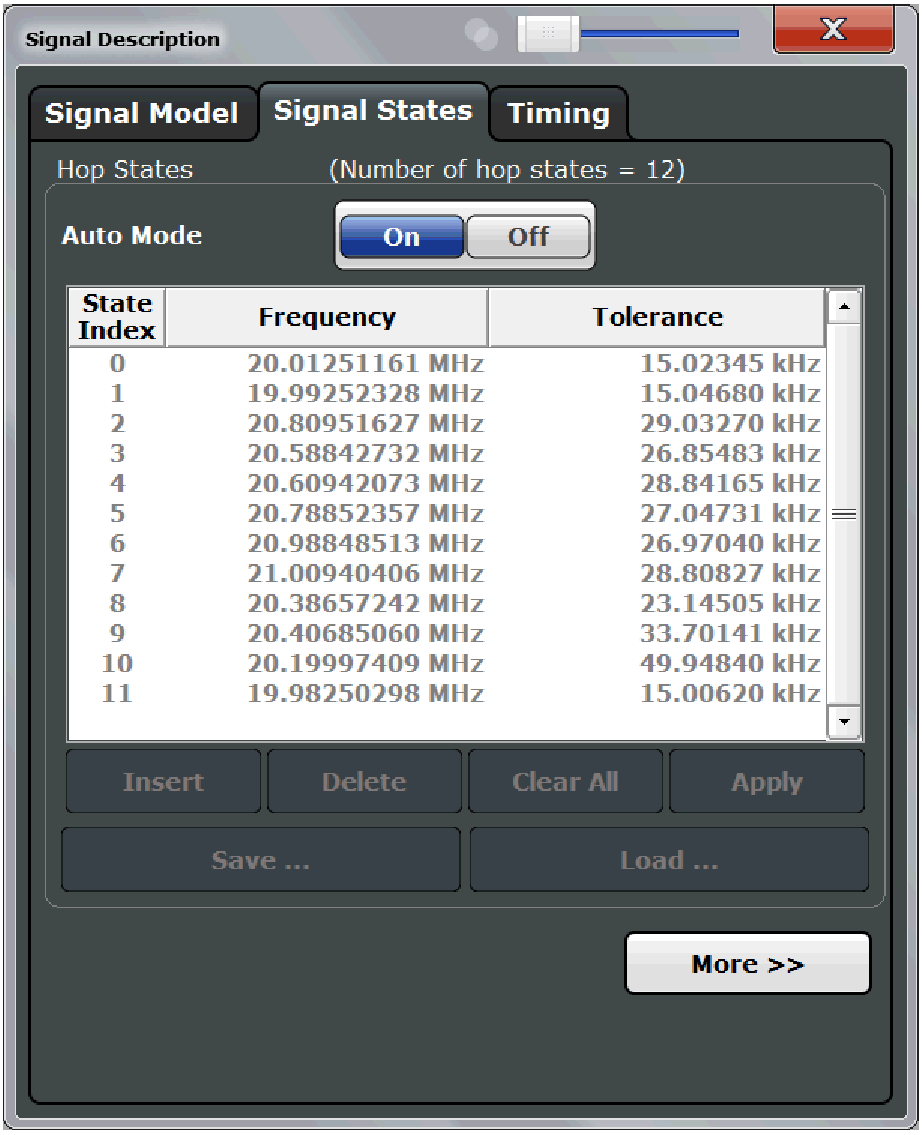


Figure 9-3: Detected hop states

To analyze an individual hop

All detected hops are indicated in the Hop Results Table. To analyze an individual hop in detail, open a Frequency Deviation display and reduce the spectrogram to a single hop.

1. From the "Meas Setup" menu, select "Display Config".
2. Replace the Full Spectrogram display by a Frequency Deviation Time Domain display.
3. Select the Spectrogram display.

4. Tap the "Change result type" icon, then select "Spectrogram" > "Hop" to restrict the Spectrogram display to a single hop.
5. Select "Meas Setup" > "Select hop" and enter *7* to show the results for the hop number 7.

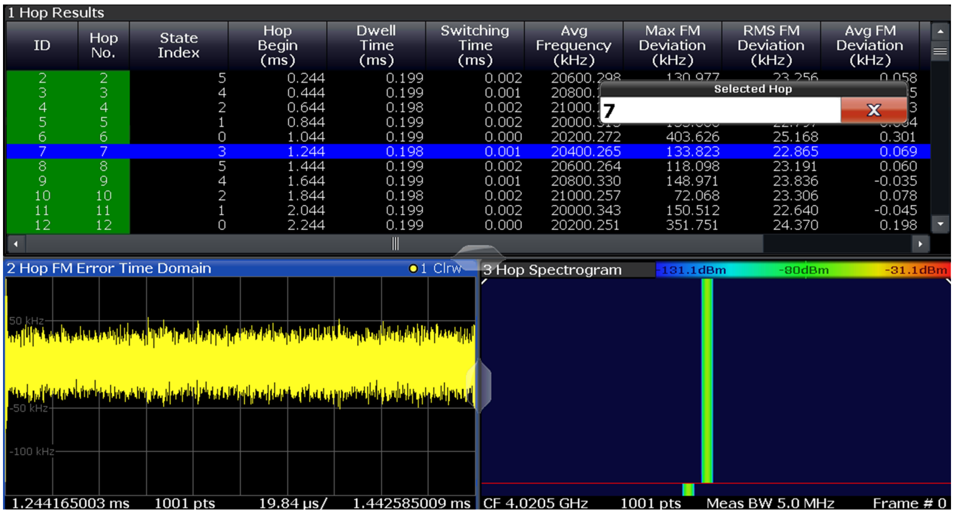


Figure 9-4: Results for a single hop

By default, both the Frequency Deviation and the Spectrogram displays show 100 % of the dwell time of the selected hop.

To analyze settling effects using a VBW filter

One possibility to remove noise from the Frequency Deviation trace is using a video filter with a smaller VBW.

1. From the "Bandwidth" menu, select "FM Video BW".
2. As the "FM Video Bandwidth", select *Low Pass 1% BW*.

   Note the impact on the Frequency Deviation trace. Settling effects on the hop FM are now clearly visible.

Figure 9-5: Effect of the FM video bandwidth

To analyze settling effects by defining a result range

Another possibility to analyze the settling effects is by defining a result range. Move the result range to the hop begin to see the settling in more detail.

1. From the "Meas Setup" menu, select "Result Config".
2. In the "Result Range" tab, set "Automatic Range Scaling" to *Off*.
3. Set the reference point of the result range to *Rise*.
4. Set the result range "Length" to *100 µs*.

   Note that fewer spectrogram frames may be calculated as the result range length gets smaller.

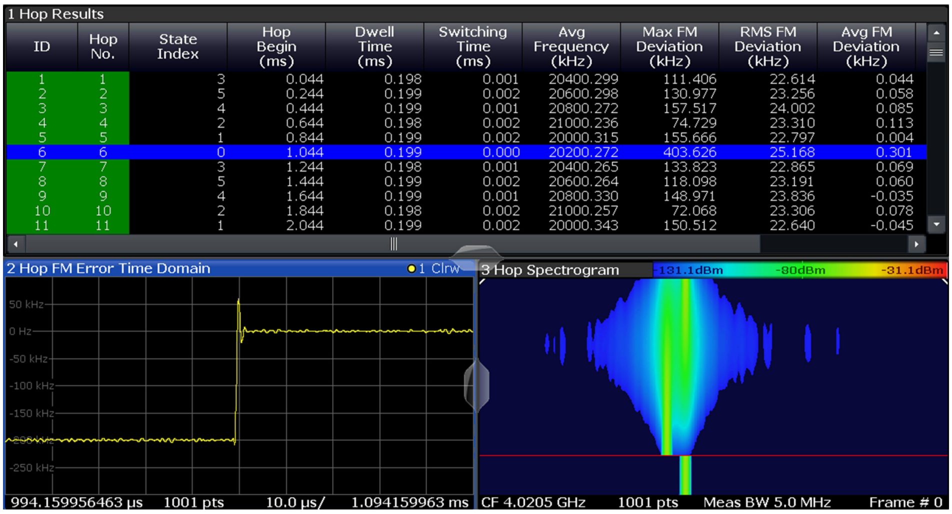


Figure 9-6: Hop displays for a result range at the beginning of the hop

9.2 Example: chirped FM signal

The following example demonstrates how to detect chirps and how to analyze an individual chirp.

The measurement is performed using the following devices:

- A signal analyzer with bandwidth extension option R&S VSE-B160
- A vector signal generator, e.g. R&S SMBV100A
- The R&S VSE software with the application firmware R&S VSE-K60: Transient Analysis+ K60C (Chirped Transient Analysis)

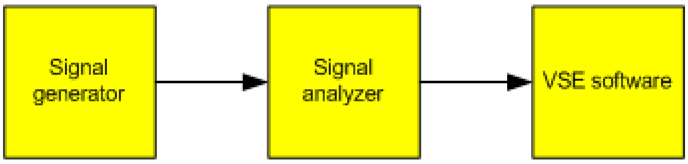


Figure 9-7: Test setup

Signal generator settings (e.g. R&S SMF):

Frequency:	4 GHz
Level:	-30 dBm
Channels	Linear FM up/down chirp channel:±40 MHz (trapezoidal shape) Sinusoidal interference on FM with 10 kHz deviation and FM spike in up-chirp with 1 MHz deviation
Chirp length	100 µs (= chirp rate 800 kHz/µs)
Sample rate	100 MHz

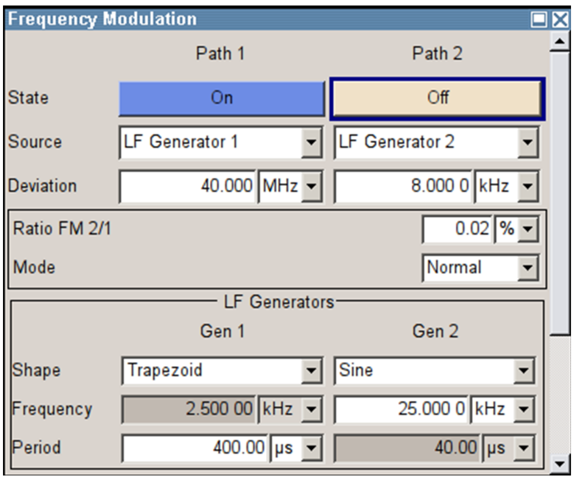


Figure 9-8: R&S® SMF frequency modulation configuration for chirped FM signal example

Settings in the R&S VSE Transient Analysis application

To detect chirps in an FM signal

1. Preset the R&S VSE.
2. Open a new channel or replace an existing one and select the "Transient Analysis" application.
3. Set the center frequency to *4 GHz*.
4. Set the reference level to *-30 dBm*.
5. Select "Signal Description > Signal Model" and select the signal model *Chirp*.
6. From the "Meas Setup" menu, select "Data Acquisition".
7. Set the measurement time to *1 ms*.
8. Set the measurement bandwidth to *160 MHz*.
9. Define an analysis region to extract the chirped FM signal. Make sure that a sufficient number of chirps are inside the analysis region.

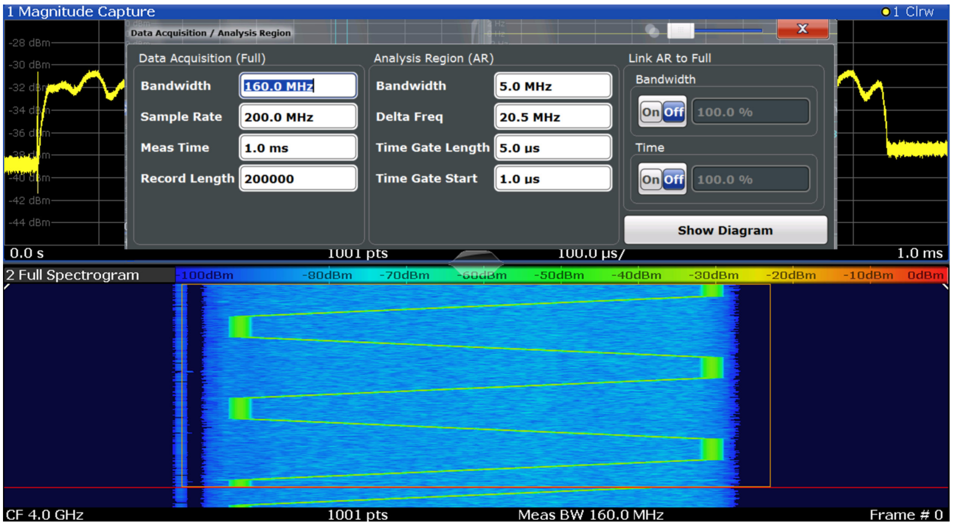


Figure 9-9: Configuring an analysis region for a chirped FM signal

   a) Define the starting point of the analysis region as an offset from the center frequency ("Delta Freq").
   b) Define the width of the analysis region as a "Bandwidth". Be sure to include several chirps in the frequency range.
   c) Define the starting point and the length of the time gate. Again, be sure to include several chirps in the time gate.

10. The chirps are detected automatically. The detected chirp states are listed in the order of their occurrence in the "Signal States" table. From the "Meas Setup" menu, select "Description" to check them.

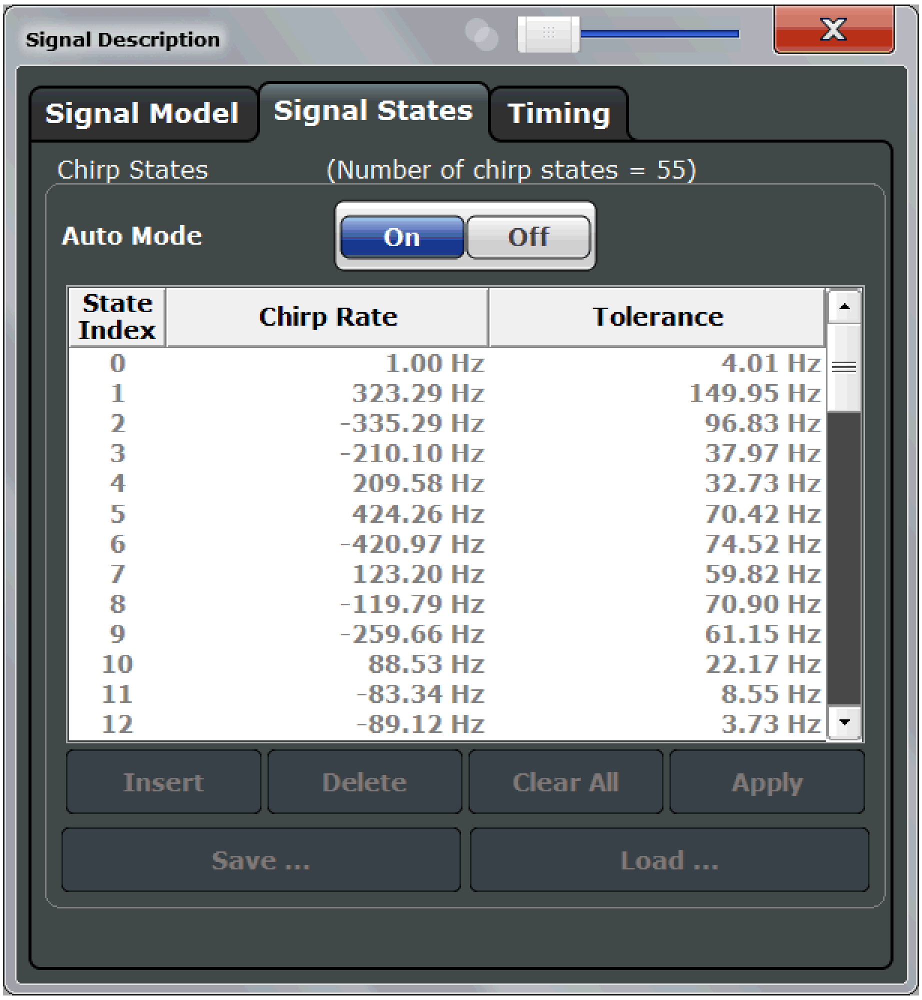


Figure 9-10: Detected chirp states

To analyze the chirp results

All detected chirps are indicated in the Results Table.

3 Chirp Results

ID	Chirp No.	State Index	Chirp Begin (ms)	Chirp Length (ms)	Chirp Rate (kHz/us)	Chirp Rate Deviation (kHz/us)	Avg Frequency (kHz)	Max FM Deviation (kHz)	RMS FM Deviation (kHz)
1	1	0	0.055	0.049	800.528	1.055	-20035.613	1178.163	197.366
2	2	0	0.105	0.049	799.235	-0.238	20079.712	767.851	139.397
3	3	1	0.255	0.099	-800.053	-1.411	-36.153	1112.765	170.175
4	4	0	0.455	0.049	800.527	1.055	-20047.582	1059.921	195.962
5	5	0	0.505	0.049	799.236	-0.237	20083.774	877.547	141.517
6	6	1	0.655	0.099	-800.055	-1.413	-38.264	1271.343	167.509
7	7	0	0.856	0.049	800.537	1.064	-19933.468	1207.126	194.168
8	8	0	0.905	0.049	799.228	-0.245	20081.857	684.792	135.391

Figure 9-11: Detected chirps

Note that the up-chirp is split up into two smaller chirps for some reason.

► Increase the detection tolerance for the up-chirp and note the impact on the detected chirp length in the Results Table.

a) From the "Meas Setup" menu, select "Signal Description > Signal States".

b) Set the "Auto Mode" for the Chirp States to *Off*.
c) Select the "Tolerance" for the state index 0 and enter *200 kHz*.

To analyze FM linearity

For radar systems using chirped FM signals, FM linearity is an important measurement.

The FM Time Domain and the Frequency Deviation Time Domain displays are useful to investigate interference of the chirp FM.

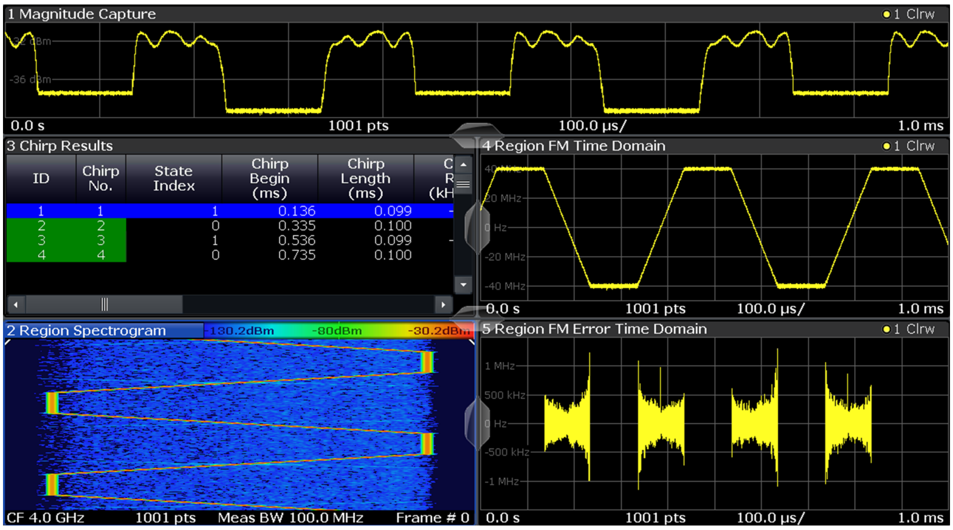


Figure 9-12: Typical display arrangement for FM linearity measurement

The Frequency Deviation display is dominated by noise, but a spike in the up-chirp is already clearly visible (this spike caused the up-chirp to be detected as two individual chirps).

To remove noise using trace averaging

Noise can be removed by averaging the Frequency Deviation Time Domain trace over multiple chirps.

1. To restrict trace statistics to the up-chirp, discard all down-chirps by deleting the corresponding chirp state from the chirp state list.
   a) From the "Meas Setup" menu, select "Signal Description > Signal States".
   b) Select the state index 1.
   c) Select "Delete".
2. Restrict the Frequency Deviation Time Domain display to a single chirp.
   a) Select the Frequency Deviation Time Domain display.
   b) Tap the "Change result type" icon ( ), then select "Frequency Deviation Time Domain" > "Chirp" to restrict the display to a single chirp.
3. Enable trace averaging for the Frequency Deviation Time Domain display.
   a) From the "Trace" menu, select "Trace...".

b) For trace 1, select the "Mode": *Max Hold*.
c) For trace 2, select the "Mode": *Average*.
d) For trace 3, select the "Mode": *Min Hold*.
e) Define an average count of *1000*.

The display now shows the trace statistics as output of an auto peak detector of one chirp.

4. For statistics over multiple chirps you must define a common result range to make sure that statistics are calculated over time intervals of a constant length.
   a) From the "Meas Setup" menu, select "Result Config".
   b) In the "Result Range" tab, set "Automatic Range Scaling" to *Off*.
   c) Set the result range "Alignment" to the *Center* of the chirp.
   d) Set the result range "Length" to *90 µs*.

   After averaging 1000 chirps, you see not only the FM spike on the max trace, but also a sinusoidal interference on the average trace.

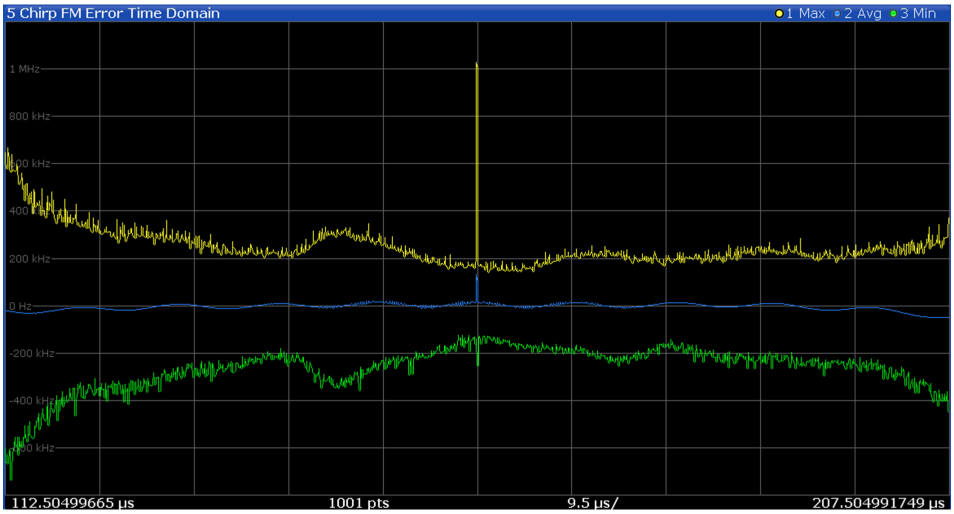


Figure 9-13: Min/average/max traces for chirp Frequency Deviation

To limit the noise bandwidth using a video filter

The noise bandwidth can be reduced using a video filter.

1. Disable trace averaging for the Frequency Deviation Time Domain display.
   a) From the "Trace" menu, select "Trace...".
   b) For trace 1, select the "Mode": *Clr/Write*.
   c) For trace 2 and 3, select the "Mode": *Blank*.
2. From the "Bandwidth" menu, select "FM Video Bandwidth".
3. As the "FM Video Bandwidth", select *Low Pass 1% BW*.

   Note the different behavior of limiting the noise bandwidth by VBW filtering and trace averaging.

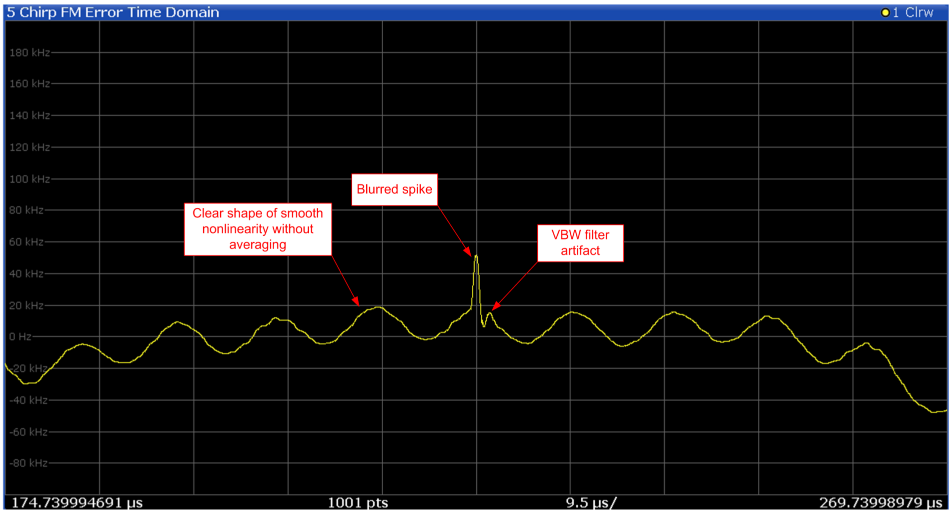


Figure 9-14: Chirp Frequency Deviation clear/write trace with 1% VBW filter

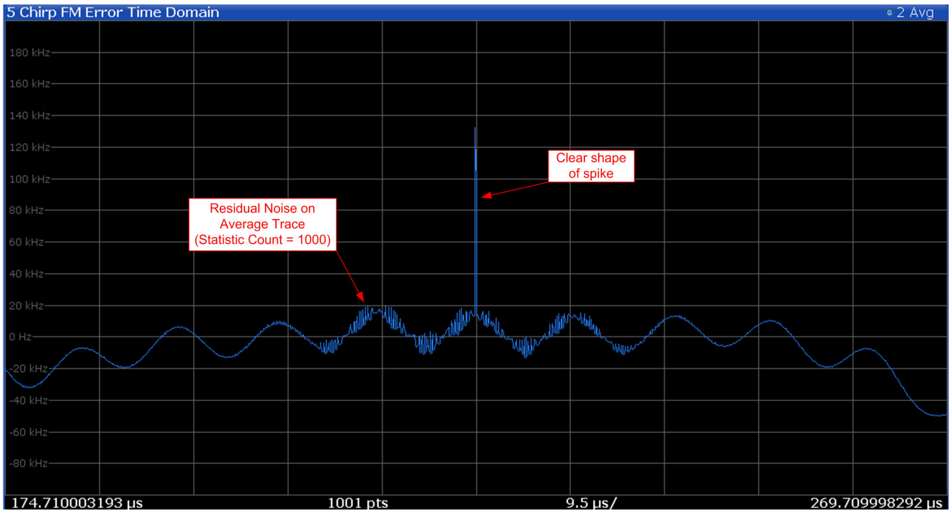


Figure 9-15: Chirp Frequency Deviation average trace (statistic count = 1000)

10 Optimizing and troubleshooting

If the results do not meet your expectations, or if problems occur during measurement, try the following solutions.

Too many hop/chirp states have been detected in auto mode
Switch auto mode off and edit hop/chirp state table manually (see Chapter 6.2.2, "Signal states", on page 83).

Usually, these unwanted hop/chirp states will not appear in the Results Table.

The desired hop/chirp states are not detected
Make sure that a sufficient number of hops/chirps are inside the analysis region (see Analysis Region).

Instead of one hop/chirp, several shorter hop/chirps of the same hop/chirp state are detected
Increase the detection tolerance of the corresponding hop/chirp state (see "Tolerance" on page 86).

Use a video filter with a smaller VBW (see "FM Video Bandwidth" on page 114).

Instead of one hop/chirp, several shorter hop/chirps of a different hop/chirp state are detected
Adjust the detection tolerance of the corresponding hop/chirp states to make sure that tolerance ranges do not overlap (see "Tolerance" on page 86).

Use a video filter with a smaller VBW (see "FM Video Bandwidth" on page 114).

One or more shorter hops/chirps are detected directly before or after the desired hop/chirp
Specify a minimum and maximum dwell time/chirp length corresponding to the desired hop/chirp (see "Length" on page 112).

Spectrogram of a selected hop/chirp is empty
Increase the result range length (see "Length" on page 118).

11 Remote commands to perform transient analysis

The following commands are required to perform measurements in the Transient Analysis application in a remote environment. It is assumed that the R&S VSE has already been set up for remote operation in a network as described in the R&S VSE 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 R&S VSE 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 the Transient Analysis application are described here:

11.1 Introduction

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

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

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

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

Remote command examples

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

11.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S VSE 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.

11.1.2 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`.

11.1.3 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.

11.1.4 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.

11.1.5 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`.

11.1.6 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.

11.1.6.1 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.

11.1.6.2 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`

11.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 11.1.2, "Long and short form", on page 172.

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`

11.1.6.4 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'`

11.1.6.5 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.

11.2 Common suffixes

In the R&S VSE Transient Analysis application, the following common suffixes are used in remote commands:

Table 11-1: Common suffixes used in remote commands in the R&S VSE Transient Analysis application

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 16	Window (**in the currently selected channel**)
<t>	1 to 6	Trace
	1 to 8	Limit line

11.3 Activating Transient Analysis measurements

Transient Analysis measurements require a special application in the R&S VSE. The common commands for configuring and controlling measurement channels, as well as blocks and sequences, are also used in the R&S VSE Transient Analysis application.

They are described in the R&S VSE base software user manual.

11.4 Configuring transient analysis

The following commands are required to configure a measurement for transient analysis.

11.4.1 Restoring the default configuration (Preset)

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default software settings in the current channel.

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 82

11.4.2 Configuring data input

The following commands are required to configure data input.

Data output is described in the R&S VSE Base Software User Manual.

11.4.2.1 RF input

Remote commands exclusive to configuring RF input:

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

Turns the availability of attenuation levels of 10 dB or less on and off.

Suffix:

<ip>	1..n

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
Attenuation levels of 10 dB or less are not allowed to protect the RF input connector of the connected instrument.

OFF | 0
Attenuation levels of 10 dB or less are not blocked. Provide appropriate protection for the RF input connector of the connected instrument yourself.

*RST: 1

Example: `INP:ATT:PROT ON`
Turns on the input protection.

INPut:ATTenuation:PROTection:RESet [<DeviceName>]

Resets the attenuator and reconnects the RF input with the input mixer for the connected instrument 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.

For details on the protection mechanism, see the instrument's documentation.

Setting parameters:
<DeviceName> string
Name of the instrument for which the RF input protection is to be reset.

Example: `INP:ATT:PROT:RES 'MyDevice'`

Manual operation: See "10 dB Minimum Attenuation" on page 94

INPut<ip>:COUPling<ant> <CouplingType>

Selects the coupling type of the RF input.

Suffix:
<ip> 1 | 2
irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:
<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling " on page 90

INPut<ip>:DPATh <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Suffix:

<ip> 1..n

Parameters:

<DirectPath> AUTO | OFF

AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
The analog mixer path is always used.

Example: `INP:DPAT OFF`

Manual operation: See "Direct Path " on page 91

INPut<ip>:FILE:ZPADing <State>

Enables or disables zeropadding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

Suffix:

<ip> 1..n

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILE:ZPAD ON`

Manual operation: See "Zero Padding" on page 96

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the connected instrument to measure the harmonics for a DUT, for example.

Requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Suffix:
<ip> 1..n

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Manual operation: See "High Pass Filter 1 to 3 GHz " on page 91

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

Enables or disables the YIG filter.

Suffix:
<ip> 1 | 2
irrelevant

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

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector " on page 92

INPut<ip>:IMPedance<ant> <Impedance>

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

Suffix:
<ip> 1 | 2
irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:
<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance " on page 91

INPut<ip>:PRESelection:SET <Mode>

Selects the preselector mode.

The command is available with the optional preselector.

Suffix:
<ip> 1..n

Parameters:
<Mode>

NARRow
Performs a measurement by automatically applying all available combinations of low and high pass filters consecutively. These combinations all have a narrow bandwidth.

WIDE
Performs a measurement by automatically applying all available bandpass filters consecutively. The bandpass filters have a wide bandwidth.

Manual operation: See "Preselector Mode" on page 94

INPut<ip>:PRESelection[:STATe] <State>

Turns the preselector on and off.

Suffix:
<ip> 1 | 2
irrelevant

Manual operation: See "Preselector State" on page 94

INPut<ip>:RF:CAPMode <CAPMode>

Determines how data from an oscilloscope is input to the R&S VSE software.

Is only available for connected oscilloscopes.

Suffix:
<ip> 1..n

Parameters:
<CAPMode> AUTO | IQ | WAVeform

IQ
The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.

WAVeform
The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.

AUTO
Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement).

*RST: IQ

Example: `INP:RF:CAPM WAV`

Manual operation: See "Capture Mode" on page 92

INPut<ip>:RF:CAPMode:IQ:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for I/Q capture mode (see `INPut<ip>:RF:CAPMode` on page 182).

This setting is only available if an R&S oscilloscope is used to obtain the input data.

Suffix:

<ip> 1..n

Parameters:

<SamplingRate> 20 GHz | 40 GHz

No other sample rate values are allowed.

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

40 GHz
Provides a maximum sample rate.
Only available for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet).

*RST: 20 GHz
Default unit: HZ

Example:
```
INP:RF:CAPM IQ
INP:RF:CAPM:IQ:SRAT 40 GHZ
```

Manual operation: See "Oscilloscope Sample Rate" on page 93

INPut<ip>:RF:CAPMode:WAVeform:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for waveform capture mode (see `INPut<ip>:RF:CAPMode` on page 182).

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

Suffix:

<ip> 1..n

Parameters:

<SamplingRate> 10 GHz | 20 GHz

No other sample rate values are allowed.

10 GHz
Default ; provides maximum record length

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).
For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used.

*RST: 10 GHz
Default unit: HZ

Example:
```
INP:RF:CAPM WAV
INP:RF:CAPM:WAVE:SRAT 10000000
```

Manual operation: See "Oscilloscope Sample Rate" on page 93

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

If no additional input options are installed, only RF input or file input is supported.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file

*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 90

INPut:TYPE <Input>

The command selects the input path for R&S FSW85 models.

Parameters:

<Input>

INPUT1
Selects RF input 1.

INPUT2
Selects RF input 2.

*RST: INPUT1

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

Manual operation: See "Input 1 / Input 2" on page 90

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si> <Type>

Selects an instrument or a file as the source of input provided to the channel.

Suffix:

<si> 1 to 99
LTE-MIMO only: input source number

Parameters:

<Type> FILE | DEVice | NONE

FILE
A loaded file is used for input.

DEVice
A configured device provides input for the measurement

NONE
No input source defined.

Manual operation: See "Input Type (Instrument / File)" on page 90

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:CONFig <Port>

Configures the port to be used for input on the selected instrument.

Is only available if an oscilloscope is connected.

Suffix:

<si> 1 to 99
LTE-MIMO only: input source number

Parameters:

<Port>

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:TYPE <Source>

Configures the source of input to be used from the selected instrument.

Not all input sources are supported by all R&S VSE applications.

Suffix:

<si> 1 to 99
LTE-MIMO only: input source number

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

'Channel 1' | 'Channel 2' | 'Channel 3' | 'Channel 4'
Oscilloscope input channel 1, 2, 3, or 4

'Channel 1,2 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 2 (for oscilloscopes with 2 channels only)

'Channel 1,3 (I+Q)' | 'Channel 2,4 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 3, or 2 and 4 (for oscilloscopes with 4 channels only)

'Channels 1-4 (diff. I+Q)'
Differential I/Q data provided by oscilloscope input channels (for oscilloscopes with 4 channels only):
Channel 1: I (pos.)
Channel 2: Ī (neg.)
Channel 3: Q (pos.)
Channel 4: Q̄ (neg.)

'Channels 1,3 (Waveform)'
Waveform data provided by oscilloscope input channels 1 and 3 (for oscilloscopes with 2 channels only)

'Channels 2,4 (Waveform)'
Waveform data provided by oscilloscope input channels 2 and 4 (for oscilloscopes with 2 channels only)

'Channels 1-4 (Waveform)'
Waveform data provided by oscilloscope input channels 1 to 4 (for oscilloscopes with 4 channels only)

*RST: RF

Example: INST:BLOC:CHAN:SOUR:TYPE 'Channel 2,4 (I+Q)'
I/Q data is provided by oscilloscope input channels 2 and 4

SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] <State>

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC ON`

Manual operation: See "B2000 State" on page 92

SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip <Address>

Defines the TCPIP address or computer name of the oscilloscope connected to the R&S VSE via LAN.

Note: The IP address is maintained after a [PRESET], and is transferred between applications.

Parameters:
<Address> computer name or IP address

Example: `SYST:COMM:RDEV:OSC:TCP '192.0.2.0'`

Example: `SYST:COMM:RDEV:OSC:TCP 'FSW43-12345'`

Manual operation: See "Oscilloscope IP Address" on page 93

SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe] <State>

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&S VSE and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the R&S FSW I/Q Analyzer and I/Q Input User Manual

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:PSM ON`

Manual operation: See "Oscilloscope Splitter Mode" on page 93

SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe <Rate>

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHZ mode achieves a higher decimation gain, but reduces the record length by half.

Parameters:
<Rate> 10 GHz | 20 GHz

No other sample rate values are allowed.

*RST: 10 GHz
Default unit: HZ

Example:
```
TRAC:IQ:SRAT?
//Result: 100000000
TRAC:IQ:RLEN?
//Result: 3128
SYST:COMM:RDEV:OSC:SRAT 20GHZ
TRAC:IQ:SRAT?
//Result: 200000000
TRAC:IQ:RLEN?
//Result: 1564
```

Manual operation: See "Oscilloscope Sample Rate" on page 93

SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?

Queries whether the connected instrument is supported by the 2 GHz bandwidth extension option(B2000).

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VDEV?`

Usage: Query only

SYSTem:COMMunicate:RDEVice:OSCilloscope:VFIRmware?

Queries whether the firmware on the connected oscilloscope is supported by the 2 GHz bandwidth extension (B2000) option.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `SYST:COMM:RDEV:OSC:VFIR?`

Usage: Query only

11.4.2.2 Using external mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the connected instrument to have an external mixer option installed and an external mixer to be connected to the connected instrument.

Basic settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer<x>[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

Suffix:
<x> 1..n
irrelevant

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

Example: `MIX ON`

[SENSe:]MIXer<x>:BIAS:HIGH <BiasSetting>

Defines the bias current for the high (last) range.

Is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 189).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:BIAS[:LOW] <BiasSetting>

Defines the bias current for the low (first) range.

Is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 189).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:LOPower <Level>

Specifies the LO level of the external mixer's LO port.

Suffix:
<x> 1..n
irrelevant

Parameters:

<Level>	Range: 13.0 dBm to 17.0 dBm Increment: 0.1 dB *RST: 15.5 dBm Default unit: DBM

Example: `MIX:LOP 16.0dBm`

Mixer settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer<x>:FREQuency:HANDover <Frequency>

Defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 189).

Suffix:

<x>	1..n irrelevant

Parameters:

<Frequency>	Default unit: HZ

Example:

`MIX ON`
Activates the external mixer.
`MIX:FREQ:HAND 78.0299GHz`
Sets the handover frequency to 78.0299 GHz.

[SENSe:]MIXer<x>:FREQuency:STARt

Sets or queries the frequency at which the external mixer band starts.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:FREQ:STAR?`
Queries the start frequency of the band.

[SENSe:]MIXer<x>:FREQuency:STOP

Sets or queries the frequency at which the external mixer band stops.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:FREQ:STOP?`
Queries the stop frequency of the band.

[SENSe:]MIXer<x>:HARMonic:BAND:PRESet

Restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the [PRESET] function. Use this command to restore the predefined band ranges.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:HARM:BAND:PRES`
Presets the selected waveguide band.

[SENSe:]MIXer<x>:HARMonic:BAND <Band>

Selects the external mixer band. The query returns the currently selected band.

Is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 189).

Suffix:

<x> 1..n
irrelevant

Parameters:

<Band> KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.

Table 11-2: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)
***)** The band formerly referred to as "A" is now named "KA".		

[SENSe:]MIXer<x>:HARMonic:HIGH:STATe <State>

Specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Suffix:
<x> 1..n

Parameters:
<State> ON | OFF
*RST: ON

Example: `MIX:HARM:HIGH:STAT ON`

[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue] <HarmOrder>

Specifies the harmonic order to be used for the high (second) range.

Suffix:
<x> 1..n
irrelevant

Parameters:
<HarmOrder> Range: 2 to 128 (USER band); for other bands: see band definition

Example:
```
MIX:HARM:HIGH:STAT ON
MIX:HARM:HIGH 3
```

[SENSe:]MIXer<x>:HARMonic:TYPE <OddEven>

Specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Suffix:

<x> 1..n
irrelevant

Parameters:

<OddEven> ODD | EVEN | EODD

ODD | EVEN | EODD

*RST: EVEN

Example: `MIX:HARM:TYPE ODD`

[SENSe:]MIXer<x>:HARMonic[:LOW] <HarmOrder>

Specifies the harmonic order to be used for the low (first) range.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:HARM 3`

[SENSe:]MIXer<x>:IF?

Queries the intermediate frequency currently used by the external mixer.

Suffix:

<x> 1..n
irrelevant

Example: `MIX:IF?`

Example: See "Programming example: working with an external mixer" on page 195.

Usage: Query only

[SENSe:]MIXer<x>:LOSS:HIGH <Average>

Defines the average conversion loss to be used for the entire high (second) range.

Suffix:

<x> 1..n

Parameters:

<Average> Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS:HIGH 20dB`

[SENSe:]MIXer<x>:LOSS:TABLe:HIGH <FileName>

Defines the conversion loss table to be used for the high (second) range.

Suffix:

<x> 1..n

Parameters:

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

[SENSe:]MIXer<x>:LOSS:TABLe[:LOW] <FileName>

Defines the file name of the conversion loss table to be used for the low (first) range.

Suffix:

<x> 1..n

Parameters:

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

Example:

```
MIX:LOSS:TABL '101567'
MIX:LOSS:TABL?
//Result:
'101567_MAG_6_B5000_3G5.B5G'
```

[SENSe:]MIXer<x>:LOSS[:LOW] <Average>

Defines the average conversion loss to be used for the entire low (first) range.

Suffix:

<x> 1..n

Parameters:

<Average> Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example:

```
MIX:LOSS 20dB
```

[SENSe:]MIXer<x>:PORTs <PortType>

Selects the mixer type.

Suffix:
<x> 1..n
irrelevant

Parameters:
<PortType> **2 | 3**

2
Two-port mixer.

3
Three-port mixer.

*RST: 2

Example: `MIX:PORT 3`

[SENSe:]MIXer<x>:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Suffix:
<x> 1..n
irrelevant

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

*RST: 0

Programming example: working with an external mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
```

```
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

11.4.2.3 Remote commands for external frontend control

The following commands are available and required only if the optional external frontend control is installed on the connected instrument.

Further commands for external frontend control described elsewhere:

- `INPut:SELect RF`; see `INPut:SELect` on page 184
- `[SENSe<ip>:]FREQuency:CENTer` on page 211
- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 217
- `INPut<ip>:ATTenuation:AUTO` on page 218
- `INPut<ip>:ATTenuation` on page 218

Commands for initial configuration

The following commands are required when you initially set up a measurement with an external frontend on the connected instrument. Note that some commands are not available for all connected instruments, or only as queries.

[SENSe:]EFRontend:ALIGnment<ch>:FILE <File>

Selects or queries the touchstone file that contains correction data to compensate for signal losses in the cable occurring at different IF signal frequencies.

Suffix:

<ch> 1..n
Currently irrelevant

Parameters:

<File> string in double quotes

Path and file name of the correction data file. The file must be in `s2p` format.
If the specified file is not found or does not have the correct format, an error message is returned (`-256, "File name not found"`, `-150, "String data error"`).

Example: `EFR:ALIG:FILE "FE44S.s2p"`

[SENSe:]EFRontend:ALIGnment<ch>:STATe <State>

Activates correction of the IF signal due to cable loss from the frontend to the analyzer. Specify the file with correction data using `[SENSe:]EFRontend:ALIGnment<ch>:FILE` on page 197.

Suffix:

<ch> 1..n
Currently irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

[SENSe:]EFRontend:CONNection[:STATe] <State>

Queries the external frontend connection state in the firmware.

Note: to query the physical connection state of the external frontend, use [SENSe:]EFRontend:CONNection:CSTate? on page 199.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The connection to the frontend is deactivated temporarily. The frontend is thus available for use elsewhere, for example by a signal generator. The measurement settings on the R&S VSE remain untouched.

ON | 1
Frontend connection enabled.
The frontend is reserved for exclusive use by the R&S VSE.

*RST: 0

Example:

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S","123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

[SENSe:]EFRontend:CONNection:CONFig <Type>, <IPAddress>[, <DeviceID>, <SymbolicName>]

Configures the connection to the external frontend.

Parameters:

<Type> String in double quotes containing the type of frontend to be connected.

<IPAddress> string in double quotes

The IP address or computer name of the frontend connected to the R&S VSE via LAN. The IP address and computer name are indicated on the electronic ink display on the side panel of the frontend.

<DeviceID> string in double quotes

Unique device ID consisting of <type>-<serialnumber>
Not required or relevant for the R&S VSE.

<SymbolicName> string in double quotes

Symbolic name of the external frontend.
Not required or relevant for the R&S VSE.

Example:

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S","123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

[SENSe:]EFRontend:CONNection:CSTate?

Queries the status of the physical connection to the external frontend.

Return values:

<State> ON | OFF | 0 | 1

OFF | 0
Frontend not connected; connection error

ON | 1
Frontend connected

Usage: Query only

[SENSe:]EFRontend:FREQuency:BAND:COUNt?

Queries the number of frequency bands provided by the selected frontend.

Return values:

<NoBands> integer

Number of frequency bands

Example:

```
//Query number of frequency bands
EFR:FREQ:BAND:COUN?
//Result: 2
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BAND<b>:LOWer?

Queries the start of the frequency range supported by the selected frontend frequency band.

Suffix:

<b> 1..n
Band for multi-band frontends
Use `[SENSe:]EFRontend:FREQuency:BAND:COUNt?` on page 199 to determine the number of available bands.

Return values:

<StartFreq> Start frequency of the specified band

Example:
```
//Query start frequency of second band
EFR:FREQ:BAND2:LOW?
//Result: 24000000000
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BAND<b>:UPPer?

Queries the end of the frequency range supported by the selected frontend frequency band.

Suffix:

<b> 1..n
Band for multi-band frontends
Use `[SENSe:]EFRontend:FREQuency:BAND:COUNt?` on page 199 to determine the number of available bands.

Return values:

<StopFreq> End frequency of the specified band

Example:
```
//Query end frequency of second band
EFR:FREQ:BAND2:UPP?
//Result: 44000000000
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BCONfig:AUTO <State>

Determines whether the frequency band of the external frontend is configured automatically or manually.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Uses the frequency band configured by `[SENSe:]EFRontend:FREQuency:BCONfig:SELect` on page 201.

ON | 1
Configures the frequency band automatically

*RST: 1

Example: //Configures the use of the IF high band manually.
```
EFR:FREQ:BCON:AUTO 0
EFR:FREQ:BCON:SEL "IF HIGH"
```

[SENSe:]EFRontend:FREQuency:BCONfig:LIST?

Returns the intermediate frequency (output) range of the external frontend.

Return values:

<BandConfigs> string

"IF LOW"
A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the R&S VSE.

"IF HIGH"
A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the R&S VSE.

Example:
```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:BCONfig:SELect <BandConfig>

Defines the intermediate frequency (output) range of the external frontend.

Parameters:

<BandConfig>

"IF HIGH"
(R&S FE44S/ R&S FE50DTR)
A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the connected instrument.

"IF LOW"
(R&S FE44S/ R&S FE50DTR)
A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the connected instrument.

"Spur Optimized"
(R&S FE170SR/R&S FE110SR only)
The selected IF range avoids unwanted spurious effects.

"EVM Optimized"
(R&S FE170SR/R&S FE110SR only)
The selected IF range provides an optimal EVM result.

"Shared LO"
(R&S FE170SR/R&S FE110SR only)
Ensures that multiple external frontends (R&S FE170SR/ R&S FE170ST or R&S FE110SR/R&S FE110ST) use the same LO frequencies for upconversion and downconversion.

Example:
```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

[SENSe:]EFRontend:FREQuency:IFRequency:SIDeband?

Queries the currently used sideband for frequency conversion.

Return values:

<Sideband> "USB" | "LSB"

"USB"
Upper sideband

"LSB"
Lower sideband

Example:
```
EFR:FREQ:IFR?
EFR:FREQ:IFR:SID?
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:IFRequency[:VALue]?

Queries the currently used intermediate frequency (IF) for frequency conversion.

Return values:

<IFFrequency> numeric

Example:
```
EFR:FREQ:IFR?
```

Usage: Query only

[SENSe:]EFRontend:FREQuency:REFerence <Frequency>

Sets the reference frequency that is used for frequency conversion on the frontend. Depending on the connected type of frontend, different values are available. To determine which reference levels are available, use `[SENSe:]EFRontend:FREQuency:REFerence:LIST?` on page 202.

Parameters:

<Frequency> Default unit: HZ

Example:
```
//Query the available reference levels
EFR:FREQ:REF:LIST?
//Result: 10000000,640000000,1000000000
//Use 640 MHz reference
EFR:FREQ:REF 640000000
```

[SENSe:]EFRontend:FREQuency:REFerence:LIST?

Queries the available reference signals for the connected frontend type.

Return values:
<References> 10000000 | 640000000 | 1000000000

Example:
```
//Query the available reference levels
EFR:FREQ:REF:LIST?
//Result: 10000000,640000000,1000000000
//Use 640 MHz reference
EFR:FREQ:REF 640000000
```

Usage: Query only

[SENSe:]EFRontend:IDN?

Queries the device identifcation information (`*IDN?`) of the frontend.

Return values:
<DevInfo> string without quotes

Rohde&Schwarz,<device type>,<part number>/<serial number>,<firmware version>

Example:
```
EFR:IDN?
//Result: Rohde&Schwarz,FE44S,
1234.5678K00/123456,0.8.0
```

Usage: Query only

[SENSe:]EFRontend[:STATe] <State>

Enables or disables the general use of an external frontend for the application.

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

OFF | 0
The frontend is disconnected. The application adapts the measurement settings to the common settings supported by the R&S VSE.

ON | 1
The R&S VSE allows you to configure and connect an external frontend for the application. The application adapts the available measurement settings to the connected frontend.
The channel bar indicates "Inp: ExtFe".

*RST: 0

Example:
```
EFR ON
```

11.4.2.4 Working with power sensors

The following commands describe how to work with power sensors.

These commands require the use of a Rohde & Schwarz power sensor. For a list of supported sensors, see the data sheet.

Configuring power sensors

SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe] <State>

Turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> Power sensor index

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

Example: `SYST:COMM:RDEV:PMET:CONF:AUTO OFF`

SYSTem:COMMunicate:RDEVice:PMETer<p>:COUNt?

Queries the number of power sensors currently connected to the R&S VSE.

Suffix:
<p> Power sensor index

Return values:
<NumberSensors> Number of connected power sensors.

Example: `SYST:COMM:RDEV:PMET:COUN?`

Usage: Query only

SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

Assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:
<p> Power sensor index

Parameters:
<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

Example:
```
SYST:COMM:RDEV:PMET2:DEF '','NRP-Z81','',
'123456'
```
Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".
```
SYST:COMM:RDEV:PMET2:DEF?
```
Queries the sensor assigned to "Power Sensor 2".
Result:
```
'','NRP-Z81','USB','123456'
```
The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Configuring power sensor measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE

Zeroes the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:
<p> Power sensor index

Example:
```
CAL:PMET2:ZERO:AUTO ONCE;*WAI
```
Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>

Defines the reference value for relative measurements.

Suffix:

<n> Window

<p> Power sensor index

Parameters:

<RefValue> Range: -200 dBm to 200 dBm
*RST: 0
Default unit: DBM

Example: `CALC:PMET2:REL -30`
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE

Sets the current measurement result as the reference level for relative measurements.

Suffix:

<n> Window

<p> Power sensor index

Example: `CALC:PMET2:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

CALCulate<n>:PMETer<p>:RELative:STATe <State>

Turns relative power sensor measurements on and off.

Suffix:

<n> Window

<p> Power sensor index

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:PMET2:REL:STAT ON`
Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

Queries the results of power sensor measurements.

Suffix:
<p> Power sensor index

Usage: Query only

READ:PMETer<p>?

Initiates a power sensor measurement and queries the results.

Suffix:
<p> Power sensor index

Usage: Query only

[SENSe:]PMETer<p>:DCYCle[:STATe] <State>

Turns the duty cycle correction on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:DCYC:STAT ON`

[SENSe:]PMETer<p>:DCYCle:VALue <Percentage>

Defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:
<p> Power sensor

Parameters:
<Percentage> Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example: `PMET2:DCYC:STAT ON`
Activates the duty cycle correction.
`PMET2:DCYC:VAL 0.5`
Sets the correction value to 0.5%.

[SENSe:]PMETer<p>:FREQuency <Frequency>

Defines the frequency of the power sensor.

Suffix:
<p> Power sensor index

Parameters:
<Frequency> The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz
Default unit: HZ

Example: `PMET2:FREQ 1GHZ`
Sets the frequency of the power sensor to 1 GHz.

[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>

Selects the frequency coupling for power sensor measurements.

Suffix:
<p> Power sensor index

Parameters:
<Coupling>
CENTer
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

Example: `PMET2:FREQ:LINK CENT`
Couples the frequency to the center frequency of the analyzer

[SENSe:]PMETer<p>:MTIMe <Duration>

Selects the duration of power sensor measurements.

Suffix:
<p> Power sensor index

Parameters:
<Duration> SHORt | NORMal | LONG
*RST: NORMal

Example: `PMET2:MTIM SHOR`
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt <NumberReadings>

Sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:
<p> Power sensor index

Parameters:
<NumberReadings> An average count of 0 or 1 performs one power reading.

Range: 0 to 256
Increment: binary steps (1, 2, 4, 8, ...)

Example:
`PMET2:MTIM:AVER ON`
Activates manual averaging.
`PMET2:MTIM:AVER:COUN 8`
Sets the number of readings to 8.

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>

Turns averaging for power sensor measurements on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`PMET2:MTIM:AVER ON`
Activates manual averaging.

[SENSe:]PMETer<p>:ROFFset[:STATe] <State>

Includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:ROFF OFF`
Takes no offset into account for the measured power.

[SENSe:]PMETer<p>:SOFFset <SensorOffset>

Takes the specified offset into account for the measured power. Only available if `[SENSe:]PMETer<p>:ROFFset[:STATe]` is disabled.

Suffix:
<p> Power sensor index

Parameters:
<SensorOffset> Default unit: DB

Example: `PMET2:SOFF 0.001`

[SENSe:]PMETer<p>[:STATe] <State>

Turns a power sensor on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET1 ON`
Switches the power sensor measurements on.

[SENSe:]PMETer<p>:UPDate[:STATe] <State>

Turns continuous update of power sensor measurements on and off.

If on, the results are updated even if a single sweep is complete.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET1:UPD ON`
The data from power sensor 1 is updated continuously.

UNIT<n>:PMETer<p>:POWer <Unit>

Selects the unit for absolute power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

Parameters:
<Unit> DBM | WATT | W | DB | PCT
*RST: DBM

Example: `UNIT:PMET:POW DBM`

UNIT<n>:PMETer<p>:POWer:RATio <Unit>

Selects the unit for relative power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: `UNIT:PMET:POW:RAT DB`

11.4.3 Frequency

[SENSe<ip>:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Suffix:
<ip> 1..n

Parameters:
<Frequency> The allowed range and f_{max} is specified in the data sheet.
*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency " on page 97

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

Defines the center frequency step size.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

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

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

Manual operation: See "Center Frequency Stepsize " on page 97

[SENSe<ip>:]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.

Suffix:

<ip> 1..n

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 98

11.4.4 Phase noise (R&S VSE-K60P)

CALCulate<n>:CHRDetection:PNOise:FREQuency:STARt <Frequency>

Sets the start frequency for the phase noise chirp measurement.

Suffix:
<n> irrelevant

Parameters:
<Frequency> Default unit: Hz

Example: `CALC4:CHRD:PNO:FREQ:STAR 10 MHZ`

Manual operation: See "Start / Stop Offset" on page 113

CALCulate<n>:CHRDetection:PNOise:FREQuency:STOP <Frequency>

Sets the stop frequency for the phase noise chirp measurement.

Suffix:
<n> irrelevant

Parameters:
<Frequency> Default unit: Hz

Example: `CALC4:CHRD:PNO:FREQ:STOP 100 MHZ`

Manual operation: See "Start / Stop Offset" on page 113

CALCulate<n>:HOPDetection:PNOise:FREQuency:STARt <Frequency>

Sets the start frequency for the phase noise hop measurement.

Suffix:
<n> irrelevant

Parameters:
<Frequency> Default unit: Hz

Example: `CALC4:HOPD:PNO:FREQ:STAR 10 MHZ`

Manual operation: See "Start / Stop Offset" on page 113

CALCulate<n>:HOPDetection:PNOise:FREQuency:STOP <Frequency>

Sets the stop frequency for the phase noise hop measurement.

Suffix:
<n> irrelevant

Parameters:

<Frequency> Default unit: Hz

Example: `CALC4:HOPD:PNO:FREQ:STOP 100 MHZ`

Manual operation: See "Start / Stop Offset" on page 113

CALCulate<n>:CHRDetection:PNOise:REFerence <Reference>

Suffix:

<n> irrelevant

Parameters:

<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:CHRDetection:PNOise:OFFSet:BEGin` on page 215 and `CALCulate<n>:CHRDetection:PNOise:OFFSet:END` on page 216).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC4:CHRD:PNO:REF EDGE`

Manual operation: See "Reference" on page 111

CALCulate<n>:HOPDetection:PNOise:REFerence <Reference>

Defines the reference point for positioning the phase noise measurement range.

Suffix:

<n> irrelevant

Parameters:

<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:HOPDetection:PNOise:OFFSet:BEGin` on page 216 and `CALCulate<n>:HOPDetection:PNOise:OFFSet:END` on page 216).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see [SENSe:]HOP:FMSettling:FMSPoint? on page 395).

PMSettling
The measurement range starts at the PM settling point (see [SENSe:]HOP:PMSettling:PMSPoint? on page 405).

Example: CALC4:HOPD:PNO:REF EDGE

Manual operation: See "Reference" on page 111

CALCulate<n>:CHRDetection:PNOise:LENGth <Percent>

Defines the length of the measurement range for power results in percent of the chirp length. This command is only available if the reference is CENT (see CALCulate<n>:CHRDetection:PNOise:REFerence on page 214).

Suffix:
<n> irrelevant

Parameters:
<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example: CALC4:CHRD:PNO:LENG 50

Manual operation: See "Length" on page 112

CALCulate<n>:HOPDetection:PNOise:LENGth <Percent>

Defines the length of the measurement range for power results in percent of the chirp length. This command is only available if the reference is CENT (see CALCulate<n>:HOPDetection:PNOise:REFerence on page 214).

Suffix:
<n> irrelevant

Parameters:
<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example: CALC4:HOPD:PNO:LENG 50

Manual operation: See "Length" on page 112

CALCulate<n>:CHRDetection:PNOise:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for phase noise results as an offset in seconds from the chirp start. This command is only available if the reference is EDGE (see CALCulate<n>:CHRDetection:PNOise:REFerence on page 214).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC4:CHRD:PNO:OFF:BEG 10 MS`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:PNOise:OFFSet:END <Time>

Defines the end of the measurement range for phase noise results as an offset in seconds from the chirp end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:PNOise:REFerence` on page 214).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC4:CHRD:PNO:OFF:END 50 MS`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:PNOise:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for phase noise results as an offset in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:PNOise:REFerence` on page 214).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC4:HOPD:PNO:OFF:BEG 10 MS`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:PNOise:OFFSet:END <Time>

Defines the end of the measurement range for phase noise results as an offset in seconds from the hop end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:PNOise:REFerence` on page 214).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC4:HOPD:PNO:OFF:END 50 MS`

Manual operation: See "Offset Begin / Offset End" on page 112

11.4.5 Amplitude settings

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

Useful commands for amplitude settings described elsewhere:

- `INPut<ip>:COUPling<ant>` on page 179
- `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 348

Remote commands exclusive to amplitude settings:

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

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

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

Suffix:

<n>	irrelevant
<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm
Default unit: DBM

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

Manual operation: See "Reference Level " on page 99

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

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

Suffix:

<n>	irrelevant
<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	Input source (for MIMO measurements only)

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 99

INPut<ip>: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.

Suffix:

<ip> 1..n

Parameters:

<Attenuation>
Range: see data sheet
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 99

INPut<ip>:ATTenuation:AUTO <State>

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

Suffix:

<ip> 1..n

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 99

INPut<ip>:GAIN<ant>:STATe <State>

Turns the internal preamplifier on the connected instrument on and off. It requires the additional preamplifier hardware option on the connected instrument.

Suffix:

<ip> 1 | 2

irrelevant

<ant> Input source (for MIMO measurements only)

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`

`INP:GAIN:VAL 15`

Switches on 15 dB preamplification.

Manual operation: See "Preamplifier " on page 100

INPut<ip>:GAIN<ant>[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut<ip>:GAIN<ant>:STATe` on page 219).

The command requires the additional preamplifier hardware option.

Suffix:

<ip> 1 | 2

irrelevant

<ant> Input source (for MIMO measurements only)

Parameters:

<Gain>
15 dB and 30 dB
All other values are rounded to the nearest of these two.
30 dB
Default unit: DB

Example:
`INP:GAIN:STAT ON`
`INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier " on page 100

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 220).

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 data sheet
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 100

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Parameters:

<State>
ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example:
`INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation " on page 100

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 100

11.4.6 Triggering

The following remote commands are required to configure a triggered measurement in a remote environment. More details are described for manual operation in Chapter 6.4, "Trigger settings", on page 101.

*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.

11.4.6.1 Configuring the triggering conditions

The following commands are required to configure triggered measurements.

Note that the availability of trigger settings depends on the connected instrument.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

Parameters:

<DropoutTime> Dropout time of the trigger.

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

Manual operation: See "Drop-Out Time " on page 104

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

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

Parameters:

<Offset> *RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset " on page 104

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

Defines the holding time before the next trigger event.

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

Parameters:

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

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

Manual operation: See "Trigger Holdoff " on page 105

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis " on page 104

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

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

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level " on page 104

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the data sheet.
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IFP -30DBM`

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IQP -30DBM`

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the data sheet.
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

Defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths, see the data sheet.
Default unit: DBM

Example: `TRIG:LEV:MAP -30DBM`

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

Defines the holding time before the next trigger event for (offline) input from a file.

Parameters:

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

Example: `TRIG:SOUR MAGN`
Sets an offline magnitude trigger source.
`TRIG:MAP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff " on page 105

TRIGger[:SEQuence]:MAPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example:
`TRIG:SOUR MAP`
Sets the (offline) magnitude trigger source.
`TRIG:MAP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis " on page 104

TRIGger[:SEQuence]:OSCilloscope:COUPling <CoupType>

Configures the coupling of the external trigger to the oscilloscope.

Parameters:

<CoupType> Coupling type

DC
Direct connection with 50 Ω termination, passes both DC and AC components of the trigger signal.

CDLimit
Direct connection with 1 MΩ termination, passes both DC and AC components of the trigger signal.

AC
Connection through capacitor, removes unwanted DC and very low-frequency components.

*RST: DC

TRIGger[:SEQuence]:SLOPe <Type>

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

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

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope " on page 104

TRIGger[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note that the availability of trigger sources depends on the connected instrument.

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.
If the optional 2 GHz bandwidth extension (B2000) is installed and active, this parameter activates the "Ch3" input connector on the oscilloscope. Then the R&S VSE triggers when the signal fed into the "Ch3" input connector on the oscilloscope meets or exceeds the specified trigger level.
Note: In previous firmware versions, the external trigger was connected to the "Ch2" input on the oscilloscope. As of firmware version R&S VSE 2.30, the **"Ch3"** input on the oscilloscope must be used!
If power splitter mode is active, this parameter activates the "EXT TRIGGER INPUT" connector on the oscilloscope. Then the R&S VSE triggers when the signal fed into the "EXT TRIGGER INPUT" connector on the oscilloscope meets or exceeds the specified trigger level.

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding "TRIGGER INPUT/ OUTPUT" connector on the connected instrument, or the oscilloscope's corresponding input channel (if not used as an input source).
For details on the connectors see the instrument's Getting Started manual.

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

MAGNitude
For (offline) input from a file, rather than an instrument.
The trigger level is specified by `TRIGger[:SEQuence]:LEVel:MAPower`.

MAIT
For trigger information stored as markers in an `.iqx` file.

MANual
Only available for a connected R&S RTP:
Any trigger settings in the R&S VSE software are ignored; only trigger settings defined on the connected instrument are considered. Thus, you can use the more complex trigger settings available on an R&S RTP.

*RST: IMMediate

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

Manual operation: See "Trigger Source" on page 102
See "Free Run " on page 102
See "External Trigger 1/2/3/4" on page 102
See "External Channel 3 " on page 103
See "IF Power " on page 103
See "I/Q Power " on page 103
See "RF Power " on page 103

11.4.6.2 Configuring the trigger output

The following commands are required to send the trigger signal to one of the variable "TRIGGER INPUT/OUTPUT" connectors on the connected instrument.

OUTPut:TRIGger<tp>:DIRection <Direction>

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

Suffix:
<Undefp> irrelevant

<tp>

Parameters:
<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

OUTPut:TRIGger<tp>:LEVel <Level>

Defines the level of the (TTL compatible) signal generated at the trigger output.

Works only if you have selected a user-defined output with OUTPut:TRIGger<tp>:OTYPe.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:
<Level> **HIGH**
5 V
LOW
0 V
*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

OUTPut:TRIGger<tp>:OTYPe <OutputType>

Selects the type of signal generated at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S VSE has triggered internally.
TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.
UDEFined
Sends a user-defined trigger signal. For more information, see OUTPut:TRIGger<tp>:LEVel.
*RST: DEVice

OUTPut:TRIGger<tp>:PULSe:IMMediate

Generates a pulse at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

OUTPut:TRIGger<tp>:PULSe:LENGth <Length>

Defines the length of the pulse generated at the trigger output.

Suffix:
<tp> Selects the trigger port to which the output is sent.

Parameters:

<Length> Pulse length in seconds.

Default unit: S

Example: `OUTP:TRIG2:PULS:LENG 0.02`

11.4.7 Data acquisition

You must define how much and how data is captured from the input signal.

[SENSe:]BANDwidth:DEMod <Bandwidth>
[SENSe:]BWIDth:DEMod <Bandwidth>

Parameters:

<Bandwidth> Range: 80 Hz to depends on options installed
*RST: maximum allowed
Default unit: HZ

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Measurement Bandwidth" on page 105

[SENSe:]FREQuency:SPAN <Span>

Defines the frequency span.

Parameters:

<Span> Range: 80 Hz to depends on options installed
*RST: maximum allowed
Default unit: Hz

Manual operation: See "Measurement Bandwidth" on page 105

[SENSe:]MTIMe <MeasTime>

Defines the time data is captured. Note that the record length and the measurement time are interdependent (see `[SENSe:]RLENgth` on page 230).

Parameters:

<MeasTime>	Range:	18.75 us to 1.298 ms
	*RST:	350 us
	Default unit:	S

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Measurement Time" on page 106

[SENSe:]RLENgth <SampleCount>

Defines the record length (in samples) for the current measurement. Note that the record length and the measurement time are interdependent (see `[SENSe:]MTIMe` on page 229).

Parameters:

<SampleCount> The maximum record length is limited only by the available memory.

*RST: 140000

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Record Length" on page 106

[SENSe:]SRATe <SampleRate>

Defines the sample rate for the current measurement.

Note that the sample rate and the measurement bandwidth are interdependent (see `[SENSe:]BWIDth:DEMod` on page 229). For information on supported sample rates and bandwidths see the data sheet.

Parameters:

<SampleRate>	Range:	100 Hz to depends on installed options
	*RST:	maximum allowed
	Default unit:	HZ

Example: `SRATe 100e6`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Sample Rate" on page 106

TRACe:IQ:LCAPture <State>

The long capture buffer provides functionality to use the full I/Q memory depth of the R&S VSE for data acquisition.

Parameters:

<State> AUTO | ON | OFF

AUTO
The long capture buffer is activated in case that the record length exceeds the amount of data which can be acquired within the standard memory capacity of the R&S VSE. If the record length decreases again, the long capture buffer is deactivated automatically.

ON
The long capture buffer is activated permanently. A data capture in a different measurement channel will overwrite and invalidate the acquired I/Q data. A red "IQ" icon in the channel tab indicates that the results for the channel no longer match the data currently in the capture buffer.

OFF
This is the default setting. Only the standard I/Q memory capacity of the R&S VSE is used. The available I/Q memory capacity is shared by all measurement channels.

11.4.8 Bandwidth settings

Useful commands for bandwidth settings described elsewhere:

- `[SENSe:]SWEep:FFT:WINDow:TYPE` on page 359
- `CALCulate<n>:SGRam:TRESolution` on page 356
- `CALCulate<n>:SGRam:TRESolution:AUTO` on page 356
- `[SENSe:]MTIMe` on page 229
- `[SENSe:]BWIDth:DEMod` on page 229
- `[SENSe:]DEMod:FMVF:TYPE` on page 258

Remote commands exclusive to bandwidth settings:

[SENSe:]BANDwidth[:WINDow<n>]:RATio <Bandwidth Ratio>

Suffix:

<n> 1..n
Window

Parameters:

<Bandwidth Ratio>

Manual operation: See "ABW / RBW" on page 108

[SENSe:]BANDwidth[:WINDow<n>]:RESolution <Bandwidth Resolution>

Suffix:

<n>	1..n Window

Parameters:

<Bandwidth Resolution>	Default unit: HZ

Manual operation: See "RBW" on page 108

11.4.9 Selecting the signal model

The signal model defines which type of signal to expect (if known), thus determining the analysis method. These settings are only available if the additional options R&S VSE-K60C/-K60H are installed.

[SENSe:]SIGNal:MODel <Signal>

Defines which type of signal to expect (if known), thus determining the analysis method.

Is only required if the additional options R&S VSE-K60C/-K60H are installed.

Parameters:

<Signal> HOP | CHIRp

HOP
Signals "hop" between random carrier frequencies in short intervals

CHIRp
The carrier frequency is either increased or decreased linearly over time

NONE
No specific signal model is used; this is the default setting if no additional options are installed

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Hop Model / Chirp Model" on page 82

11.4.10 Configuring signal detection

The signal detection settings define the conditions under which a hop/chirp is detected within the input signal.

These commands are only available if the additional options R&S VSE-K60C/-K60H are installed.

11.4.10.1 Chirp states

CALCulate<n>:CHRDetection:LENGth:AUTO <State>

Suffix:
<n> irrelevant

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

Example: `CALC:CHRD:LENG:AUTO ON`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Auto Mode" on page 88

CALCulate<n>:CHRDetection:LENGth:MAXimum <Time>

Suffix:
<n> irrelevant

Parameters:
<Time> Range: 0.000000752 to 0.00035
*RST: 0.00035
Default unit: S

Example: `CALC:CHRD:LENG:MAX 0.00035`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 88

CALCulate<n>:CHRDetection:LENGth:MINimum <Time>

Defines the minimum chirp length for detection.

Suffix:

<n> irrelevant

Parameters:

<Time> Range: 0.000000251 to 0.00035
*RST: 0.000000752
Default unit: S

Example: `CALC:CHRD:LENG:MIN 0.000001`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 88

CALCulate<n>:CHRDetection:STATes:AUTO <State>

Activates and deactivates the auto chirp state detection. If deactivated, the states defined using `CALCulate<n>:CHRDetection:STATes[:DATA]` are used.

Suffix:

<n> irrelevant

Parameters:

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

Example: `CALC:CHRD:STAT:AUTO ON`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Hop / Chirp Settings" on page 85

CALCulate<n>:CHRDetection:STATes[:DATA] {<ChirpRate>, <Tolerance>}...

Sets and queries the chirp state detection table. It consists of a comma-separated list of value pairs, one for each possible chirp state.

The parameters that can be set in the chirp state detection table depend on the chirp settings defined using `CALCulate<n>:CHRDetection:STATes:AUTO` on page 234 and the chirp detection mode defined using `CALCulate<n>:CHRDetection:DETection` on page 236:

	Chirp Settings "Auto"	Chirp Settings "Manual"
Chirp Detection "On"	All parameters are set automatically.	Manual setting of: • Chirp Rate • Tolerance
Chirp Detection "Off"	Manual setting of: • Chirp start • Chirp length	Manual setting of: • Chirp start • Chirp length • Start frequency • Stop frequency

Suffix:
<n> irrelevant

Parameters:

<ChirpRate> <numeric value>
Default unit: Hz/µs

<Tolerance> <numeric value>
Tolerance above or below the nominal chirp rate.
Default unit: Hz/µs

<ChirpStart> <numeric value>
Default unit: s

<ChirpLength> <numeric value>
Default unit: s

<StartFreq> <numeric value>
Default unit: Hz

<StopFreq> <numeric value>
Default unit: Hz

Example: `CALC:CHRD:STAT 1e6, 0.3, 1e5, 0.4`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Frequency Offset / Chirp Rate" on page 85
See "Tolerance" on page 86

CALCulate<n>:CHRDetection:STATes:NUMBer?

Suffix:
<n> irrelevant

Return values:
<States> Range: 0 to 1000

Usage: Query only

Manual operation: See "Hop / Chirp State Index" on page 85

CALCulate<n>:CHRDetection:STATes:TABLe:LOAD <Filename>

Loads the signal state table configuration from the selected file.

Suffix:
<n> irrelevant

Setting parameters:
<Filename> String containing the path and name of the file.

Usage: Setting only

Manual operation: See "Loading a signal state table from a file" on page 86

CALCulate<n>:CHRDetection:STATes:TABLe:SAVE <Filename>

Saves the current signal state table configuration to a file for later use.

Suffix:
<n> irrelevant

Setting parameters:
<Filename> String containing the path and name of the file.

Example:
```
CALC:CHRD:STAT:TABL:SAVE 'C:
\R_S\userdata\HopStates.csv'
```

Usage: Setting only

Manual operation: See "Applying changes to the signal state table" on page 86
See "Saving the signal state table to a file" on page 86

CALCulate<n>:CHRDetection:DETection <State>

Sets and queries the chirp detection mode.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
```
CALCulate{n}:CHRDetection:DETEction ON
```

Manual operation: See "Chirp Detection" on page 85

11.4.10.2 Hop states

CALCulate<n>:HOPDetection:DWELl:AUTO <State>

Suffix:
<n> irrelevant

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

Example: `CALC:HOPD:DWEL:AUTO ON`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Auto Mode" on page 88

CALCulate<n>:HOPDetection:DWELl:MAXimum <Time>

Suffix:
<n> irrelevant

Parameters:
<Time> Range: 0.000000052 to 0.00035
*RST: 0.00035
Default unit: S

Example: `CALC:HOPD:DWEL:MAX 0.00129822`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 88

CALCulate<n>:HOPDetection:DWELl:MINimum <Time>

Suffix:

<n> irrelevant

Parameters:

<Time> Range: 0.000000017 to 0.00035
*RST: 0.000000052
Default unit: S

Example: `CALC:HOPD:DWEL:MIN 0.000001`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 88

CALCulate<n>:HOPDetection:STATes:AUTO <State>

Activates and deactivates the auto hop state detection. If deactivated, the states defined using `CALCulate<n>:HOPDetection:STATes[:DATA]` are used.

Suffix:

<n> irrelevant

Parameters:

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

Example: `CALC:HOPD:STAT:AUTO ON`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Hop / Chirp Settings" on page 85

CALCulate<n>:HOPDetection:STATes[:DATA] {<FreqOffset>, <Tolerance>}...

Sets and queries the hop state detection table. It consists of a comma-separated list of value pairs, one for each possible hop state. A maximum of 1000 states can be defined.

Note that the state table can only be configured manually if `CALCulate<n>:HOPDetection:STATes:AUTO` is `OFF`.

Suffix:

<n> irrelevant

Parameters:

<FreqOffset> Frequency offsets from the center frequency
Default unit: HZ

<Tolerance> Tolerance above or below the nominal frequency.
Default unit: HZ

Example: `CALC:HOPD:STAT 1e6, 0.3, 1e5, 0.4`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Frequency Offset / Chirp Rate" on page 85
See "Tolerance" on page 86

CALCulate<n>:HOPDetection:STATes:NUMBer?

Suffix:
<n> irrelevant

Return values:
<TotalHops> Range: 0 to 1000

Usage: Query only

Manual operation: See "Hop / Chirp State Index" on page 85

CALCulate<n>:HOPDetection:STATes:TABLe:ADD {<start>, <step>, <number>}...

Suffix:
<n> irrelevant

Setting parameters:
<start> The frequency at which the first hop state will be generated.
Default unit: HZ

<step> The distance between two hop states.
Default unit: HZ

<number> Number of hop states to be generated.
Range: 0 to 1000 - (number of existing states)

Example: `CALC:HOPD:STAT:TABL:ADD 1 MHZ, 500 KHZ, 10`

Usage: Setting only

Manual operation: See "Add to Table" on page 87

CALCulate<n>:HOPDetection:STATes:TABLe:LOAD <Filename>

Loads the signal state table configuration from the selected file.

Suffix:
<n> irrelevant

Setting parameters:
<Filename> String containing the path and name of the file.

Example: `CALC:HOPD:STAT:TABL:LOAD 'C:\R_S\userdata\HopStates.csv'`

Usage: Setting only

Manual operation: See "Loading a signal state table from a file" on page 86

CALCulate<n>:HOPDetection:STATes:TABLe:NStates?

Queries the number of hop states to be generated by a subsequent `CALCulate<n>:HOPDetection:STATes:TABLe:ADD` or `CALCulate<n>:HOPDetection:STATes:TABLe:REPLace` command.

Suffix:
<n> irrelevant

Return values:
<NoOfStates> Range: 0 to 1000

Usage: Query only

Manual operation: See "Hop / Chirp State Index" on page 85
See "No of States" on page 87

CALCulate<n>:HOPDetection:STATes:TABLe:OFFSet <Offset>

Suffix:
<n> irrelevant

Setting parameters:
<Offset> Default unit: HZ

Usage: Setting only

Manual operation: See "Applying a global frequency offset" on page 87

CALCulate<n>:HOPDetection:STATes:TABLe:REPLace {<start>, <step>, <number>}...

Suffix:
<n> irrelevant

Setting parameters:
<start> The frequency at which the first hop state will be generated.
Default unit: HZ

<step> The distance between two hop states.
Default unit: HZ

<number> Number of hop states to be generated.

Example: `CALC:HOPD:STAT:TABL:REPL 1 MHZ, 500 KHZ, 10`

Usage: Setting only

Manual operation: See "Replace Table" on page 87

CALCulate<n>:HOPDetection:STATes:TABLe:SAVE <Filename>

Saves the current signal state table configuration to a file for later use.

Suffix:
<n> irrelevant

Setting parameters:
<Filename> String containing the path and name of the file.

Example: `CALC:HOPD:STAT:TABL:SAVE 'C:\R_S\userdata\HopStates.csv'`

Usage: Setting only

Manual operation: See "Applying changes to the signal state table" on page 86
See "Saving the signal state table to a file" on page 86

CALCulate<n>:HOPDetection:STATes:TABLe:STARt?

Suffix:
<n> irrelevant

Return values:
<Start>

Usage: Query only

Manual operation: See "Start Frequency" on page 86

CALCulate<n>:HOPDetection:STATes:TABLe:STEP?

Suffix:
<n> irrelevant

Return values:
<Step>

Usage: Query only

Manual operation: See "Step Size" on page 87

CALCulate<n>:HOPDetection:STATes:TABLe:TOLerance <Tolerance>

Suffix:
<n> irrelevant

Setting parameters:
<Tolerance> Default unit: HZ

Usage: Setting only

Manual operation: See "Applying a global tolerance value" on page 87

11.4.11 Configuring the measurement range

For some frequency or power calculations, it may be useful not to take the entire dwell time of the hop or length of the chirp into consideration, but only a certain range within the dwell time/length.

These settings are only available if the additional options R&S VSE-K60C/-K60H are installed.

CALCulate<n>:CHRDetection:COMPensation[:STATe] <State>

If activated, the calculated chirp rate error is compensated for when determining the measurement range for frequency parameters.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Compensate Hop State Deviation/Compensate Chirp Rate Deviation" on page 110

CALCulate<n>:CHRDetection:FDEViation:LENGth <Percent>

Defines the length of the measurement range for frequency deviation results in percent of the chirp length. This command is only available if the reference is `CENT` (see `CALCulate<n>:CHRDetection:PDEViation:REFerence` on page 248).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example:

```
CALC:CHRD:FDEV:RANG CENT
CALC:CHRD:FDEV:LENG 10
```

Manual operation: See "Length" on page 112

CALCulate<n>:CHRDetection:FDEViation:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for frequency deviation results as an offset in seconds from the chirp start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FDEViation:REFerence` on page 244).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:CHRD:FDEV:RANG EDGE`
`CALC:CHRD:FDEV:OFFS:BEG 3e-6 S`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:FDEViation:OFFSet:END <Time>

Defines the end of the measurement range for frequency deviation results as an offset in seconds from the chirp end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FDEViation:REFerence` on page 244).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:CHRD:FDEV:RANG EDGE`
`CALC:CHRD:FDEV:OFFS:END 3e-6 S`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:FDEViation:REFerence <Reference>

Defines the reference point for positioning the frequency deviation measurement range.

Suffix:

<n> 1..n
irrelevant

Parameters:

<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin` on page 245 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 246).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:CHRD:FDEV:REF CENT`

Manual operation: See "Reference" on page 111

CALCulate<n>:CHRDetection:FMTolerance <Tolerance>

Defines the allowed deviation from the detected FM signal model state where the chirp is considered as "settled".

Suffix:
<n> 1..n
irrelevant

Parameters:
<Tolerance> Default unit: HZ

Example: `CALC:CHRD:FMT 10 MHZ`

Manual operation: See "FM Settling Tolerance" on page 110

CALCulate<n>:CHRDetection:FREQuency:LENGth <Percent>

Defines the length of the measurement range for frequency results in percent of the chirp length. This command is only available if the reference is `CENT` (see `CALCulate<n>:CHRDetection:POWer:REFerence` on page 250).

Suffix:
<n> irrelevant

Parameters:
<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example: `CALC:CHRD:FREQ:LENG 10`

Manual operation: See "Length" on page 112

CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for power results as an offset in seconds from the chirp start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FREQuency:REFerence` on page 246).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:CHRD:FREQ:OFFS:BEG 3e-6`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:FREQuency:OFFSet:END <Time>

Defines the end of the measurement range for frequency results as an offset in seconds from the chirp end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FREQuency:REFerence` on page 246).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:FREQuency:REFerence <Reference>

Defines the reference point for positioning the frequency measurement range.

Suffix:

<n> irrelevant

Parameters:

<Reference> CENTer | EDGE

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin` on page 245 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 246).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:CHRD:FREQ:REF CENTer`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Reference" on page 111

CALCulate<n>:CHRDetection:PDEViation:LENGth <Percent>

Defines the length of the measurement range for phase deviation results in percent of the chirp length. This command is only available if the reference is `CENT` (see `CALCulate<n>:CHRDetection:PDEViation:REFerence` on page 248).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example:

```
CALC:CHRD:PDEV:RANG CENT
CALC:CHRD:PDEV:LENG 10
```

Manual operation: See "Length" on page 112

CALCulate<n>:CHRDetection:PDEViation:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for phase deviation results as an offset in seconds from the chirp start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FDEViation:REFerence` on page 244).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example:

```
CALC:CHRD:PDEV:RANG EDGE
CALC:CHRD:PDEV:OFFS:BEG 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:PDEViation:OFFSet:END <Time>

Defines the end of the measurement range for phase deviation results as an offset in seconds from the chirp end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:FDEViation:REFerence` on page 244).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example:

```
CALC:CHRD:FDEV:RANG EDGE
CALC:CHRD:FDEV:OFFS:END 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:PDEViation:REFerence <Reference>

Defines the reference point for positioning the phase deviation measurement range.

Suffix:
<n> 1..n
irrelevant

Parameters:
<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin` on page 245 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 246).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:CHRD:PDEV:REF CENT`

Manual operation: See "Reference" on page 111

CALCulate<n>:CHRDetection:PMTolerance <Tolerance>

Defines the allowed deviation from the detected PM signal model state where the chirp is considered as "settled".

Suffix:
<n> 1..n
irrelevant

Parameters:
<Tolerance> Default unit: degrees

Example: `CALC:CHRD:PMT 180`

Manual operation: See "PM Settling Tolerance" on page 111

CALCulate<n>:CHRDetection:POWer:LENGth <Percent>

Defines the length of the measurement range for power results in percent of the chirp length. This command is only available if the reference is `CENT` (see `CALCulate<n>:CHRDetection:POWer:REFerence` on page 250).

Suffix:
<n> irrelevant

Parameters:
<Percent> percent of the chirp length

Range: 0 to 100
*RST: 75

Example: `CALC:CHRD:POW:LENG 2e-4`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Length" on page 112

CALCulate<n>:CHRDetection:POWer:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for power results as an offset in seconds from the chirp start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:POWer:REFerence` on page 250).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:CHRD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:POWer:OFFSet:END <Time>

Defines the end of the measurement range for power results as an offset in seconds from the chirp end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:CHRDetection:POWer:REFerence` on page 250).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:CHRD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:CHRDetection:POWer:REFerence <Reference>

Defines the reference point for positioning the power measurement range.

Suffix:
<n> irrelevant

Parameters:
<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the chirp's rising or falling edge (see `CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin` on page 245 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 246).

CENTer
The measurement range is defined in reference to the center of the chirp.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:CHRD:POW:REF EDGE`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Reference" on page 111

CALCulate<n>:HOPDetection:COMPensation[:STATe] <State>

If activated, the calculated hop frequency is compensated for when determining the measurement range for frequency parameters.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Compensate Hop State Deviation/Compensate Chirp Rate Deviation" on page 110

CALCulate<n>:HOPDetection:FDEViation:LENGth <Percent>

Defines the length of the measurement range for frequency deviation results in percent of the hop's dwell time. This command is only available if the reference is `CENT` (see `CALCulate<n>:HOPDetection:FDEViation:REFerence` on page 252).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Percent> percent of the hop dwell time

Range: 0 to 100
*RST: 75

Example:
```
CALC:HOPD:FDEV:RANG CENT
CALC:HOPD:FDEV:LENG 10
```

Manual operation: See "Length" on page 112

CALCulate<n>:HOPDetection:FDEViation:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for frequency deviation results as an offset in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:FDEViation:REFerence` on page 252).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example:
```
CALC:HOPD:FDEV:RANG EDGE
CALC:HOPD:FDEV:OFFS:BEG 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:FDEViation:OFFSet:END <Time>

Defines the end of the measurement range for frequency deviation results as an offset in seconds from the hop end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:FDEViation:REFerence` on page 252).

Suffix:

<n> 1..n
irrelevant

Parameters:

<Time> Default unit: S

Example:
```
CALC:HOPD:FDEV:RANG EDGE
CALC:HOPD:FDEV:OFFS:END 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:FDEViation:REFerence <Reference>

Defines the reference point for positioning the frequency deviation measurement range.

Suffix:

<n> 1..n
irrelevant

Parameters:

<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the hop's rising or falling edge (see `CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin` on page 253 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 253).

CENTer
The measurement range is defined in reference to the center of the hop.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:HOPD:FDEV:REF CENT`

Manual operation: See "Reference" on page 111

CALCulate<n>:HOPDetection:FMTolerance <Tolerance>

Defines the allowed deviation from the detected FM signal model state where the hop is considered as "settled".

Suffix:

<n> 1..n
irrelevant

Parameters:

<Tolerance> Default unit: HZ

Example: `CALC:HOPD:FMT 10 MHZ`

Manual operation: See "FM Settling Tolerance" on page 110

CALCulate<n>:HOPDetection:FREQuency:LENGth <Percent>

Defines the length of the measurement range for frequency results in percent of the hop's dwell time. This command is only available if the reference is `CENT` (see `CALCulate<n>:HOPDetection:FREQuency:REFerence` on page 254).

Suffix:

<n> irrelevant

Parameters:

<Percent> percent of the hop dwell time

Range: 0 to 100
*RST: 75

Example: `CALC:HOPD:FREQ:LENG 10`

Manual operation: See "Length" on page 112

CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for frequency results as an offset in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:FREQuency:REFerence` on page 254).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:FREQ:OFFS:BEG 3e-6`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:FREQuency:OFFSet:END <Time>

Defines the end of the measurement range for frequency results as an offset in seconds from the hop end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:FREQuency:REFerence` on page 254).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:FREQ:OFFS:END 3e-6`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:FREQuency:REFerence <Reference>

Defines the reference point for positioning the frequency measurement range.

Suffix:

<n> irrelevant

Parameters:

<Reference> CENTer | EDGE

EDGE
The measurement range is defined in reference to the hop's rising or falling edge (see `CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin` on page 253 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 253).

CENTer
The measurement range is defined in reference to the center of the hop.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:HOPD:FREQ:REF CENTer`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Reference" on page 111

CALCulate<n>:HOPDetection:PCOHerent[:STATe] <State>

Turns on the coherent phase deviation measurement.

Is only available for the R&S VSE-K60H option.

For details see "Coherent phase deviation measurement" on page 49.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:HOPD:PCOH:STAT ON`

Manual operation: See "Coherent Phase Deviation Measurement" on page 110

CALCulate<n>:HOPDetection:PDEViation:LENGth <Percent>

Defines the length of the measurement range for frequency results in percent of the hop's dwell time. This command is only available if the reference is `CENT` (see `CALCulate<n>:HOPDetection:PDEViation:REFerence` on page 256).

Suffix:
<n> 1..n
irrelevant

Parameters:
<Percent> percent of the hop dwell time
Range: 0 to 100
*RST: 75

Example:
```
CALC:HOPD:PDEV:RANG CENT
CALC:HOPD:PDEV:LENG 10
```

Manual operation: See "Length" on page 112

CALCulate<n>:HOPDetection:PDEViation:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for phase deviation results as an offset in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:PDEViation:REFerence` on page 256).

Suffix:
<n> 1..n
irrelevant

Parameters:
<Time> Default unit: S

Example:
```
CALC:HOPD:PDEV:RANG EDGE
CALC:HOPD:PDEV:OFFS:BEG 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:PDEViation:OFFSet:END <Time>

Defines the end of the measurement range for phase deviation results as an offset in seconds from the hopend . This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:PDEViation:REFerence` on page 256).

Suffix:
<n> 1..n
irrelevant

Parameters:
<Time> Default unit: S

Example:
```
CALC:HOPD:PDEV:RANG EDGE
CALC:HOPD:PDEV:OFFS:END 3e-6 S
```

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:PDEViation:REFerence <Reference>

Defines the reference point for positioning the phase deviation measurement range.

Suffix:
<n> 1..n
irrelevant

Parameters:
<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the hop's rising or falling edge (see `CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin` on page 253 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 253).

CENTer
The measurement range is defined in reference to the center of the hop.

FMSEttling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSEttling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example:
```
CALC:HOPD:PDEV:REF CENT
```

Manual operation: See "Reference" on page 111

CALCulate<n>:HOPDetection:PMTolerance <Tolerance>

Defines the allowed deviation from the detected PM signal model state where the hop is considered as "settled".

Suffix:
<n> 1..n
irrelevant

Parameters:
<Tolerance> Default unit: degrees

Example:
```
CALC:HOPD:PMT 180
```

Manual operation: See "PM Settling Tolerance" on page 111

CALCulate<n>:HOPDetection:POWer:LENGth <Percent>

Defines the length of the measurement range in percent of the dwell time. This command is only available if the reference is `CENT` (see `CALCulate<n>:HOPDetection:POWer:REFerence` on page 257).

Suffix:

<n> irrelevant

Parameters:

<Percent> Range: 0 to 100
*RST: 75

Example: `CALC:HOPD:POW:LENG 2e-4`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Length" on page 112

CALCulate<n>:HOPDetection:POWer:OFFSet:BEGin <Time>

Defines the beginning of the measurement range as an offset in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:POWer:REFerence` on page 257).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:POWer:OFFSet:END <Time>

Defines the end of the measurement range as an offset in seconds from the hop end. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:POWer:REFerence` on page 257).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 112

CALCulate<n>:HOPDetection:POWer:REFerence <Reference>

Defines the reference point for positioning the frequency/power measurement range.

Suffix:

<n> irrelevant

Parameters:

<Reference> CENTer | EDGE | FMSettling | PMSettling

EDGE
The measurement range is defined in reference to the hop's rising or falling edge (see `CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin` on page 253 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 253).

CENTer
The measurement range is defined in reference to the center of the hop.

FMSettling
The measurement range starts at the FM settling point (see `[SENSe:]HOP:FMSettling:FMSPoint?` on page 395).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 405).

Example: `CALC:HOPD:POW:REF EDGE`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Reference" on page 111

11.4.12 Configuring demodulation

[SENSe:]DEMod:FMVF:TYPE <Filter>

Activates or deactivates additional filters applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Parameters:

<Filter> NONE | LP01 | LP1 | LP5 | LP10 | LP25

NONE
No video filter applied

LP01
Low pass filter 0.1 % bandwidth

LP1
Low pass filter1 % bandwidth

LP5
Low pass filter 5 % bandwidth

LP10
Low pass filter 10 % bandwidth

LP25
Low pass filter 25 % bandwidth

Example: `SENS:DEM:FMVF:TYPE LP01`

Manual operation: See "FM Video Bandwidth" on page 114

11.4.13 Selecting the analysis region

The analysis region determines which data is displayed on the screen (see also Chapter 4.5, "Analysis region", on page 25).

CALCulate<n>:AR:FREQuency:BANDwidth <Frequency>

Suffix:
<n> 1..n
irrelevant

Parameters:
<Frequency> Default unit: HZ

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Analysis Bandwidth" on page 106

CALCulate<n>:AR:FREQuency:DELTa <Frequency>

Defines the center of the frequency span for the analysis region. It is defined as an offset from the center frequency.

Suffix:
<n> 1..n
irrelevant

Parameters:
<Frequency> Default unit: HZ

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Delta Frequency" on page 107

CALCulate<n>:AR:FREQuency:PERCent <BWPercent>

For `CALCulate<n>:AR:FREQuency:PERCent:STATe` `TRUE`, the width of the frequency span for the analysis region is defined as a percentage of the full capture buffer. It is centered around the point defined by `CALCulate<n>:AR:FREQuency:DELTa` on page 259.

Suffix:

<n> 1..n
irrelevant

Parameters:

<BWPercent> percentage of the full analysis bandwidth

Manual operation: See "Linked analysis bandwidth" on page 107

CALCulate<n>:AR:FREQuency:PERCent:STATe <State>

If activated, the width of the frequency span for the analysis region is defined as a percentage of the full capture buffer (using `CALCulate<n>:AR:FREQuency:PERCent` on page 260).

Suffix:

<n> 1..n
irrelevant

Parameters:

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

Manual operation: See "Linked analysis bandwidth" on page 107

CALCulate<n>:AR:TIME:LENGth <Length>

Defines the length of the time gate, that is, the duration (or height) of the analysis region.

Suffix:

<n> 1..n
irrelevant

Parameters:

<Length> Default unit: S

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Time Gate Length" on page 107

CALCulate<n>:AR:TIME:PERCent <TimePercent>

For `CALCulate<n>:AR:TIME:PERCent:STATe` `TRUE`,the length of the time gate, that is, the duration (or height) of the analysis region, is defined as a percentage of the full measurement time. The time gate start is the start of the capture buffer plus an offset defined by `CALCulate<n>:AR:TIME:STARt` on page 261.

Suffix:

<n> 1..n
irrelevant

Parameters:

<TimePercent> percentage of the full measurement time

Manual operation: See "Linked analysis time span" on page 107

CALCulate<n>:AR:TIME:PERCent:STATe <State>

If activated, the length of the time gate, that is, the duration (or height) of the analysis region, is defined as a percentage of the full measurement time (using `CALCulate<n>:AR:TIME:PERCent` on page 261).

Suffix:

<n> 1..n
irrelevant

Parameters:

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

Manual operation: See "Linked analysis time span" on page 107

CALCulate<n>:AR:TIME:STARt <StartTime>

Defines the starting point of the time span for the analysis region. The starting point is defined as a time offset from the capture start time.

Suffix:

<n> 1..n
irrelevant

Parameters:

<StartTime> Default unit: S

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Time Gate Start" on page 107

11.4.14 Adjusting settings automatically

The following remote commands are required to adjust settings automatically in a remote environment.

[SENSe<ip>:]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 R&S VSE is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Suffix:
<ip> 1..n

Example: `ADJ:LEV`

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 114

11.5 Analyzing transient effects

The following commands are required to analyze transient effects in a measured signal.

11.5.1 Configuring the result display

The commands required to configure the screen display in a remote environment are described here.

11.5.1.1 Global layout commands

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in Chapter 11.5.1.2, "Working with windows in the display", on page 266 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]?
<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

Adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

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

Parameters:

<ExChanName>	string Name of an existing channel
<ExWinName>	string Name of the existing window within the <ExChanName> channel 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:GLOBal:IDENtify[:WINDow]?` query.
<Direction>	LEFT | RIGHt | ABOVe | BELow | TAB Direction the new window is added relative to the existing window. **TAB** The new window is added as a new tab in the specified existing window.
<NewChanName>	string Name of the channel for which a new window is to be added.

<NewWinType>	string 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:	`LAYout:GLOBal:ADD:WINDow? 'IQ Analyzer','1',RIGH,'IQ Analyzer2','FREQ'` Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.
Usage:	Query only

LAYout:GLOBal:CATalog[:WINDow]?

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

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

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

Return values:

<ChannelName>	String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
<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:GLOB:CAT?`
	Result:
	`IQ Analyzer: '1',1,'2',2`
	`Analog Demod: '1',1,'4',4`
	For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
	For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage:	Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

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

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

Parameters:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example: `LAYout:GLOBal:IDENtify? 'IQ Analyzer','Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>, <WindowName>

Setting parameters:

<ChannelName>

<WindowName>

Usage: Setting only

LAYout:GLOBal:REPLace[:WINDow] <ExChannelName>, <WindowName>, <NewChannelName>, <WindowType>

Setting parameters:

<ExChannelName>

<WindowName>

<NewChannelName>

<WindowType>

Usage: Setting only

11.5.1.2 Working with windows in the display

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

The following commands are required to change the evaluation type and rearrange the screen layout for a channel as you do 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.

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

To configure the layout of windows across channels, use the Chapter 11.5.1.1, "Global layout commands", on page 263.

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

Adds a window to the display in the active channel.

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

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

Query parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.
<Direction>	LEFT | RIGHt | ABOVe | BELow Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values. Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

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 "RF Spectrum" on page 67
See "Spectrogram" on page 68
See "RF Power Time Domain" on page 69
See "FM Time Domain" on page 70
See "I/Q Time Domain" on page 70
See "Frequency Deviation Time Domain" on page 70
See "PM Time Domain" on page 71
See "PM Time Domain (Wrapped)" on page 72
See "Phase Deviation Time Domain" on page 72
See "Chirp Rate Time Domain" on page 73
See "Hop/Chirp Results Table" on page 74
See "Hop/Chirp Statistics Table" on page 74
See "Parameter Distribution" on page 75
See "Parameter Trend" on page 76
See "Phase Noise" on page 76
See "Frequency Deviation Spectrogram" on page 77
See "Frequency Deviation Spectrum" on page 77
See "Phase Deviation Spectrum" on page 78
See "Phase Deviation Spectrogram" on page 78
See "Marker Table " on page 79

For a detailed example, see Chapter 11.8, "Programming examples", on page 456.

Table 11-3: <WindowType> parameter values for Transient Analysis application

Parameter value	Window type
SGR	"Spectrogram"
RFPTime	RF Power "Time Domain"
FMTime	"FM Time Domain"
IQTime	I/Q "Time Domain"
FDEViation	Frequency Deviation "Time Domain"[1)]
FDSG	Frequency Deviation Spectrogram[2)]
FDSP	Frequency Deviation Spectrum[2)]
PDEViation	Phase Deviation "Time Domain"[1)]
[1)] requires additional option R&S VSE-K60C/-K60H [2)] requires additional option R&S VSE-K60P	

Parameter value	Window type
PDIStribution	Parameter Distribution
PDSG	Phase Deviation Spectrogram[2)]
PDSP	Phase Deviation Spectrum[2)]
PMTime	"PM Time Domain"
PMWRapped	"PM Time Domain" (Wrapped)
PNO	Phase Noise[2)]
PTRend	Parameter Trend
RFSPectrum	"RF Spectrum"
CRTime	Chirp Rate "Time Domain"[1)]
MTABle	Marker table
RTABle	Results table[1)]
STABle	Statistics table[1)]
[1)] requires additional option R&S VSE-K60C/-K60H [2)] requires additional option R&S VSE-K60P	

LAYout:CATalog[:WINDow]?

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

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

To query the name and index of all windows in all channels, use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

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

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

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

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

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

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

To query the index of a window in a different channel, use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

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, 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, 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 while keeping its position, index and window name.

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

Setting parameters:

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

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 266 for a list of available window types.
Note that the window type must be valid for the active channel.
To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

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

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 266 for a list of available window types. Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Return values:

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

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

Usage:	Query only

LAYout:WINDow<n>:IDENtify?

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

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

Suffix:

<n>	Window

Return values:

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

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

Usage:	Query only

LAYout:WINDow<n>:REMove

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

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

To remove a window in a different channel, use the `LAYout:GLOBal:REMove[:WINDow]` command.

Suffix:

<n>	Window

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

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

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

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

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

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 266 for a list of available window types.
Note that the window type must be valid for the active channel.
To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

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

Usage: Setting only

11.5.1.3 General window commands

The following commands are required to work with windows, independently of the application.

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

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:
<Format>

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

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

11.5.2 Defining the evaluation basis

Depending on the measurement task, not all of the measured data in the capture buffer may be of interest. In some cases it may be useful to restrict analysis to a specific user-definable region, or to a selected individual chirp rate or hop.

Which measurement basis is available for which result display is indicated in Table 5-1.

These commands are only available if the additional options R&S VSE-K60C/-K60H are installed.

DISPlay[:WINDow<n>]:EVALuate <Dsp>

Determines the evaluation basis for the specified result display.

Which evaluation basis is available for which result display is indicated in Table 5-1.

Suffix:

<n> 1..n
Window

Parameters:

<Dsp> FULL | REGion | HOP | CHIRp

FULL
the full capture buffer

REGion
the selected analysis region (see Chapter 11.4.13, "Selecting the analysis region", on page 259)

HOP
an individual selected hop (see CALCulate<n>:HOPDetection:SELected on page 277)

CHIRp
an individual selected chirp (see CALCulate<n>:CHRDetection:SELected on page 277)

*RST: depends on result display

Example: `DISP:WIND1:EVAL HOP`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Full Capture / Region Analysis / Hop / Chirp" on page 125

11.5.3 Configuring the result range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 43).

These settings are only available if the additional options R&S VSE-K60C/-K60H are installed.

CALCulate<n>:RESult:ALIGnment <Reference>

Defines the alignment of the result range in relation to the selected reference point (see CALCulate<n>:RESult:REFerence on page 276).

Suffix:
<n> irrelevant

Parameters:
<Reference> LEFT | CENTer | RIGHt

LEFT
The result range starts at the hop/chirp center or selected edge.

CENTer
The result range is centered around the hop/chirp center or selected edge.

RIGHt
The result range ends at the hop/chirp center or selected edge.

*RST: CENTer

Example: `CALC:RES:ALIG LEFT`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Alignment" on page 118

CALCulate<n>:RESult:LENGth <Time>

Defines the length or duration of the result range.

Note this command is only available for manual range scaling (see `CALCulate<n>:RESult:RANGe:AUTO` on page 276).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:RES:LENG 1us`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Length" on page 118

CALCulate<n>:RESult:OFFSet <Time>

The offset in seconds from the hop/chirp edge or center at which the result range reference point occurs.

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset" on page 118

CALCulate<n>:RESult:RANGe:AUTO <State>

Defines whether the result range length is determined automatically according to the width of the selected hop/chirp.

Suffix:
<n> irrelevant

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

Example: `CALC:RES:RANG:AUTO ON`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Automatic Range Scaling" on page 117

CALCulate<n>:RESult:REFerence <Reference>

Defines the reference point for positioning the result range.

Suffix:
<n> irrelevant

Parameters:
<Reference> RISE | CENTer | FALL

RISE
The result range is defined in reference to the rising edge.

CENTer
The result range is defined in reference to the center of the hop/chirp top.

FALL
The result range is defined in reference to the falling edge.

*RST: CENTer

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Result Range Reference Point" on page 117

11.5.4 Selecting the hop/chirp

The selected hop/chirp determines which results are calculated and displayed.

These commands are only available if the additional options R&S VSE-K60C/-K60H are installed.

CALCulate<n>:CHRDetection:SELected <ChirpNo>

Defines the individual chirp number within the current sweep for which results are calculated and displayed.

Suffix:
<n> irrelevant

Parameters:
<ChirpNo> Chirp number

Example: `CALC:CHRD:SEL 3`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Select Hop / Select Chirp" on page 125

CALCulate<n>:HOPDetection:SELected <HopNo>

Defines or queries the individual hop number in the current sweep for which results are calculated and displayed.

Suffix:
<n> irrelevant

Parameters:
<HopNo> Hop number

Example: `CALC:HOPD:SEL 3`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Select Hop / Select Chirp" on page 125

11.5.5 Table configuration

The following commands define which statistical and characteristic values are determined for measured hops/chirps.

These commands are only available if the additional options R&S VSE-K60C/-K60H are installed.

11.5.5.1 Chirp results

CALCulate<n>:CHRDetection:TABLe:COLumn <State>, <Headers>...

Enables or disables columns in all chirp results and statistics tables.

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

Enables or disables all subsequently listed headers

ON | 1
Provides results for the defined `<Headers>` only

OFF | 0
Provides results for all table parameters except the specified `<Headers>`.

*RST: 1

<Headers> ALL | STATe | BEGin | LENGth | RATE | CHERror | FREQuency | MAXFm | RMSFm | AVGFm | MINPower | MAXPower | AVGPower | PWRRipple | AVPHm | MXPHm | RMSPm | FMSPoint | FMSTime | FMSLength | BWIDth | AVGNonlinear | RMSNonlinear | MAXNonlinear | PMSPoint | PMSTime | PMSLength

All listed parameters are displayed or hidden in the table results (depending on the `<State>` parameter).

ALL
See Chapter 5.2, "Chirp parameters", on page 54.

STATe
Chirp state

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC:CHRD:TABL:COL ON, CHRNo, STATe`
Provides results for the chirp number and chirp state only.

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

CALCulate<n>:CHRDetection:TABLe:FMSettling:ALL[:STATe] <State>[, <Scaling>]

If enabled, all FM settling parameters are included in the result tables (see "FM settling parameters" on page 64).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> S | MS | US | NS

Defines the scaling for the FM settling parameters

Example: `CALC:CHRD:TABL:FMS:ALL ON, S`

Usage: Setting only

Manual operation: See "FM settling parameters" on page 64

CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSLength <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSPoint <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSTime <State>[, <Scaling>]

If enabled, the FM settling time parameter is included in the result tables (see "FM settling parameters" on page 64).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> S | MS | US | NS

Defines the scaling for the FM settling parameters

Example: `CALC:CHRD:TABL:FMS:FMST ON, MS`

Manual operation: See "FM settling time" on page 64

CALCulate<n>:CHRDetection:TABLe:FREQuency:ALL[:STATe] <State>[, <Scaling>]

If enabled, all frequency parameters are included in the result tables (see "Frequency parameters" on page 58).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> GHZ | MHZ | KHZ | HZ

Defines the scaling for the frequency parameters

Usage: Setting only

Manual operation: See "Frequency parameters" on page 58

CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGFm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:BWIDth <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:CHERror <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:FREQuency <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXFm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSFm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:OVERshoot <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:FREQuency:UNDershoot <State>[, <Scaling>]

Suffix:

<n> 1..n

Setting parameters:

<State>

<Scaling> GHZ | MHZ | KHZ | HZ

CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGNonlinear <State>
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXNonlinear <State>
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSNonlinear <State>

If enabled, the frequency nonlinearity parameter is included in the result tables (see "Frequency Deviation (RMS)" on page 59).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:CHRD:TABL:FREQ:RMSN ON`

Manual operation: See "Frequency INL (RMS)" on page 63

CALCulate<n>:CHRDetection:TABLe:PHASe:ALL[:STATe] <State>[, <Scaling>]

If enabled, all phase deviation parameters are included in the result tables (see "Phase parameters" on page 60).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:
<Scaling> DEG | RAD

Defines the scaling for the phase parameters

Usage: Setting only

Manual operation: See "Phase parameters" on page 60

CALCulate<n>:CHRDetection:TABLe:PHASe:AVGPm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PHASe:MAXPm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PHASe:RMSPm <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PHASe:OVERshoot <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PHASe:UNDershoot <State>[, <Scaling>]

Suffix:
<n> 1..n

Setting parameters:
<State>

<Scaling> S | MS | US | NS

CALCulate<n>:CHRDetection:TABLe:PMSettling:ALL[:STATe] <State>[, <Scaling>]

If enabled, all PM settling parameters are included in the result tables (see "PM settling parameters" on page 64).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:
<Scaling> S | MS | US | NS

Defines the scaling for the PM settling parameters

Usage: Setting only

Manual operation: See "PM settling parameters" on page 64

CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSLength <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSPoint <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSTime <State>[, <Scaling>]

If enabled, the specified PM settling parameter is included in the result tables (see "PM settling parameters" on page 64).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:
<Scaling> S | MS | US | NS

Defines the scaling for the PM settling parameters

Example: `CALC:CHRD:TABL:PMS:PMST ON, MS`

Manual operation: See "PM settling time" on page 65

CALCulate<n>:CHRDetection:TABLe:POWer:ALL[:STATe] <State>

If enabled, all power parameters are included in the result tables (see "Power parameters" on page 61).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Scaling is always in dB and need not be specified.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:CHRD:TABL:POW:ALL ON`

Usage: Setting only

Manual operation: See "Power parameters" on page 61

CALCulate<n>:CHRDetection:TABLe:POWer:AVEPower <State>
CALCulate<n>:CHRDetection:TABLe:POWer:MAXPower <State>

CALCulate<n>:CHRDetection:TABLe:POWer:MINPower <State>
CALCulate<n>:CHRDetection:TABLe:POWer:PWRRipple <State>

Suffix:

<n> 1..n
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Manual operation: See "Power Ripple" on page 62

CALCulate<n>:CHRDetection:TABLe:STATe:ALL[:STATe] <State>

If enabled, all state parameters are included in the result tables (see "State parameters" on page 57).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Usage: Setting only

Manual operation: See "State parameters" on page 57

CALCulate<n>:CHRDetection:TABLe:STATe:INDex <State>

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:CHRD:TABL:STAT:IND ON`

Manual operation: See "State Index" on page 57

CALCulate<n>:CHRDetection:TABLe:TIMing:ALL[:STATe] <State>[, <Scaling>]

If enabled, all timing parameters are included in the result tables (see"Timing parameters" on page 57).

Note that only the enabled columns are returned for the `CALCulate<n>:CHRDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Setting parameters:
<Scaling> S | MS | US | NS

Defines the scaling for the timing parameters

Usage: Setting only

Manual operation: See "Timing parameters" on page 57

CALCulate<n>:CHRDetection:TABLe:TIMing:BEGin <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:TIMing:LENGth <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:TIMing:RATE <State>[, <Scaling>]
CALCulate<n>:CHRDetection:TABLe:TIMing:SWITching <State>[, <Scaling>]

Suffix:
<n> 1..n

Parameters:
<State>

<Scaling> S | MS | US | NS

11.5.5.2 Hop results

CALCulate<n>:HOPDetection:TABLe:COLumn <State>, <Headers>...

Enables or disables columns in all hop results and statistics tables.

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

Enables or disables all subsequently listed headers

ON | 1
Provides results for the defined `<Headers>` only

OFF | 0
Provides results for all table parameters except the specified `<Headers>`.

*RST: 1

<Headers> ALL | STATe | BEGin | DWELl | SWITching | STAFrequency | FREQuency | RELFrequency | FMERror | MAXFm | RMSFm | AVGFm | MINPower | MAXPower | AVGPower | PWRRipple | AVPHm | MXPHm | RMSPm | FMSPoint | FMSTime | FMSLength | PMSPoint | PMSTime | PMSLength

All listed parameters are displayed or hidden in the table results (depending on the `<State>` parameter).

ALL
See Chapter 5.1, "Hop parameters", on page 44.

STATe
Hop state

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

STAFrequency
State frequency (nominal)

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum frequency deviation

RMSFm
RMS frequency deviation

AVGFm
Average frequency deviation

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC:HOPD:TABL:COL ON, HOPNo, STATe`
Provides results for the HOP number and HOP state only.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

CALCulate<n>:HOPDetection:TABLe:FMSettling:ALL[:STATe] <State>[, <Scaling>]

If enabled, all FM settling parameters are included in the result tables (see "FM settling parameters" on page 52).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:
<Scaling> S | MS | US | NS

Defines the scaling for the FM settling parameters

Example: `CALC:HOPD:TABL:FMS:ALL ON, S`

Usage: Setting only

Manual operation: See "FM settling parameters" on page 52

CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSLength <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSPoint <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSTime <State>[, <Scaling>]

If enabled, the specified FM settling parameter is included in the result tables (see "FM settling parameters" on page 52).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> S | MS | US | NS

Defines the scaling for the FM settling parameters

Example: `CALC:HOPD:TABL:FMS:FMST ON, MS`

Manual operation: See "FM settling time" on page 53

CALCulate<n>:HOPDetection:TABLe:FREQuency:ALL[:STATe] <State>[, <Scaling>]

If enabled, all frequency parameters are included in the result tables (see "Frequency parameters" on page 47).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> GHZ | MHZ | KHZ | HZ

Defines the scaling for the frequency parameters

Usage: Setting only

CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FREQuency:FMERror <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FREQuency:FREQuency <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FREQuency:MAXFm <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FREQuency:RELFrequency <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:FREQuency:RMSFm <State>[, <Scaling>]

If enabled, the specified frequency parameter is included in the result tables (see "Frequency parameters" on page 47).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ

Defines the scaling for the frequency parameters

Manual operation: See "Frequency Deviation (RMS)" on page 48

CALCulate<n>:HOPDetection:TABLe:PHASe:ALL[:STATe] <State>[, <Scaling>]

If enabled, all phase deviation parameters are included in the result tables (see "Phase parameters" on page 49).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Setting parameters:

<Scaling> DEG | RAD

Defines the scaling for the phase parameters

Usage: Setting only

Manual operation: See "Phase parameters" on page 49

CALCulate<n>:HOPDetection:TABLe:PHASe:AVGPm <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:PHASe:MAXPm <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:PHASe:RMSPm <State>[, <Scaling>]

If enabled, the specified phase deviation parameter is included in the result tables (see "Phase parameters" on page 49).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Setting parameters:

<Scaling> DEG | RAD

Defines the scaling for the phase parameters

Manual operation: See "Phase Deviation (RMS)" on page 51

CALCulate<n>:HOPDetection:TABLe:PMSettling:ALL[:STATe] <State>[, <Scaling>]

If enabled, all PM settling parameters are included in the result tables (see "PM settling parameters" on page 53).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on
*RST: 0

Setting parameters:
<Scaling> S | MS | US | NS
Defines the scaling for the FM settling parameters

Example: `CALC:HOPD:TABL:PMS:ALL ON, X`

Usage: Setting only

Manual operation: See "PM settling parameters" on page 53

CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSLength <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSPoint <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:PMSettling:PMSTime <State>[, <Scaling>]

If enabled, the PM settling time parameter is included in the result tables (see "PM settling time" on page 54).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on
*RST: 0

Setting parameters:
<Scaling> S | MS | US | NS
Defines the scaling for the FM settling parameters

Example: `CALC:HOPD:TABL:PMS:PMST ON, MS`

Manual operation: See "PM settling time" on page 54

CALCulate<n>:HOPDetection:TABLe:POWer:ALL[:STATe] <State>

If enabled, all power parameters are included in the result tables (see "Power parameters" on page 51).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:HOPD:TABL:POW:ALL ON`

Usage: Setting only

Manual operation: See "Power parameters" on page 51

CALCulate<n>:HOPDetection:TABLe:POWer:AVEPower <State>
CALCulate<n>:HOPDetection:TABLe:POWer:MAXPower <State>
CALCulate<n>:HOPDetection:TABLe:POWer:MINPower <State>
CALCulate<n>:HOPDetection:TABLe:POWer:PWRRipple <State>

Suffix:
<n> 1..n
irrelevant

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

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Manual operation: See "Power Ripple" on page 52

CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe] <State>

If enabled, all state parameters are included in the result tables (see "State parameters" on page 46).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on
*RST: 0

Example: `CALC:HOPD:TABL:STAT:ALL ON`

Usage: Setting only

Manual operation: See "State parameters" on page 46
See "Frequency parameters" on page 47

CALCulate<n>:HOPDetection:TABLe:STATe:INDex <State>

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on
*RST: 0

Example: `CALC:HOPD:TABL:STAT:IND ON`

Manual operation: See "State Index" on page 46

CALCulate<n>:HOPDetection:TABLe:STATe:STAFrequency <State>[, <Scaling>]

If enabled, the hop state frequency parameter is included in the result tables (see "State parameters" on page 46).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on
*RST: 0

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the scaling for the frequency parameters

Example: `CALC:HOPD:TABL:STAT:STAF ON,KHZ`

Manual operation: See "State Frequency (Nominal)" on page 47

CALCulate<n>:HOPDetection:TABLe:TIMing:ALL[:STATe] <State>[, <Scaling>]

If enabled, all timing parameters are included in the result tables (see "Timing parameters" on page 46).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Setting parameters:
<Scaling> S | MS | US | NS

Defines the scaling for the timing parameters

Usage: Setting only

Manual operation: See "Timing parameters" on page 46

CALCulate<n>:HOPDetection:TABLe:TIMing:BEGin <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:TIMing:DWELl <State>[, <Scaling>]
CALCulate<n>:HOPDetection:TABLe:TIMing:SWITching <State>[, <Scaling>]

If enabled, the specified time parameter is included in the result tables (see "Timing parameters" on page 46).

Note that only the enabled columns are returned for the `CALCulate<n>:HOPDetection:TABLe:RESults?` query.

Suffix:
<n> irrelevant

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

OFF | 0
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Setting parameters:

<Scaling> S | MS | US | NS

Defines the scaling for the timing parameters

Manual operation: See "Switching Time" on page 47

11.5.6 Configuring parameter distribution displays

For details on the parameter distribution result displays see "Parameter Distribution" on page 75.

CALCulate<n>:DISTribution:CHIRp:FMSettling <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp FM settling parameters.

Suffix:

<n> 1..n

Window

Setting parameters:

<XAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:CHIR:FMS TIME, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:FREQuency <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp frequency parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> AVGFm | AVGNonlinear | BWIDth | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:CHIR:FREQ MAXF, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:PHASe <XAxis>, <YAxis>

Configures the x-axis and y-axis of the Parameter Distribution result display for chirp phase parameters over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:PMSettling <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp PM settling parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:CHIR:PMS TIME, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:POWer <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp power parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> AVGPower | MAXPower | MINPower | PWRRipple

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:STATe <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp state parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> INDex

Chirp state index

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:CHIRp:TIMing <XAxis>, <YAxis>

Configures the Parameter Distribution result display for chirp timing parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> BEGin | LENGth | RATE

Chirp parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 5.2, "Chirp parameters", on page 54.

BEGin
Chirp begin

LENGth
Chirp length

RATE
Chirp rate

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of chirps in which the parameter value occurred.

OCCurance
Percentage of all measured chirps in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:HOP:FMSettling <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop FM settling parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:HOP:FMS TIME, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:HOP:FREQuency <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop frequency parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:HOP:FREQ MAXF, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:HOP:PHASe <XAxis>, <YAxis>

Configures the x-axis and y-axis of the Parameter Distribution result display for hop phase parameters over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:HOP:PMSettling <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop PM settling parameters.

Suffix:
<n> 1..n

Setting parameters:
<XAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:HOP:PMS TIME, COUN`

Usage: Setting only

CALCulate<n>:DISTribution:HOP:POWer <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop power parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVGPower | MAXPower | MINPower | PWRRipple

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:HOP:STATe <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop state parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> INDex | STAFrequency

INDex
Hop state index

STAFrequency
State frequency (nominal)

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:HOP:TIMing <XAxis>, <YAxis>

Configures the Parameter Distribution result display for hop timing parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> BEGin | DWELl | SWITching

Hop parameter to be displayed on the x-axis. For a description of the available parameters see Chapter 5.1, "Hop parameters", on page 44Chapter 5.2, "Chirp parameters", on page 54.

BEGin
Hop begin time

DWELl
Hop dwell time

SWITching
Hop switching time

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of hops in which the parameter value occurred.

OCCurance
Percentage of all measured hops in which the parameter value occurred.

*RST: COUNt

Example: `CALC:DIST:HOP:TIM SWIT,COUN`

Usage: Setting only

CALCulate<n>:DISTribution:NBINs <#bins>

Defines the number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Suffix:
<n> Window

Parameters:
<#bins> Number of columns

Range: 1 to 1000

Example: `CALC:DIST:NBIN 10`

Manual operation: See "Histogram Bins" on page 120

CALCulate<n>:DISTribution:X?

Queries the x-axis values of the specified Parameter Distribution display.

Suffix:
<n> 1..n
Window

Return values:
<XAxis> <char_data>

The number of values is defined by `CALCulate<n>:DISTribution:NBINs`. The used unit depends on the selected parameter.

Example: `CALC:DIST:X?`

Usage: Query only

Manual operation: See "Parameter Distribution" on page 75
See "X-Axis" on page 120

CALCulate<n>:DISTribution:Y?

Queries the y-axis values of the specified Parameter Distribution display.

Suffix:
<n> 1..n
Window

Return values:
<YAxis> <char_data>
The number of values is defined by `CALCulate<n>:DISTribution:NBINs`. The used unit depends on the selected parameter.

Usage: Query only

Manual operation: See "Parameter Distribution" on page 75
See "Y-Axis" on page 120

11.5.7 Configuring parameter trends

For details on the parameter trend result displays see "Parameter Trend" on page 76.

11.5.7.1 General commands

CALCulate<n>:TRENd:SWAP:XY

Swaps the parameters on the x-axis and y-axis of the specified trend display.

Suffix:
<n> Window

Example:
```
CALC2:TREN:X?
//Result: 'FREQ'
CALC2:TREN:Y?
//Result: 'BEG'
CALC2:TREN:SWAP:XY
//Result: 'BEG'
CALC2:TREN:Y?
//Result: 'FREQ'
```

Usage: Event

Manual operation: See "Swap X and Y Axis" on page 121

CALCulate<n>:TRENd:X?

Queries the x-axis parameter used for the specified Parameter Trend result display.

Suffix:
<n> 1..n
Window

Return values:
<XAxis> Name of the parameter displayed on the x-axis of the trend display.
For a description of the parameters see Chapter 11.5.7.2, "Chirp parameter trends", on page 309 and Chapter 11.5.7.3, "Hop parameter trends", on page 328.

Example:
```
CALC2:TREN:X?
//Result: 'FREQ'
```

Usage: Query only

Manual operation: See "Parameter Trend" on page 76
See "X-Axis" on page 121

CALCulate<n>:TRENd:Y?

Queries the y-axis parameter used for the specified Parameter Trend result display.

Suffix:
<n> Window

Return values:
<YAxis> Name of the parameter displayed on the y-axis of the trend display.
For a description of the parameters see Chapter 11.5.7.2, "Chirp parameter trends", on page 309 and Chapter 11.5.7.3, "Hop parameter trends", on page 328.

Example:
```
CALC2:TREN:Y?
//Result: 'BEG'
```

Usage: Query only

Manual operation: See "Parameter Trend" on page 76
See "Y-Axis" on page 121

11.5.7.2 Chirp parameter trends

CALCulate<n>:TRENd:CHIRp:FMSettling <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Example: `CALC2:TREN:CHIR:FMSTIME, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:FMSettling:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp FM settling parameters.

Suffix:
<n> Window

Setting parameters:
<XAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

Example: `CALC2:TREN:CHIR:FMS:X FMSTIME`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:FMSettling:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp FM settling parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

Example: `CALC2:TREN:CHIR:FMS:Y FMSTIME`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:FREQuency <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVGFm | AVGNonlinear | BWIDth | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Example: `CALC2:TREN:CHIR:FREQ AVEFm, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp frequency parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVGFm | AVGNonlinear | BWIDth | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:CHIR:FREQ:X AVEFm`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp frequency parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVGFm | AVGNonlinear | BWIDth | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:CHIR:FREQ:Y AVEFm`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PHASe <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp phase parameters over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp phase parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp phase parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PMSettling <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Example: `CALC2:TREN:CHIR:PMSTIME, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PMSettling:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp PM settling parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:CHIR:PMS:X TIME`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:PMSettling:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp PM settling parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:CHIR:PMS:Y TIME`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:POWer <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVGPower | MAXPower | MINPower | PWRRipple

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp power parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> AVGPower | MAXPower | MINPower | PWRRipple

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp power parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVGPower | MAXPower | MINPower | PWRRipple

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:STATe <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> INDex

Chirp state index

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:STATe:X <XAxis>

Configures the y-axis of the Parameter Trend result display for chirp state parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> **INDex**
Chirp state index

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:STATe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp state parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> **INDex**
Chirp state index

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:TIMing <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for chirp trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> BEGin | LENGth | RATE

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

<XAxis> AVGFm | AVGNonlinear | CHERror | FREQuency | MAXFm | MAXNonlinear | RMSFm | RMSNonlinear | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | BEGin

CHERror
Chirp state deviation

FREQuency
Average frequency

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

BWIDth
Bandwidth

AVGNonlinear
Average frequency non-linearity

RMSNonlinear
RMS frequency non-linearity

MAXNonlinear
Peak frequency non-linearity

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

AVGPower
Average power

MINPower
Minimum power

MAXPower
Maximum power

PWRRipple
Power ripple

PWRRipple
Power ripple

Example: `CALC2:TREN:CHIR:TIM NUMB,LENG`

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display for chirp timing parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> BEGin | LENGth | RATE

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

Usage: Setting only

CALCulate<n>:TRENd:CHIRp:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for chirp timing parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> BEGin | LENGth | RATE

BEGin
Chirp Begin

LENGth
Chirp length

RATe
Chirp rate

Example: `CALC2:TREN:CHIR:TIM:Y BEGin`

Usage: Setting only

11.5.7.3 Hop parameter trends

CALCulate<n>:TRENd:HOP:FMSettling <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:

<n> 1..n

Window

Setting parameters:

<YAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Example: `CALC2:TREN:HOP:FMSTIME, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:HOP:FMSettling:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop FM settling parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

Example: `CALC2:TREN:HOP:FMS:X TIME`

Usage: Setting only

CALCulate<n>:TRENd:HOP:FMSettling:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop FM settling parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> FMSLength | FMSPoint | FMSTime

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

Example: `CALC2:TREN:HOP:FMS:Y TIME`

Usage: Setting only

CALCulate<n>:TRENd:HOP:FREQuency <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Example: `CALC2:TREN:HOP:FREQ AVGF, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:HOP:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop frequency parameters.

Suffix:
<n> Window

Setting parameters:
<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

Example: `CALC2:TREN:HOP:FREQ:X AVGFm`

Usage: Setting only

CALCulate<n>:TRENd:HOP:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop frequency parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:HOP:FREQ:Y AVGFm`

Usage: Setting only

CALCulate<n>:TRENd:HOP:PHASe <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop phase parameters over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

CALCulate<n>:TRENd:HOP:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop phase parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

Usage: Setting only

CALCulate<n>:TRENd:HOP:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop phase parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVPHm | MXPHm | RMSPm

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

Usage: Setting only

CALCulate<n>:TRENd:HOP:PMSettling <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Example: `CALC2:TREN:HOP:PMSTIME, BEGin`

Usage: Setting only

CALCulate<n>:TRENd:HOP:PMSettling:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop PM settling parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:HOP:PMS:X PMSTIME`

Usage: Setting only

CALCulate<n>:TRENd:HOP:PMSettling:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop PM settling parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> PMSLength | PMSPoint | PMSTime

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

Example: `CALC2:TREN:HOP:PMS:Y TIME`

Usage: Setting only

CALCulate<n>:TRENd:HOP:POWer <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> AVGPower | MAXPower | MINPower | PWRRipple

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

CALCulate<n>:TRENd:HOP:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop power parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<XAxis> AVGPower | MAXPower | MINPower | PWRRipple

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:HOP:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop power parameters.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> AVGPower | MAXPower | MINPower | PWRRipple

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

Usage: Setting only

CALCulate<n>:TRENd:HOP:STATe <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:

<n> 1..n
Window

Setting parameters:

<YAxis> INDex | STAFrequency

INDex
Hop index

STAFrequency
State frequency (nominal)

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

CALCulate<n>:TRENd:HOP:STATe:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop state parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> INDex | STAFrequency

INDex
Hop index

STAFrequency
State frequency (nominal)

Usage: Setting only

CALCulate<n>:TRENd:HOP:STATe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop state parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> INDex | STAFrequency

INDex
Hop index

STAFrequency
State frequency (nominal)

Usage: Setting only

CALCulate<n>:TRENd:HOP:TIMing <YAxis>, <XAxis>

Configures the x-axis and y-axis of the Parameter Trend result display for hop trends over time.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> BEGin | DWELl | SWITching

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

<XAxis> AVGFm | FMERror | FREQuency | MAXFm | RELFrequency | RMSFm | FMSLength | FMSPoint | FMSTime | AVPHm | MXPHm | RMSPm | PMSLength | PMSPoint | PMSTime | AVGPower | MAXPower | MINPower | PWRRipple | INDex | STAFrequency | BEGin | DWELl | SWITching

FREQuency
Average frequency

RELFrequency
Relative frequency (hop-to-hop)

FMERror
Hop state deviation

MAXFm
Maximum Frequency Deviation

RMSFm
RMS Frequency Deviation

AVGFm
Average Frequency Deviation

FMSPoint
FM settling point

FMSTime
FM settling time

FMSLength
FM settled length

AVPHm
Average phase deviation

MXPHm
Maximum phase deviation

RMSPm
RMS phase deviation

PMSPoint
PM settling point

PMSTime
PM settling time

PMSLength
PM settled length

MINPower
Minimum power

MAXPower
Maximum power

AVGPower
Average power

PWRRipple
Power ripple

INDex
Hop index

STAFrequency
State frequency (nominal)

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

CALCulate<n>:TRENd:HOP:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display for hop timing parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<XAxis> BEGin | DWELl | SWITching

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

CALCulate<n>:TRENd:HOP:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display for hop timing parameters.

Suffix:
<n> 1..n
Window

Setting parameters:
<YAxis> BEGin | DWELl | SWITching

BEGin
Hop Begin

DWELl
Hop dwell time

SWITching
Switching time

Usage: Setting only

11.5.8 Configuring the Y-Axis scaling and units

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

Useful commands for configuring scaling described elsewhere:

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 217

Remote commands exclusive to scaling the y-axis

CALCulate<n>:UNIT:ANGLe <Unit>

Selects the global unit for phase results.

Suffix:

<n>	irrelevant

Setting parameters:

<Unit>	DEG | RAD	
	*RST:	RAD

Manual operation: See "Phase Unit" on page 124

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 124

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

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters for setting and query:

<State> **OFF**
Switch the function off

ON
Switch the function on

ONCE
Execute the function once

*RST: ON

Manual operation: See "Automatic Grid Scaling" on page 122
See "Auto Scale Once " on page 122

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Max> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MAX 10`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 123

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value on the y-axis in the specified window.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Min> numeric value

Example: `DISP:WIND2:TRAC:Y:SCAL:MIN -90`

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 123

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

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

In spectrum displays, for example, this command is not available.

Suffix:

<n> — Window

<w> — subwindow
Not supported by all applications

<t> — irrelevant

Parameters:

<Value> — numeric value WITHOUT UNIT (unit according to the result display)
Defines the range per division (total range = 10*<Value>)
*RST: depends on the result display
Default unit: DBM

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Per Division" on page 123

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

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

The R&S VSE 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% corresponds to the upper display border.
*RST: 100 PCT = frequency display; 50 PCT = time display
Default unit: PCT

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Ref Position" on page 123
See "Ref Level Position " on page 124

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

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

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	numeric value WITHOUT UNIT Default unit: dBm

Manual operation: See "Ref Value" on page 123

11.5.9 Configuring traces

The trace settings determine how the measured data is analyzed and displayed in the window. Depending on the result display, between 1 and 6 traces may be displayed.

CALCulate<n>:TRACe<t>[:VALue] <EvalType>

Defines which signal component (I/Q) is evaluated in which trace for the I/Q Time Domain result display. This setting is not available for any other result displays. By default, the I component is displayed by trace 1, while the Q component is displayed by trace 4.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<EvalType>	ITIMe | QTIMe **ITIMe** The I component is evaluated by the selected trace. **QTIMe** The Q component is evaluated by the selected trace.

Example: `CALC2:TRAC2 QTIM`
Trace 2 in window 2 evaluates the Q component of the signal.

Manual operation: See "Evaluation" on page 128

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

Selects the trace mode. If necessary, the selected trace is also activated.

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.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S VSE 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 R&S VSE saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

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 126

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.

Manual operation: See "Hold " on page 127

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/Trace 5/Trace 6" on page 126
See "Trace 1 / Trace 2 / Trace 3 / Trace 4 (Softkeys)" on page 128

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

Suffix:

<n> Window

<t> Trace

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

AVERage
Average

*RST: APEak

Example: `DET POS`
Sets the detector to "positive peak".

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

Couples and decouples the detector to the trace mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 127

[SENSe:]MEASure:POINts <MeasurementPoints>

Parameters:

<MeasurementPoints>

Manual operation: See "Maximum number of trace points" on page 128

[SENSe:]STATistic<n>:TYPE <Statistic Type>

Suffix:

<n> 1..n
Window

Parameters:

<Statistic Type> SELected | ALL

SELected
Only the selected hop/chirp from each sweep (capture) is included in the statistical evaluation.

ALL
All measured hops/chirps from each sweep (capture) are included in the statistical evaluation.

Manual operation: See "Selected Hop/Selected Chirp vs All Hops/All Chirps" on page 128

[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.

Manual operation: See "Capture Count " on page 128

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Return values:

<CurrentCount>

Usage: Query only

11.5.10 Configuring spectrograms

The remote commands required for the individual settings available for spectrogram displays are described here. For color mapping commands, see Chapter 11.5.11, "Configuring color maps", on page 359.

CALCulate<n>:SGRam:CLEar

Suffix:

<n> 1..n
irrelevant

Usage: Event

Manual operation: See "Clear Spectrogram " on page 135
See "Clear All Spectrograms" on page 135

CALCulate<n>:SGRam: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> 1..n
irrelevant

Parameters:

<Frame|Time> 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

Example:

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

Manual operation: See "Select Frame" on page 131

CALCulate<n>:SGRam:HDEPth <Depth>

Defines the number of frames to be stored in the R&S VSE memory.

Suffix:
<n> 1..n
irrelevant

Parameters:
<Depth>

Example: `CALC:SGR:SPEC 1500`
Sets the history depth to 1500.

Manual operation: See "History Depth " on page 132

CALCulate<n>:SGRam:TRESolution <TimeRes>

Suffix:
<n> 1..n
irrelevant

Parameters:
<TimeRes> The values depend on the evaluation basis of the spectrogram (see `DISPlay[:WINDow<n>]:EVALuate` on page 273)

Range: full capture area: 1 / sample rate; analysis region or hop/chirp: (1 / sample rate) * (meas bw / analysis region bw); to full capture area: measurement time; analysis region: time gate length; hop/chirp: result range length
*RST: 0
Default unit: S

Manual operation: See "Time Resolution" on page 132

CALCulate<n>:SGRam:TRESolution:AUTO <Reference>

Suffix:
<n> 1..n
irrelevant

Parameters:
<Reference> AUTO | MANual

AUTO
The optimal resolution is determined automatically according to the data acquisition settings.

MANual
You must define the time resolution using `CALCulate<n>:SGRam:TRESolution`.

Manual operation: See "Time Resolution" on page 132

CALCulate<n>:SGRam:TSTamp:DATA? <Frames>

Queries the time stamp (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`

See `TRACe<n>[:DATA]?` on page 450.

Suffix:

<n>	1..n irrelevant

Query parameters:

<Frames>	ALL | CURRent **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 till the frame start
<Nanoseconds>	Number of nanoseconds that have passed *in addition to the <Seconds>* since 01.01.1970 till the frame start.
<Reserved>	The third and fourth value are reserved for future uses.

Example:	`CALC:SGR:TST ON`
	Activates the time stamp.
	`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 132

CALCulate<n>:SGRam: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 379
- `CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 374
- `CALCulate<n>:SGRam:FRAMe:SELect` on page 355

Suffix:
<n> 1..n
irrelevant

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

Example:
```
CALC:SGR:TST ON
CALC:SPEC:TST ON
```
Activates the time stamp.

Manual operation: See "Time Stamp " on page 132

[SENSe:][WINDow<n>:]SGRam|SPECtrogram:DETector:FUNCtion <Detector>

This command queries or sets the spectrogram detector type for the specified window.

Suffix:
<n> Window

Parameters:
<Detector> SUM | AVERage | RMS | MAXimum | MINimum | SAMPle

SUM
Calculates the sum of all values in one sample point

AVERage
Calculates the linear average of all values in one sample point

RMS
Calculates the RMS of all values in one sample point

MAXimum
Determines the largest of all values in one sample point

MINimum
Determines the minimum of all values in one sample point

SAMPle
Selects the last measured value for each sample point

*RST: MAXimum

Example:
```
SENS:SGR:DET:FUNC SUM
```

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Detector" on page 134

[SENSe:]SWEep:FFT:WINDow:LENGth?

Return values:

<WindowLength> 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096

*RST: 1024

Example: `SWE:FFT:WIND:LENG?`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Usage: Query only

[SENSe:]SWEep:FFT:WINDow:TYPE <ColorScheme>

Queries or sets the FFT windowing function.

Parameters:

<ColorScheme> BLACkharris | CHEByshev | FLATtop | GAUSsian | HAMMing | HANNing | RECTangular

*RST: BLACkharris

Example: `SWE:FFT:WIND:TYPE BLAC`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "FFT Window" on page 108

11.5.11 Configuring color maps

The color display used in spectrograms is highly configurable to adapt the display to your needs.

For details see Chapter 4, "Measurement basics", on page 18.

DISPlay[:WINDow<n>]:SGRam:COLor[:STYLe]:DEFault
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault

Restores the original color map.

Suffix:

<n> Window

Manual operation: See "Set to Default " on page 136

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%.

Manual operation: See "Start / Stop " on page 136

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

Manual operation: See "Shape " on page 136

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%.

Manual operation: See "Start / Stop " on page 136

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.

Manual operation: See "Hot /Cold /Radar /Grayscale " on page 136

11.5.12 Working with markers remotely

In the Transient Analysis application, up to 16 markers or delta markers can be activated for each window simultaneously.

11.5.12.1 Setting up individual markers

The following commands define the position of markers in the diagram.

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 142

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

Links the normal source marker <ms> to any active destination marker <md> (normal or delta marker).

If you change the horizontal position of marker <md>, marker <ms> changes its horizontal position to the same value.

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker " on page 141

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 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139
See "Marker State " on page 140
See "Marker Type " on page 140
See "Select Marker " on page 141

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>

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

Manual operation: See "Assigning the Marker to a Trace " on page 141

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 79
See "M1 Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139
See "Marker Position X-value " on page 140

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 79
See "M1 Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139

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`

Manual operation: See "Linking to Another Marker " on page 141

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

Links the delta source marker <ms> to any active destination marker <md> (normal or delta marker).

Suffix:
<n> Window

<ms> source marker, see Marker

<md> destination marker, see Marker

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker " on page 141

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> **D1**
Selects the deltamarker 1 as the 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 141

CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker 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 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139
See "Marker State " on page 140
See "Marker Type " on page 140
See "Select Marker " on page 141

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

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139
See "Marker Position X-value " on page 140

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

Manual operation: See "Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139

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

Manual operation: See "Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139

11.5.12.2 General marker settings

The following commands control general marker functionality.

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 143

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.

AUTO
Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display " on page 143

CALCulate<n>:MARKer<m>:LINK <State>

If enabled, the markers in all Transient Analysis diagrams - regardless of the x-axis unit - are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same position in time. Linking is also possible across spectrogram and spectrum displays.

Suffix:

<m>	irrelevant
<n>	irrelevant

Parameters:

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

Example: `CALC2:MARK:LINK ON`

Manual operation: See "Linked Markers" on page 144

11.5.12.3 Configuring and performing a marker search

The following commands control the marker search.

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

Manual operation: See "Peak Excursion " on page 146

11.5.12.4 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

Positioning normal markers

The following commands position markers on the trace.

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

CALCulate<n>:MARKer<m>:MAXimum:NEXT

Moves a marker to the next positive peak.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Peak" on page 147

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

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

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

CALCulate<n>:MARKer<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 147

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 "Search Minimum " on page 147

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

Positioning delta markers

The following commands position delta markers on the trace.

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

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 147

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

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

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

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 147

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 "Search Minimum " on page 147

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

11.5.12.5 Marker search (spectrograms)

The following commands automatically define the marker and delta marker position in the spectrogram.

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 370
- `CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 370
- `CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 370
- `CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 370
- `CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 371
- `CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 371
- `CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 371
- `CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 371

Remote commands exclusive to spectrogram markers

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 (for Spectrograms only)" on page 140

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.

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 146

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

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

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 145

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 145

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 145

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

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 145

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 145

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 145

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

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 372
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 372
- `CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 372
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 372
- `CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 373
- `CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 373
- `CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 373
- `CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 373

Remote commands exclusive to spectrogram markers

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.

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 146

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

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

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 145

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 145

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 145

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

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 145

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 145

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 145

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

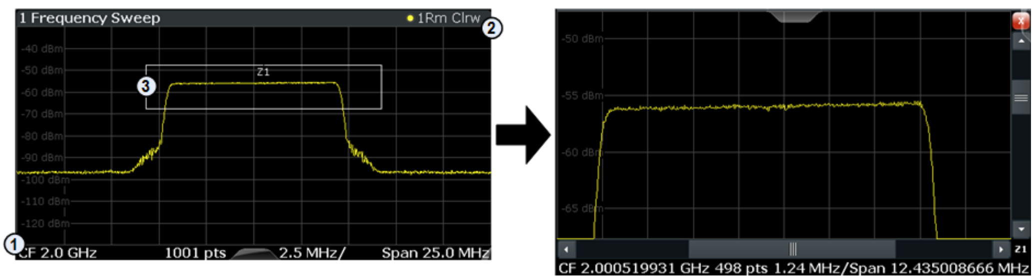
11.5.13 Zooming into the display

11.5.13.1 Using the single zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

Defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Parameters:

<x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom " on page 148

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.

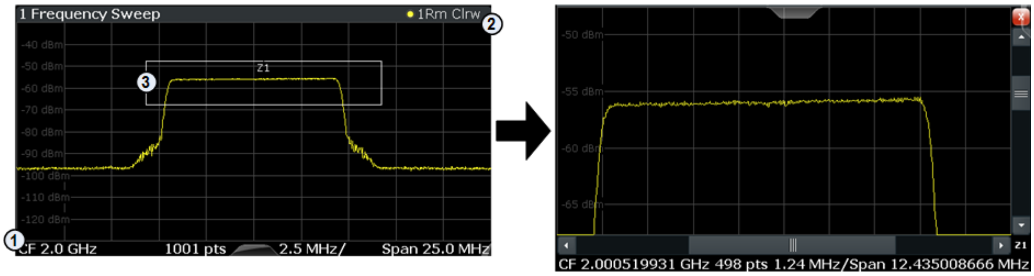
Manual operation: See "Single Zoom " on page 148
See "Restore Original Display " on page 148

11.5.13.2 Using the multiple zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA <x1>,<y1>,<x2>,<y2>

Defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<zn> Selects the zoom window.

Parameters:

<x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

<y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

<x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multi-Zoom " on page 148

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>

Turns the multiple zoom on and off.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<zn> Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Multi-Zoom " on page 148
See "Restore Original Display " on page 148

11.6 Retrieving results

The following commands are required to query the results of the transient analysis.

Note that for each hop/chirp result query you can specify for which hop/chirp(s) you require results:

- **ALL**: for all hops/chirps detected in the entire measurement
- **CURRent**: for all hops/chirps in the current capture buffer
- **SELected**: only for the currently selected hop/chirp

For each hop/chirp result, you can query either the current value (default) or the following statistical values for the hops/chirps detected in the capture buffer or the entire measurement:

- **AVER:** average of the results
- **MIN:** minimum of the results
- **MAX:** maximum of the results
- **SDEV:** standard deviation of the results

11.6.1 Retrieving information on detected hops

The following commands return information on the currently selected or all detected hops.

CALCulate<n>:HOPDetection:TABLe:RESults? [<Start>, <End>]

Queries the hop results table. The result is a comma-separated list of value sets, one set for each hop.

If no query parameters are specified, the results for all detected hops are returned.

Which values are returned depends on the enabled parameters for the results tables (see `CALCulate<n>:HOPDetection:TABLe:COLumn` on page 288).

Suffix:

<n> irrelevant

Query parameters:

<Start> integer
The hop number of the first hop to be returned. Hop numbers start at 1.

<End> integer
The hop number of the last hop to be returned.

Return values:

<ID> <char_data>
timestamp which corresponds to the absolute time the beginning of the hop was detected

<HopNo> consecutive number of detected hop, starts at 1 for each new measurement

<StateIndex> consecutive number of corresponding nominal hop state as defined in the "hop States" table (see `CALCulate<n>:HOPDetection:STATes[:DATA]` on page 238)

<Begin> <char_data>
relative time (in ms) from the capture start at which the signal first enters the tolerance area of a nominal hop (within the analysis region)
Default unit: ms

<DwellTime> <char_data>
The duration of a hop from begin to end, that is, the time the signal remains in the tolerance area of a nominal hop frequency.
Default unit: ms

<SwitchTime> <char_data>
The time the signal requires to "hop" from one level to the next. It is defined as the time between a hop end and the following hop begin.
Default unit: ms

<FreqNom>	Nominal frequency of the hop state Default unit: kHz
<FreqAvg>	Average frequency measured within the frequency measurement range of the hop Default unit: kHz
<FreqDev>	Deviation of the hop frequency from the nominal hop state frequency For details see "Hop State Deviation" on page 47. Default unit: kHz
<FreqRel>	Relative difference in frequency between two hops. For details see "Relative Frequency (Hop-to-Hop)" on page 48. Default unit: kHz
<FMDevMax>	Maximum deviation of the hop frequency from the nominal hop frequency as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Frequency Deviation (Peak)" on page 48. Default unit: kHz
<FMDevRMS>	RMS deviation of the hop frequency from the nominal (linear) hop frequency as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Frequency Deviation (RMS)" on page 48. Default unit: kHz
<FMDevAvg>	Average deviation of the hop frequency from the nominal (linear) hop frequency as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Frequency Deviation (Average)" on page 49. Default unit: kHz
<PMDevMax>	Maximum deviation of the hop phase from the nominal hop phase as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Phase Deviation (Peak)" on page 50. Default unit: kHz
<PMDevRMS>	RMS deviation of the hop phase from the nominal (linear) hop phase as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Phase Deviation (RMS)" on page 51. Default unit: kHz

<PMDevAvg>	Average deviation of the hop phase from the nominal (linear) hop phase as defined in the "Hop States" table. The deviation is calculated within the frequency measurement range of the hop. For details see "Phase Deviation (Average)" on page 51. Default unit: kHz
<PowMin>	Minimum power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowMax>	Maximum power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowAvg>	Average power level measured during a hop. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowRip>	Power level measured during the hop ripple time. Which part of the hop precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm

Example:

`CALC3:HOPD:TABLe? 1, 1`

Result: all values for one hop

```
+1.000000000,+1.000000000,+1.000000000,+1.128800000E-005,
+8.520000000E-006,-8.000545699E+006,-1.480198659E+004,
-4.081549959E+004,-6.816464936E+007,+1.128800000E-005,
+0.000000000,+8.520000000E-006,+8.783117187E+004,+2.335132135E+004,
-2.352772411E+002,-1.288514981E-003,-3.425723094E-004,
+3.451602015E-006,+1.128800000E-005,+0.000000000,+8.520000000E-006,
+3.619130211E-001,+1.349333728E-001,+4.170447636E-006,
-3.075210936E-001,+6.831753999E-002,-1.069623511E-001,
+3.758383915E-001
```

Interpretation:

```
1_    +1.000000000
2_    +1.000000000
3_    +1.000000000
4_    +1.128800000E-005
5_    +8.520000000E-006
6_    -8.000545699E+006
7_    -1.480198659E+004
8_    -4.081549959E+004
9_    -6.816464936E+007
10_    +1.128800000E-005
11_    +0.000000000
12_    +8.520000000E-006
13_    +8.783117187E+004
14_    +2.335132135E+004
15_    -2.352772411E+002
16_    -1.288514981E-003
17_    -3.425723094E-004
18_    +3.451602015E-006
19_    +1.128800000E-005
20_    +0.000000000
21_    +8.520000000E-006
22_    +3.619130211E-001
23_    +1.349333728E-001
24_    +4.170447636E-006
25_    -3.075210936E-001
26_    +6.831753999E-002
27_    -1.069623511E-001
28_    +3.758383915E-001;
```

Relative difference in frequency between two hops (<10_Freq-Rel>) = +1.128800000E-005 kHz

Example:

See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Usage:

Query only

Manual operation: See "State Index" on page 46
See "Hop Begin" on page 46
See "Dwell Time" on page 46
See "Switching Time" on page 47
See "State Frequency (Nominal)" on page 47
See "Average Frequency" on page 47
See "Hop State Deviation" on page 47
See "Relative Frequency (Hop-to-Hop)" on page 48
See "Frequency Deviation (Peak)" on page 48
See "Frequency Deviation (RMS)" on page 48
See "Frequency Deviation (Average)" on page 49
See "Phase Deviation (Peak)" on page 50
See "Phase Deviation (RMS)" on page 51
See "Phase Deviation (Average)" on page 51
See "Minimum Power" on page 51
See "Maximum Power" on page 52
See "Average Power" on page 52
See "Power Ripple" on page 52
See "FM settling point" on page 52
See "FM settling time" on page 53
See "FM settled length" on page 53
See "PM settling point" on page 53
See "PM settling time" on page 54
See "PM settled length" on page 54

CALCulate<n>:HOPDetection:TABLe:TOTal?

Queries the number of hops in the current capture buffer.

Suffix:
<n> irrelevant

Return values:
<TotalHops> integer

Usage: Query only

Manual operation: See "Hop/Chirp Results Table" on page 74

CALCulate<n>:HOPDetection:TOTal?

Suffix:
<n> irrelevant

Return values:
<TotalHops>

Usage: Query only

Manual operation: See "Hop/Chirp Results Table" on page 74

[SENSe:]HOP:FREQuency:AVGFm? <QueryRange>

Returns the average Frequency Deviation from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (Average)" on page 49

[SENSe:]HOP:FMSettling:FMSLength? <QueryRange>

Returns the FM settled length from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `HOP:FMS:FMSL? CURR`

Usage: Query only

Manual operation: See "FM settled length" on page 53

[SENSe:]HOP:FMSettling:FMSLength:AVERage? <QueryRange>

Query parameters:

<QueryRange> CURRent | ALL

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:FMSettling:FMSLength:MAXimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:FMSettling:FMSLength:MINimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:FMSettling:FMSLength:SDEViation? <QueryRange>

Returns the statistical value for the FM settled length from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:FMS:FMSL:SDEV? CURR`

Usage: Query only

[SENSe:]HOP:FMSettling:FMSPoint? <QueryRange>

Returns the FM settling point from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:FMS:FMSP? CURR`

Usage: Query only

Manual operation: See "FM settling point" on page 52

[SENSe:]HOP:FMSettling:FMSPoint:AVERage? <QueryRange>
[SENSe:]HOP:FMSettling:FMSPoint:MAXimum? <QueryRange>
[SENSe:]HOP:FMSettling:FMSPoint:MINimum? <QueryRange>
[SENSe:]HOP:FMSettling:FMSPoint:SDEViation? <QueryRange>

Returns the statistical value for the FM settling point from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:FMS:FMSP? CURR`

Usage: Query only

[SENSe:]HOP:FMSettling:FMSTime? <QueryRange>

Returns the FM settling time from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:FMS:FMST? CURR`

Usage: Query only

Manual operation: See "FM settling time" on page 53

[SENSe:]HOP:FMSettling:FMSTime:AVERage? <QueryRange>
[SENSe:]HOP:FMSettling:FMSTime:MAXimum? <QueryRange>
[SENSe:]HOP:FMSettling:FMSTime:MINimum? <QueryRange>
[SENSe:]HOP:FMSettling:FMSTime:SDEViation? <QueryRange>

Returns the statistical value for the FM settling time from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `HOP:FMS:FMST:SDEV? CURR`

Usage: Query only

[SENSe:]HOP:FREQuency:AVGFm:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:AVGFm:MAXimum? <QueryRange>
[SENSe:]HOP:FREQuency:AVGFm:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:AVGFm:SDEViation? <QueryRange>

Returns the statistical value for the average Frequency Deviation from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:FREQuency:FMERror? <QueryRange>

Returns the frequency deviation from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Hop State Deviation" on page 47

[SENSe:]HOP:FREQuency:FMERror:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:FMERror:MAXimum? <QueryRange>
[SENSe:]HOP:FREQuency:FMERror:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:FMERror:SDEViation? <QueryRange>

Returns the statistical value for the frequency deviation from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:FREQuency:FREQuency? <QueryRange>

Returns the average frequency from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Average Frequency" on page 47

[SENSe:]HOP:FREQuency:FREQuency:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:FREQuency:MAXimum? <QueryRange>

[SENSe:]HOP:FREQuency:FREQuency:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:FREQuency:SDEViation? <QueryRange>

Returns the statistical value for the average frequency from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:FREQuency:MAXFm? <QueryRange>

Returns the maximum Frequency Deviation from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (Peak)" on page 48

[SENSe:]HOP:FREQuency:MAXFm:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:MAXFm:MAXimum? <QueryRange>
[SENSe:]HOP:FREQuency:MAXFm:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:MAXFm:SDEViation? <QueryRange>

Returns the statistical value for the maximum Frequency Deviation from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:FREQuency:RELFrequency? <QueryRange>

Returns the relative hop-to-hop frequency from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Relative Frequency (Hop-to-Hop)" on page 48

[SENSe:]HOP:FREQuency:RELFrequency:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:RELFrequency:MAXimum? <QueryRange>
[SENSe:]HOP:FREQuency:RELFrequency:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:RELFrequency:SDEViation? <QueryRange>

Returns the statistical value for the relative hop-to-hop frequency from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:FREQuency:RMSFm? <QueryRange>

Returns the RMS Frequency Deviation from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (RMS)" on page 48

[SENSe:]HOP:FREQuency:RMSFm:AVERage? <QueryRange>
[SENSe:]HOP:FREQuency:RMSFm:MAXimum? <QueryRange>
[SENSe:]HOP:FREQuency:RMSFm:MINimum? <QueryRange>
[SENSe:]HOP:FREQuency:RMSFm:SDEViation? <QueryRange>

Returns the statistical value for the RMS Frequency Deviation from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:ID? <QueryRange>

Returns the hop IDs from the Results table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]HOP:PHASe:AVGPm? <QueryRange>

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Phase Deviation (Average)" on page 51

[SENSe:]HOP:PHASe:AVGPm:AVERage? <QueryRange>
[SENSe:]HOP:PHASe:AVGPm:MAXimum? <QueryRange>
[SENSe:]HOP:PHASe:AVGPm:MINimum? <QueryRange>
[SENSe:]HOP:PHASe:AVGPm:SDEViation? <QueryRange>

Returns the statistical value for the Average Phase Deviation from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:PHASe:MAXPm? <QueryRange>

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Phase Deviation (Peak)" on page 50

[SENSe:]HOP:PHASe:MAXPm:AVERage? <QueryRange>
[SENSe:]HOP:PHASe:MAXPm:MAXimum? <QueryRange>
[SENSe:]HOP:PHASe:MAXPm:MINimum? <QueryRange>
[SENSe:]HOP:PHASe:MAXPm:SDEViation? <QueryRange>

Returns the statistical value for the Maximum Phase Deviation from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:PHASe:RMSPm? <QueryRange>

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Phase Deviation (RMS)" on page 51

[SENSe:]HOP:PHASe:RMSPm:AVERage? <QueryRange>
[SENSe:]HOP:PHASe:RMSPm:MAXimum? <QueryRange>
[SENSe:]HOP:PHASe:RMSPm:MINimum? <QueryRange>
[SENSe:]HOP:PHASe:RMSPm:SDEViation? <QueryRange>

Returns the statistical value for the RMS Phase Deviation from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:PMSettling:PMSLength? <QueryRange>

Returns the PM settled length from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `HOP:PMS:PMSL? CURR`

Usage: Query only

Manual operation: See "PM settled length" on page 54

[SENSe:]HOP:PMSettling:PMSLength:AVERage? <QueryRange>

Query parameters:

<QueryRange> CURRent | ALL

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:PMSettling:PMSLength:MAXimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:PMSettling:PMSLength:MINimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:PMSettling:PMSLength:SDEViation? <QueryRange>

Returns the statistical value for the PM settled length from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:PMS:PMSL:SDEV? CURR`

Usage: Query only

[SENSe:]HOP:PMSettling:PMSPoint? <QueryRange>

Returns the PM settling point from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:PMS:PMSP? CURR`

Usage: Query only

Manual operation: See "PM settling point" on page 53

[SENSe:]HOP:PMSettling:PMSPoint:AVERage? <QueryRange>
[SENSe:]HOP:PMSettling:PMSPoint:MAXimum? <QueryRange>
[SENSe:]HOP:PMSettling:PMSPoint:MINimum? <QueryRange>
[SENSe:]HOP:PMSettling:PMSPoint:SDEViation? <QueryRange>

Returns the statistical value for the PM settling point from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:PMS:PMSP:SDEV? CURR`

Usage: Query only

[SENSe:]HOP:PMSettling:PMSTime? <QueryRange>

Returns the PM settling time from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `HOP:PMS:PMST? CURR`

Usage: Query only

Manual operation: See "PM settling time" on page 54

[SENSe:]HOP:PMSettling:PMSTime:AVERage? <QueryRange>
[SENSe:]HOP:PMSettling:PMSTime:MAXimum? <QueryRange>
[SENSe:]HOP:PMSettling:PMSTime:MINimum? <QueryRange>
[SENSe:]HOP:PMSettling:PMSTime:SDEViation? <QueryRange>

Returns the statistical value for the PM settling time from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `HOP:PMS:PMST:SDEV? CURR`

Usage: Query only

[SENSe:]HOP:NUMBer? <QueryRange>

Returns the hop numbers from the Results table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result> <char_data>

Usage: Query only

[SENSe:]HOP:POWer:AVEPower? <QueryRange>

Returns the average power from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Average Power" on page 52

[SENSe:]HOP:POWer:AVEPower:AVERage? <QueryRange>
[SENSe:]HOP:POWer:AVEPower:MAXimum? <QueryRange>
[SENSe:]HOP:POWer:AVEPower:MINimum? <QueryRange>
[SENSe:]HOP:POWer:AVEPower:SDEViation? <QueryRange>

Returns the statistical value for the average power from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:POWer:MAXPower? <QueryRange>

Returns the maximum hop power from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Maximum Power" on page 52

[SENSe:]HOP:POWer:MAXPower:AVERage? <QueryRange>
[SENSe:]HOP:POWer:MAXPower:MAXimum? <QueryRange>

[SENSe:]HOP:POWer:MAXPower:MINimum? <QueryRange>
[SENSe:]HOP:POWer:MAXPower:SDEViation? <QueryRange>

Returns the statistical value for the maximum power from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:POWer:MINPower? <QueryRange>

Returns the minimum hop power from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Minimum Power" on page 51
See "Power Ripple" on page 52

[SENSe:]HOP:POWer:MINPower:AVERage? <QueryRange>
[SENSe:]HOP:POWer:MINPower:MAXimum? <QueryRange>
[SENSe:]HOP:POWer:MINPower:MINimum? <QueryRange>
[SENSe:]HOP:POWer:MINPower:SDEViation? <QueryRange>

Returns the statistical value for the minimum power from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:POWer:PWRRipple? <QueryRange>

Returns the ripple power from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:POWer:PWRRipple:AVERage? <QueryRange>
[SENSe:]HOP:POWer:PWRRipple:MAXimum? <QueryRange>
[SENSe:]HOP:POWer:PWRRipple:MINimum? <QueryRange>
[SENSe:]HOP:POWer:PWRRipple:SDEViation? <QueryRange>

Returns the statistical value for the ripple power from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:STATe[:INDex]? <QueryRange>

Returns the hop state indexes from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result> integer

Usage: Query only

Manual operation: See "State Index" on page 46

[SENSe:]HOP:STATe[:INDex]:AVERage? <QueryRange>
[SENSe:]HOP:STATe[:INDex]:MAXimum? <QueryRange>
[SENSe:]HOP:STATe[:INDex]:MINimum? <QueryRange>
[SENSe:]HOP:STATe[:INDex]:SDEViation? <QueryRange>

Returns the statistical value for the hop state indexes from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:STATe:STAFrequency? <QueryRange>

Returns the nominal hop state frequency from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "State Frequency (Nominal)" on page 47

[SENSe:]HOP:STATe:STAFrequency:AVERage? <QueryRange>
[SENSe:]HOP:STATe:STAFrequency:MAXimum? <QueryRange>
[SENSe:]HOP:STATe:STAFrequency:MINimum? <QueryRange>
[SENSe:]HOP:STATe:STAFrequency:SDEViation? <QueryRange>

Returns the statistical value for the nominal hop state frequency from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:TIMing:BEGin? <QueryRange>

Returns the begin times from the Results table for the specified hop(s).

The begin time is the relative time (in ms) from the capture start at which the signal first enters the tolerance area of a nominal hop (within the analysis region).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Hop Begin" on page 46

[SENSe:]HOP:TIMing:BEGin:AVERage? <QueryRange>
[SENSe:]HOP:TIMing:BEGin:MAXimum? <QueryRange>

[SENSe:]HOP:TIMing:BEGin:MINimum? <QueryRange>
[SENSe:]HOP:TIMing:BEGin:SDEViation? <QueryRange>

Returns the statistical value for the begin time from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]HOP:TIMing:DWELl? <QueryRange>

Returns the dwell time from the Results table for the specified hop(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Dwell Time" on page 46

[SENSe:]HOP:TIMing:DWELl:AVERage? <QueryRange>
[SENSe:]HOP:TIMing:DWELl:MAXimum? <QueryRange>
[SENSe:]HOP:TIMing:DWELl:MINimum? <QueryRange>
[SENSe:]HOP:TIMing:DWELl:SDEViation? <QueryRange>

Returns the statistical value for the hop dwell time from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]HOP:TIMing:SWITching? <QueryRange>

Returns the switching time from the Results table for the specified hop(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected hop

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Switching Time" on page 47

[SENSe:]HOP:TIMing:SWITching:AVERage? <QueryRange>
[SENSe:]HOP:TIMing:SWITching:MAXimum? <QueryRange>
[SENSe:]HOP:TIMing:SWITching:MINimum? <QueryRange>
[SENSe:]HOP:TIMing:SWITching:SDEViation? <QueryRange>

Returns the statistical value for the hop switching time from the statistics table for the specified hop(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

11.6.2 Retrieving information on detected chirps

The following commands return information on the currently selected or all detected chirps.

CALCulate<n>:CHRDetection:TABLe:RESults? [<Start>, <End>]

Queries the chirp results table. The result is a comma-separated list of value sets, one set for each chirp.

If no query parameters are specified, the results for all detected chirps are returned.

Which values are returned depends on the enabled parameters for the results tables (see `CALCulate<n>:CHRDetection:TABLe:COLumn` on page 278).

Suffix:

<n> irrelevant

Query parameters:

<Start> integer

The chirp number of the first chirp to be returned. Chirp numbers start at 1.

<End> integer

The chirp number of the last chirp to be returned.

Return values:

<ID> <char_data>

Timestamp which corresponds to the absolute time the beginning of the chirp was detected

<ChirpNo> Consecutive number of detected chirp, starts at 1 for each new measurement

<StateIndex> Consecutive number of corresponding nominal chirp state as defined in the "Chirp States" table (see `CALCulate<n>:CHRDetection:STATes[:DATA]` on page 234)

<Begin> <char_data>

Time offset from the analysis region start at which the signal first enters the tolerance area of a nominal chirp

Default unit: ms

<Length> <char_data>

The duration of a chirp from begin to end, that is, the time the signal remains in the tolerance area of a nominal chirp.

Default unit: ms

<CRate>	<char_data> Derivative of the FM vs time trace within the frequency measurement range Default unit: kHz/µs
<CRateDev>	Deviation of the detected chirp rate from the nominal chirp state (in kHz/us). For details see "Chirp State Deviation" on page 58. Default unit: kHz/µs
<FreqAvg>	Average frequency measured within the frequency measurement range of the chirp Default unit: kHz
<FMDevMax>	Maximum deviation of the chirp frequency from the nominal chirp frequency as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Frequency Deviation (Peak)" on page 59. Default unit: kHz
<FMDevRMS>	RMS deviation of the chirp frequency from the nominal (linear) chirp frequency as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Frequency Deviation (RMS)" on page 59. Default unit: kHz
<FMDevAvg>	Average deviation of the chirp frequency from the nominal (linear) chirp frequency as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Frequency Deviation (Average)" on page 60. Default unit: kHz
<PMDevMax>	Maximum deviation of the chirp phase from the nominal chirp phase as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Phase Deviation (Peak)" on page 60. Default unit: kHz
<PMDevRMS>	RMS deviation of the chirp phase from the nominal (linear) chirp phase as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Phase Deviation (RMS)" on page 61. Default unit: kHz

<PMDevAvg>	Average deviation of the chirp phase from the nominal (linear) chirp phase as defined in the "Chirp States" table. The deviation is calculated within the frequency measurement range of the chirp. For details see "Phase Deviation (Average)" on page 61. Default unit: kHz
<PowMin>	Minimum power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowMax>	Maximum power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowAvg>	Average power level measured during a chirp. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm
<PowRip>	Power level measured during the chirp ripple time. Which part of the chirp precisely is used for calculation depends on the power parameters in the "Power" measurement range configuration. Default unit: dBm

Example:

```
CALC3:CHRD:TABLe? 1, 1
```

Result: all values for first chirp

```
+1.000000000,+1.000000000,+1.000000000,+1.128800000E-005,
+8.520000000E-006,-8.000545699E+006,-1.480198659E+004,
-4.081549959E+004,-6.816464936E+007,+1.128800000E-005,
+0.000000000,+8.520000000E-006,+8.783117187E+004,
+2.335132135E+004,-2.352772411E+002,-1.288514981E-003,
-3.425723094E-004,+3.451602015E-006,+1.128800000E-005,
+0.000000000,+8.520000000E-006,+3.619130211E-001,
+1.349333728E-001,+4.170447636E-006,-3.075210936E-001,
+6.831753999E-002,-1.069623511E-001,+3.758383915E-001;
```

Interpretation:

```
1_    +1.000000000
2_    +1.000000000
3_    +1.000000000
4_    +1.128800000E-005
5_    +8.520000000E-006
6_    -8.000545699E+006
7_    -1.480198659E+004
8_    -4.081549959E+004
9_    -6.816464936E+007
10_    +1.128800000E-005
11_    +0.000000000
12_    +8.520000000E-006
13_    +8.783117187E+004
14_    +2.335132135E+004
15_    -2.352772411E+002
16_    -1.288514981E-003
17_    -3.425723094E-004
18_    +3.451602015E-006
19_    +1.128800000E-005
20_    +0.000000000
21_    +8.520000000E-006
22_    +3.619130211E-001
23_    +1.349333728E-001
24_    +4.170447636E-006
25_    -3.075210936E-001
26_    +6.831753999E-002
27_    -1.069623511E-001
28_    +3.758383915E-001;
```

Maximum frequency integrated non-linearity (<16_FreqINL-Max>) = -1.288514981E-003

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Usage: Query only

Manual operation: See "State Index" on page 57
See "Chirp Begin" on page 57
See "Chirp Length" on page 58
See "Chirp Rate" on page 58
See "Chirp State Deviation" on page 58
See "Average Frequency" on page 59
See "Frequency Deviation (Peak)" on page 59
See "Frequency Deviation (RMS)" on page 59
See "Frequency Deviation (Average)" on page 60
See "Phase Deviation (Peak)" on page 60
See "Phase Deviation (RMS)" on page 61
See "Phase Deviation (Average)" on page 61
See "Minimum Power" on page 62
See "Maximum Power" on page 62
See "Average Power" on page 62
See "Power Ripple" on page 62
See "Bandwidth" on page 63
See "Frequency INL (Peak)" on page 63
See "Frequency INL (RMS)" on page 63
See "Frequency INL (Average)" on page 63
See "FM settling point" on page 64
See "FM settling time" on page 64
See "FM settled length" on page 64
See "PM settling point" on page 65
See "PM settling time" on page 65
See "PM settled length" on page 65

CALCulate<n>:CHRDetection:TABLe:TOTal?

Queries the number of chirps in the current capture buffer.

Suffix:
<n> irrelevant

Return values:
<TotalChirps> integer

Example: `CALC:CHRD:TABL:TOT?`

Usage: Query only

Manual operation: See "Hop/Chirp Results Table" on page 74

CALCulate<n>:CHRDetection:TOTal?

Suffix:
<n> irrelevant

Return values:
<TotalChirps> integer

Example: `CALC:CHRD:TOT?`

Usage: Query only

Manual operation: See "Hop/Chirp Results Table" on page 74

[SENSe:]CHIRp:FREQuency:AVGFm? <QueryRange>

Returns the average Frequency Deviation from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (Average)" on page 60

[SENSe:]CHIRp:FMSettling:FMSLength? <QueryRange>

Returns the FM settled length from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `CHIR:FMS:FMSL? CURR`

Usage: Query only

Manual operation: See "FM settled length" on page 64

[SENSe:]CHIRp:FMSettling:FMSLength:AVERage? <QueryRange>

Query parameters:

<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FMSettling:FMSLength:MAXimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FMSettling:FMSLength:MINimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FMSettling:FMSLength:SDEViation? <QueryRange>

Returns the statistical value for the FM settled length from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:FMS:FMSL:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FMSettling:FMSPoint? <QueryRange>

Returns the FM settling point from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:FMS:FMSP? CURR`

Usage: Query only

Manual operation: See "FM settling point" on page 64

[SENSe:]CHIRp:FMSettling:FMSPoint:AVERage? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSPoint:MAXimum? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSPoint:MINimum? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSPoint:SDEViation? <QueryRange>

Returns the statistical value for the FM settling point from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:FMS:FMSP:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FMSettling:FMSTime? <QueryRange>

Returns the FM settling time from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:FMS:FMST? CURR`

Usage: Query only

Manual operation: See "FM settling time" on page 64

[SENSe:]CHIRp:FMSettling:FMSTime:AVERage? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSTime:MAXimum? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSTime:MINimum? <QueryRange>
[SENSe:]CHIRp:FMSettling:FMSTime:SDEViation? <QueryRange>

Returns the statistical value for the FM settling time from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `CHIR:FMS:FMST:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FREQuency:AVGFm:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGFm:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGFm:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGFm:SDEViation? <QueryRange>

Returns the statistical value for the average Frequency Deviation from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:AVGNonlinear? <QueryRange>

Returns the average frequency integral non-linearity from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Example: `CHIR:FREQ:AVGN? SEL`

Usage: Query only

Manual operation: See "Frequency INL (Average)" on page 63

[SENSe:]CHIRp:FREQuency:AVGNonlinear:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGNonlinear:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGNonlinear:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:AVGNonlinear:SDEViation? <QueryRange>

Returns the statistical value for the average frequency integrated non-linearity from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Example: `CHIR:FREQ:AVGN:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FREQuency:BWIDth? <QueryRange>

Returns the chirp bandwidth from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result> Default unit: kHz

Example: `CHIR:FREQ:BWID:SDEV? CURR`

Usage: Query only

Manual operation: See "Bandwidth" on page 63

[SENSe:]CHIRp:FREQuency:BWIDth:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:BWIDth:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:BWIDth:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:BWIDth:SDEViation? <QueryRange>

Returns the statistical value for the chirp bandwidth from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Example: `CHIR:FREQ:BWID:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FREQuency:CHERror? <QueryRange>

Returns the chirp rate deviation from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Chirp State Deviation" on page 58

[SENSe:]CHIRp:FREQuency:CHERror:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:CHERror:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:CHERror:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:CHERror:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate deviation from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:FREQuency? <QueryRange>

Returns the average frequency from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Average Frequency" on page 59

[SENSe:]CHIRp:FREQuency:FREQuency:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:FREQuency:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:FREQuency:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:FREQuency:SDEViation? <QueryRange>

Returns the statistical value for the average frequency from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:MAXFm? <QueryRange>

Returns the maximum Frequency Deviation from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (Peak)" on page 59

[SENSe:]CHIRp:FREQuency:MAXFm:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXFm:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXFm:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXFm:SDEViation? <QueryRange>

Returns the statistical value for the maximum Frequency Deviation from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:MAXNonlinear? <QueryRange>

Returns the maximum frequency integral non-linearity from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Example: `CHIR:FREQ:MAXN? SEL`

Usage: Query only

Manual operation: See "Frequency INL (Peak)" on page 63

[SENSe:]CHIRp:FREQuency:MAXNonlinear:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXNonlinear:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXNonlinear:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:MAXNonlinear:SDEViation? <QueryRange>

Returns the statistical value for the maximum frequency integrated non-linearity from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Example: `CHIR:FREQ:MAXN:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:FREQuency:RMSFm? <QueryRange>

Returns the RMS Frequency Deviation from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Frequency Deviation (RMS)" on page 59

[SENSe:]CHIRp:FREQuency:RMSFm:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSFm:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSFm:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSFm:SDEViation? <QueryRange>

Returns the statistical value for the RMS Frequency Deviation from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:RMSNonlinear? <QueryRange>

Returns the RMS frequency integral non-linearity from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Example: `CHIR:FREQ:RMSN? SEL`

Usage: Query only

Manual operation: See "Frequency INL (RMS)" on page 63

[SENSe:]CHIRp:FREQuency:RMSNonlinear:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSNonlinear:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSNonlinear:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:RMSNonlinear:SDEViation? <QueryRange>
[SENSe:]CHIRp:FREQuency:OVERshoot? <QueryRange>

Queries chirp frequency overshoot from the result table.

Query parameters:
<QueryRange> SELected | CURRent | ALL

Return values:
<Result> <numeric value>

Example: `CHIR:FREQ:OVER? SEL`

Usage: Query only

Manual operation: See "Frequency Overshoot" on page 60

[SENSe:]CHIRp:FREQuency:OVERshoot:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:OVERshoot:MAXimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:OVERshoot:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:OVERshoot:SDEViation? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:FREQuency:UNDershoot? <QueryRange>

Queries chirp frequency undershoot from the result table.

Query parameters:
<QueryRange> SELected | CURRent | ALL

Return values:
<Result> <numeric value>

Example: `CHIR:FREQ:UND? SEL`

Usage: Query only

Manual operation: See "Frequency Undershoot" on page 60

[SENSe:]CHIRp:FREQuency:UNDershoot:AVERage? <QueryRange>
[SENSe:]CHIRp:FREQuency:UNDershoot:MAXimum? <QueryRange>

[SENSe:]CHIRp:FREQuency:UNDershoot:MINimum? <QueryRange>
[SENSe:]CHIRp:FREQuency:UNDershoot:SDEViation? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:ID? <QueryRange>

Returns the chirp IDs from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result> <char_data>

Usage: Query only

[SENSe:]CHIRp:NUMBer? <QueryRange>

Returns the chirp numbers from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PHASe:AVGPm? <QueryRange>

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Phase Deviation (Average)" on page 61

[SENSe:]CHIRp:PHASe:AVGPm:AVERage? <QueryRange>
[SENSe:]CHIRp:PHASe:AVGPm:MAXimum? <QueryRange>
[SENSe:]CHIRp:PHASe:AVGPm:MINimum? <QueryRange>
[SENSe:]CHIRp:PHASe:AVGPm:SDEViation? <QueryRange>

Returns the statistical value for the Average Phase Deviation from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PHASe:MAXPm? <QueryRange>

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Phase Deviation (Peak)" on page 60

[SENSe:]CHIRp:PHASe:MAXPm:AVERage? <QueryRange>
[SENSe:]CHIRp:PHASe:MAXPm:MAXimum? <QueryRange>

[SENSe:]CHIRp:PHASe:MAXPm:MINimum? <QueryRange>
[SENSe:]CHIRp:PHASe:MAXPm:SDEViation? <QueryRange>

Returns the statistical value for the Maximum Phase Deviation from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]CHIRp:PHASe:RMSPm? <QueryRange>

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Phase Deviation (RMS)" on page 61

[SENSe:]CHIRp:PHASe:RMSPm:AVERage? <QueryRange>
[SENSe:]CHIRp:PHASe:RMSPm:MAXimum? <QueryRange>
[SENSe:]CHIRp:PHASe:RMSPm:MINimum? <QueryRange>
[SENSe:]CHIRp:PHASe:RMSPm:SDEViation? <QueryRange>

Returns the statistical value for the RMS Phase Deviation from the statistics table for the specified hop(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected hops in the current capture buffer

ALL
All hops detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PHASe:OVERshoot? <QueryRange>

Queries chirp phase overshoot from the result table.

Query parameters:
<QueryRange> SELected | CURRent | ALL

Return values:
<Result> <numeric value>

Example: `CHIR:PHAS:OVER? SEL`

Usage: Query only

Manual operation: See "Phase Overshoot" on page 61

[SENSe:]CHIRp:PHASe:OVERshoot:AVERage? <QueryRange>
[SENSe:]CHIRp:PHASe:OVERshoot:MAXimum? <QueryRange>
[SENSe:]CHIRp:PHASe:OVERshoot:MINimum? <QueryRange>
[SENSe:]CHIRp:PHASe:OVERshoot:SDEViation? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PHASe:UNDershoot? <QueryRange>

Queries chirp phase undershoot from the result table.

Query parameters:
<QueryRange> SELected | CURRent | ALL

Return values:
<Result> <numeric value>

Example: `CHIR:PHAS:UND? SEL`

Usage: Query only

Manual operation: See "Phase Undershoot" on page 61

[SENSe:]CHIRp:PHASe:UNDershoot:AVERage? <QueryRange>
[SENSe:]CHIRp:PHASe:UNDershoot:MAXimum? <QueryRange>

[SENSe:]CHIRp:PHASe:UNDershoot:MINimum? <QueryRange>
[SENSe:]CHIRp:PHASe:UNDershoot:SDEViation? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSLength? <QueryRange>

Returns the PM settled length from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:PMS:PMSL? CURR`

Usage: Query only

Manual operation: See "PM settled length" on page 65

[SENSe:]CHIRp:PMSettling:PMSLength:AVERage? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSLength:MAXimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSLength:MINimum? <QueryRange>

Query parameters:
<QueryRange> CURRent | ALL

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSLength:SDEViation? <QueryRange>

Returns the statistical value for the PM settled length from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:PMS:PMSL:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSPoint? <QueryRange>

Returns the PM settling point from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:
<Result>

Example: `CHIR:PMS:PMSP? CURR`

Usage: Query only

Manual operation: See "PM settling point" on page 65

[SENSe:]CHIRp:PMSettling:PMSPoint:AVERage? <QueryRange>
[SENSe:]CHIRp:PMSettling:PMSPoint:MAXimum? <QueryRange>
[SENSe:]CHIRp:PMSettling:PMSPoint:MINimum? <QueryRange>
[SENSe:]CHIRp:PMSettling:PMSPoint:SDEViation? <QueryRange>

Returns the statistical value for the PM settling point from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `CHIR:PMS:PMSP:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:PMSettling:PMSTime? <QueryRange>

Returns the PM settling time from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `CHIR:PMS:PMST? CURR`

Usage: Query only

Manual operation: See "PM settling time" on page 65

[SENSe:]CHIRp:PMSettling:PMSTime:AVERage? <QueryRange>
[SENSe:]CHIRp:PMSettling:PMSTime:MAXimum? <QueryRange>

[SENSe:]CHIRp:PMSettling:PMSTime:MINimum? <QueryRange>
[SENSe:]CHIRp:PMSettling:PMSTime:SDEViation? <QueryRange>

Returns the statistical value for the PM settling time from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Return values:

<Result>

Example: `CHIR:PMS:PMST:SDEV? CURR`

Usage: Query only

[SENSe:]CHIRp:POWer:AVEPower? <QueryRange>

Returns the average power from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Average Power" on page 62

[SENSe:]CHIRp:POWer:AVEPower:AVERage? <QueryRange>
[SENSe:]CHIRp:POWer:AVEPower:MAXimum? <QueryRange>
[SENSe:]CHIRp:POWer:AVEPower:MINimum? <QueryRange>
[SENSe:]CHIRp:POWer:AVEPower:SDEViation? <QueryRange>

Returns the statistical value for the average power from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:POWer:MAXPower? <QueryRange>

Returns the Chirp Maximum Power from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Maximum Power" on page 62

[SENSe:]CHIRp:POWer:MAXPower:AVERage? <QueryRange>
[SENSe:]CHIRp:POWer:MAXPower:MAXimum? <QueryRange>
[SENSe:]CHIRp:POWer:MAXPower:MINimum? <QueryRange>
[SENSe:]CHIRp:POWer:MAXPower:SDEViation? <QueryRange>

Returns the statistical value for the Chirp Maximum Power from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:POWer:MINPower? <QueryRange>

Returns the Chirp Minimum Power from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Minimum Power" on page 62

[SENSe:]CHIRp:POWer:MINPower:AVERage? <QueryRange>
[SENSe:]CHIRp:POWer:MINPower:MAXimum? <QueryRange>
[SENSe:]CHIRp:POWer:MINPower:MINimum? <QueryRange>
[SENSe:]CHIRp:POWer:MINPower:SDEViation? <QueryRange>

Returns the statistical value for the Chirp Minimum Power from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]CHIRp:POWer:PWRRipple? <QueryRange>

Returns the Chirp Power Ripple from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Power Ripple" on page 62

[SENSe:]CHIRp:POWer:PWRRipple:AVERage? <QueryRange>
[SENSe:]CHIRp:POWer:PWRRipple:MAXimum? <QueryRange>
[SENSe:]CHIRp:POWer:PWRRipple:MINimum? <QueryRange>
[SENSe:]CHIRp:POWer:PWRRipple:SDEViation? <QueryRange>

Returns the statistical value for the Chirp Power Ripple from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:STATe? <QueryRange>

Returns the chirp states from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "State Index" on page 57

[SENSe:]CHIRp:STATe:AVERage? <QueryRange>
[SENSe:]CHIRp:STATe:MAXimum? <QueryRange>

[SENSe:]CHIRp:STATe:MINimum? <QueryRange>
[SENSe:]CHIRp:STATe:SDEViation? <QueryRange>

Returns the statistical value for the chirp states from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

[SENSe:]CHIRp:TIMing:BEGin? <QueryRange>

Returns the chirp begin time from the Results table for the specified chirp(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:

<Result>

Usage: Query only

Manual operation: See "Chirp Begin" on page 57

[SENSe:]CHIRp:TIMing:BEGin:AVERage? <QueryRange>
[SENSe:]CHIRp:TIMing:BEGin:MAXimum? <QueryRange>
[SENSe:]CHIRp:TIMing:BEGin:MINimum? <QueryRange>
[SENSe:]CHIRp:TIMing:BEGin:SDEViation? <QueryRange>

Returns the statistical value for the chirp begin from the statistics table for the specified chirp(s).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:TIMing:LENGth? <QueryRange>

Returns the chirp length from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Chirp Length" on page 58

[SENSe:]CHIRp:TIMing:LENGth:AVERage? <QueryRange>
[SENSe:]CHIRp:TIMing:LENGth:MAXimum? <QueryRange>
[SENSe:]CHIRp:TIMing:LENGth:MINimum? <QueryRange>
[SENSe:]CHIRp:TIMing:LENGth:SDEViation? <QueryRange>

Returns the statistical value for the chirp begin from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:TIMing:RATE? <QueryRange>

Returns the chirp rate from the Results table for the specified chirp(s).

Query parameters:
<QueryRange> SELected | CURRent | ALL

SELected
Selected chirp

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

Manual operation: See "Chirp Rate" on page 58

[SENSe:]CHIRp:TIMing:RATE:AVERage? <QueryRange>
[SENSe:]CHIRp:TIMing:RATE:MAXimum? <QueryRange>
[SENSe:]CHIRp:TIMing:RATE:MINimum? <QueryRange>
[SENSe:]CHIRp:TIMing:RATE:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate from the statistics table for the specified chirp(s).

Query parameters:
<QueryRange> CURRent | ALL

CURRent
Detected chirps in the current capture buffer

ALL
All chirps detected in the entire measurement

Return values:
<Result>

Usage: Query only

[SENSe:]CHIRp:TIMing:SWITching? <QueryRange>

Queries the chirp switching time from the result table.

Query parameters:
<QueryRange> SELected | CURRent | ALL

Return values:
<Result> <numeric value>

Example: `CHIR:TIM:SWIT? SEL`

Usage: Query only

Manual operation: See "Switching Time" on page 58

[SENSe:]CHIRp:TIMing:SWITching:AVERage? <QueryRange>
[SENSe:]CHIRp:TIMing:SWITching:MAXimum? <QueryRange>

[SENSe:]CHIRp:TIMing:SWITching:MINimum? <QueryRange>
[SENSe:]CHIRp:TIMing:SWITching:SDEViation? <QueryRange>

Query parameters:

<QueryRange> CURRent | ALL

Return values:

<Result>

Usage: Query only

11.6.3 Retrieving trace data

In order to retrieve the trace results in a remote environment, use the following command:

Useful commands for retrieving trace results described elsewhere:

- CALCulate<n>:DISTribution:X? on page 307
- CALCulate<n>:DISTribution:Y? on page 308

Remote commands exclusive to retrieving trace data:

CALCulate<n>:SGRam:FRAMe:COUNt?
CALCulate<n>:SPECtrogram:FRAMe:COUNt?

Queries the number of frames that are contained in the selected result display (depends on the evaluation basis).

Suffix:

<n> 1..n
Window

Return values:

<Frames> The maximum number of frames depends on the history depth.

Range: 1 to history depth
Increment: 1

Example: `INIT:CONT OFF`
Selects single sweep mode.
`LAY:REPL 2,SGR`
Replaces the result display in window 2 by a spectrogram.
`DISP:WIND2:EVAL REG`
Defines the analysis region as the evaluation basis for the spectrogram in window 2.
`CALC:SGR:FRAM:COUN?`
Queries the number of frames in the spectrogram based on the analysis region.

Usage: Query only

DISPlay[:WINDow<n>]:TRACe<t>:LENGth?

Queries the trace length for the specified trace in the specified window.

Suffix:

<n> 1..n
Window

<t> 1..n
Trace

Return values:

<TraceLength> Number of measurement points for the trace.

Example: `DISP:WIND:TRAC:LENG?`

Usage: Query only

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

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

Note that the command has no effect for data that you send to the R&S VSE. The R&S VSE 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".

<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]? <Trace>

Suffix:

<n> 1..n
Window

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | SGRam | SPECtrogram

Determines which trace results are returned.
If no trace parameter is provided with the query, trace 1 is assumed.

*RST: TRACe1

Return values:

<Result> <char_data> | <list>

Example: `TRAC:DATA? TRACe2`

Example: See Chapter 11.8.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Usage: Query only

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

This remote control command returns the X values only for the trace in the selected result display. Depending on the type of result display and the scaling of the x-axis, this can be either the pulse number or a timestamp for each detected pulse in the capture buffer.

Is only available for graphical displays, except for the Magnitude Capture display.

Suffix:
<n> 1..n
Window

Query parameters:
<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6
The trace number whose values are to be returned.

Return values:
<Data> <char_data>

Usage: Query only

11.6.4 Exporting trace and table results

Trace and table results can be exported to a file.

For more commands concerning data and results storage see the R&S VSE User Manual.

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 130

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.

Trace data resulting from encrypted file input cannot be queried.

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

Manual operation: See "Include Instrument & Measurement Settings " on page 129

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 453).

Trace data resulting from encrypted file input cannot be queried.

Parameters:
<Selection> SINGle | ALL

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

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

*RST: SINGle

Manual operation: See "Export all Traces and all Table Results " on page 129

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.

MMEMory:STORe:TA:MEAS <File>

Stores the current measurement results (all enabled traces of all windows) into the specified .csv file.

Setting parameters:

<File> path and file name

Example: `MMEM:STOR:TA:MEAS 'C:\R_S\userdata\MyMeas.csv'`

Example: See Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

Usage: Setting only

MMEMory:STORe<n>:TABLe <Columns>, <FileName>

Exports result table data from the specified window to an ASCii file (`.DAT`).

For details on the file format see Chapter B, "Reference: ASCII file export format", on page 473.

Suffix:

<n> Window

Setting parameters:

<Columns> Columns to be stored in file

SELected
Export only the selected (visible) table columns

ALL
Export all table columns (all possible measured parameters)

*RST: SEL

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

Example: `MMEM:STOR1:TABL SEL,'TEST.DAT'`
Stores the selected columns from the result table in window 1 in the file `TEST.DAT`.

Usage: Setting only

Manual operation: See "Export table to ASCII File " on page 137
See "Columns to Export" on page 137

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

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

You cannot query trace data resulting from encrypted file input.

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 "Export Trace to ASCII File " on page 130

11.6.5 Retrieving captured I/Q data

The raw captured I/Q data is output in the form of a list.

TRACe:IQ:DATA?

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

Corresponds to:

`INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?`

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Trace data resulting from encrypted file input cannot be queried.

Return values:
<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.

Default unit: V

Example: `TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
`FORMat REAL,32`
Selects format of response data
`TRAC:IQ:DATA?`
Starts measurement and reads results

Usage: Query only

TRACe:IQ:DATA:FORMat <Format>

Selects the order of the I/Q data.

Parameters:

<Format> COMPatible | IQBLock | IQPair

COMPatible
I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

IQBLock
First all I-values are listed, then the Q-values (I,I,I,I,I,I,...Q,Q,Q,Q,Q,Q)

IQPair
One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

*RST: IQBL

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

Queries the I/Q data currently stored in the capture buffer of the R&S VSE.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as `TRACe:IQ:DATA?`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

Trace data resulting from encrypted file input cannot be queried.

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using `TRACe:IQ:DATA:FORMat`.
The data format of the individual values depends on `FORMat[:DATA]` on page 449.

Default unit: V

Example:
// Perform a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Usage: Query only

11.7 Status reporting system

The status reporting system stores all information on the current operating state of the instrument, e.g. information on errors or limit violations which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The R&S VSE Transient Analysis application uses only the registers provided by the base system.

For details on the common R&S VSE status registers refer to the description of remote control basics in the R&S VSE User Manual.

11.8 Programming examples

The following examples demonstrate how to perform transient analysis in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

11.8.1 Programming example: performing a basic transient analysis measurement

This example demonstrates how to perform a basic transient analysis measurement for an unknown signal in a remote environment.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the transient analysis application
INST:SEL 'TA'

//-----------Configuring the measurement -----------
//Set the center frequency
FREQ:CENT 1GHz

// Configure a power trigger to detect transient power effects
TRIG:SEQ:SOUR IFP
TRIG:SEQ:LEV:IFP -50dBm

//Configure data acquisition for 5 ms in a 80 MHz bandwidth
BAND:DEM 80MHz
MTIM 5ms

//----------- Configuring the results -------------------------------
//Result displays (default):
//upper row: (1)RF Spectrum (2)FM Time Domain
//bottom row: (3)Spectrogram (4)RF Power Time Domain

//Configure RF Power Time Domain: automatic scaling
DISP:WIND4:TRAC:Y:SCAL:AUTO ON

//Configure Spectrogram: MAX detector, GAUSS window function;
// Query number of bins
SENS:WIND3:SGR:DET:FUNC MAX
SWE:FFT:WIND:TYPE GAUS
SWE:FFT:WIND:LENG?

//-----------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
INIT;*WAI
```

```
//-----------Retrieving Results-------------
//Retrieve trace data for RF Power Time Domain
TRAC1:DATA? TRACe1
TRAC1:DATA:X? TRACe1
```

11.8.2 Programming example: performing a chirp detection measurement

This example demonstrates how to perform transient analysis on a chirped signal in a remote environment.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the transient analysis application
INST:SEL 'TA'

//-----------Configuring the measurement -----------
//Set the center frequency
FREQ:CENT 1GHz

// Configure a power trigger to detect transient power effects
TRIG:SEQ:SOUR IFP
TRIG:SEQ:LEV:IFP -50dBm

//Configure data acquisition for 5 ms in a 80 MHz bandwidth
BAND:DEM 80MHz
MTIM 1ms
SRAT 100 MHz
RLEN 100000

//Configure the expected chirp signal manually
SIGN:MOD CHIR
CALC:CHRD:STAT:AUTO OFF
CALC:CHRD:STAT 400kHz, 4kHz
CALC:CHRD:LENG:AUTO OFF
CALC:CHRD:LENG:MIN 0.000003022
CALC:CHRD:LENG:MAX 0.001

//Configure the measurement range
//Frequency calc: cut off 5us at beginning and end of chirp
CALC:CHRD:FREQ:REF EDGE
CALC:CHRD:FREQ:OFFS:BEG 0.000005
CALC:CHRD:FREQ:OFFS:END 0.000005
//Power calc. : cut off 5% at each end of chirp
CALC:CHRD:POW:REF CENT
CALC:CHRD:POW:LENG 90
```

```
//Configure the analysis region: analyze 0.5 ms in 20MHz bandwidth in center
CALC:AR:FREQ:BAND 40MHz
CALC:AR:FREQ:DELT -20MHz
CALC:AR:TIME:LENG 500 us
CALC:AR:TIME:STAR 250 us

//Configure the result range manually: display 50us at beginning of each chirp,
//but cut off first 5us
CALC:RES:RANG:AUTO OFF
CALC:RES:REF RISE
CALC:RES:OFFS 0.000005
CALC:RES:ALIG LEFT
CALC:RES:LENG 0.00005

//----------- Configuring the results ------------------------------
//Result displays:
//upper row: (1)RF Spectrum (A.Region) (2)RF Spectrum (chirp1)
//middle row: (3) Spectrogram (full capture), default (4) RF Power Time Domain (full capture)
//bottom row: (5) Chirp Results table (default) (4) Chirp Statistics table
DISP:WIND1:EVAL REG
LAY:ADD:WIND? '1',RIGH,RFSP
DISP:WIND2:EVAL ##SIGN##
INIT:CONT OFF
INIT:IMM;*WAI
CALC:CHRD:SEL 1
LAY:REPL:WIND '4',RFPT
DISP:WIND4:EVAL FULL
LAY:ADD:WIND? '5',RIGH,STAB

//Configure RF Power Time Domain: automatic scaling
DISP:WIND4:TRAC:Y:SCAL:AUTO ON

//Configure range for (1)RF Spectrum (A. Region)
DISP:WIND1:TRAC:Y:SCAL:AUTO OFF
DISP:WIND1:TRAC:Y:SCAL:MAX -80 dBM
DISP:WIND1:TRAC:Y:SCAL:MIN -130 dBM

//Configure table results: show state,begin, length, frequency, max fm, average power
CALC:CHRD:TABL:COL OFF, ALL
CALC:CHRD:TABL:COL ON, STAT, BEG, LENG, FREQ, MAXF, AVGP

//Configure Spectrogram. MAX detector, GAUSS window function; Query number of bins
SENS:WIND3:SGR:DET:FUNC MAX
SWE:FFT:WIND:TYPE GAUS
SWE:FFT:WIND:LENG?

//-----------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
```

```
INIT;*WAI

//-----------Retrieving Results-------------
//Retrieve trace data for RF Power Time Domain
TRAC1:DATA? TRACe1
TRAC1:DATA:X? TRACe1

//Retrieve trace length for single transient
DISP:WIND2:TRAC1:LENG?

//Retrieve table results for first 10 chirps
CALC5:CHRD:TABL:RES? 1,10
CALC5:CHRD:STAT:DATA?

//Export entire statistics result table (all params) to an ASCII file
MMEM:STOR6:TABL ALL,'C:\R_S\Instr\AllStatResults.dat'
```

11.8.3 Programming example: performing a hop detection measurement

This example demonstrates how to perform transient analysis on a hopped signal in a remote environment.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the transient analysis application
INST:SEL 'TA'

//-----------Configuring the measurement -----------
//Set the center frequency
FREQ:CENT 1GHz

// Configure a power trigger to detect transient power effects
TRIG:SEQ:SOUR IFP
TRIG:SEQ:LEV:IFP -50dBm

//Configure data acquisition for 1 ms in a 80 MHz bandwidth
BAND:DEM 80MHz
SRAT 100 MHz
MTIM 5ms
RLEN 500000


//Configure the expected hop signal manually
SIGN:MOD HOP
CALC:HOPD:STAT:AUTO OFF
CALC:HOPD:STAT -5e6, 5MHZ, 1e6, 5MHZ
CALC:HOPD:STAT:DATA? !-5e+006, 5e+006, 1e+006, 5e+006
CALC:HOPD:DWEL:AUTO OFF
```

```
CALC:HOPD:DWEL:MIN 0.0001
CALC:HOPD:DWEL:MAX 0.000350

//Configure the measurement range
//Frequency calc: cut off 5us at beginning and end of chirp
CALC:HOPD:FREQ:REF EDGE
CALC:HOPD:FREQ:OFFS:BEG 0.000005
CALC:HOPD:FREQ:OFFS:END 0.000005
//Power calc. : cut off 5% at each end of hop
CALC:HOPD:POW:REF CENT
CALC:HOPD:POW:LENG 90

//Configure the analysis region: analyze 1 ms in 20MHz bandwidth in center
CALC:AR:FREQ:BAND 40MHz
CALC:AR:FREQ:DELT -20MHz
CALC:AR:TIME:LENG 1ms
CALC:AR:TIME:STAR 2 ms

//Configure the result range manually: display 50us at beginning of each hop,
//but cut off first 5us
CALC:RES:RANG:AUTO OFF
CALC:RES:REF RISE
CALC:RES:OFFS 0.000005
CALC:RES:ALIG LEFT
CALC:RES:LENG 0.00005

//----------- Configuring the results -------------------------------
//Result displays:
//upper row: (1)RF Spectrum (full capture),default (2)RF Spectrum (hop1)
//middle row: (3) Spectrogram (full capture), default (4) RF Power Time Domain (A. Region)
//bottom row: (5) Hop Results table (default) (4) Hop Statistics table
DISP:WIND1:EVAL REG
LAY:ADD:WIND? '1',RIGH,RFSP
DISP:WIND2:EVAL HOP
INIT:CONT OFF
INIT:IMM;*WAI
CALC:HOPD:SEL 1
LAY:REPL:WIND '4',RFSP
DISP:WIND3:EVAL REG
LAY:ADD:WIND? '6',RIGH,STAB

//Configure RF Power Time Domain: automatic scaling
DISP:WIND4:TRAC:Y:SCAL:AUTO ON

//Configure range for (4)RF Spectrum (A. Region)
DISP:WIND4:TRAC:Y:SCAL:AUTO OFF
DISP:WIND4:TRAC:Y:SCAL:MAX -80 dBM
DISP:WIND4:TRAC:Y:SCAL:MIN -130 dBM

//Configure table results: show state,begin, length, frequency, max fm, average power
```

```
CALC:HOPD:TABL:COL ON, STAT, BEG, DWEL, FREQ, MAXF, AVGP

//Configure Spectrogram. MAX detector, largeR no. of bins, GAUSS window function;
// Query number of bins
SENS:WIND3:SGR:DET:FUNC MAX
SWE:FFT:WIND:TYPE GAUS
SWE:FFT:WIND:LENG?

//-----------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
INIT;*WAI

//-----------Retrieving Results-------------
//Retrieve trace data for RF Power Time Domain
TRAC1:DATA? TRACe1
TRAC1:DATA:X? TRACe1

//Retrieve trace length for single transient
DISP:WIND2:TRAC1:LENG?

//Retrieve table results for first 10 hops
CALC5:HOPD:TABL:RES? 1,10
CALC5:HOPD:STAT:DATA?

//Store all enabled traces in all windows to a CSV file
MMEM:STOR:TA:MEAS 'C:\R_S\Instr\MyMeas.csv'
```

11.8.4 Programming example: analyzing parameter distribution

This example demonstrates how to analyze parameter distribution for a hopped signal in a remote environment. It can be performed subsequently to the measurement described in Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

```
//------------- Adding a parameter distribution result -------------------------------
//Result displays:
//upper row: (1)RF Power Time Domain (full capture), (2) Average Frequency dist. (vs. count)
//middle row: (3)Spectrogram (full capture), default (4)RF Spectrum (A.Region)
//bottom row: (5)Hop Results table, default (6)Hop Statistics table
LAY:REPL:WIND '2',PDIS

//Configure parameter distribution: 20 bins
CALC2:DIST:NBIN 20
CALC2:DIST:HOP:FREQ FREQ,COUN

//-----------Performing the Measurement-----
//Select single sweep mode.
```

```
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
INIT;*WAI

//---------------Retrieving Results-------------
//Retrieve results for parameter distribution
//CALC2:DIST:X?
//CALC2:DIST:Y?
```

11.8.5 Programming example: analyzing parameter trends

This example demonstrates how to analyze parameter trend for a hopped signal in a remote environment. It can be performed subsequently to the measurement described in Chapter 11.8.3, "Programming example: performing a hop detection measurement", on page 460.

```
//------------- Adding parameter trend results -------------------------------
//Result displays:
//upper row: (1)RF Power Time Domain (full capture), (2) Avg. Power vs. Dwell Time Trend
//middle row: (3)Average Frequency vs Begin Trend (4)RF Spectrum (A.Region)
//bottom row: (5)Hop Results table, default (6)Hop Statistics table
LAY:REPL:WIND '2',PTR
CALC2:TREN:HOP:TIM:X DWEL
CALC2:TREN:HOP:POW:Y AVGP
LAY:REPL:WIND '3',PTR
CALC3:TREN:HOP:FREQ FREQ,BEG

//-----------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
INIT;*WAI

//---------------Retrieving Results-------------
//Retrieve results for parameter trends
//CALC2:TREN:X?
//CALC2:TREN:Y?
//CALC3:TREN:X?
//CALC3:TREN:Y?
```

Annex

A Reference

Most functions in the R&S VSE are available from the menus.

A.1 Common R&S VSE menus

The following menus provide **basic functions for all applications**:

A.1.1 File menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE base software user manual.

Menu item	Correspond-ing icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> Rename Group	-	Changes the name of the selected group
> New Measurement Channel	-	Inserts a new channel in the selected group
> Replace Measure-ment Channel	-	Replaces the currently selected channel by the selected applica-tion.

Menu item	Corresponding icon in toolbar	Description
> Rename Measurement Channel	-	Changes the name of the selected channel.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> Selected Channel	-	Restores the default software configuration for an individual channel
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

A.1.2 Window menu

The "Window" menu allows you to hide or show individual windows.

Menu item	Correspond-ing icon in toolbar	Description
Player	-	Displays the "Player" tool window to recall I/Q data recordings
Instruments	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measurement channel
Channel Information >	-	Displays the channel bar with global channel information for the selected measurement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated

A.1.3 Help menu

The "Help" menu provides access to help, support and licensing functions.

Menu item	Correspond-ing icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Opens the Rohde & Schwarz support page (http://www.rohde-schwarz.com/support) in a browser for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.2 Transient analysis measurements menus

The following menus are only available if a Transient Analysis measurement channel is selected.

A.2.1 Edit menu

The "Edit" menu contains functions for processing the temporarily stored current measurement results.

Menu item	Correspond-ing icon in toolbar	Description
Trace Export	-	Stores the currently selected trace in the active window to an ASCII file. See Chapter 7.4, "Trace / data export configuration", on page 129.
Table Export	-	Stores the currently selected table in the active window to an ASCII file. See "Table Export Configuration" on page 137.
Copy to Clipboard	-	Copies the graphical measurement results (ASCII data) to the Windows clipboard for further processing.

A.2.2 Input & output menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table A-1: "Input" menu items for Transient Analysis measurements

Menu item	Description
Amplitude	Chapter 6.3.3, "Amplitude settings", on page 98
Scale	Chapter 7.1.4, "Y-Axis scaling", on page 122
Frequency	Chapter 6.3.2, "Frequency settings", on page 96
Trigger	Chapter 6.4, "Trigger settings", on page 101
Input Source	Chapter 6.3.1, "Input source settings", on page 89
Output	See the R&S VSE Base Software User Manual

A.2.3 Meas setup menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table A-2: "Meas Setup" menu items for Transient Analysis measurements

Menu item	Description
Signal Description	Chapter 6.2, "Signal description", on page 82
Input/Frontend	Chapter 6.3, "Input and frontend settings", on page 88
Data Acquisition	Chapter 6.5, "Data acquisition and analysis region", on page 105
Capture Count	"Capture Count " on page 128
Hop Meas / Chirp Meas	Chapter 6.7, "Hop / chirp measurement settings", on page 109
Spectrogram	Chapter 7.5, "Spectrogram settings", on page 130
Result	Chapter 7.1, "Result configuration", on page 116
Select Frame	"Select Frame" on page 131
Select Hop / Chirp	"Select Hop / Select Chirp" on page 125
Expert mode	For Rohde & Schwarz oscilloscopes only: Configuration directly on the instrument, see the R&S VSE Base Software User Manual.
User Correction	User-defined frequency response correction, see the R&S VSE Base Software User Manual.
Overview	Chapter 6.1, "Configuration overview", on page 80

A.2.4 Trace menu

The "Trace" menu provides access to trace-specific functions.

This menu is application-specific.

Table A-3: "Trace" menu items for Transient Analysis measurements

Menu item	Description
Trace <x>	Selects the corresponding trace for configuration. The currently selected trace is highlighted blue
Clear Spectrogram	"Clear Spectrogram " on page 135
Clear All Spectrograms	"Clear All Spectrograms" on page 135
Spectrogram	Chapter 7.5, "Spectrogram settings", on page 130
Trace Export	Chapter 7.4, "Trace / data export configuration", on page 129
Trace ...	Opens the "Traces" configuration dialog box

A.2.5 Marker menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table A-4: "Marker" menu items for Transient Analysis measurements

Menu item	Correspond-ing icon in toolbar	Description
Select marker <x>		"Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 139
Marker to Trace	-	"Assigning the Marker to a Trace " on page 141
All Markers Off		"All Markers Off " on page 142
Marker...		Chapter 7.7, "Marker settings", on page 138
Search...	-	Chapter 7.7.3.1, "Marker search settings", on page 144

A.2.6 Limits menu

The "Limits" menu is not available for Transient Analysis measurements.

A.3 Reference of toolbar functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

Table A-5: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel
	MultiView mode: displays windows for all active measurement channels (disabled: only windows for currently selected channel are displayed)

"Control" toolbar

Table A-6: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement mode for next capture
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

Table A-7: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

Table A-8: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
	Zoom off: displays the diagram in its original size

Table A-9: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
	Select marker
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right

Icon	Description
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table A-10: Functions in the "AutoSet" toolbar

Icon	Description
	Refresh measurement results (R&S VSE VSA and OFDM VSA applications only)
	Auto level
	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

B Reference: ASCII file export format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling 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 130).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

If the spectrogram display is selected when you select "ASCII Trace Export", the entire histogram buffer with all frames is exported to a file. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Table B-1: ASCII file format for table export

File contents	Description
Header data	
Type;R&S VSE;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2013;	Date of data set storage
Mode;Ta;	Application
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Meas Time;0.000350000;s	Measurement time
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Number of Windows;6;	Number of result displays
Window section	

File contents	Description
Window;1;Full RF Time Domain;	Window number and type
Trace section	
Trace 1;;	Trace number
Trace Mode;Clear Write;	Trace mode
x-Axis;Linear;	x-axis scaling mode
Start Freq;0;s	x-axis start value
Stop Freq;0.00035;s	x-axis stop value
x-Unit;s;	x-axis unit
y-Axis;Linear;	y-axis scaling mode
Level Range;0.0010;dBm	y-axis range per division
Ref Position;100.0000;%	y-axis reference position
Ref Value;-113.97900;dBm	y-axis reference value
y-Unit;dBm;	y-axis unit
Data section	
Values; 1001;	Number of rows of measured values in the table
0;-113.97937774658203125 0;-113.97937774658203125 …;…	Measured values: <x-value>;<y-value>

C I/Q data file format (iq-tar)

I/Q data is packed in a file with the extension .iq.tar. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

The iq-tar container packs several files into a single .tar archive file. Files in .tar format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of .tar files is that the archived files inside the .tar file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the .tar file first.

Sample iq-tar files

Some sample iq-tar files are provided in the C:\ProgramData\Rohde-Schwarz\VSE\<version_no>\user\Demo\ directory on the R&S VSE.

These files are also available in the demo mode of the R&S VSE software.

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. xyz.xml
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. xyz.complex.float32
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. open_IqTar_xml_file_in_web_browser.xslt
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

C.1 I/Q parameter XML file specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. `iq-tar` uses an "ordered XML schema". For your own implementation of the `iq-tar` file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S VSE</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

C.1.1 Minimum data elements

The following data elements are the minimum required for a valid `iq-tar` file. They are always provided by an `iq-tar` file export from a Rohde & Schwarz product. If not specified otherwise, it must be available in all `iq-tar` files used to import data to a Rohde & Schwarz product.

Element	Possible Values	Description
<RS_IQ_TAR_FileFormat>	-	The root element of the XML file. It must contain the attribute fileFormatVersion that contains the number of the file format definition.
<Name>	string	Optional: describes the device or application that created the file.
<Comment>	string	Optional: contains text that further describes the contents of the file.
<DateTime>	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is xs:dateTime (see RsIqTar.xsd).
<Samples>	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also <Format> element.
<Clock>	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute unit must be set to "Hz".
<Format>	complex | real | polar	Specifies how the binary data is saved in the I/Q data binary file (see <DataFilename> element). Every sample must be in the same format. The format can be one of the following: ● complex: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● real: Real number (unitless) ● polar: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires DataType = float32 or float64
<DataType>	int8 | int16 | int32 | float32 | float64	Specifies the binary format used for samples in the I/Q data binary file (see <DataFilename> element and Chapter C.2, "I/Q data binary file", on page 485). The following data types are allowed: ● int8: 8 bit signed integer data ● int16: 16 bit signed integer data ● int32: 32 bit signed integer data ● float32: 32 bit floating point data (IEEE 754) ● float64: 64 bit floating point data (IEEE 754)
<ScalingFactor>	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <ScalingFactor>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <ScalingFactor> must be applied to all channels. The attribute unit must be set to "V". The <ScalingFactor> must be > 0. If the <ScalingFactor> element is not defined, a value of 1 V is assumed.

Element	Possible Values	Description
<NumberOfChannels>	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter C.2, "I/Q data binary file", on page 485). If the <NumberOfChannels> element is not defined, one channel is assumed.
<DataFilename>		Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see Format element) ● <Channels> = Number of channels (see NumberOfChannels element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see DataType element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
<UserData>	xml	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
<PreviewData>	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S VSE). For the definition of this element refer to the RsIqTar.xsd schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet open_IqTar_xml_file_in_web_browser.xslt is available.

C.1.2 User-defined data elements

You can insert additional user, application or device-specific XML data that is not part of the iq-tar specification in the <UserData> element. User data must be valid XML content.

Rohde & Schwarz products use this element to import and export application-specific data. While some elements are mandatory in order to import the iq-tar file to the product, others are optional.

The subelements within the <UserData> element provided by the Rohde & Schwarz products are <DataImportExport_MandatoryData> and <DataImportExport_OptionalData>. To import an iq-tar file to the R&S VSE software, either both of these elements or none of them must be provided.

C.1.2.1 Mandatory data elements

The following information is always provided by an iq-tar file export from Rohde & Schwarz products. It is contained in the <DataImportExport_MandatoryData> element. It must be available in all iq-tar files used to import data to the R&S VSE software if optional data is included (see Chapter C.1.2.2, "Optional data elements", on page 479).

Table C-1: Subelements of <DataImportExport_MandatoryData>

Element Name	Possible Values	Description
<ChannelNames>	<ChannelName>	Mapping of channels in iq-tar file to channel names in R&S VSE software. CH_1 = first <ChannelName> CH_2 = second <ChannelName> ... CH_n = last <ChannelName>
<ChannelName>	String	Channel name in R&S VSE software
<CenterFrequency>	Double	Center frequency of captured I/Q data

C.1.2.2 Optional data elements

Optionally, the following information can be provided in iq-tar files used to import data to Rohde & Schwarz products. This information can also be provided by an iq-tar file export from the R&S VSE software, if selected. Note that the available information during data export depends on the connected instrument.

Optional information is contained in the <DataImportExport_OptionalData> element. If this element is included in the <UserData> element, the <DataImportExport_MandatoryData> element must also be included (see Chapter C.1.2.1, "Mandatory data elements", on page 479).

Optional data is included in <Key> subelements with a specific name attribute. Keys for an individual channel are provided together, i.e. first all keys for CH_1, then all keys for CH_2 etc. The channel index is provided as a prefix for the key name attribute and corresponds to the mapping defined in the <ChannelNames> in <DataImportExport_MandatoryData> (see Chapter C.1.2.1, "Mandatory data elements", on page 479).

Table C-2: Possible information in <DataImportExport_OptionalData>

<Key> element name attribute	Possible Values
Ch<n>_RefLevel[dBm]	Double
Ch<n>_RefLevelOffset[dB]	Double
Ch<n>_AttenuMech[dB]	Integer
Ch<n>_AttenuElecState	ON | OFF
Ch<n>_AttenuElecValue[dB]	Integer

<Key> element name attribute	Possible Values
Ch<n>_PreampState	ON | OFF
Ch<n>_PreampGain[dB]	Integer
Ch<n>_PreSelectorState	ON | OFF (R&S FSWT only)
Ch<n>_PreSelectorType	NARROW | WIDE (R&S FSWT only)
Ch<n>_Impedance[Ohm]	50 | 75
Ch<n>_InputCoupling	AC | DC
Ch<n>_DeviceId	String
Ch<n>_DeviceOptions	String
Ch<n>_DeviceHwInfo	String
Ch<n>_DeviceVersions	String
Ch<n>_CalibrationState	ON | OFF
Ch<n>_RefOscillatorInput	OFF | ON
Ch<n>_RefOscillatorFreq[Hz]	Double
Ch<n>_InputPath	RF
Ch<n>_InputSelection	INPUT1 | INPUT2 (R&S FSWT only)
Ch<n>_HighPassFilterState	ON | OFF
Ch<n>_YigPreSelectorState	ON | OFF
Ch<n>_ExtMixerState	ON | OFF
Ch<n>_MeasBandwidth[Hz]	Double
Ch<n>_FilterSettings	FLAT | GAUSS | OFF
Ch<n>_TrgSource	Extern <1 ..4> | I/Q Power | IF Power | RF Power | Power Sensor | Time
Ch<n>_TrgLevel[dB]	Double
Ch<n>_TrgHysteresis[dB]	Double
Ch<n>_TrgTpis[s]	Double
Ch<n>_TrgOffset[s]	Double
Ch<n>_TrgSlope	Rising | Falling | Rising/Falling
Ch<n>_TrgHoldoff[s]	Double
Ch<n>_TrgDropOut[s]	Double
Ch<n>_NumberOfPostSamples	Integer
Ch<n>_NumberOfPreSamples	Integer

Example: Example for <DataImportExport_OptionalData>

```
<DataImportExport_OptionalData>
<Key name="Ch1_AttenElecState">OFF</Key>
<Key name="Ch1_AttenElecValue[dB]">0</Key>
<Key name="Ch1_AttenMech[dB]">0</Key>
<Key name="Ch1_CalibrationState">ON</Key>
<Key name="Ch1_DeviceHwInfo"></Key>
<Key name="Ch1_DeviceId">Rohde-Schwarz,RTP,1320.5007k08/101011,4.15.1.0</Key>
<Key name="Ch1_DeviceOptions">B4,B10,B110</Key>
<Key name="Ch1_FilterSettings">FLAT</Key>
<Key name="Ch1_HighPassFilterState">OFF</Key>
<Key name="Ch1_Impedance[Ohm]">50</Key>
<Key name="Ch1_InputCoupling">AC</Key>
<Key name="Ch1_InputPath">RF</Key>
<Key name="Ch1_MeasBandwidth[Hz]">1000000000</Key>
<Key name="Ch1_NumberOfPostSamples">0</Key>
<Key name="Ch1_NumberOfPreSamples">0</Key>
<Key name="Ch1_PreampGain[dB]">0</Key>
<Key name="Ch1_PreampState">OFF</Key>
<Key name="Ch1_RefLevelOffset[dB]">0</Key>
<Key name="Ch1_RefLevel[dBm]">-15.0362</Key>
<Key name="Ch1_RefOscillatorInput">OFF</Key>
<Key name="Ch1_SelectedIqInputSource">CHAN1_CHAN3_WV</Key>
<Key name="Ch1_TrgSource">FREE RUN</Key>
<Key name="Ch1_YigPreSelectorState">OFF</Key>
<Key name="Ch2_AttenElecState">OFF</Key>
<Key name="Ch2_AttenElecValue[dB]">0</Key>
<Key name="Ch2_AttenMech[dB]">0</Key>
<Key name="Ch2_CalibrationState">ON</Key>
<Key name="Ch2_DeviceHwInfo"></Key>
<Key name="Ch2_DeviceId">Rohde-Schwarz,RTP,1320.5007k08/101011,4.15.1.0</Key>
<Key name="Ch2_DeviceOptions">B4,B10,B110</Key>
<Key name="Ch2_FilterSettings">FLAT</Key>
<Key name="Ch2_HighPassFilterState">OFF</Key>
<Key name="Ch2_Impedance[Ohm]">50</Key>
<Key name="Ch2_InputCoupling">AC</Key>
<Key name="Ch2_InputPath">RF</Key>
<Key name="Ch2_MeasBandwidth[Hz]">1000000000</Key>
<Key name="Ch2_NumberOfPostSamples">0</Key>
<Key name="Ch2_NumberOfPreSamples">0</Key>
<Key name="Ch2_PreampGain[dB]">0</Key>
<Key name="Ch2_PreampState">OFF</Key>
<Key name="Ch2_RefLevelOffset[dB]">0</Key>
<Key name="Ch2_RefLevel[dBm]">-15.0362</Key>
<Key name="Ch2_RefOscillatorInput">OFF</Key>
<Key name="Ch2_SelectedIqInputSource">CHAN1_CHAN3_WV</Key>
<Key name="Ch2_TrgSource">FREE RUN</Key>
<Key name="Ch2_YigPreSelectorState">OFF</Key>
```

```
<Key name="FirmwareVersion">1.80-20.5.16.0 Beta</Key>
</DataImportExport_OptionalData>
```

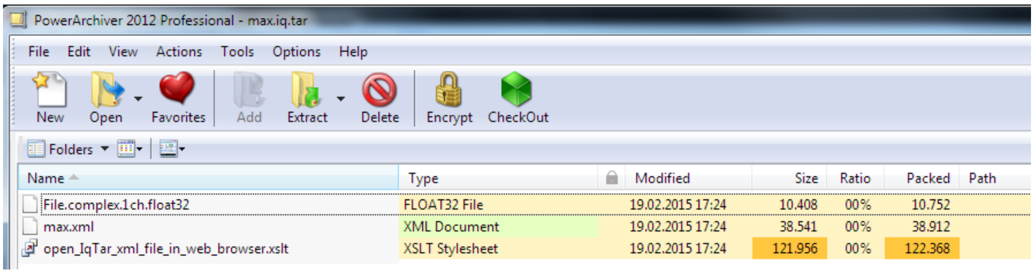
C.1.2.3 Example: userdata for I/Q recordings by R&S VSE software


```
<UserData>
      <RohdeSchwarz>
         <DataImportExport_MandatoryData>
            <CenterFrequency unit="Hz">1e+09</CenterFrequency>
         </DataImportExport_MandatoryData>

         <DataImportExport_OptionalData>
            <Key name="Ch1_RefLevel[dBm]">11.3</Key>
            <Key name="Ch1_RefLevelOffset[dB]">15.375</Key>
            <Key name="Ch1_AttenuMech[dB]">20</Key>
            <Key name="Ch1_AttenuElecState">ON | OFF</Key>
            <Key name="Ch1_AttenuElecValue[dB]">3</Key>
            <Key name="Ch1_PreampState">ON</Key>
            <Key name="Ch1_PreampGain[dB]">15</Key>
            <Key name="Ch1_PreampGain[dB]">15</Key>

            <Key name="Ch1_Impedance[Ohm]">50</Key>
            <Key name="Ch1_InputCoupling">AC</Key>
            <Key name="Ch1_PreampGain[dB]">15</Key>
            <Key name="Ch1_PreampGain[dB]">15</Key>

            <Key name="Ch1_DeviceId">string</Key>
            <Key name="Ch1_DeviceOptions">string</Key>
            <Key name="Ch1_DeviceHwInfo">string</Key>
            <Key name="Ch1_DeviceVersions">string</Key>
            <Key name="Ch1_DeviceHwInfo">string</Key>

            <Key name="Ch1_CalibrationState">ON | OFF</Key>

            <Key name="Ch1_RefOscillatorInput">enum</Key>
            <Key name="Ch1_RefOscillatorFreq[Hz]">15</Key>
            <Key name="Ch1_InputPath">RF | AIQ | FIQ | DIQ</Key>
            <Key name="Ch1_HighPassFilterState">ON | OFF</Key>
            <Key name="Ch1_YigPreSelectorState">ON | OFF</Key>
            <Key name="Ch1_ExtMixerState">ON | OFF</Key>

            <Key name="Ch1_MeasBandwidth[Hz]">8e+06</Key>
            <Key name="Ch1_FilterSettings">FLAT | GAUSS | OFF</Key>

            <Key name="Ch1_TrgSource">enum</Key>
            <Key name="Ch1_TrgLevel[dB]">15</Key>
            <Key name="Ch1_TrgHysteresis[dB]">15</Key>
            <Key name="Ch1_TrgTpis[s]">15</Key>
            <Key name="Ch1_TrgOffset[s]">15</Key>
```

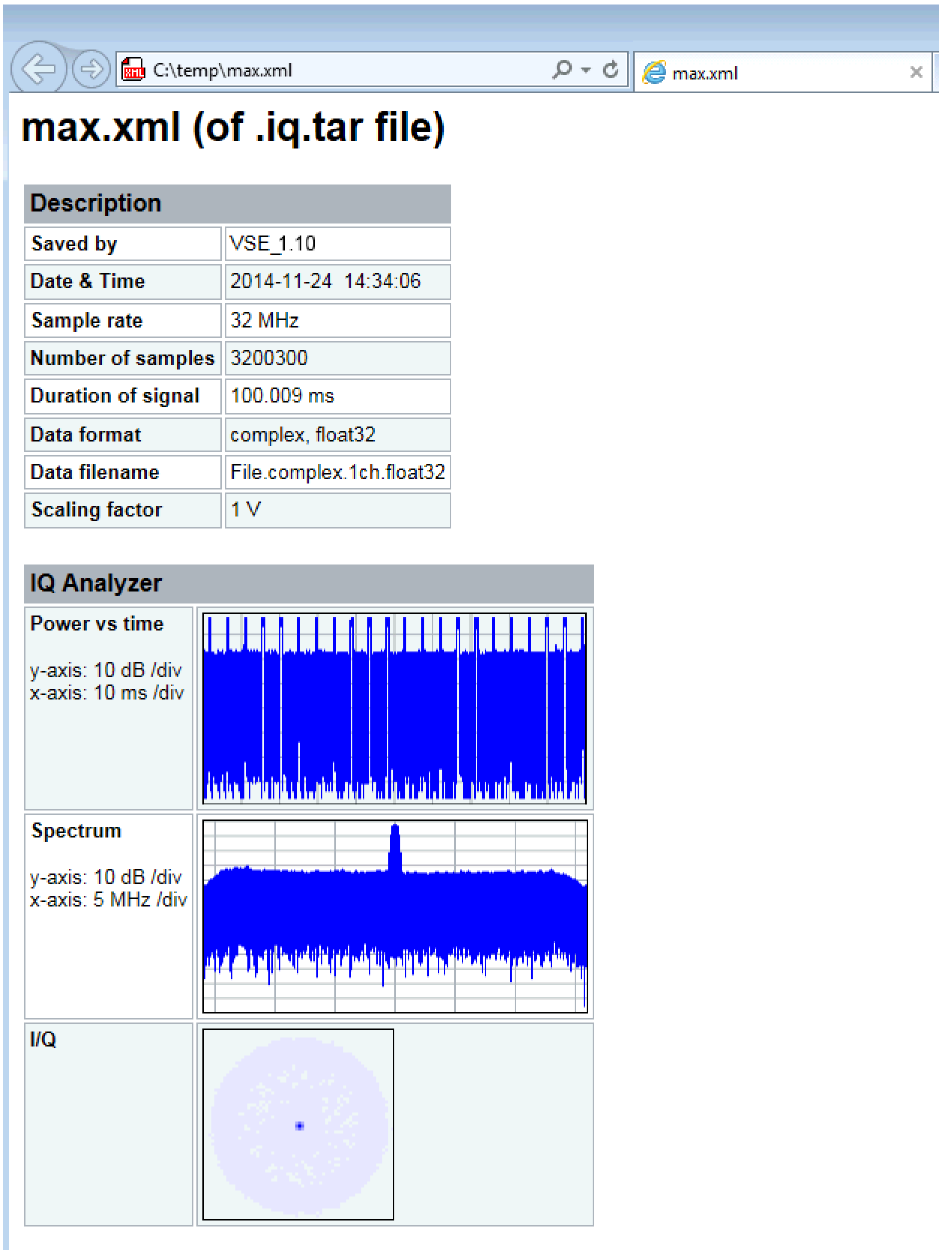
```
            <Key name="Ch1_TrgSlope">Rising | Falling</Key>
            <Key name="Ch1_TrgHoldoff[s]">15</Key>
            <Key name="Ch1_TrgDropOut[s]">15</Key>

            <Key name=" Ch1_NumberOfPreSamples">300</Key>
            <Key name=" Ch1_NumberOfPostSamples">300</Key>
         </DataImportExport_OptionalData>
      </RohdeSchwarz>
</UserData>
```

C.1.3 Example

The following example demonstrates the XML description inside the `iq-tar` file. Note that this preview is not supported by all web browsers.



Open the xml file in a web browser. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.



Description	
Saved by	VSE_1.10
Date & Time	2014-11-24 14:34:06
Sample rate	32 MHz
Number of samples	3200300
Duration of signal	100.009 ms
Data format	complex, float32
Data filename	File.complex.1ch.float32
Scaling factor	1 V

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
```

```
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

<UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>
```

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1= 32767$	0.999969482421875 V

C.2 I/Q data binary file

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `<Format>` element and `<DataType>` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `<NumberOfChannels>` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                    // Real sample 0
I[1],                    // Real sample 1
I[2],                    // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                  // Real and imaginary part of complex sample 0
I[1], Q[1],                  // Real and imaginary part of complex sample 1
I[2], Q[2],                  // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],              // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],              // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],              // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],            // Channel 0, Complex sample 0
I[1][0], Q[1][0],            // Channel 1, Complex sample 0
I[2][0], Q[2][0],            // Channel 2, Complex sample 0

I[0][1], Q[0][1],            // Channel 0, Complex sample 1
I[1][1], Q[1][1],            // Channel 1, Complex sample 1
I[2][1], Q[2][1],            // Channel 2, Complex sample 1

I[0][2], Q[0][2],            // Channel 0, Complex sample 2
I[1][2], Q[1][2],            // Channel 1, Complex sample 2
I[2][2], Q[2][2],            // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

Example: PreviewData in XML

```
  <PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
```

```
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
              <float>-111</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-67</float>
              <float>-69</float>
              ...
              <float>-70</float>
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </Spectrum>
        <IQ>
          <Histogram width="64" height="64">0123456789...0</Histogram>
        </IQ>
      </Channel>
    </ArrayOfChannel>
  </PreviewData>
```

List of Remote Commands (Transient Analysis)

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