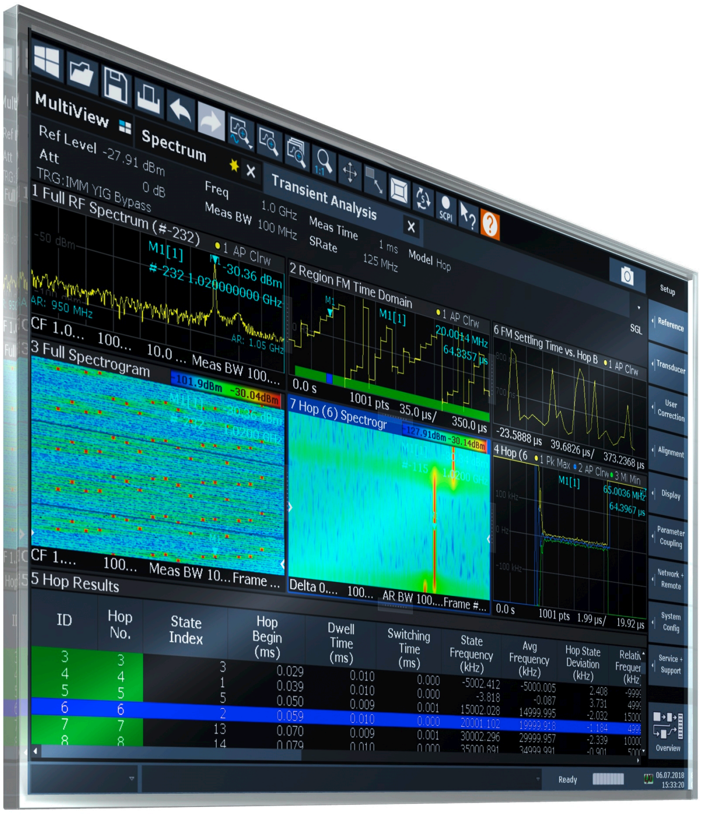
R&S®FSW-K60
Transient Analysis
User Manual



1175647802
Version 28

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following FSW models with firmware version 6.10 and later:

- R&S®FSW8 (1331.5003K08 / 1312.8000K08)
- R&S®FSW13 (1331.5003K13 / 1312.8000K13)
- R&S®FSW26 (1331.5003K26 / 1312.8000K26)
- R&S®FSW43 (1331.5003K43 / 1312.8000K43)
- R&S®FSW50 (1331.5003K50 / 1312.8000K50)
- R&S®FSW67 (1331.5003K67 / 1312.8000K67)
- R&S®FSW85 (1331.5003K85 / 1312.8000K85)

The following firmware options are described:

- FSW-K60 Transient Analysis (1313.7495.02)
- FSW-K60H Transient Hop Measurements (1322.9916.02)
- FSW-K60C Transient Chirp Measurements (1322.9745.02)
- FSW-K60P Transient Phase Noise Measurements (1353.2413.02)

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1175.6478.02 | Version 28 | R&S®FSW-K60

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

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1 Preface

This chapter provides safety-related information, an overview of the user documentation and the conventions used in the documentation.

1.1 Documentation overview

This section provides an overview of the FSW user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/FSW

Further documents are available at:

www.rohde-schwarz.com/product/FSW

1.1.1 Getting started manual

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

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

1.1.2 User manuals and help

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

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

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

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

1.1.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.1.4 Instrument security procedures

Deals with security issues when working with the FSW in secure areas. It is available for download on the internet.

1.1.5 Printed safety instructions

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

1.1.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the FSW. 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/FSW

1.1.7 Release notes and open-source acknowledgment (OSA)

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

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

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

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

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

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

1.1.9 Videos

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

1.2 About this manual

This Transient Analysis User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main FSW User Manual.

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

- **Welcome to the Transient Analysis Application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **How to Perform Measurements in the Transient Analysis Application**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Measurement Examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup
- **Remote Commands for Transient Analysis**
  Remote commands required to configure and perform Transient Analysis in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main FSW User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Reference**
  File format description
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual

- **Index**

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for procedure descriptions

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

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

1.3.3 Notes on screenshots

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

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

2 Welcome to the transient analysis application

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

The R&S FSW 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 Spectrum application and are described in the FSW User Manual. The latest version is available for download at the product homepage.

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

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

Installation

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

2.1 Starting the transient analysis application

The Transient Analysis application adds a new application to the FSW.

To activate the Transient Analysis application

1. Press [MODE] on the front panel of the FSW.

   A dialog box opens that contains all operating modes and applications currently available on your FSW.

2. Select the "Transient Analysis" item.

   

   The FSW opens a new measurement channel for the Transient Analysis application.

The measurement is started immediately with the default settings. It can be configured in the Transient "Overview" dialog box, which is displayed when you select "Overview" from any menu (see Chapter 6.1, "Configuration overview", on page 83).

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+3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information
6 = Instrument status bar with error messages, progress bar and date/time display

MSRA/MSRT operating mode

In MSRA and MSRT operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA/MSRT operating mode.

For details on the MSRA operating mode see the FSW MSRA User Manual. For details on the MSRT operating mode see the FSW Realtime Spectrum Application and MSRT Operating Mode User Manual.

Channel bar information

In the Transient Analysis application, the FSW 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)
SGL	The sweep is set to single sweep mode.

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the FSW Getting Started 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 FSW Transient Analysis application

1 = Window number
2 = Window type
3 = Trace color
4 = Trace number
5 = Detector mode
6 = Trace mode

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

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram. Furthermore, the progress of the current operation is displayed in the status bar.

3 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.

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4.1 Data acquisition

The R&S FSW 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 Basics on input from I/Q data files

The I/Q data to be evaluated in a particular FSW application cannot only be captured by the application itself, it can also be loaded from a file, provided it has the correct format. The file is then used as the input source for the application.

For example, you can capture I/Q data using the I/Q Analyzer application, store it to a file, and then analyze the signal parameters for that data later using the AM/FM/PM Modulation Analysis application.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`

- .wv
- .aid

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

When importing data from an I/Q data file using the import functions provided by some FSW applications, the data is only stored temporarily in the capture buffer. It overwrites the current measurement data and is in turn overwritten by a new measurement. If you use an I/Q data file as input, the stored I/Q data remains available for any number of subsequent measurements. Furthermore, the (temporary) data import requires the current measurement settings in the current application to match the settings that were applied when the measurement results were stored (possibly in a different application). When the data is used as an input source, however, the data acquisition settings in the current application (attenuation, center frequency, measurement bandwidth, sample rate) can be ignored. As a result, these settings cannot be changed in the current application. Only the measurement time can be decreased, to perform measurements on an extract of the available data (from the beginning of the file) only.

For input files that contain multiple data streams from different channels, you can define which data stream to be used for the currently selected channel in the input settings. You can define whether the data stream is used only once, or repeatedly, to create a larger amount of input data.

When using input from an I/Q data file, the [RUN SINGLE] function starts a single measurement (i.e. analysis) of the stored I/Q data, while the [RUN CONT] function repeatedly analyzes the same data from the file.

Sample iq.tar files

If you have the optional FSW VSA application (R&S FSW-K70), some sample `iq.tar` files are provided in the `C:\R_S\INSTR\USER\vsa\DemoSignals` directory on the FSW.

Pre-trigger and post-trigger samples

In applications that use pre-triggers or post-triggers, if no pre-trigger or post-trigger samples are specified in the I/Q data file, or too few trigger samples are provided to satisfy the requirements of the application, the missing pre- or post-trigger values are filled up with zeros. Superfluous samples in the file are dropped, if necessary. For pre-trigger samples, values are filled up or omitted at the beginning of the capture buffer. For post-trigger samples, values are filled up or omitted at the end of the capture buffer.

4.3 Signal processing

The R&S FSW 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 FSW 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).

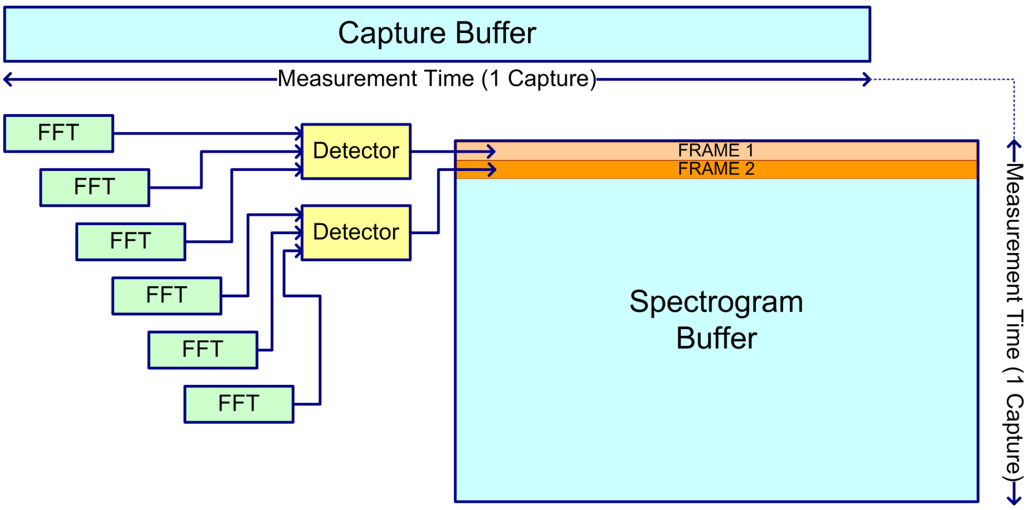

Figure 4-1: Signal processing: calculating one spectrogram frame

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.

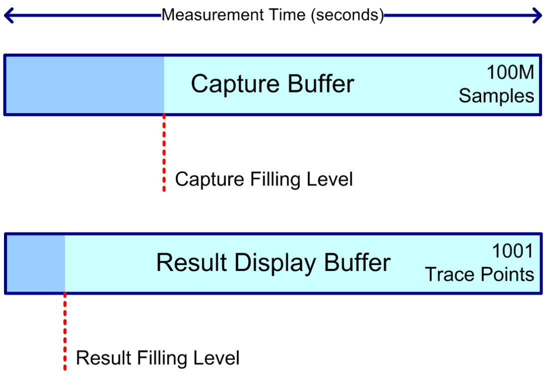

Figure 4-2: Asynchronous data processing

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.

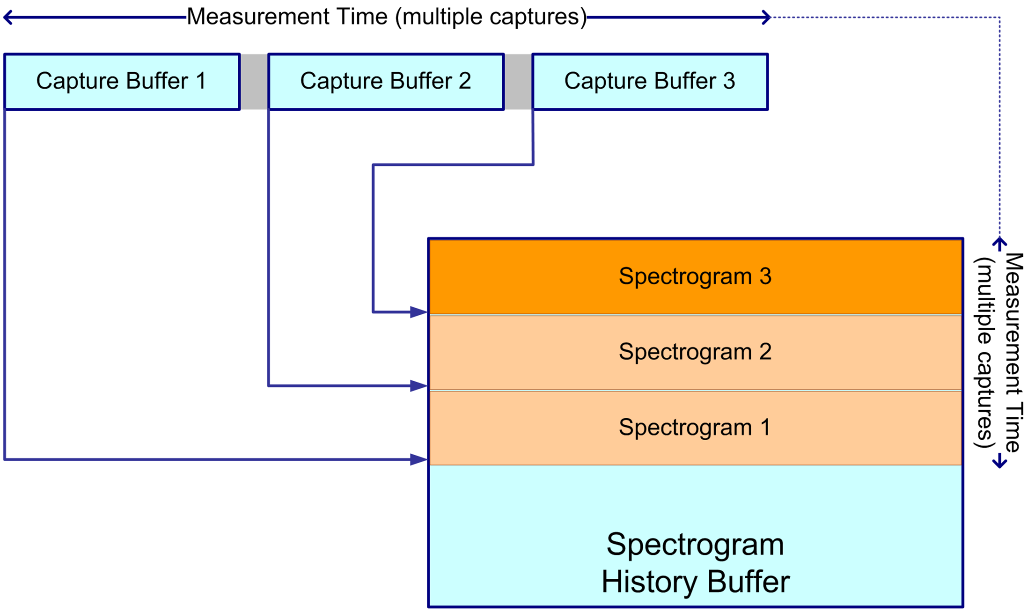

Figure 4-3: Signal processing: calculating several spectrograms

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. 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.

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 FSW can be defined manually or automatically according to the data acquisition settings.

4.4 Signal models

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

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4.4.1 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.

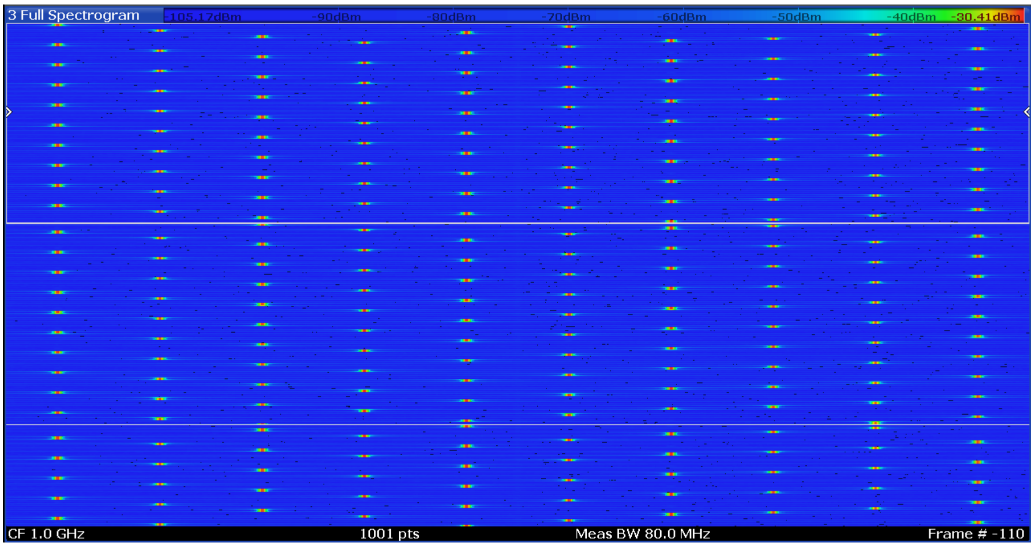


Figure 4-4: Typical spectrogram of a frequency-hopping signal

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 FSW Transient Analysis application (with the additional FSW-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.

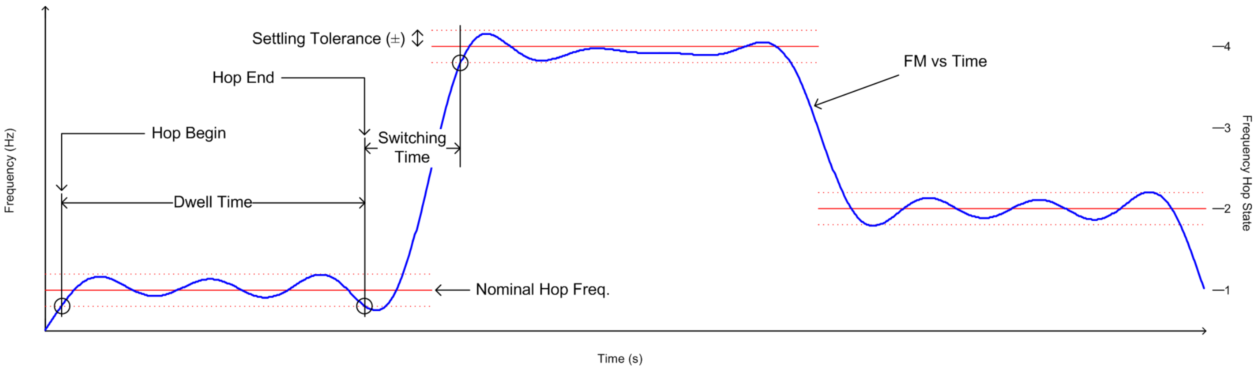


Figure 4-5: Parameters required to detect hops

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 86), 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.

4.4.2 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 FSW application (and the additional FSW-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*.

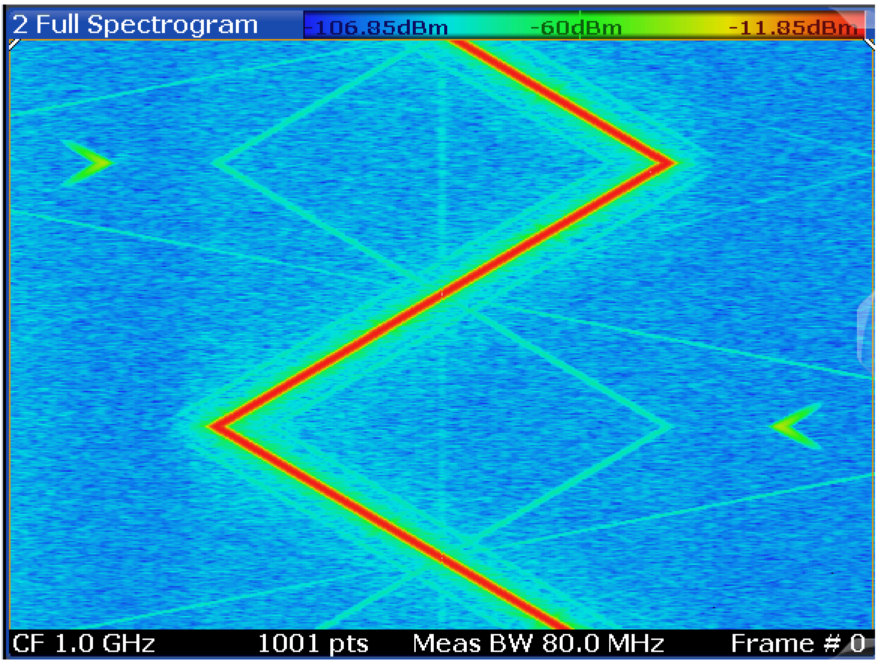


Figure 4-6: Typical spectrogram of a chirped signal

The R&S FSW 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.

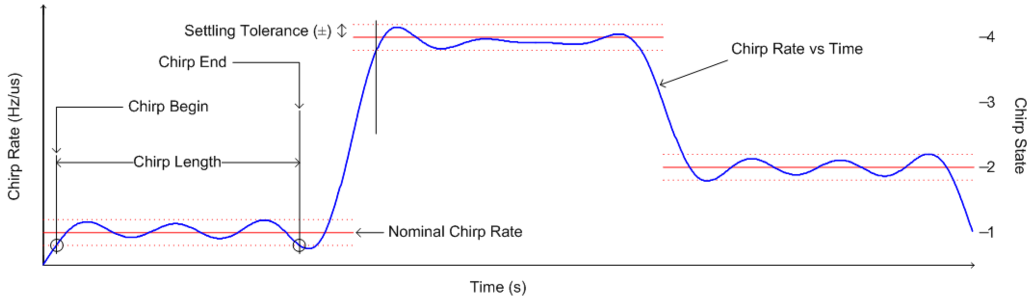


Figure 4-7: Parameters required to detect chirps

In the R&S FSW 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.

4.4.3 Automatic vs. manual hop/chirp state detection

By default, the R&S FSW 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.

4.5 Basis of evaluation

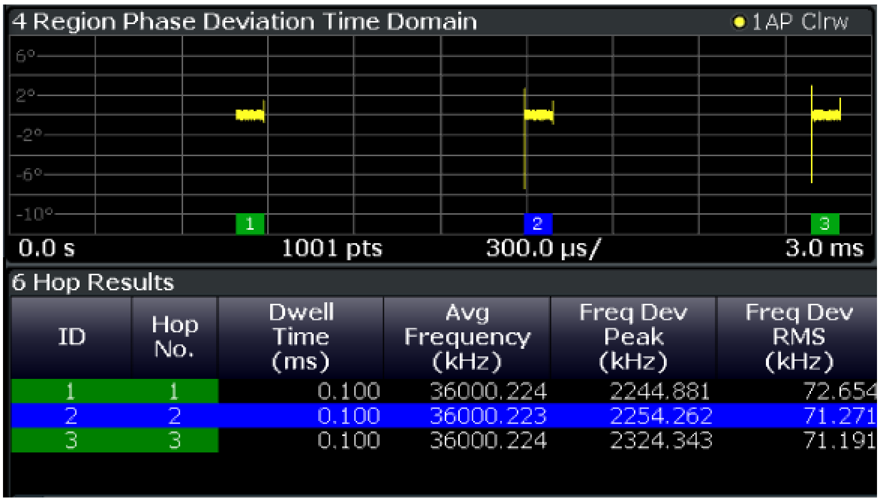
Depending on the measurement task, not all of the measured data in the capture buffer may be of interest. In some cases it may be useful to restrict analysis to a specific user-definable region, or to a selected individual chirp or hop. This makes analysis more efficient and the display clearer.

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 135) is indicated by a blue bar. The hop/chirp index as displayed in the result tables is indicated at the bottom of each bar.



ID	Hop No.	Dwell Time (ms)	Avg Frequency (kHz)	Freq Dev Peak (kHz)	Freq Dev RMS (kHz)
1	1	0.100	36000.224	2244.881	72.654
2	2	0.100	36000.223	2254.262	71.271
3	3	0.100	36000.224	2324.343	71.191

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

4.6 Analysis region

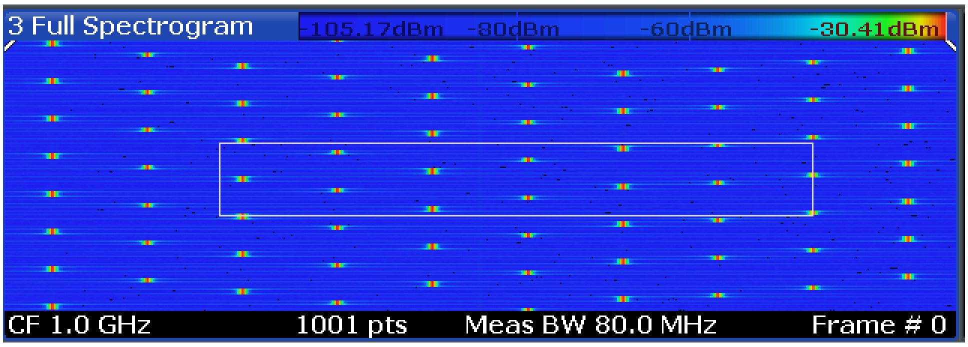
The *analysis region* determines which of the captured data is analyzed and displayed on the screen. By default, the entire capture buffer data is defined as the analysis region. However, you can select a specific frequency and time region which is of interest for analysis. The results can then be restricted to this region (see Chapter 7.3, "Evaluation basis", on page 134).

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 114).

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.



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 4.7, "Zooming and shifting results", on page 29).

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

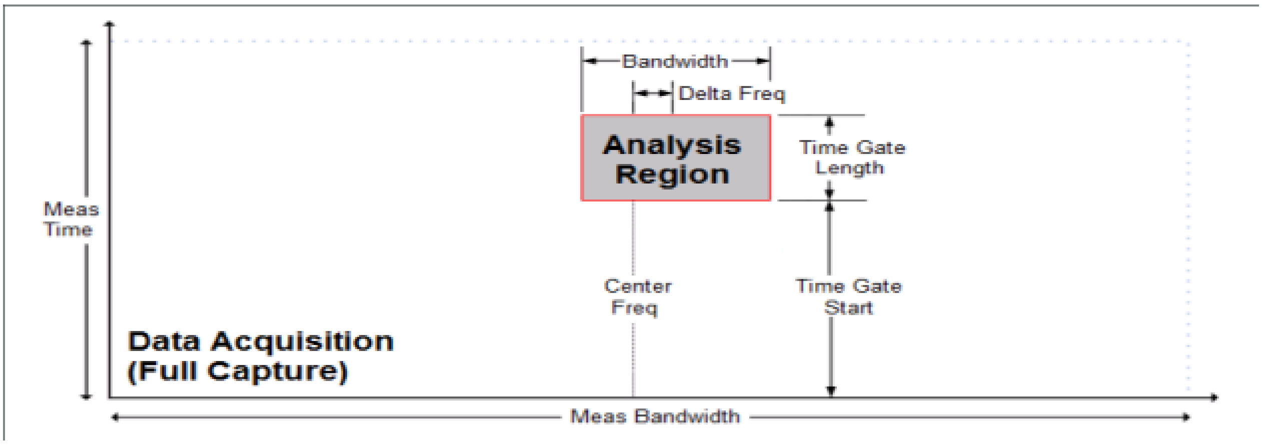


Figure 4-9: Visualization of absolute analysis region parameters

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.

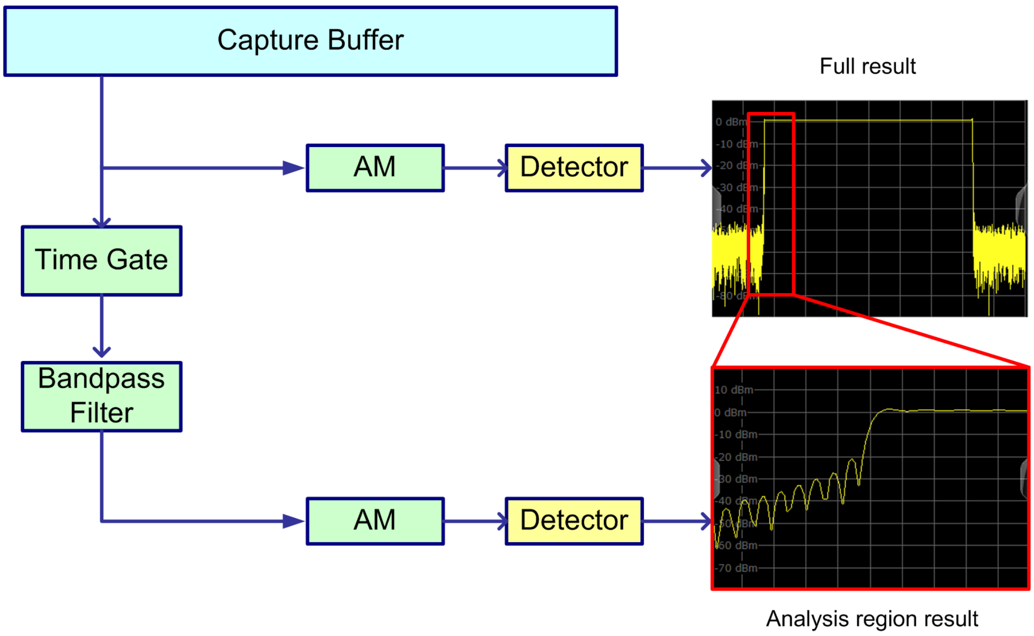


Figure 4-10: Data zoom - full result vs. analysis region result

4.7 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 7.2.1, "Result range", on page 126).

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!

4.8 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.

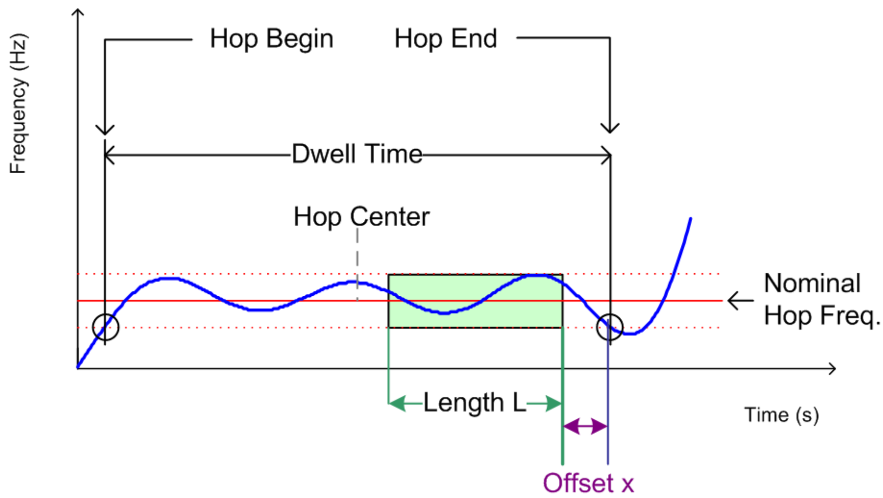


Figure 4-11: Dwell time parameters for hopped signals

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

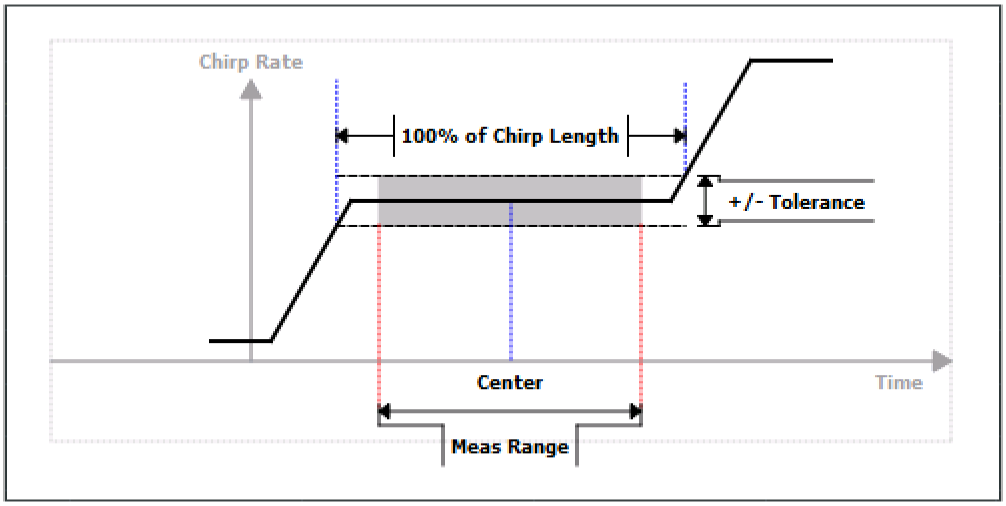


Figure 4-12: Measurement range parameters for chirped signals

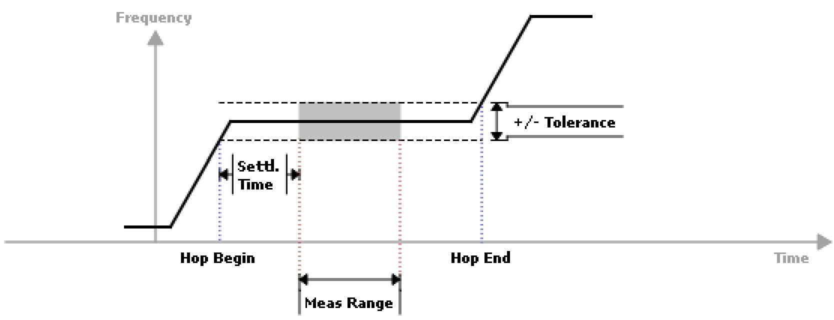
Each range is defined by a reference point, an offset, and the range length. The reference point can be either the center or either edge of the hop/chirp, or a point defined by an offset to one of these characteristic points. The range is then centered around this reference point.

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 7.2.1, "Result range", on page 126).

4.9 Trace evaluation

Traces in graphical result displays based on the defined result range (see Chapter 7.2.1, "Result range", on page 126) 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 68):

- 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:

- Mapping samples to measurement points with the trace detector.......................... 32
- Analyzing several traces - trace mode.. 34
- Trace statistics.. 35

4.9.1 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.

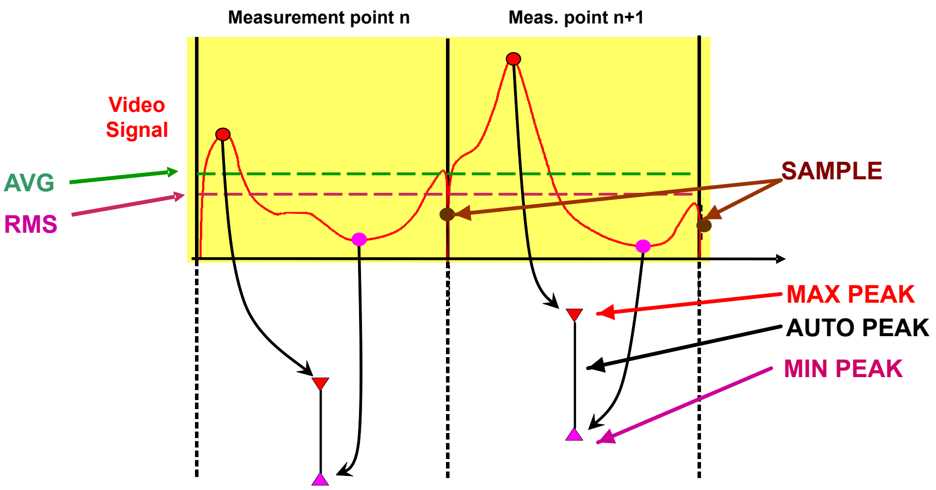
The trace detector can analyze the measured data using various methods:

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, FSW 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 FSW.

The detectors of the FSW 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 FSW 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	–

4.9.2 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 4.9.1, "Mapping samples to measurement points with the trace detector", on page 32.

The FSW 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 FSW 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 FSW 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 Sweep/Average Count determines the number of averaging procedures. (See also Chapter 4.9.3, "Trace statistics", on page 35.)
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 FSW 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.

4.9.3 Trace statistics

Each trace represents an analysis of the data measured in one result range. As described in Chapter 4.9.2, "Analyzing several traces - trace mode", on page 34, 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 Sweep/Average 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 Sweep/Average Count and the statistical evaluation mode.

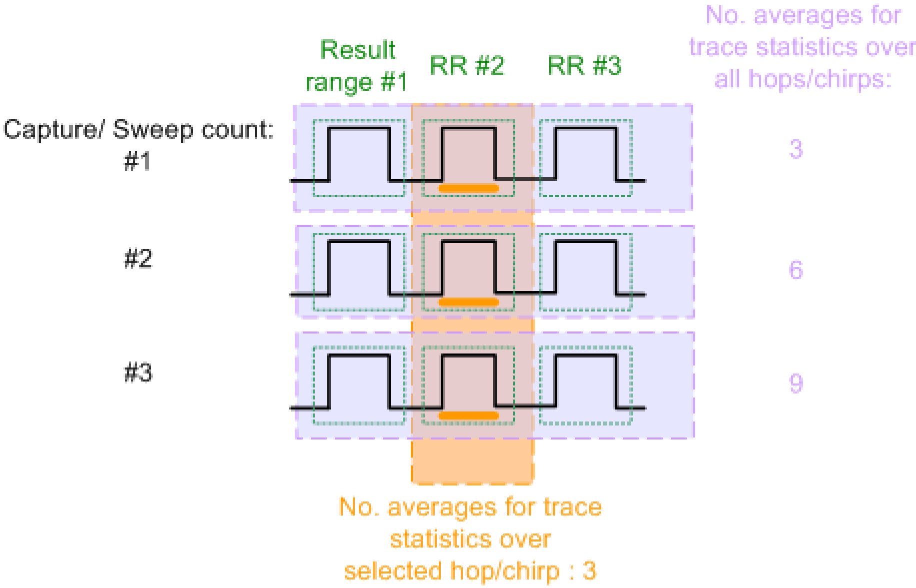


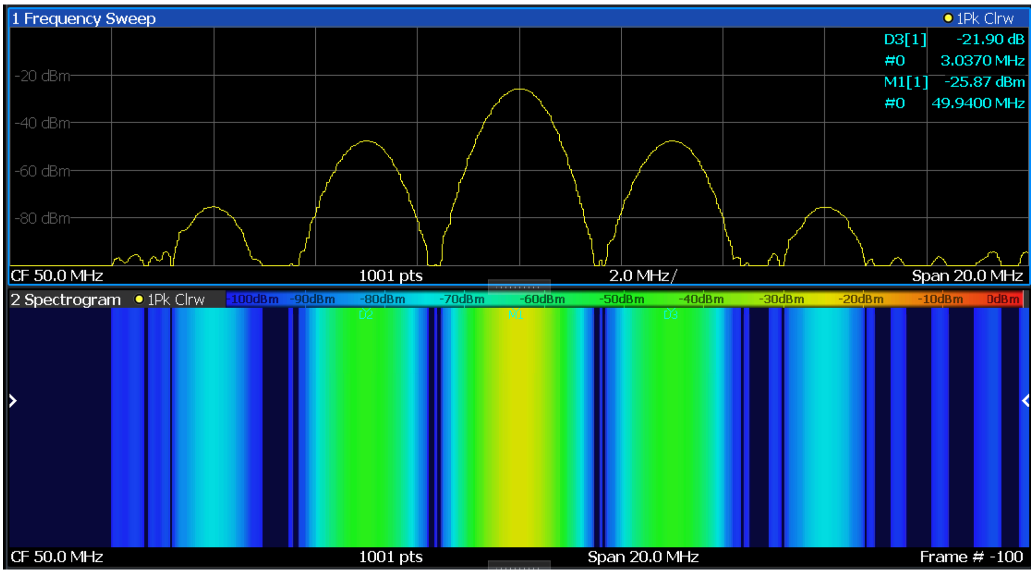
Figure 4-13: Trace statistics - number of averaging steps

4.10 Working with spectrograms

In addition to the standard "level versus frequency" or "level versus time" traces, the FSW also provides a spectrogram display of the measured data.

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 FSW, 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:

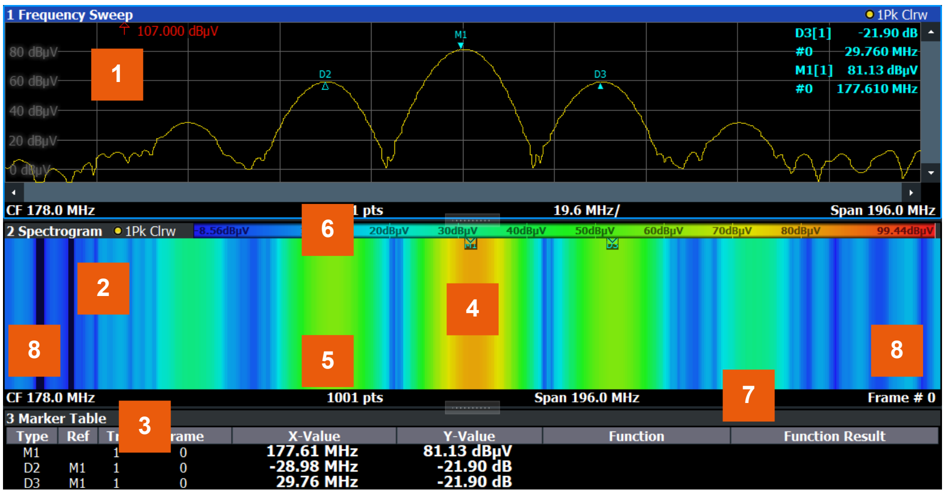


Figure 4-14: Screen layout of the spectrogram result display

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

For more information about spectrogram configuration, see Chapter 7.6, "Spectrogram settings", on page 140.

Remote commands:

Activating and configuring spectrograms:

Chapter 11.6.10, "Configuring spectrograms", on page 350

Storing results:

`MMEMory:STORe<n>:SPECtrogram` on page 451

- Time frames...38
- Markers in the spectrogram..39
- Color maps...39

4.10.1 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 4.7, "Zooming and shifting results", on page 29.)

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 spectrogram diagram contains all stored frames since it was last cleared. Arrows on the left and right border of the spectrogram indicate the currently selected frame. The spectrum diagram always displays the spectrum for the currently selected frame.

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.

4.10.2 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 posi-tioned 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.

4.10.3 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 FSW.

The Color Scheme

- **Hot**

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

  Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.
  The "Cold" color scheme is the inverse "Hot" color scheme.
- **Radar**

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

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

The value range of the color map

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

The shape and focus of the color curve

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

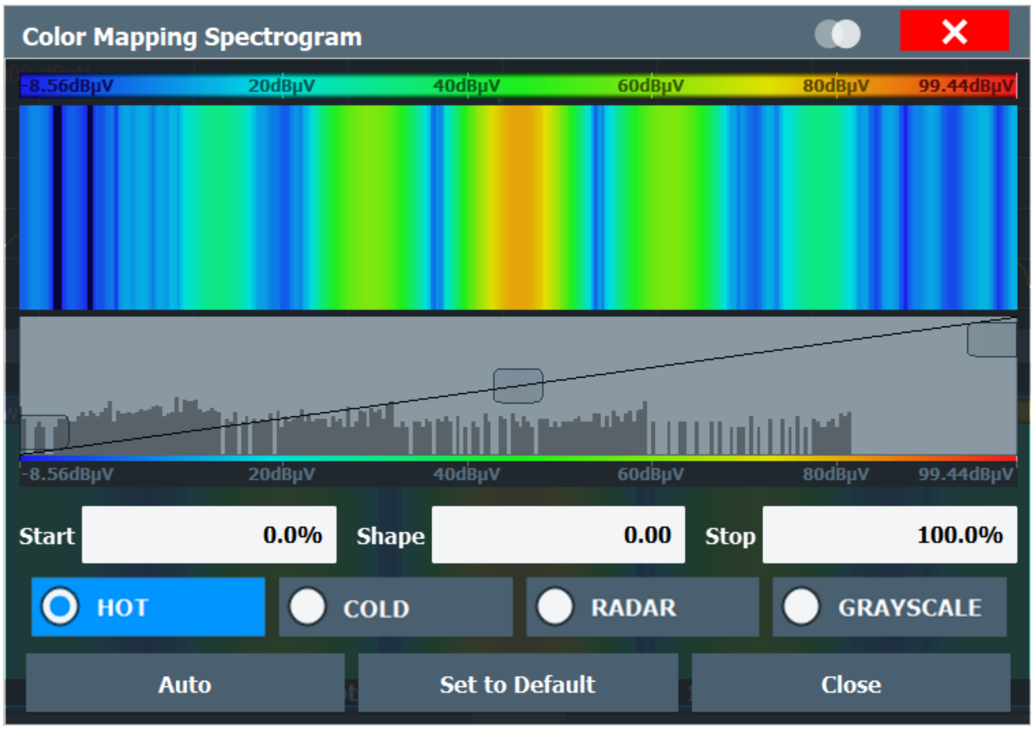


Figure 4-15: Spectrogram with (default) linear color curve shape = 0

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.

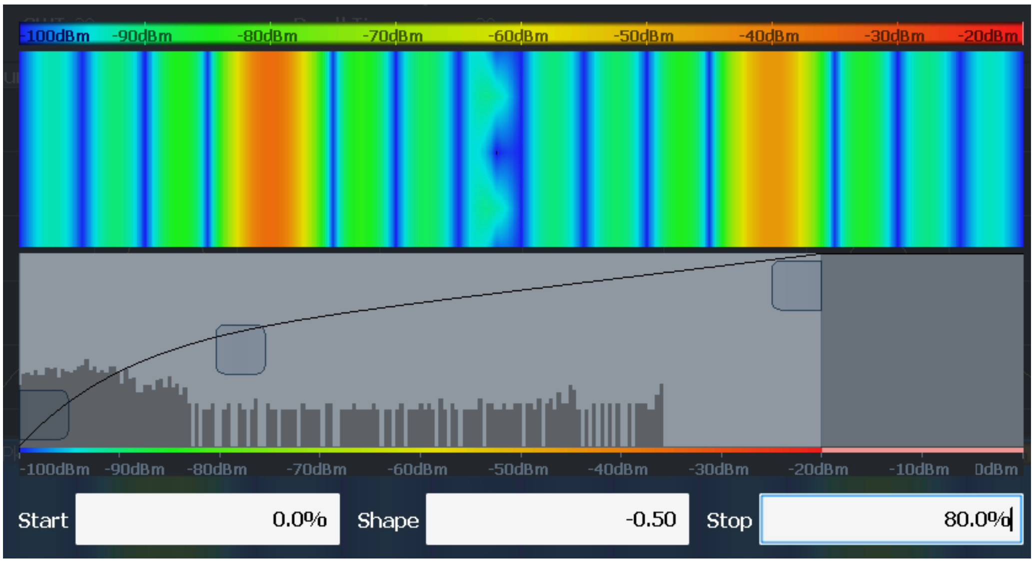


Figure 4-16: Spectrogram with non-linear color curve (shape = -0.5)

4.11 Transient analysis in MSRA/MSRT mode

The R&S FSW Transient Analysis application can also be used to analyze data in MSRA or MSRT operating mode. The main difference between the two modes is that in MSRA mode, an I/Q analyzer performs data acquisition, while in MSRT mode, a real-time measurement is performed to capture data.

In MSRA/MSRT operating mode, only the MSRA/MSRT primary actually captures data; the MSRA/MSRT applications receive an extract of the captured data for analysis, referred to as the **application data**. For the R&S FSW Transient Analysis application in MSRA/MSRT operating mode, the application data range is defined by the same settings used to define the signal capture in Signal and Spectrum Analyzer mode. In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the application data for transient analysis. The "Capture Buffer" displays show the application data of the R&S FSW Transient Analysis application in MSRA/MSRT mode.

Data acquisition in MSRT mode

By default, the R&S FSW Transient Analysis application uses the largest possible measurement bandwidth. Depending on which bandwidth extension options are installed (if any), this may be up to 500 MHz. However, in MSRT mode a maximum of 160 MHz bandwidth is available. Thus, you must ensure the measurement bandwidth for Transient Analysis is available in MSRT mode. Otherwise you will not obtain useful results.

Data coverage for each active application

Generally, if a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA/MSRT primary display indicates the data covered by each application by vertical blue lines labeled with the application name.

Analysis interval

However, the individual result displays of the application need not analyze the complete data range. The data range that is actually analyzed by the individual result display is referred to as the **analysis interval**.

In the R&S FSW Transient Analysis application the analysis interval is automatically determined according to the analysis region settings, as in Signal and Spectrum Analyzer mode. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

Analysis line

A frequent question when analyzing multi-standard signals is how each data channel is correlated (in time) to others. Thus, an analysis line has been introduced. The analysis line is a common time marker for all MSRA secondary applications. It can be positioned in any MSRA secondary application or the MSRA primary and is then adjusted in all other secondary applications. Thus, you can easily analyze the results at a specific time in the measurement in all secondary applications and determine correlations.

If the analysis interval of the secondary application contains the marked point in time, the line is indicated in all time-based result displays, such as time, symbol, slot or bit diagrams. By default, the analysis line is displayed. However, you can hide it from view manually. In all result displays, the "AL" label in the window title bar indicates whether the analysis line lies within the analysis interval or not:

- **orange "AL"**: the line lies within the interval
- **white "AL"**: the line lies within the interval, but is not displayed (hidden)
- **no "AL"**: the line lies outside the interval

Figure 4-17: Analysis line in R&S FSW Transient Analysis application

For details on the MSRA operating mode see the FSW MSRA User Manual. For details on the MSRT operating mode see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

5 Measurement results

The data that was measured by the FSW 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 FSW-K60C/-K60H)

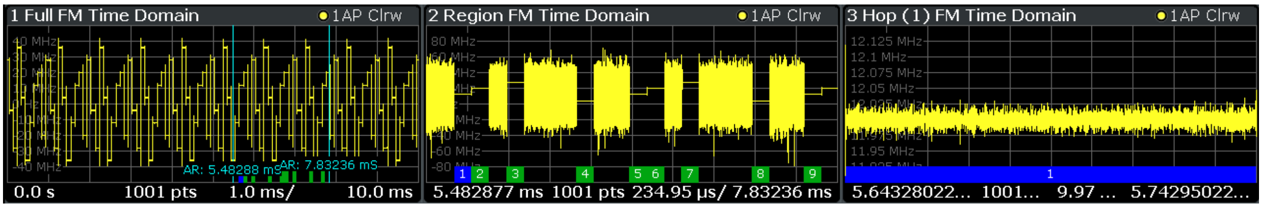


Figure 5-1: Example for different data sources for the same result display (FM Time Domain)

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 4.6, "Analysis region", on page 26.

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 167.

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- Evaluation methods for transient analysis..68

5.1 Hop parameters

If the FSW-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 4.4.1, "Frequency hopping", on page 22.)

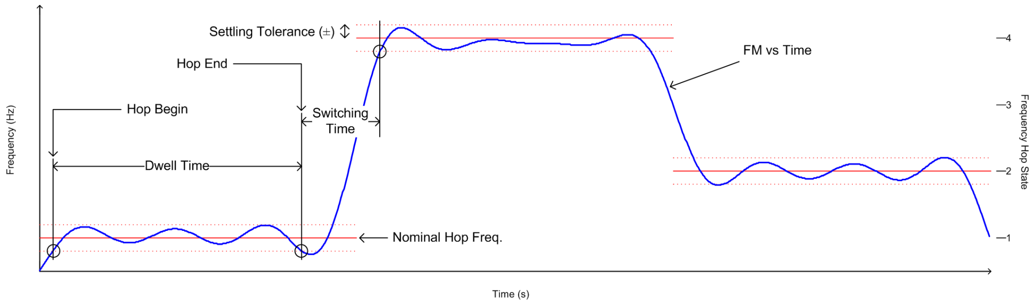

Figure 5-2: Definition of the main hop parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 7.2.2, "Table configuration", on page 127) or apply the required SCPI parameter to the remote command (see Chapter 11.6.5.2, "Hop results", on page 283 and Chapter 11.9.1, "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.

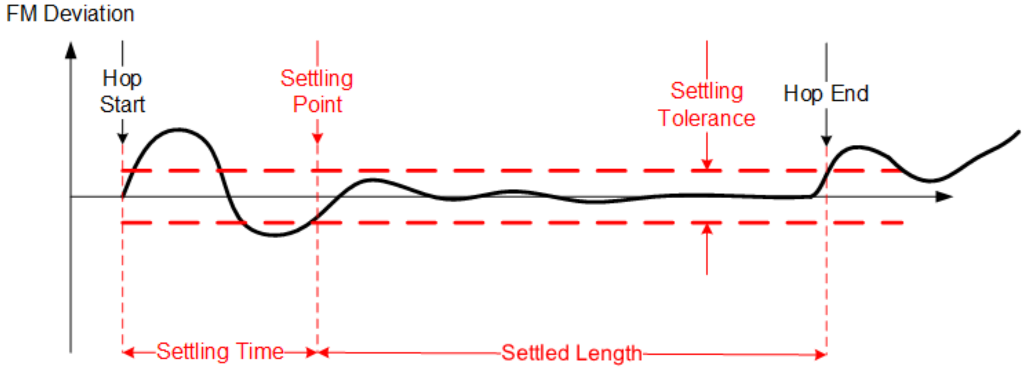

Figure 5-3: Settling parameters for hopped signals

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 400

`[SENSe:]HOP:NUMBer?` on page 406

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└ Hop Begin.....49
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└ State Frequency (Nominal).....50
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└ FM settling time.....56
└ FM settled length.....56
PM settling parameters.....56
└ PM settling point.....56
└ PM settling time.....57
└ PM settled length.....57

State parameters
Hop state parameters

Remote command:
`CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe]` on page 291

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 86), 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 291
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:STATe[:INDex]?` on page 409

Timing parameters
Hop timing parameters

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

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 293
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:TIMing:BEGin?` on page 411

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 293
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:TIMing:DWELl? on page 412

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 293
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:TIMing:SWITching? on page 413

Frequency parameters
Hop frequency parameters

Remote command:
CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe] on page 291

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 292
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:STATe:STAFrequency? on page 410

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 116).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm on page 287
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:FREQuency:FREQuency? on page 397

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 287
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:FREQuency:FMERror?` on page 396

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 287
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:FREQuency:RELFrequency?` on page 399

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 116)

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 287
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:FREQuency:MAXFm?` on page 398

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 51)

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:FREQuency:RMSFm` on page 287
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:FREQuency:RMSFm?` on page 400

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 51)

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm` on page 287
Results:
`CALCulate<n>:HOPDetection:TABLe:RESults?` on page 388
`[SENSe:]HOP:FREQuency:AVGFm?` on page 393

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.

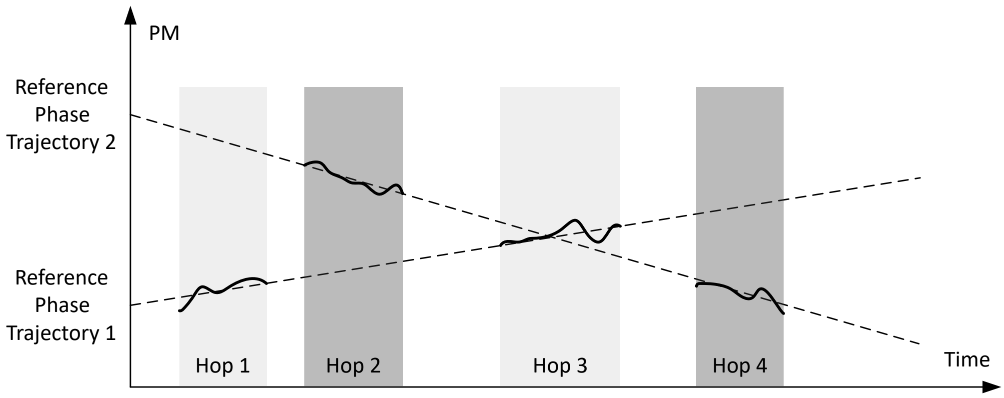

Figure 5-4: Coherent hops (1,3 and 2,4) with common reference phase trajectories

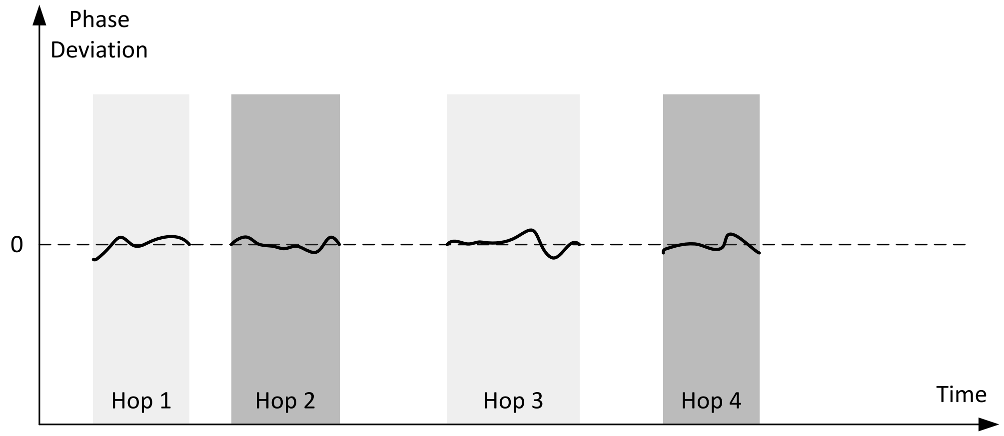

Figure 5-5: Results of a coherent phase deviation measurement

This function is only available for the FSW-K60H option.

Coherent phase deviation measurement is enabled in the "Hop Measurement" settings, see "Coherent Phase Deviation Measurement" on page 118.

Remote command:
`CALCulate<n>:HOPDetection:TABLe:PHASe:ALL[:STATe]` on page 288

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 116).

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

for k∊ {frequency meas range}

Remote command:
Display:
`CALCulate<n>:HOPDetection:TABLe:PHASe:MAXPm` on page 288
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PHASe:MAXPm? on page 401

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 288
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PHASe:RMSPm? on page 402

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 288
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PHASe:AVGPm? on page 401

Power parameters
Hop power parameters

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

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 116).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:MINPower on page 290
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:POWer:MINPower? on page 408

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 116).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:MAXPower on page 290
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:POWer:MAXPower? on page 407

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 116).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:AVEPower on page 290
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:POWer:AVEPower? on page 406

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 116).

Remote command:
Display:
CALCulate<n>:HOPDetection:TABLe:POWer:PWRRipple on page 290
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:POWer:MINPower? on page 408

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 285

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 286
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:FMSettling:FMSPoint? on page 394

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 286
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:FMSettling:FMSTime? on page 395

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 286
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:FMSettling:FMSLength? on page 393

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 289

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 289
Results:

CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PMSettling:PMSPoint? on page 404

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 289
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PMSettling:PMSTime? on page 405

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 289
Results:
CALCulate<n>:HOPDetection:TABLe:RESults? on page 388
[SENSe:]HOP:PMSettling:PMSLength? on page 403

5.2 Chirp parameters

If the additional option FSW-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 4.4.2, "Frequency chirping", on page 24.)

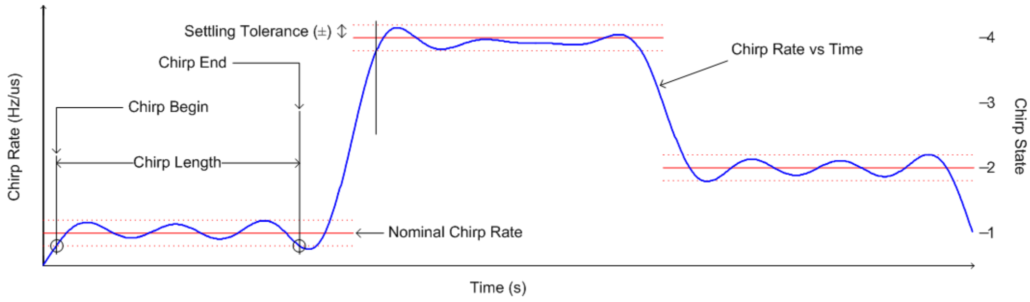

Figure 5-6: Definition of the main chirp parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see Chapter 7.2.2, "Table configuration", on page 127) or apply the required SCPI parameter to the remote command (see Chapter 11.6.5.1, "Chirp results", on page 273 and Chapter 11.9.2, "Retrieving information on detected chirps", on page 413).

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.

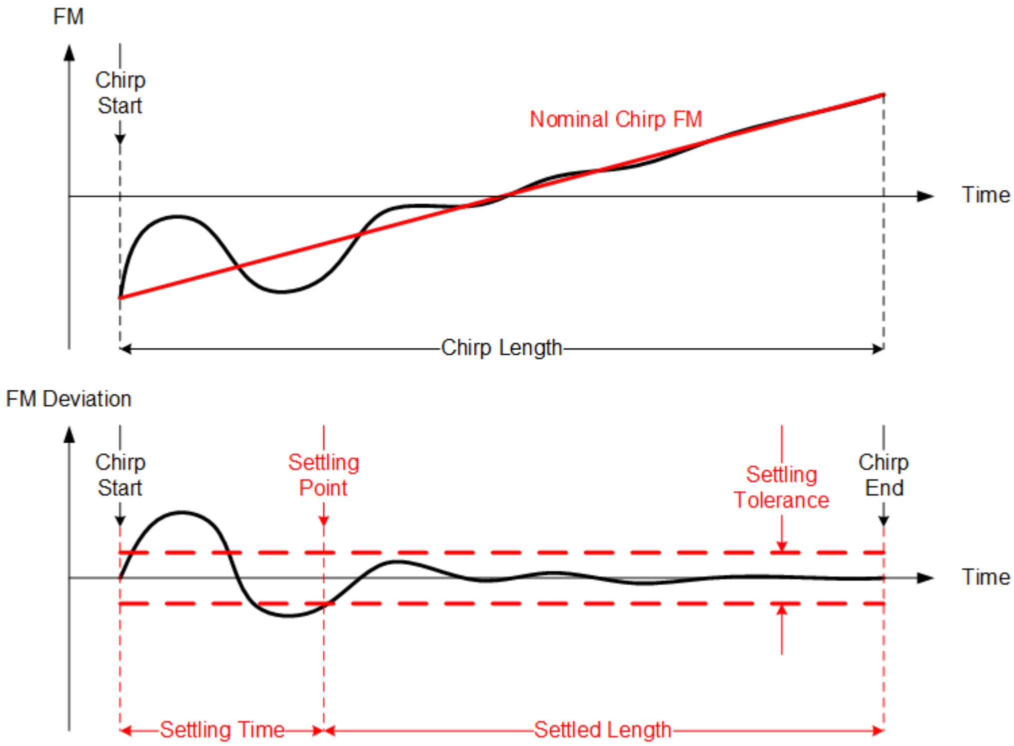

Figure 5-7: Settling parameters for chirped signals

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.

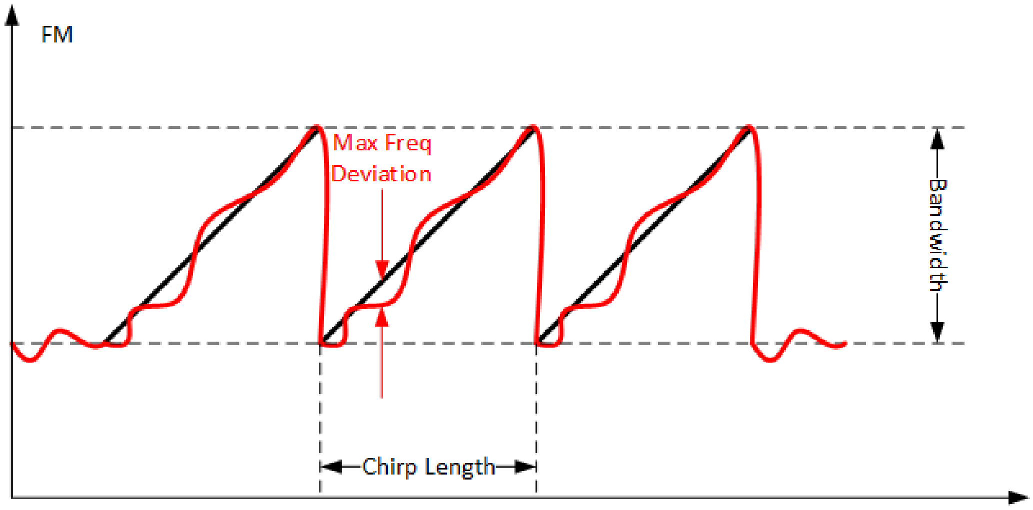

Figure 5-8: Non-linearity parameters for chirped signals

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 433

`[SENSe:]CHIRp:NUMBer?` on page 433

State parameters....60
└ State Index....60
Timing parameters....60
└ Chirp Begin....60
└ Chirp Length....61
└ Chirp Rate....61
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Frequency parameters....61
└ Chirp State Deviation....61
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└ Frequency Deviation (Peak)....62
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└ Frequency Undershoot....63
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FM settling parameters....67
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└ FM settling time....67
└ FM settled length....67
PM settling parameters....67
└ PM settling point....68
└ PM settling time....68
└ PM settled length....68

State parameters
Chirp state parameters

Remote command:
`CALCulate<n>:CHRDetection:TABLe:STATe:ALL[:STATe]` on page 281

State Index ← State parameters
The nominal chirps are numbered consecutively in the "Chirp States" table (see Chapter 6.2.2, "Signal states", on page 86), 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 282
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 417
`[SENSe:]CHIRp:STATe?` on page 443

Timing parameters
Chirp timing parameters

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

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 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:TIMing:BEGin? on page 444

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 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:TIMing:LENGth? on page 445

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 116).

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:TIMing:RATE on page 283
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:TIMing:RATE? on page 445

Switching Time ← Timing parameters
Chirp switching time parameters.

Remote command:
[SENSe:]CHIRp:TIMing:SWITching? on page 446

Frequency parameters
Chirp frequency parameters.

Remote command:
CALCulate<n>:CHRDetection:TABLe:FREQuency:ALL[:STATe] on page 277

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 278
Results:

CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:CHERror? on page 427

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 116).

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:FREQuency on page 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:FREQuency? on page 428

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 116)

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 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:MAXFm? on page 429

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 62)

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSFm on page 278
Results:

CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:RMSFm? on page 430

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 62)

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGFm on page 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:AVGFm? on page 422

Frequency Overshoot ← Frequency parameters
Chirp frequency overshoot parameters.

Remote command:
[SENSe:]CHIRp:FREQuency:OVERshoot? on page 432

Frequency Undershoot ← Frequency parameters
Chirp frequency undershoot parameters.

Remote command:
[SENSe:]CHIRp:FREQuency:UNDershoot? on page 432

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 279

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 116).

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

for k∈ {frequency meas range}

Remote command:
Display:
CALCulate<n>:CHRDetection:TABLe:PHASe:MAXPm on page 279
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PHASe:MAXPm? on page 434

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 279
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PHASe:RMSPm? on page 435

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 279
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PHASe:AVGPm? on page 433

Phase Overshoot ← Phase parameters
Chirp phase overshoot parameters.

Remote command:
[SENSe:]CHIRp:PHASe:OVERshoot? on page 436

Phase Undershoot ← Phase parameters
Chirp phase undershoot parameters.

Remote command:
[SENSe:]CHIRp:PHASe:UNDershoot? on page 436

Power parameters
Chirp power parameters

Remote command:
CALCulate<n>:CHRDetection:TABLe:POWer:ALL[:STATe] on page 281

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 116).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:MINPower` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 417
`[SENSe:]CHIRp:POWer:MINPower?` on page 442

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 116).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:MAXPower` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 417
`[SENSe:]CHIRp:POWer:MAXPower?` on page 441

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 116).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:AVEPower` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 417
`[SENSe:]CHIRp:POWer:AVEPower?` on page 440

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 116).

Remote command:
Display:
`CALCulate<n>:CHRDetection:TABLe:POWer:PWRRipple` on page 281
Results:
`CALCulate<n>:CHRDetection:TABLe:RESults?` on page 417
`[SENSe:]CHIRp:POWer:PWRRipple?` on page 442

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 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:BWIDth? on page 426

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 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:MAXNonlinear? on page 430

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 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:RMSNonlinear? on page 431

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 278
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FREQuency:AVGNonlinear? on page 426

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 276

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 277
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FMSettling:FMSPoint? on page 423

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 277
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FMSettling:FMSTime? on page 424

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 277
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:FMSettling:FMSLength? on page 422

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 279

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 280
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PMSettling:PMSPoint? on page 438

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 280
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PMSettling:PMSTime? on page 439

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 280
Results:
CALCulate<n>:CHRDetection:TABLe:RESults? on page 417
[SENSe:]CHIRp:PMSettling:PMSLength? on page 437

5.3 Evaluation methods for transient analysis

Access: "Overview" > "Display Config"

The data that was measured by the FSW 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 Spectro-gram Frequency Deviation Spectrum Phase Deviation Spectrum Phase Deviation Spectrogram	Individual hop / chirp
[1)] requires additional option FSW-K60C/-K60H [2)] requires additional option FSW-K60P		

All evaluation modes available for Transient Analysis are displayed in the selection bar in SmartGrid mode.

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

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 FSW-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....................70
Spectrogram....................71
RF Power Time Domain....................72
FM Time Domain....................73
I/Q Time Domain....................73
Frequency Deviation Time Domain....................73
PM Time Domain....................74
PM Time Domain (Wrapped)....................75
Phase Deviation Time Domain....................75
Chirp Rate Time Domain....................76
Hop/Chirp Results Table....................77
Hop/Chirp Statistics Table....................77
Parameter Distribution....................78
Parameter Trend....................79
Phase Noise....................79
Frequency Deviation Spectrogram....................80
Frequency Deviation Spectrum....................80
Phase Deviation Spectrum....................81
Phase Deviation Spectrogram....................81
Marker Table....................82

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 124) or the marker position in the spectrogram (see "Frame (for Spectrograms only)" on page 149).

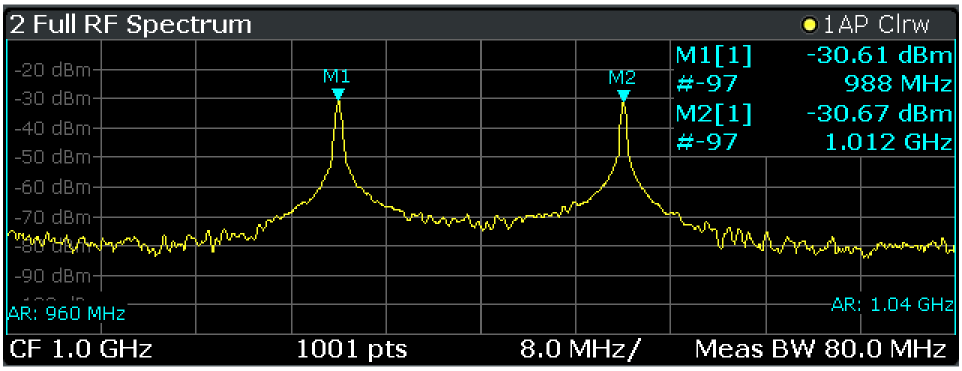


Figure 5-9: RF Spectrum result display

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 135) 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 262

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.

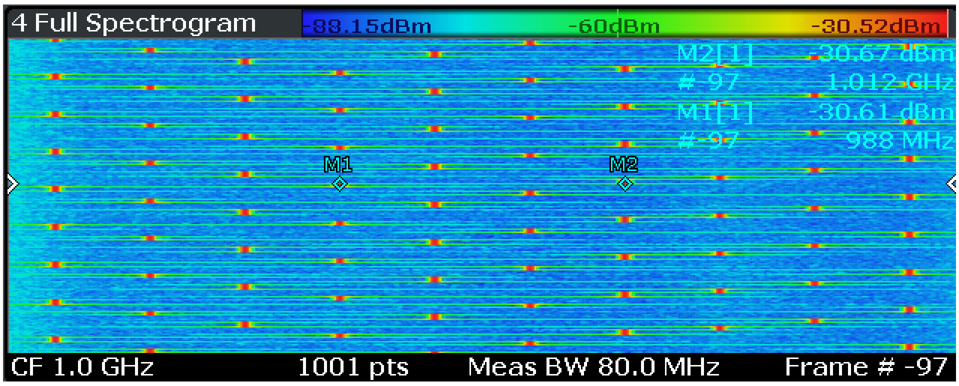


Figure 5-10: Spectrogram of a frequency hopper

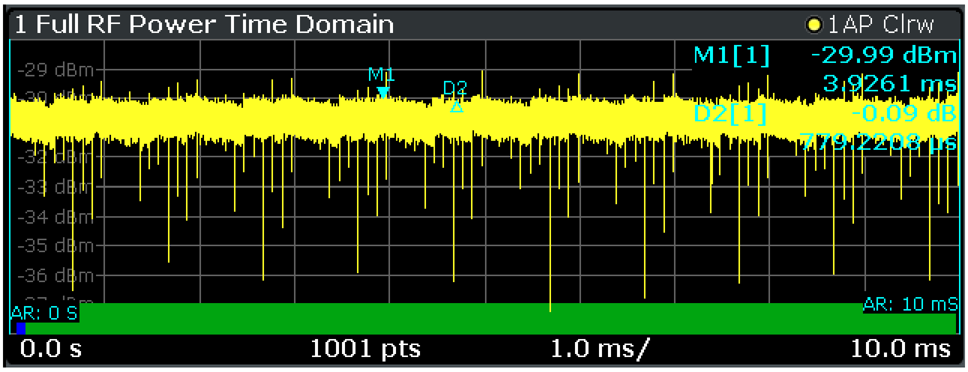
Spectrograms are highly configurable. In particular, the number of frames and the colors used to display the power levels can be defined by the user.

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.

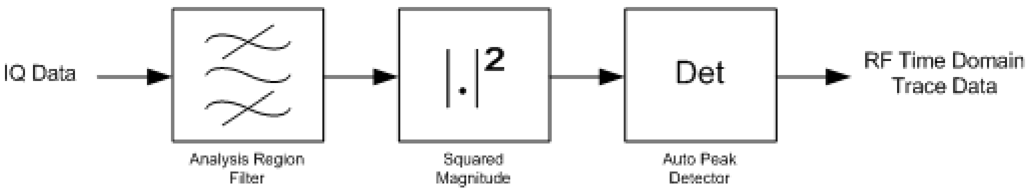
For more information on working with spectrograms see Chapter 4.10, "Working with spectrograms", on page 36.

Remote command:
`LAY:ADD? '1',RIGH, SGR`, see `LAYout:ADD[:WINDow]?` on page 262

RF Power Time Domain
Displays the RF power (in dBm) versus time.



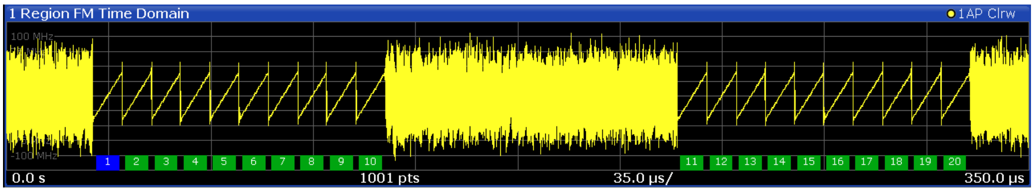
The RF Power Time Domain trace is determined as follows:



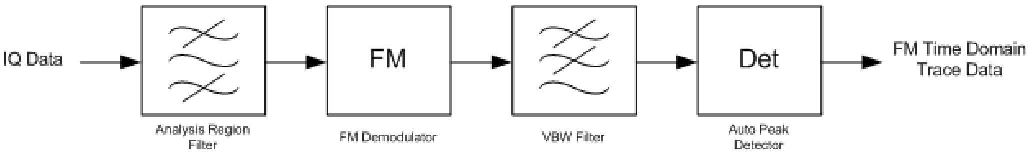
Remote command:
`LAY:ADD? '1',RIGH,RFPT`, see `LAYout:ADD[:WINDow]?` on page 262)

FM Time Domain

Displays the frequency of the demodulated FM signal versus time.



The FM time domain trace is determined as follows:

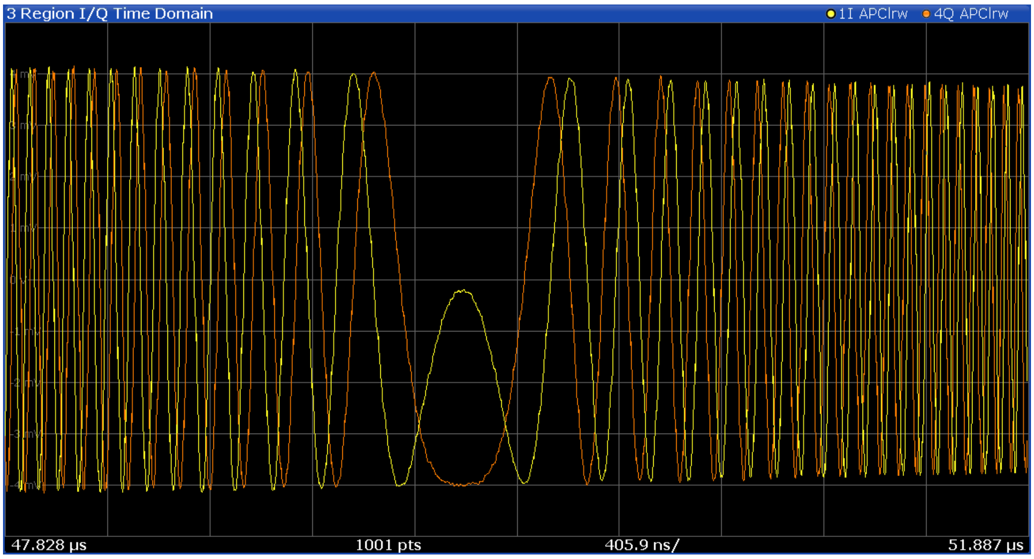


Remote command:

`LAY:ADD? '1',RIGH,FMT`, see `LAYout:ADD[:WINDow]?` on page 262)

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.



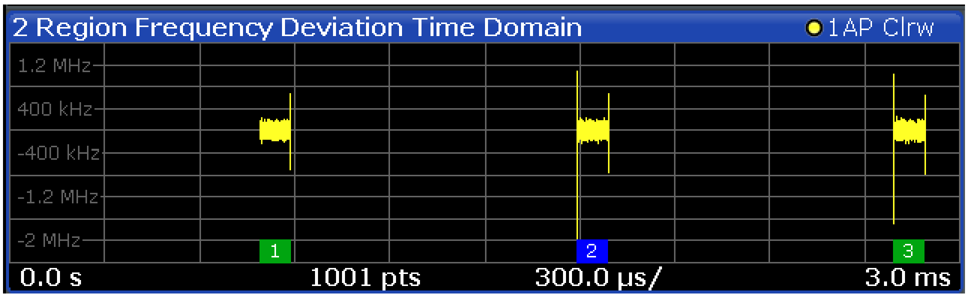
Remote command:

`LAY:ADD:WIND '2',RIGH,IQT` see `LAYout:ADD[:WINDow]?` on page 262

Frequency Deviation Time Domain

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

This display requires additional option FSW-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.

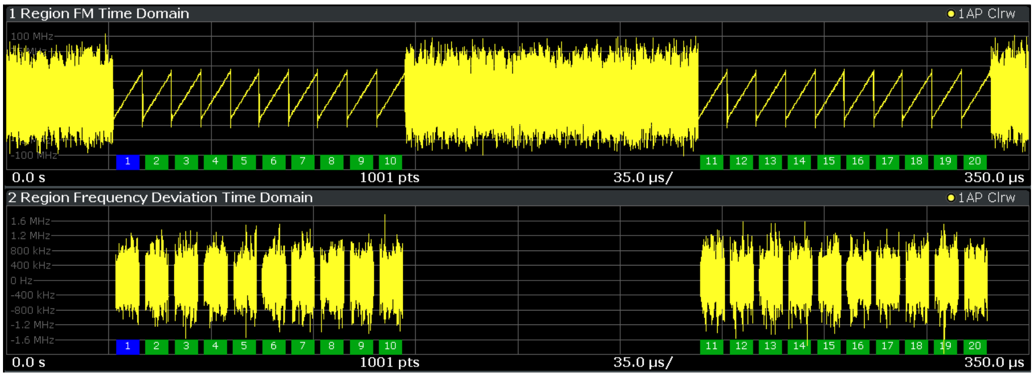


Figure 5-11: Frequency Deviation Time Domain display with gaps where no (complete) chirps are detected

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

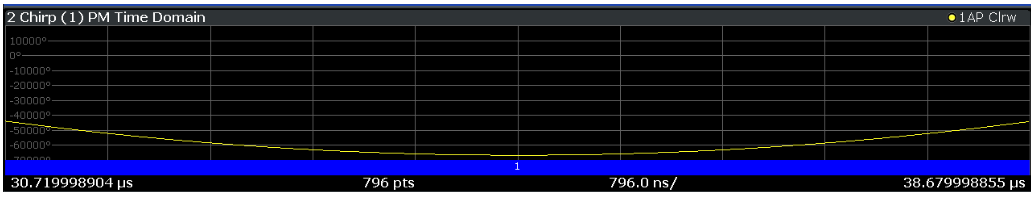
For an individual hop/chirp, *k ∈ Result Range*

Remote command:

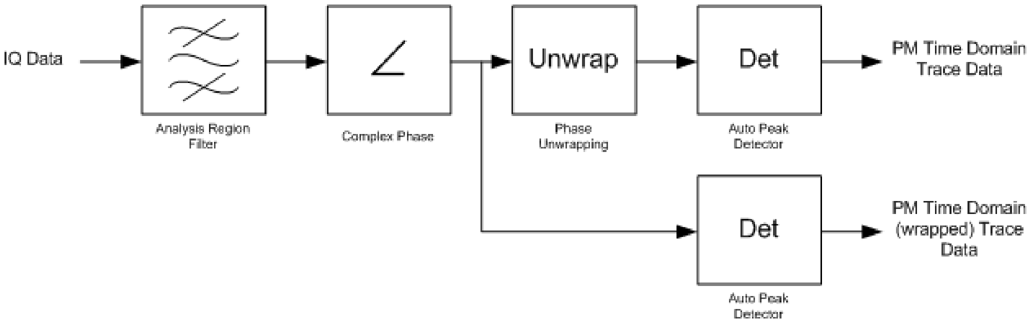
`LAY:ADD? '1',RIGH,FDEV`, see `LAYout:ADD[:WINDow]?` on page 262

PM Time Domain

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

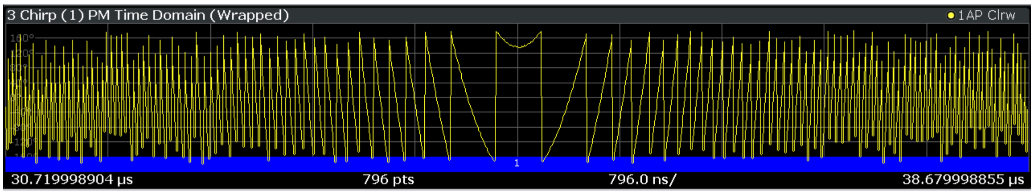


The PM time domain trace is determined as follows:



Remote command:
`LAY:ADD? '1',RIGH,PMT`, see `LAYout:ADD[:WINDow]?` on page 262)

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 262

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

This display requires additional option FSW-K60C/-K60H.

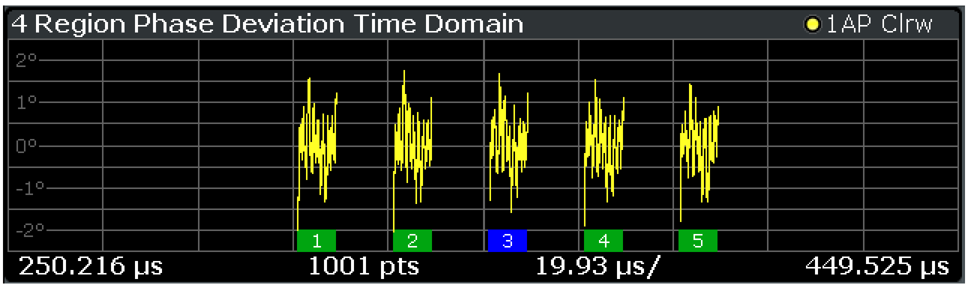


Figure 5-12: Phase deviation per chirp over time

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:

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

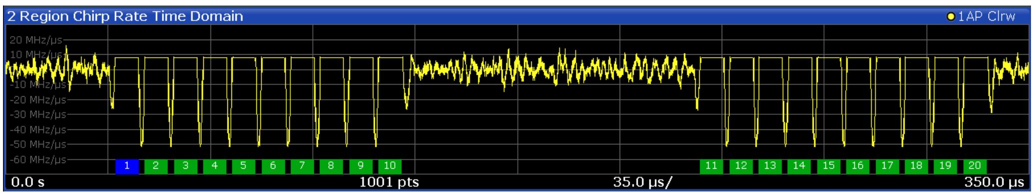
Where:

- $\widehat{df_{avg}}$: 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)

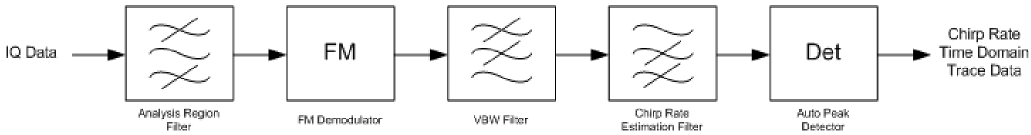
Remote command:
`LAY:ADD? '1',RIGH,PDEV`, see `LAYout:ADD[:WINDow]?` on page 262

Chirp Rate Time Domain

Displays the chirp rate versus time. This display requires additional option FSW-K60C/-K60H.



The chirp rate time domain trace is determined as follows:

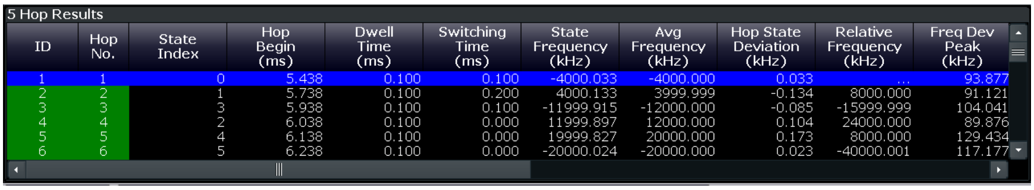


Remote command:
`LAY:ADD? '1',RIGH,CRT`, see `LAYout:ADD[:WINDow]?` on page 262

Hop/Chirp Results Table

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

Which parameters are displayed depends on the "Result Configuration" (see Chapter 7.2.2, "Table configuration", on page 127). 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 47 or Chapter 5.2, "Chirp parameters", on page 57.

Remote command:
`LAY:ADD:WIND '2',RIGH,RTAB` see `LAYout:ADD[:WINDow]?` on page 262
Results:
`CALCulate<n>:CHRDetection:TABLe:TOTal?` on page 421 / `CALCulate<n>:CHRDetection:TOTal?` on page 421
`CALCulate<n>:HOPDetection:TABLe:TOTal?` on page 392 / `CALCulate<n>:HOPDetection:TOTal?` on page 392

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 FSW-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 7.2.2, "Table configuration", on page 127).

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

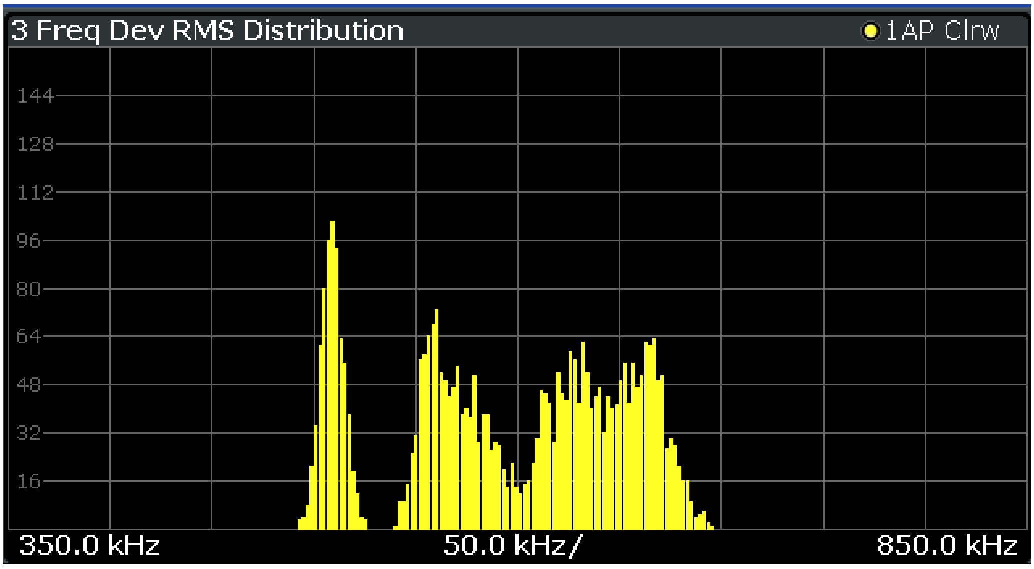
Figure 5-14: Hop Statistics Table

For details on the individual parameters see Chapter 5.1, "Hop parameters", on page 47 or Chapter 5.2, "Chirp parameters", on page 57.

Remote command:
`LAY:ADD:WIND '2',RIGH,STAB` see `LAYout:ADD[:WINDow]?` on page 262

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.



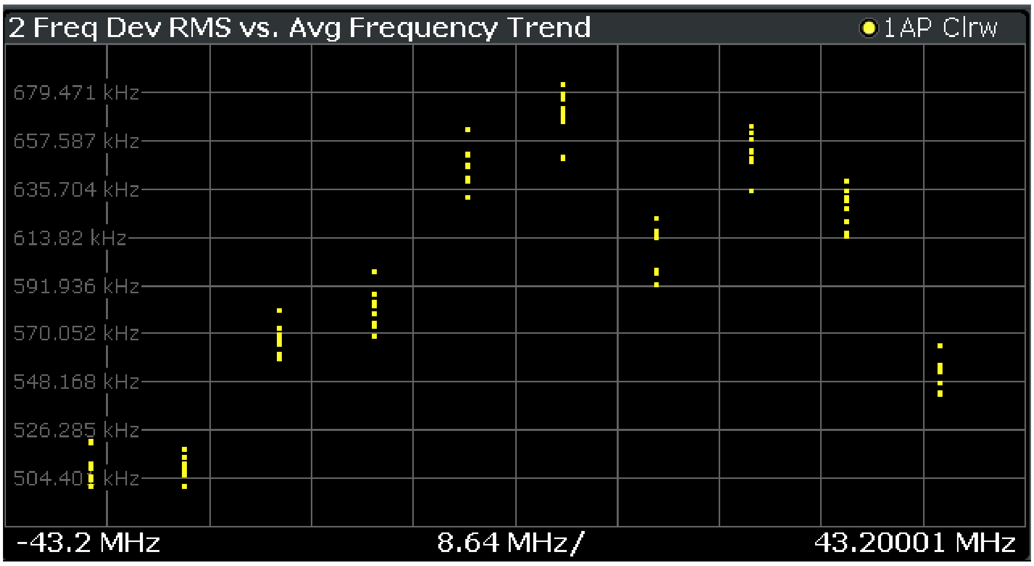
Note that averaging is not possible for parameter distribution traces.

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 262
`CALCulate<n>:DISTribution:X?` on page 303
`CALCulate<n>:DISTribution:Y?` on page 303
Chapter 11.6.6, "Configuring parameter distribution displays", on page 293

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 262

`CALCulate<n>:TRENd:X?` on page 304

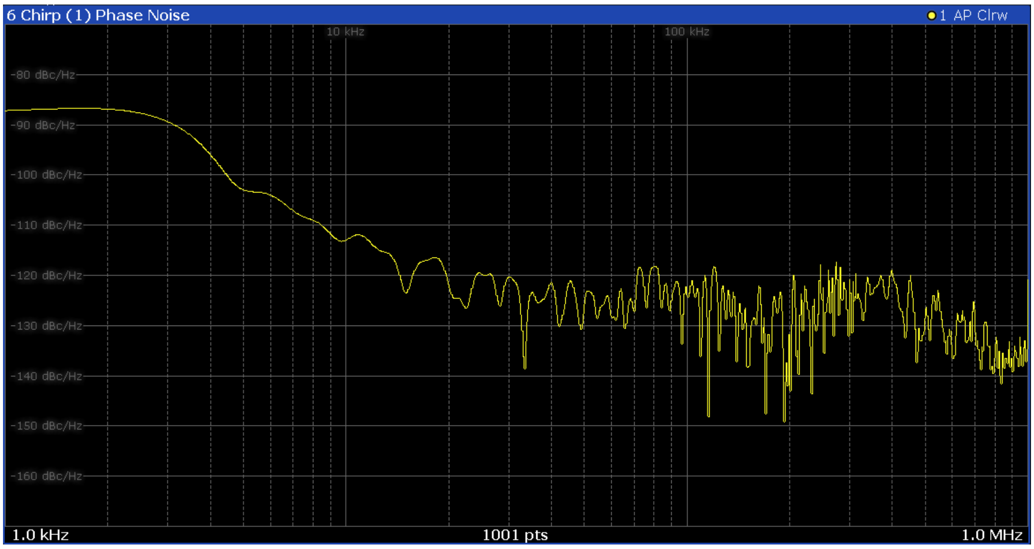
`CALCulate<n>:TRENd:Y?` on page 304

Chapter 11.6.7, "Configuring parameter trends", on page 303

Phase Noise

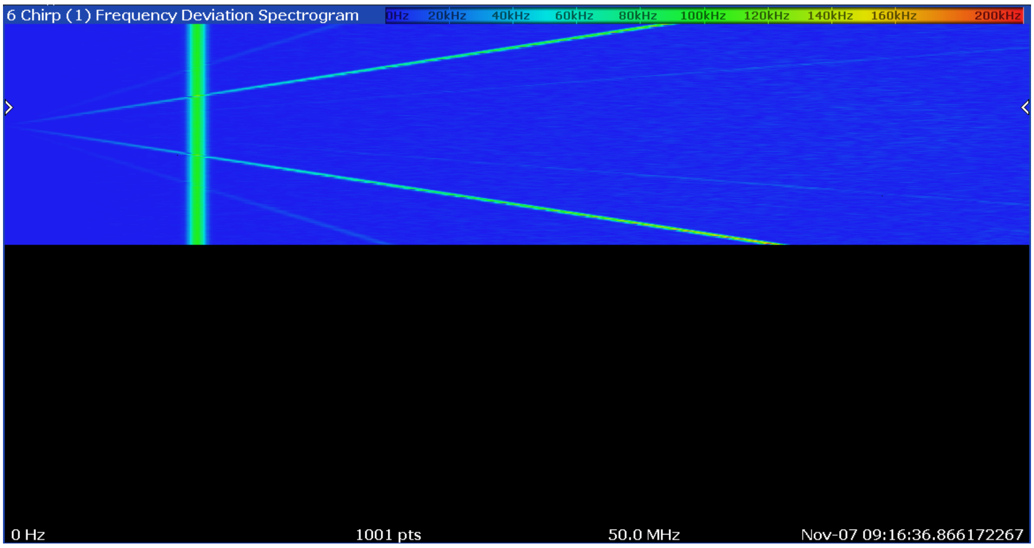
The phase noise diagram shows the power level of the phase noise over a variable frequency offset from the carrier frequency. It is only available with option FSW-K60P installed.

The unreliable region of the phase noise trace is indicated by a shaded area on the left-hand side of the result display. The shaded area symbolises 10 % of the half decade of the lower the offset frequency (e.g. the resolution bandwidth equals 100 kHz for offset frequencies from 1 Mhz to 3 Mhz). The shaded are canot be switched off and the colour cannot be changed.



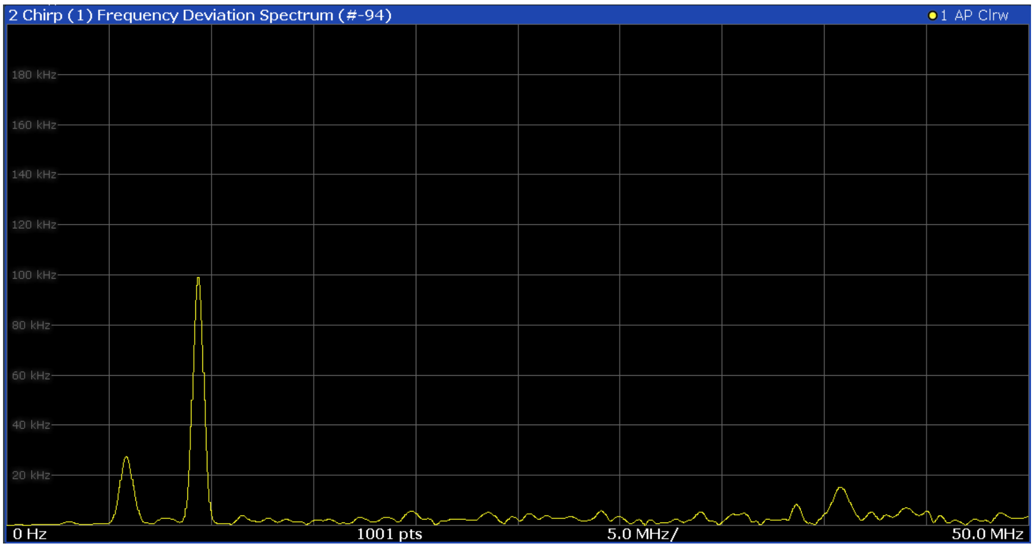
Remote command:
`LAY:ADD:WIND '2',RIGH,PNO` see `LAYout:ADD[:WINDow]?` on page 262
Shaded area: not supported

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



Remote command:
`LAY:ADD:WIND '2',RIGH,FDSG` see `LAYout:ADD[:WINDow]?` on page 262

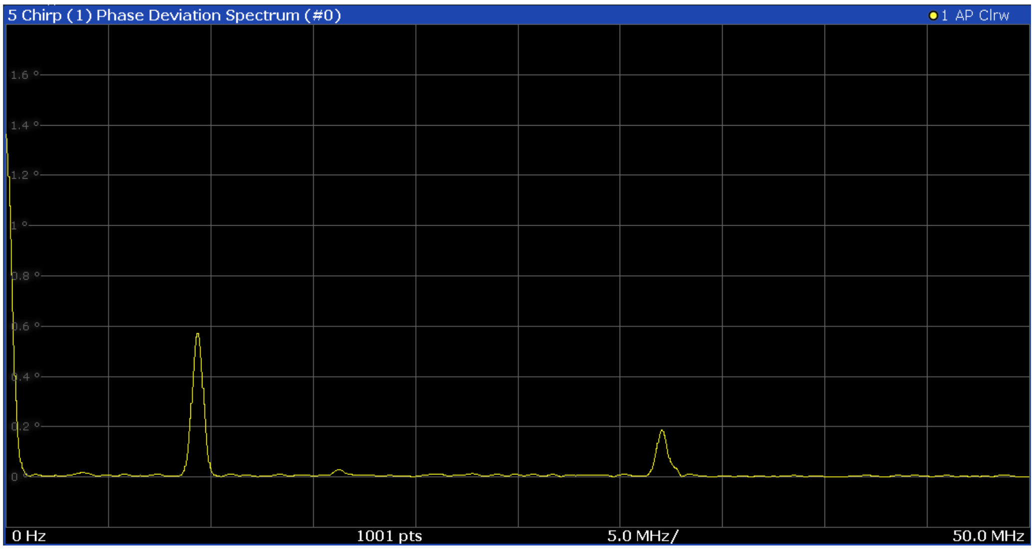
Frequency Deviation Spectrum
Shows a spectrum view of the frequency deviation. It is only available with option FSW-K60P installed.



Remote command:
`LAY:ADD:WIND '2',RIGH,FDSP` see `LAYout:ADD[:WINDow]?` on page 262

Phase Deviation Spectrum

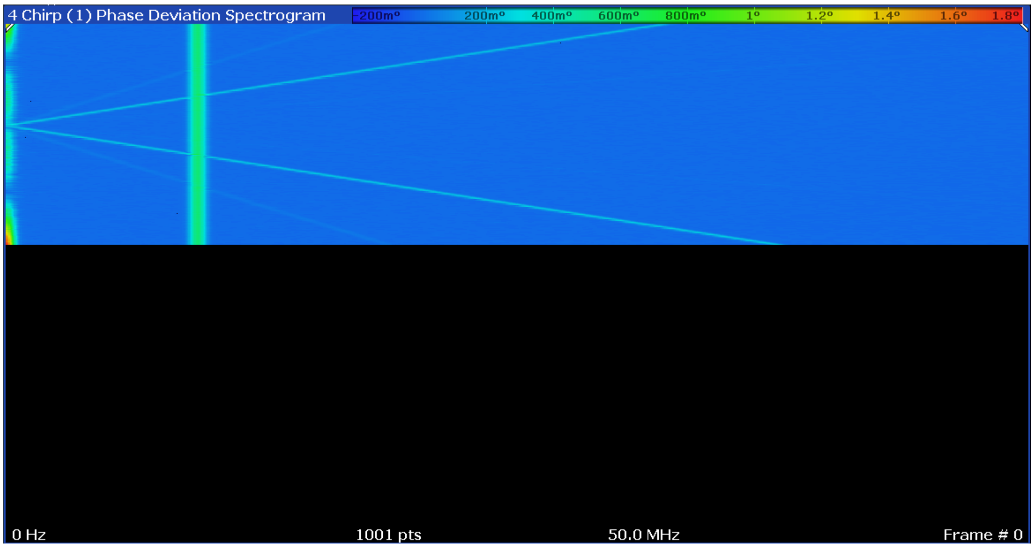
Shows a spectrum view of the phase deviation. It is only available with option FSW-K60P installed.



Remote command:
`LAY:ADD:WIND '2',RIGH,PDSG` see `LAYout:ADD[:WINDow]?` on page 262

Phase Deviation Spectrogram

Shows a spectrogram view of the phase deviation. It is only available with option FSW-K60P installed.



Remote command:
`LAY:ADD:WIND '2',RIGH,PDSP` see `LAYout:ADD[:WINDow]?` on page 262

Marker Table

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

This table is displayed automatically if configured accordingly.

1 Marker Table

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

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

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 262
Results:
`CALCulate<n>:MARKer<m>:X` on page 358
`CALCulate<n>:MARKer<m>:Y?` on page 359

6 Configuration

Access: [MODE] > "Transient Analysis"

Transient Analysis requires a special application on the FSW.

When you switch a measurement channel to the Transient Analysis application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

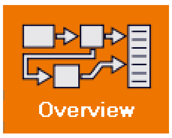
When you activate a measurement channel in the Transient Analysis application, a Transient measurement for the input signal is started automatically with the default configuration. The "Meas Config" menu is displayed and provides access to the most important configuration functions.

Automatic refresh of preview and visualization in dialog boxes after configuration changes

The FSW supports you in finding the correct measurement settings quickly and easily - after each change in settings in dialog boxes, the preview and visualization areas are updated immediately and automatically to reflect the changes. Thus, you can see if the setting is appropriate or not before closing the dialog.

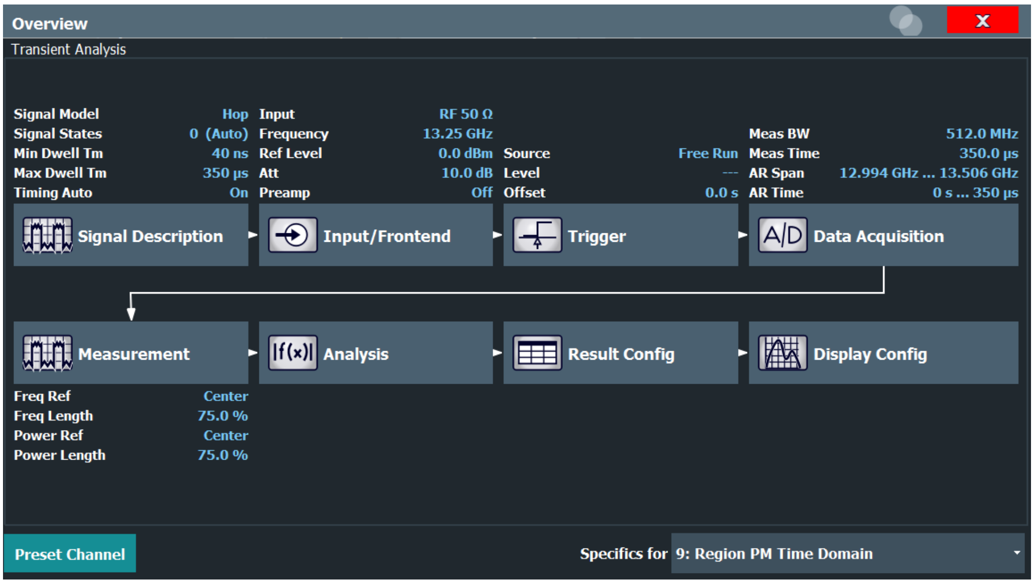
- Configuration overview....83
- Signal description....85
- Input and frontend settings....91
- Trigger settings....106
- Data acquisition and analysis region....112
- Bandwidth settings....115
- Hop / chirp measurement settings....116
- Sweep settings....122
- Adjusting settings automatically....124

6.1 Configuration overview



Access: all menus

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 85.
2. Input and frontend settings
   See Chapter 6.3, "Input and frontend settings", on page 91
3. Triggering
   See Chapter 6.4, "Trigger settings", on page 106
4. Data acquisition
   See Chapter 6.5, "Data acquisition and analysis region", on page 112
5. Measurement settings
   See Chapter 6.7, "Hop / chirp measurement settings", on page 116
6. Analysis
   See Chapter 7, "Analysis", on page 125
7. Result configuration
   See Chapter 7.2, "Result configuration", on page 125
8. Display configuration
   See Chapter 7.1, "Display configuration", on page 125

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 160.

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 189

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

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

6.2 Signal description

Access: "Overview" > "Signal Description"

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

- Signal model.. 85
- Signal states..86
- Timing.. 90

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 FSW-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 FSW-K60C/-K60H are installed.

For more information see Chapter 4.4, "Signal models", on page 22.

"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 224

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 FSW-K60C/-K60H are installed.

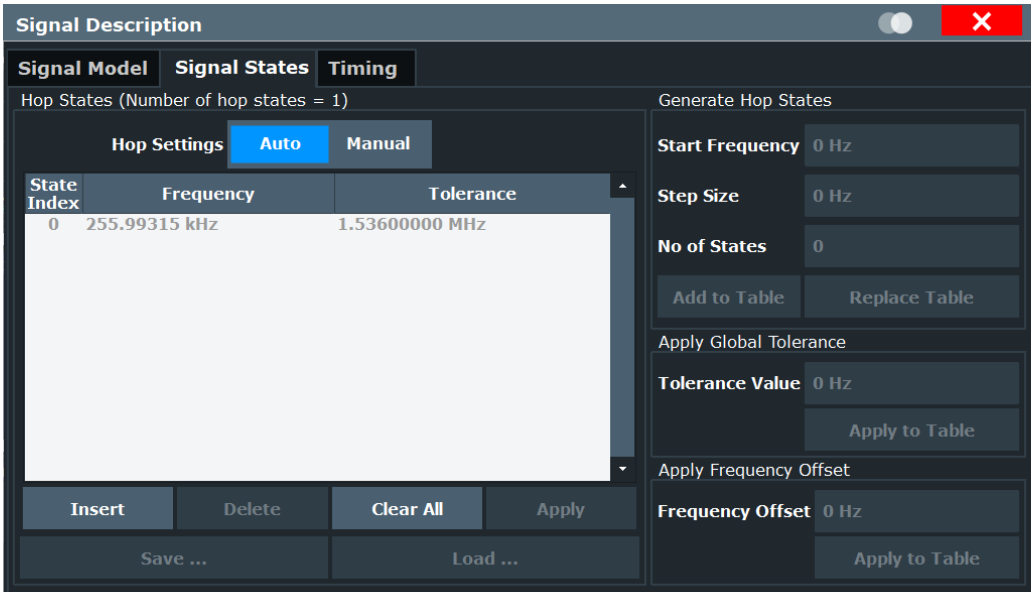


Figure 6-1: Hop States configuration dialog with additional settings

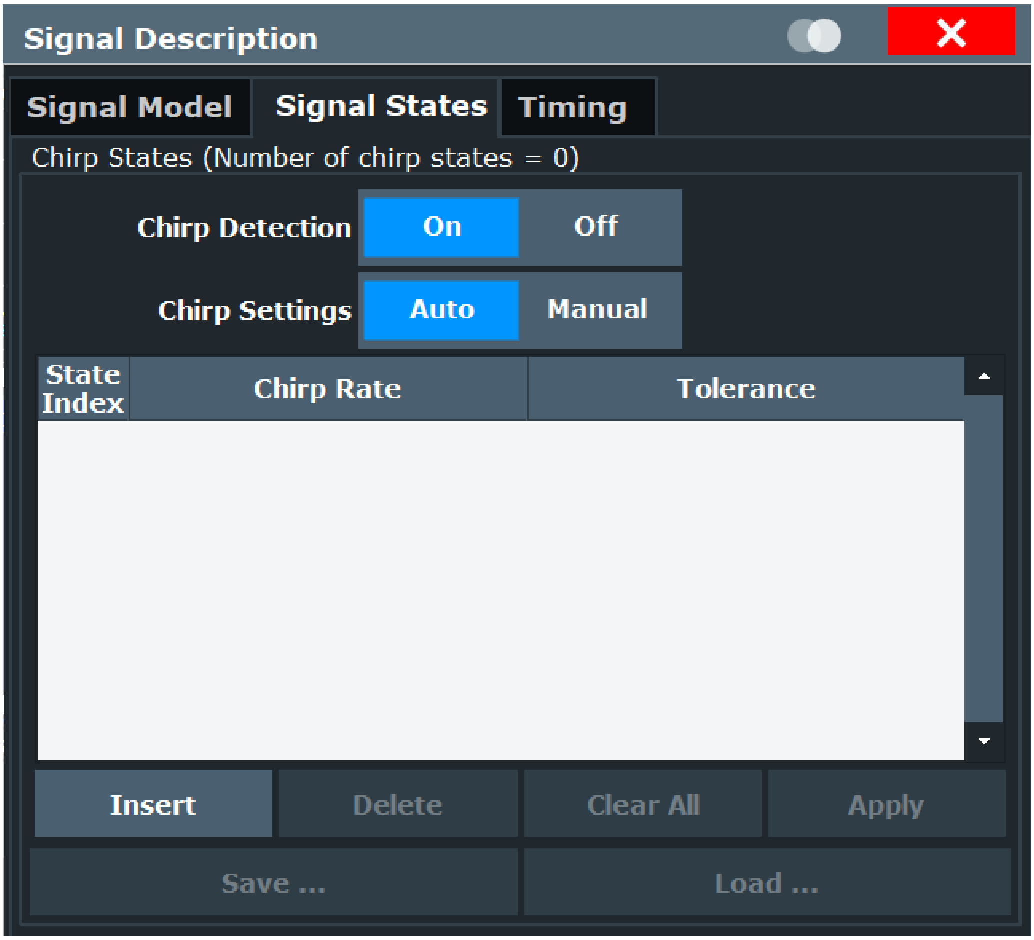


Figure 6-2: Chirp States configuration dialog

For details on the individual parameters see Chapter 4.4.1, "Frequency hopping", on page 22.

Hop / Chirp Settings....88
Chirp Detection....88
Hop / Chirp State Index....88
Frequency Offset / Chirp Rate....88
Tolerance....89
Inserting a signal state....89
Deleting a signal state....89
Clearing the signal state table....89
Applying changes to the signal state table....89
Saving the signal state table to a file....89
Loading a signal state table from a file....89
Generating a series of hop states....89
└ Start Frequency....89
└ Step Size....90
└ No of States....90
└ Add to Table....90

└ Replace Table..90
└ Applying a global tolerance value..90
└ Applying a global frequency offset...90

Hop / Chirp Settings

By default, the FSW 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 4.4.3, "Automatic vs. manual hop/chirp state detection", on page 25.

Remote command:
`CALCulate<n>:CHRDetection:STATes:AUTO` on page 226
`CALCulate<n>:HOPDetection:STATes:AUTO` on page 230

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 228

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 231
`CALCulate<n>:CHRDetection:STATes:NUMBer?` on page 228
`CALCulate<n>:HOPDetection:STATes:TABLe:NSTates?` on page 232

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 227
CALCulate<n>:HOPDetection:STATes[:DATA] on page 230

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 227
CALCulate<n>:HOPDetection:STATes[:DATA] on page 230

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 233
CALCulate<n>:CHRDetection:STATes:TABLe:SAVE on page 228

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 233
CALCulate<n>:CHRDetection:STATes:TABLe:SAVE on page 228

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 231
CALCulate<n>:CHRDetection:STATes:TABLe:LOAD on page 228

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 233

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

Remote command:
CALCulate<n>:HOPDetection:STATes:TABLe:STEP? on page 233

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 232

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 231

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 232

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 233

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 232

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......91
Min Dwell Time / Max Dwell Time......91

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 225

`CALCulate<n>:HOPDetection:DWELl:AUTO` on page 229

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 226

`CALCulate<n>:CHRDetection:LENGth:MINimum` on page 226

`CALCulate<n>:HOPDetection:DWELl:MAXimum` on page 229

`CALCulate<n>:HOPDetection:DWELl:MINimum` on page 230

6.3 Input and frontend settings

Access: "Overview" > "Input/Frontend"

The FSW 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.

ⓘ The output settings are identical to the base unit and are described in the FSW User Manual.

- Input source settings......91
- Output settings......96
- Digital I/Q 40G output settings......100
- Frequency settings......102
- Amplitude settings......103

6.3.1 Input source settings

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

Some settings are also available in the "Amplitude" tab of the "Amplitude" dialog box.

Input from other sources

The R&S FSW Transient Analysis application application can also process input from the following optional sources:

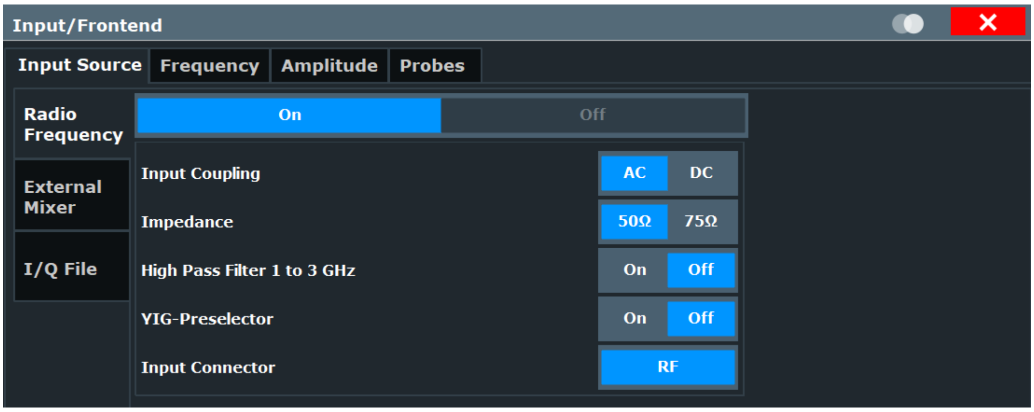
- I/Q Input files
- External mixer
- Baseband oscilloscope input (FSW-B2071)
- 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000)
- Active modular probes

- Radio frequency input....................92
- Settings for input from I/Q data files....................95

6.3.1.1 Radio frequency input

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

The default input source for the FSW is the radio frequency. If no additional options are installed, this is the only available input source.



RF Input Protection

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

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

Radio Frequency State....................93
Input Coupling....................93
Impedance....................94
Direct Path....................94
High Pass Filter 1 to 3 GHz....................94
YIG-Preselector....................94

Radio Frequency State

Activates input from the "RF Input" connector.

For FSW85 models with two input connectors, you must define which input source is used for each measurement channel.

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

"Input 2" 1.85 mm RF input connector for frequencies up to 67 GHz

Remote command:
`INPut:SELect` on page 193
`INPut:TYPE` on page 193

Input Coupling

The RF input of the FSW can be coupled by alternating current (AC) or direct current (DC).

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

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

Remote command:
`INPut:COUPling` on page 191

Impedance
For some measurements, the reference impedance for the measured levels of the FSW 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:IMPedance` on page 193

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:DPATh` on page 192

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.

This function requires an additional 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.)

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 192

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the FSW.

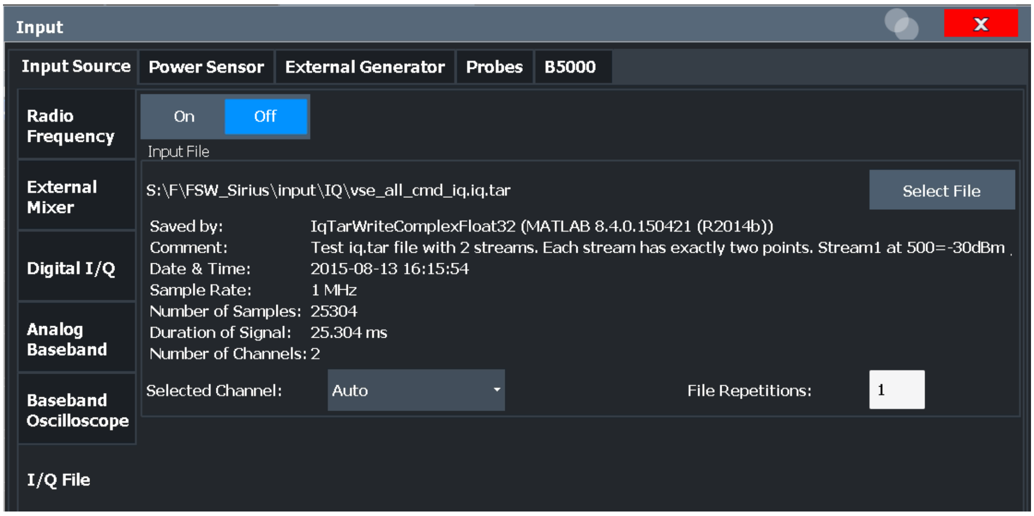
An internal YIG-preselector at the input of the FSW ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the FSW, which can lead to image-frequency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

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 192

6.3.1.2 Settings for input from I/Q data files

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

Or: [INPUT/OUTPUT] > "Input Source Config" > "Input Source" > "I/Q File"



I/Q Input File State..95
Select I/Q data file...95
File Repetitions...96

I/Q Input File State
Enables input from the selected I/Q input file.

If enabled, the application performs measurements on the data from this file. Thus, most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased to perform measurements on an extract of the available data only.

Note: Even when the file input is disabled, the input file remains selected and can be enabled again quickly by changing the state.

Remote command:
`INPut:SELect` on page 193

Select I/Q data file
Opens a file selection dialog box to select an input file that contains I/Q data.

The I/Q data file must be in one of the following supported formats:
- `.iq.tar`

- .iqw
- .csv
- .mat
- .wv
- .aid

For details on formats, see the FSW I/Q Analyzer and I/Q Input user manual.

The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be .iq.tar. For .mat files, Matlab® v4 is assumed.

Note: Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

Note: For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

The default storage location for I/Q data files is C:\R_S\INSTR\USER.

Remote command:
INPut:FILE:PATH on page 194

File Repetitions
Determines how often the data stream is repeatedly copied in the I/Q data memory to create a longer record. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Remote command:
TRACe:IQ:FILE:REPetition:COUNt on page 196

6.3.2 Output settings

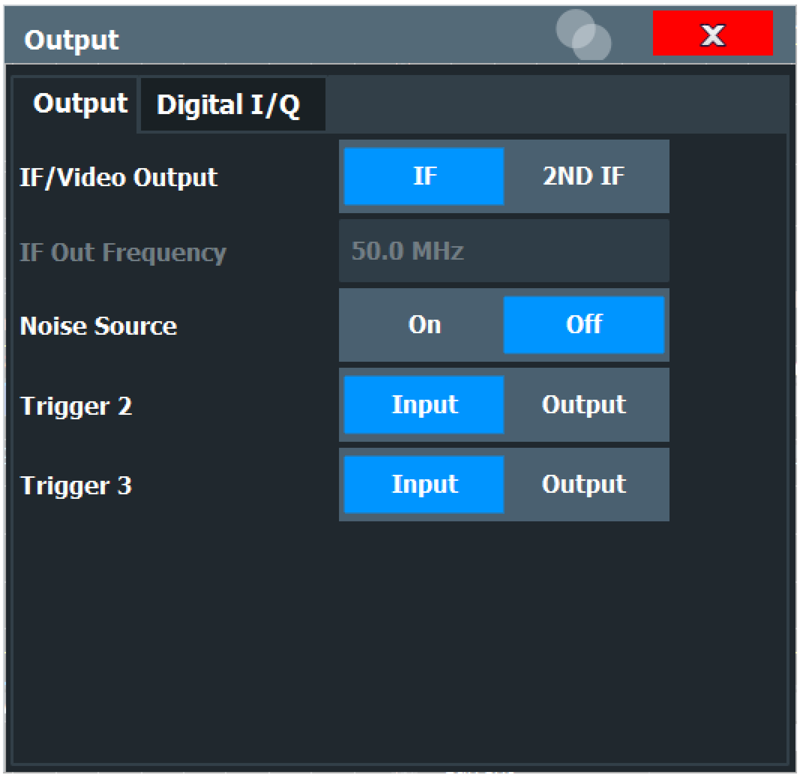
Access: "Overview" > "Input/Frontend" > "Output"

or: [INPUT/OUTPUT] > "OUTPUT Config"

The R&S FSW Transient Analysis application can provide output to special connectors for other devices.

For details on connectors, refer to the FSW Getting Started manual, "Front / Rear Panel View" chapters.

Output settings can be configured via the [Input/Output] key or in the "Outputs" dialog box.



Data Output..97
Noise Source Control..98
Trigger 2/3..98
└ Output Type..99
└ Level..99
└ Pulse Length..99
└ Send Trigger..100

Data Output

Defines the type of signal available at one of the output connectors of the FSW.

For restrictions and additional information, see the FSW I/Q Analyzer and I/Q Input User Manual.

"IF" The measured IF value is provided at the IF/VIDEO/DEMOD output connector.
For bandwidths up to 80 MHZ, the IF output is provided at the specified "IF Out Frequency".
If an optional bandwidth extension FSW-B160/-B320/-B512 is used, the measured IF value is available at the "IF WIDE OUTPUT" connector. The frequency at which this value is output is determined automatically. It is displayed as the "IF Wide Out Frequency". For details on the used frequencies, see the specifications document.
This setting is not available for bandwidths larger than 512 MHz.

"2ND IF" The measured IF value is provided at the "IF OUT 2 GHz/ IF OUT 5 GHz" output connector, if available, at a frequency of 2 GHz and with a bandwidth of 2 GHz. The availability of this connector depends on the instrument model.
This setting is not available if the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000) is active.

Remote command:
`OUTPut:IF[:SOURce]` on page 202
`OUTPut:IF:IFFRequency` on page 202

Noise Source Control

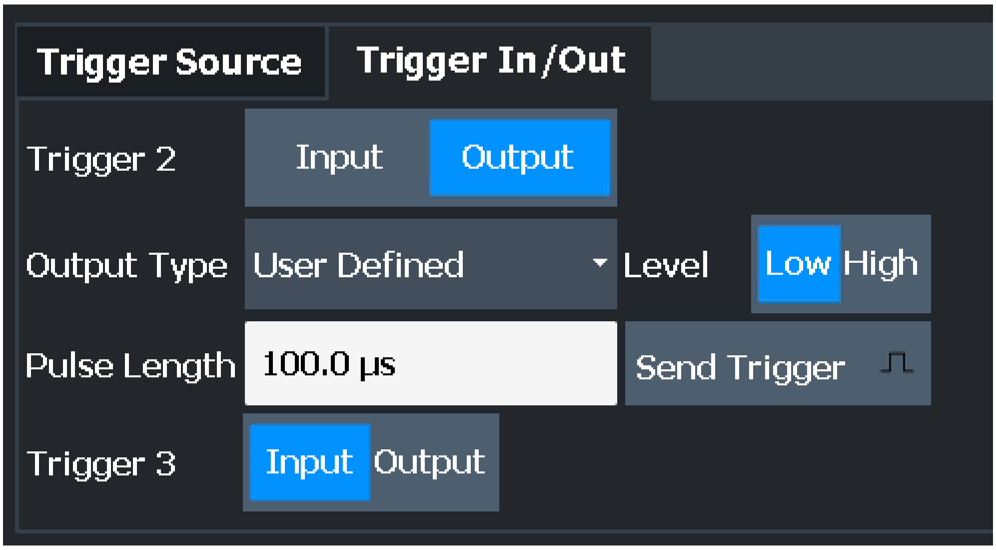
Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the FSW itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the FSW and measure the total noise power. From this value, you can determine the noise power of the FSW. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 202

Trigger 2/3



The trigger input and output functionality depends on how the variable "Trigger Input/ Output" connectors are used.

Note: Providing trigger signals as output is described in detail in the FSW base unit user manual.

"Trigger 1"	"Trigger 1" is input only.
"Trigger 2"	Defines the usage of the variable "Trigger Input/Output" connector on the front panel (not available for FSW85 models with 2 RF input connectors)
"Trigger 3"	Defines the usage of the variable "Trigger 3 Input/Output" connector on the rear panel
"Input"	The signal at the connector is used as an external trigger source by the FSW. Trigger input parameters are available in the "Trigger" dialog box.
"Output"	The FSW sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<tp>:DIRection` on page 219

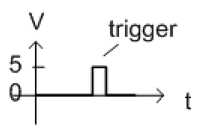
Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered"	(Default) Sends a trigger when the FSW triggers.
"Trigger Armed"	Sends a (high level) trigger when the FSW is in "Ready for trigger" state. This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).
"User Defined"	Sends a trigger when you select "Send Trigger". In this case, further parameters are available for the output signal.

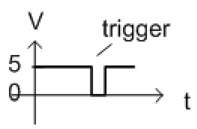
Remote command:
`OUTPut:TRIGger<tp>:OTYPe` on page 220

Level ← Output Type ← Trigger 2/3
Defines whether a high (1) or low (0) constant signal is sent to the trigger output connector (for "Output Type": "User Defined".

The trigger pulse level is always opposite to the constant signal level defined here. For example, for "Level" = "High", a constant high signal is output to the connector until you select the Send Trigger function. Then, a low pulse is provided.



low-level constant, high-level trigger



high-level constant, low-level trigger

Remote command:
`OUTPut:TRIGger<tp>:LEVel` on page 219

Pulse Length ← Output Type ← Trigger 2/3
Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:
`OUTPut:TRIGger<tp>:PULSe:LENGth` on page 220

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately.

Note that the trigger pulse level is always opposite to the constant signal level defined by the output Level setting. For example, for "Level" = "High", a constant high signal is output to the connector until you select the "Send Trigger" function. Then, a low pulse is sent.

Which pulse level is sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<tp>:PULSe:IMMediate` on page 220

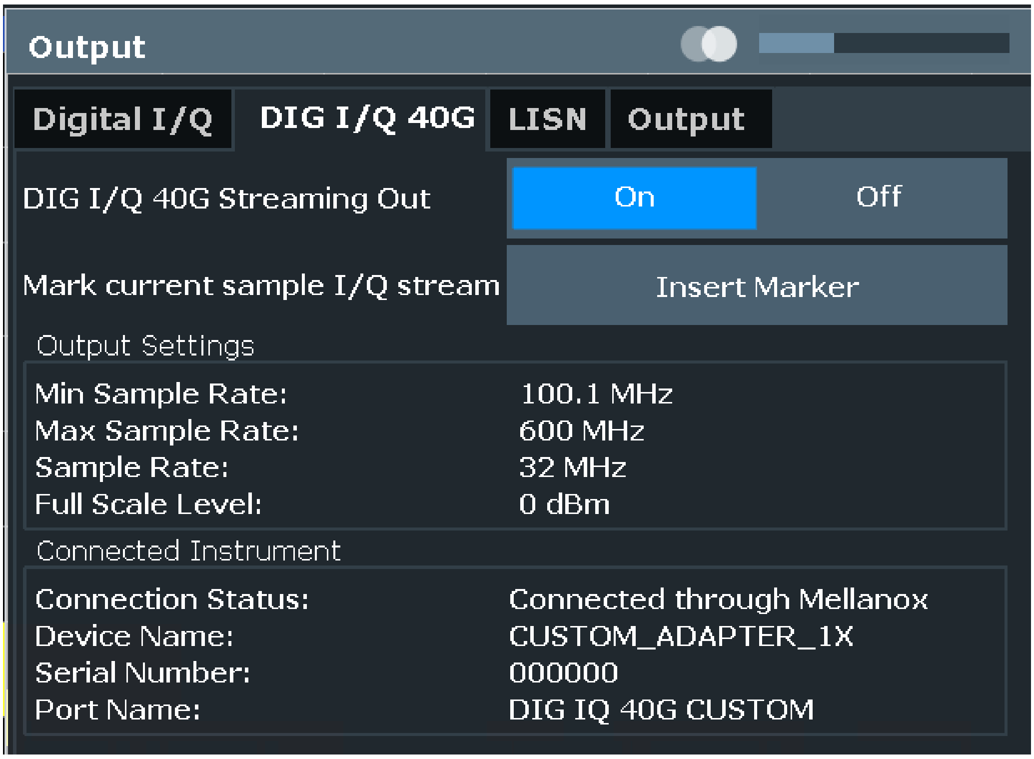
6.3.3 Digital I/Q 40G output settings

Access: "Overview" > "Output" > "Digital I/Q 40G" tab

The optional Digital I/Q 40G Streaming Output interface (FSW-B517/-B1017) allows you to output I/Q data to an external device at very high sample rates.

These settings are only available if one of the Digital I/Q 40G Streaming Output options is installed on the FSW.

For details see the FSW I/Q Analyzer and I/Q Input User Manual.



Digital I/Q 40G Streaming Out ... 101
Insert Marker ... 101
Output Settings Information ... 101
Connected Instrument ... 101

Digital I/Q 40G Streaming Out
Enables or disables a digital output stream to the optional Digital I/Q 40G Streaming Output connector, if available.

Remote command:
OUTPut:IQHS[:STATe] on page 204

Insert Marker
Inserts marker information to the data stream during a running I/Q data output recording. Useful to mark a specific event during the measurement that you detect in the result window, for example. Then you can search for the marker information in the output data to analyze the effects at that time.

Tip: The "I/Q 40G Recording" window also provides an "Insert Marker" button that remains visible throughout the measurement, without having to open a dialog box. Thus, you can insert a marker at any time during the measurement.

For more information, see the FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:
OUTPut:IQHS:MARKer on page 203

Output Settings Information
Displays information on the settings for output via the Digital I/Q 40G Streaming Output option (FSW-B517/-B1017).

The following information is displayed:

- Minimum sample rate that can be used to transfer data via the Digital I/Q 40G Streaming Output interface
- Maximum sample rate that can be used to transfer data via the Digital I/Q 40G Streaming Output interface (i.e. the maximum input sample rate that can be processed by the connected instrument)
- Sample rate currently used to transfer data via the Digital I/Q 40G Streaming Output interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full scale level)

Remote command:
OUTPut:IQHS:SRATe? on page 204

Connected Instrument
Displays information on the instrument connected to the Digital I/Q 40G Streaming Output connector, if available.

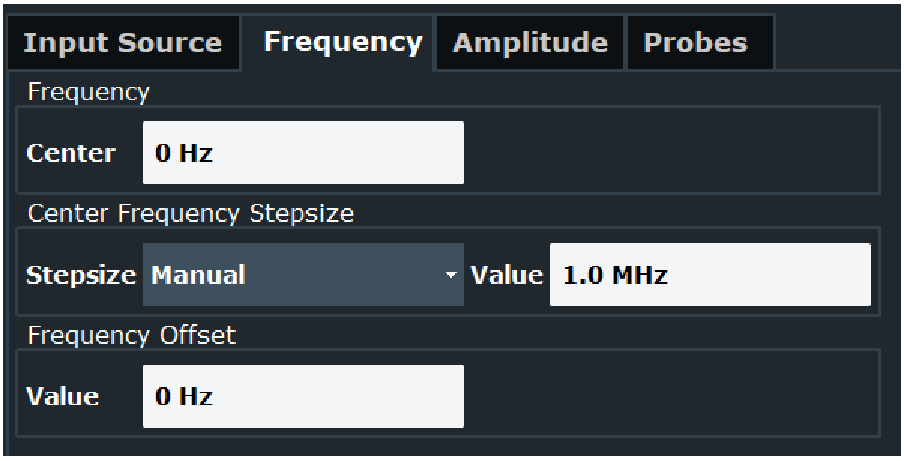
If an instrument is connected, the following information is displayed:

- Name and serial number of the instrument connected to the QSFP+ connector
- Used port

Remote command:
OUTPut:IQHS:CDEVice? on page 203

6.3.4 Frequency settings

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



Center Frequency..102
Center Frequency Stepsize..102
Frequency Offset..102

Center Frequency
Defines the center frequency of the signal in Hertz.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 204

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

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

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

"= 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 205

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.

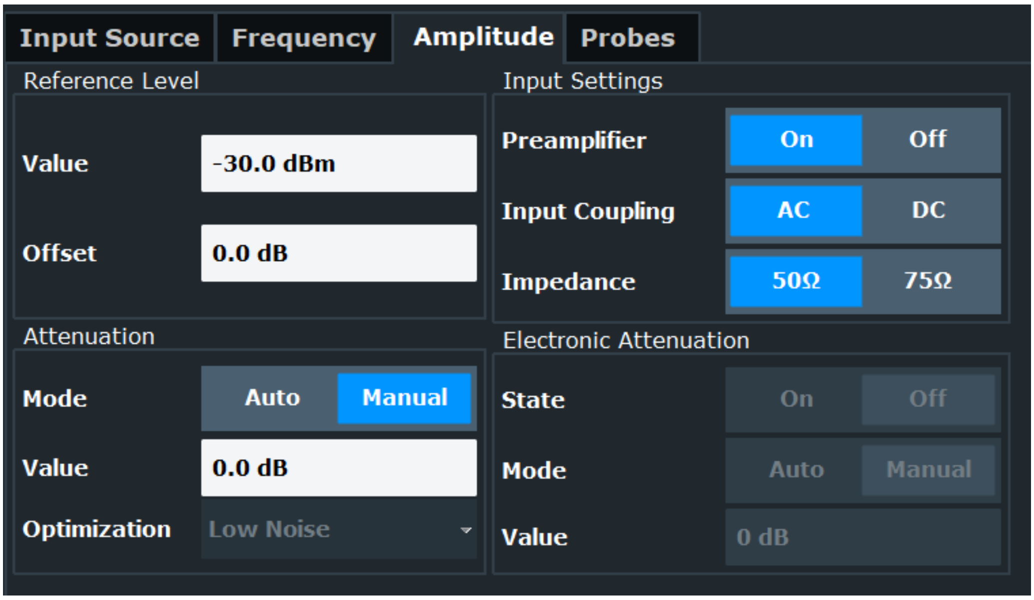
Note: In MSRA/MSRT mode, this function is only available for the MSRA/MSRT primary.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 205

6.3.5 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 104
└ Shifting the Display (Offset) 104
RF Attenuation 104
└ Attenuation Mode / Value 104
Using Electronic Attenuation 105
Input Settings 105
└ Preamplifier 105
└ Impedance 106

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 210

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 FSW 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 FSW must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 210

RF Attenuation
Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation
Defines the attenuation applied to the RF input of the FSW.

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.

By default and when no (optional) electronic attenuation is available, mechanical attenuation is applied.

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 specifications document. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed.

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

Remote command:
INPut:ATTenuation on page 211
INPut:ATTenuation:AUTO on page 211

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

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) above 15 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation can provide a better signal-to-noise ratio, however.

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

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

For the FSW85, the mechanical attenuation can be varied only in 10 dB steps.

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 213
INPut:EATT:AUTO on page 213
INPut:EATT on page 213

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 92.

Preamplifier ← Input Settings
If the (optional) internal preamplifier hardware is installed on the FSW, 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.

For all FSW models except for FSW85, the following settings are available:

"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.

For older FSW43/FSW50/FSW67 models, the input signal is always ampilfied by about 30 dB when the preamplifier is active.

For FSW85 models, no preamplifier is available.

Remote command:
`INPut:GAIN:STATe` on page 212
`INPut:GAIN[:VALue]` on page 212

Impedance ← Input Settings
For some measurements, the reference impedance for the measured levels of the FSW 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).

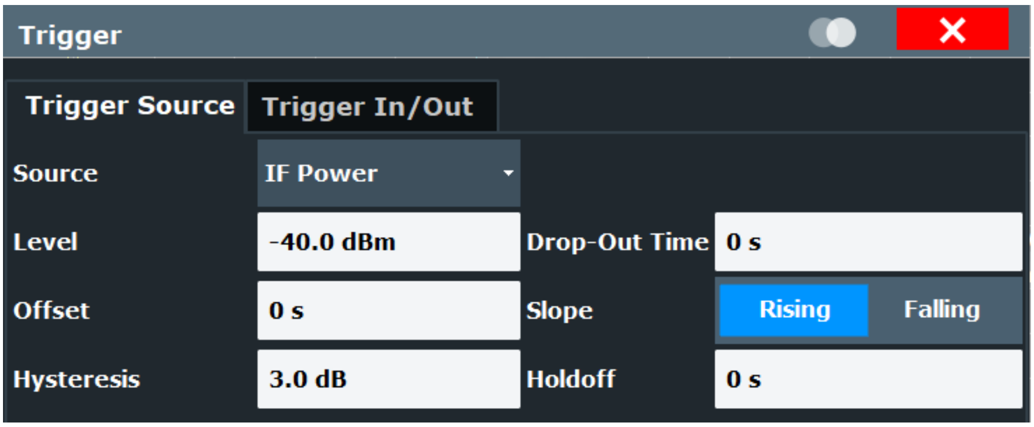
Remote command:
`INPut:IMPedance` on page 193

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 FSW are configured in a separate tab of the dialog box.

For details see the FSW User Manual.

For step-by-step instructions on configuring triggered measurements, see the FSW User Manual.

MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. Thus, no trigger settings are available in the Transient Analysis application in MSRA/MSRT operating mode. However, a **capture offset** can be defined with a similar effect as a trigger offset. It defines an offset from the start of the captured data (from the MSRA/MSRT primary) to the start of the application data for transient analysis. (See Capture Offset.)

For details on the MSRA operating mode see the FSW MSRA User Manual.

For details on the MSRT operating mode see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Trigger Settings....................107
└ Trigger Source....................107
└ Free Run....................107
└ External Trigger 1/2/3....................108
└ External Channel 3....................108
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└ IF Power....................109
└ I/Q Power....................109
└ RF Power....................109
└ Trigger Level....................110
└ Drop-Out Time....................110
└ Coupling....................110
└ Trigger Offset....................110
└ Slope....................111
└ Hysteresis....................111
└ Trigger Holdoff....................111
Capture Offset....................111

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 217

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 217

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

(See "Trigger Level" on page 110).

Note: "External Trigger 1" automatically selects the trigger signal from the "TRIGGER 1 INPUT" connector on the front panel.
If the optional 2 GHz/ 5 GHz bandwidth extension (B2000/B5000) is active, only External Channel 3 is supported.

If the optional 2 GHz/ 5 GHz bandwidth extension (B2000/B5000) *and the power splitter mode* is active, only "External Analog" on page 108 is supported.

If the optional Oscilloscope Baseband Input is active, only "External Analog" on page 108 is supported.

For details, see the "Instrument Tour" chapter in the FSW 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.
For FSW85 models, "Trigger 2" is not available due to the second RF input connector on the front panel.

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

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 217

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 FSW 2.30, the *"Ch3"* input on the oscilloscope must be used!

This trigger source is only available if the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000) is active (see FSW I/Q Analyzer and I/Q Input User Manual).

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 specifications document and documentation.

Remote command:
`TRIG:SOUR EXT`
See `TRIGger[:SEQuence]:SOURce` on page 217

External Analog ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the EXT TRIGGER INPUT connector on the oscilloscope meets or exceeds the specified trigger level.

For details, see the FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:
`TRIG:SOUR EXT`
See `TRIGger[:SEQuence]:SOURce` on page 217

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

For frequency sweeps, the third IF represents the start frequency. The trigger threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. A reference level offset, if defined, is also considered. The trigger bandwidth at the intermediate frequency depends on the RBW and sweep type. For details on available trigger levels and trigger bandwidths, see the instrument specifications document.

For measurements on a fixed frequency (e.g. zero span or I/Q measurements), 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/ 5 GHz bandwidth extension (R&S FSW-B2000/B5000) 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, see "Basics on the 2 GHz/ 5 GHz Bandwidth Extension" in the FSW I/Q Analyzer and I/Q Input User Manual.

For details on available trigger levels and trigger bandwidths, see the specifications document.

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 217

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 217

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

For this purpose, the instrument 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 specifications document.

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 217

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 215

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

When using the optional 2 GHz/ 5 GHz bandwidth extension (R&S FSW-B2000/B5000) with an IF power trigger, the drop-out time defines the width of the robust width trigger. By default it is set to 1 µs. For external triggers, no drop-out time is available when using the B2000/B5000 option.

(For details, see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 214

Coupling ← Trigger Settings
If the selected trigger source is "IF Power" or "External Channel 3", you can configure the coupling of the external trigger to the oscilloscope.

This setting is only available if the optional 2 GHz bandwidth extension is active.

"DC 50Ω"	Direct connection with 50 Ω termination, passes both DC and AC components of the trigger signal.
"DC 1 MΩ"	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.

Remote command:
`TRIGger[:SEQuence]:OSCilloscope:COUPling` on page 201

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)

Remote command:
TRIGger[:SEQuence]:HOLDoff[:TIME] on page 214

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/ 5 GHz bandwidth extension (R&S FSW-B2000/B5000) with an IF power trigger, only rising slopes can be detected.

(For details see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
TRIGger[:SEQuence]:SLOPe on page 217

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.

This setting is only available for "IF Power" trigger sources. The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

When using the optional 2 GHz/ 5 GHz bandwidth extension (R&S FSW-B2000/B5000) with an IF power trigger, the hysteresis refers to the robust width trigger.

(For details see the FSW I/Q Analyzer and I/Q Input User Manual.)

Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 215

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 215

Capture Offset
This setting is only available for secondary applications in **MSRA/MSRT operating mode**. It has a similar effect as the trigger offset in other measurements: it defines the time offset between the capture buffer start and the start of the extracted secondary application data.

In MSRA mode, the offset must be a positive value, as the capture buffer starts at the trigger time = 0.

In MSRT mode, the offset can be negative if a pretrigger time is defined.

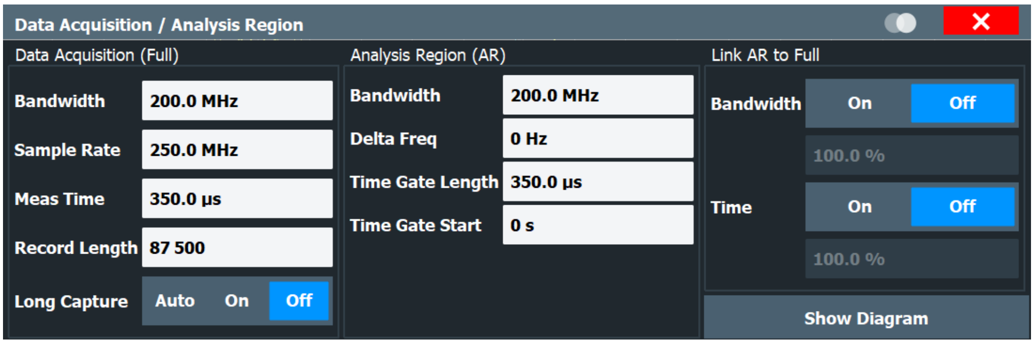
Remote command:
[SENSe:]MSRA:CAPTure:OFFSet on page 383
MSRT mode:
[SENSe:]RTMS:CAPTure:OFFSet on page 385

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.



MSRA/MSRT operating mode

In MSRA/MSRT operating mode, only the MSRA/MSRT primary channel actually captures data from the input signal. The data acquisition settings for Transient Analysis in MSRA/MSRT mode define the **application data extract** and **analysis interval**.

For details on the MSRA operating mode see the FSW MSRA User Manual.

For details on the MSRT operating mode see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Measurement Bandwidth....................112
Sample Rate....................113
Measurement Time....................113
Record Length....................113
Long Capture Buffer....................113
Analysis Region....................114
└ Analysis Bandwidth....................114
└ Delta Frequency....................114
└ Time Gate Length....................114
└ Time Gate Start....................114
└ Linked analysis bandwidth....................115
└ Linked analysis time span....................115
└ Visualizing the Analysis Region Parameters (Show Diagram)....................115

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 bandwidths see the specifications document.

All bandwidth extension options up to 2 GHz/ 5 GHz are supported.

Note: Data acquisition in MSRT mode. By default, the R&S FSW Transient Analysis application uses the largest possible measurement bandwidth. Depending on which bandwidth extension options are installed (if any), this may be up to 2 GHz/ 5 GHz. However, in MSRT mode a maximum of 160 MHz bandwidth is available. Thus, you must ensure the measurement bandwidth for Transient Analysis is available in MSRT mode. Otherwise you will not obtain useful results.

Remote command:
[SENSe:]BWIDth:DEMod on page 221
[SENSe:]FREQuency:SPAN on page 221

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 specifications document.

Remote command:
[SENSe:]SRATe on page 222

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 FSW 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 FSW.

Remote command:
[SENSe:]MTIMe on page 221

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 FSW 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 FSW.

Remote command:
[SENSe:]RLENgth on page 222

Long Capture Buffer
The long capture buffer provides functionality to use the full I/Q memory depth of the FSW for data acquisition.

This feature is only available if an optional B4001, B6001 or B8001 bandwidth extension is installed on the FSW.

The following settings are possible:

- **Off**: This is the default setting. Only the standard I/Q memory capacity of the FSW is used. The available I/Q memory capacity is shared by all measurement channels.

- **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.
- **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 FSW. If the record length decreases again, the long capture buffer is deactivated automatically.

Remote command:
`TRACe:IQ:LCAPture` on page 223

Analysis Region
The analysis region determines which data is displayed on the screen (see also Chapter 4.6, "Analysis region", on page 26).

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 251

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 251

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 252

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 253

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 252
`CALCulate<n>:AR:FREQuency:PERCent:STATe` on page 252

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 253
`CALCulate<n>:AR:TIME:PERCent:STATe` on page 253

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: [BW]/[SPAN]

Some of these settings are also available in the "Data acquisition and analysis region" and Chapter 7.6, "Spectrogram settings", on page 140 dialog box.

RBW... 115
Measurement Bandwidth...115
FM Video Bandwidth.. 116
Measurement Time...116

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

For more information see "Resolution bandwidth" on page 22.

Remote command:
`[SENSe:]BANDwidth[:WINDow<n>]:RESolution` on page 224

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 bandwidths see the specifications document.

All bandwidth extension options up to 2 GHz/ 5 GHz are supported.

Note: Data acquisition in MSRT mode. By default, the R&S FSW Transient Analysis application uses the largest possible measurement bandwidth. Depending on which bandwidth extension options are installed (if any), this may be up to 2 GHz/ 5 GHz.

However, in MSRT mode a maximum of 160 MHz bandwidth is available. Thus, you must ensure the measurement bandwidth for Transient Analysis is available in MSRT mode. Otherwise you will not obtain useful results.

Remote command:
[SENSe:]BWIDth:DEMod on page 221
[SENSe:]FREQuency:SPAN on page 221

FM Video Bandwidth
Or: [BW] > "FM Video Bandwidth"

Access: [MEAS CONFIG] > "Hop Meas / Chirp Meas" > "FM Video Bandwidth"

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

Define a relative (3-dB) filter in percent of the analysis (demodulation) bandwidth. Values from 0.1 to 100 are allowed. The filters are designed as 5th-order Butterworth filters (30 dB/octave) and active for all demodulation bandwidths.

100 % deactivates the FM video bandwidth filter (default).

Remote command:
[SENSe:]DEMod:FMVF:TYPE on page 250

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 FSW 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 FSW.

Remote command:
[SENSe:]MTIMe on page 221

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.

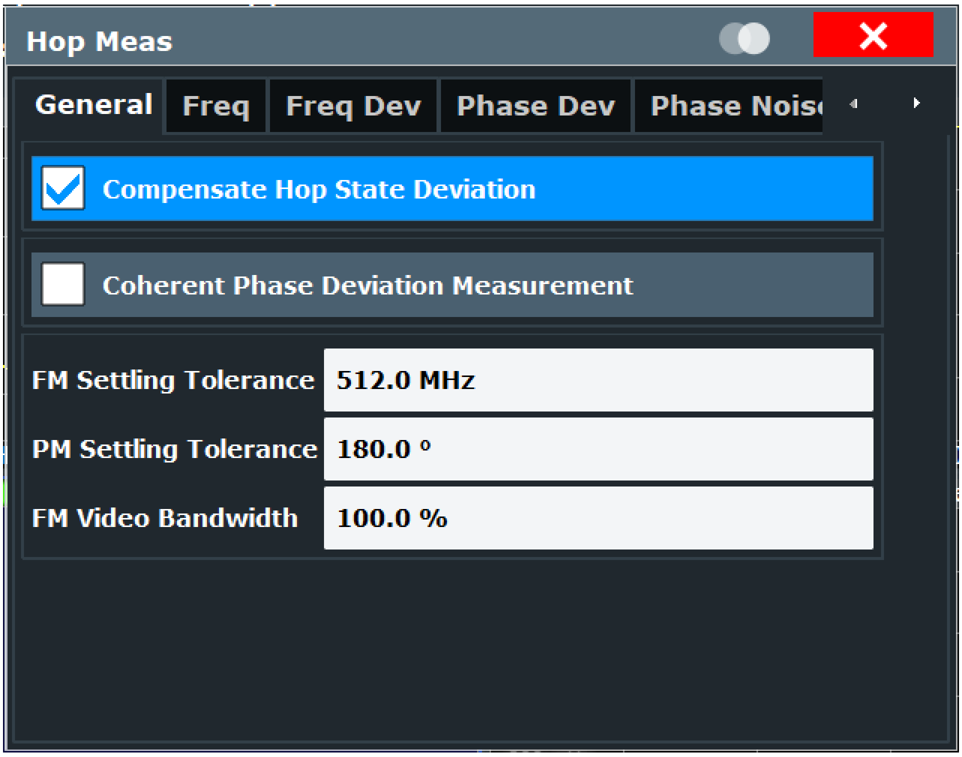
These settings are only available if at least one of the additional options FSW-K60C/-K60H are installed.

- General hop/chirp measurement settings.......117
- Specific measurement settings.......119
- Phase noise measurement settings (FSW-K60P).......121

6.7.1 General hop/chirp measurement settings

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

The following settings are available for all measurements.



Functions that are decribed elsewhere:

- "FM Video Bandwidth" on page 116

Compensate Hop State Deviation/Compensate Chirp Rate Deviation.......117
Coherent Phase Deviation Measurement.......118
FM Settling Tolerance.......118
PM Settling Tolerance.......118

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.

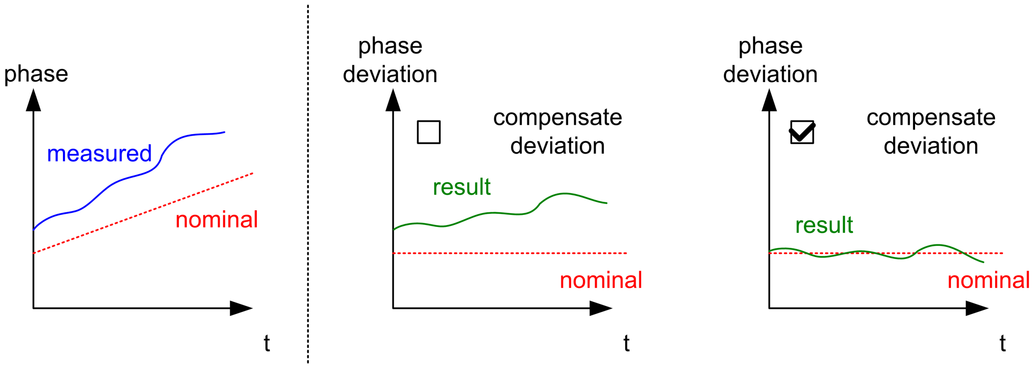


Figure 6-3: Results without and with measured deviation compensation

Remote command:
`CALCulate<n>:HOPDetection:COMPensation[:STATe]` on page 242
`CALCulate<n>:CHRDetection:COMPensation[:STATe]` on page 235

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 FSW-K60H option.

For details see "Coherent phase deviation measurement" on page 52.

Remote command:
`CALCulate<n>:HOPDetection:PCOHerent[:STATe]` on page 246

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 244
`CALCulate<n>:CHRDetection:FMTolerance` on page 237

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 248
CALCulate<n>:CHRDetection:PMTolerance on page 240

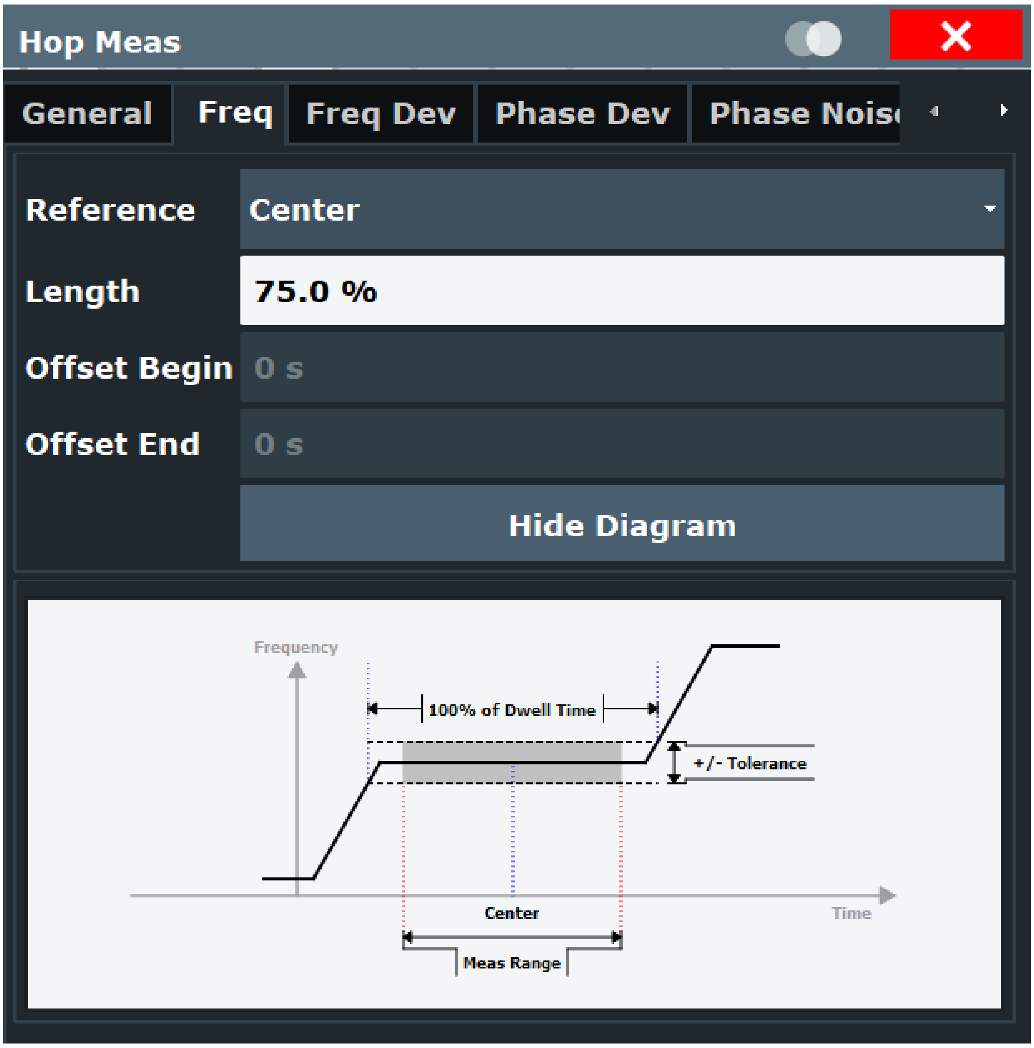
6.7.2 Specific measurement settings

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 4.8, "Measurement range", on page 30.



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 55).

Remote command:
CALCulate<n>:CHRDetection:FREQuency:REFerence on page 238
CALCulate<n>:CHRDetection:FDEViation:REFerence on page 236
CALCulate<n>:CHRDetection:PDEViation:REFerence on page 240
CALCulate<n>:CHRDetection:POWer:REFerence on page 242
CALCulate<n>:CHRDetection:PNOise:REFerence on page 207
CALCulate<n>:HOPDetection:FREQuency:REFerence on page 246
CALCulate<n>:HOPDetection:FDEViation:REFerence on page 244
CALCulate<n>:HOPDetection:PDEViation:REFerence on page 248
CALCulate<n>:HOPDetection:POWer:REFerence on page 249
CALCulate<n>:HOPDetection:PNOise:REFerence on page 207

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

Remote command:
CALCulate<n>:CHRDetection:FREQuency:LENGth on page 237
CALCulate<n>:CHRDetection:FDEViation:LENGth on page 235
CALCulate<n>:CHRDetection:PDEViation:LENGth on page 239
CALCulate<n>:CHRDetection:POWer:LENGth on page 241
CALCulate<n>:CHRDetection:PNOise:LENGth on page 208
CALCulate<n>:HOPDetection:FREQuency:LENGth on page 245
CALCulate<n>:HOPDetection:FDEViation:LENGth on page 243
CALCulate<n>:HOPDetection:PDEViation:LENGth on page 247
CALCulate<n>:HOPDetection:POWer:LENGth on page 249
CALCulate<n>:HOPDetection:PNOise:LENGth on page 208

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 237
CALCulate<n>:CHRDetection:FREQuency:OFFSet:END on page 238
CALCulate<n>:CHRDetection:FDEViation:OFFSet:BEGin on page 235
CALCulate<n>:CHRDetection:FDEViation:OFFSet:END on page 236
CALCulate<n>:CHRDetection:PDEViation:OFFSet:BEGin on page 239
CALCulate<n>:CHRDetection:PDEViation:OFFSet:END on page 239
CALCulate<n>:CHRDetection:POWer:OFFSet:BEGin on page 241
CALCulate<n>:CHRDetection:POWer:OFFSet:END on page 241

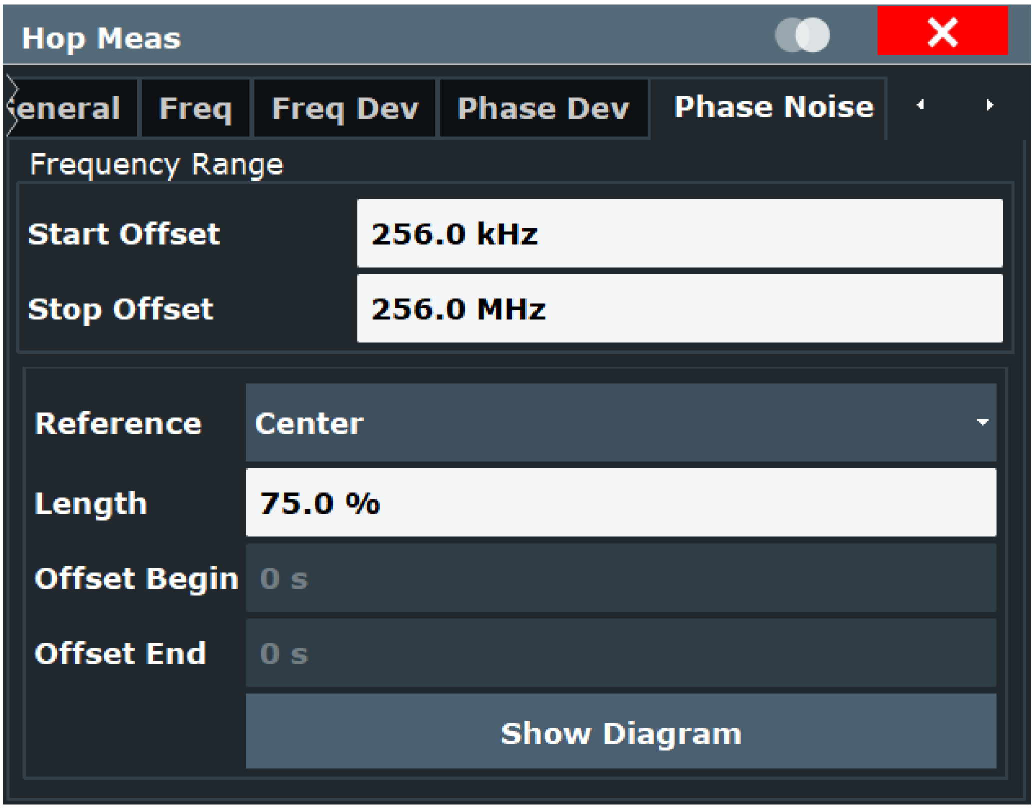
CALCulate<n>:CHRDetection:PNOise:OFFSet:BEGin on page 208
CALCulate<n>:CHRDetection:PNOise:OFFSet:END on page 209
CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin on page 245
CALCulate<n>:HOPDetection:FREQuency:OFFSet:END on page 245
CALCulate<n>:HOPDetection:FDEViation:OFFSet:BEGin on page 243
CALCulate<n>:HOPDetection:FDEViation:OFFSet:END on page 243
CALCulate<n>:HOPDetection:PDEViation:OFFSet:BEGin on page 247
CALCulate<n>:HOPDetection:PDEViation:OFFSet:END on page 247
CALCulate<n>:HOPDetection:POWer:OFFSet:BEGin on page 249
CALCulate<n>:HOPDetection:POWer:OFFSet:END on page 249
CALCulate<n>:HOPDetection:PNOise:OFFSet:BEGin on page 209
CALCulate<n>:HOPDetection:PNOise:OFFSet:END on page 209

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

6.7.3 Phase noise measurement settings (FSW-K60P)

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

The following settings are available if option FSW-K60P is installed.



Start / Stop Offset....................122

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 206
CALCulate<n>:HOPDetection:PNOise:FREQuency:STARt on page 206
Stop Offset
CALCulate<n>:CHRDetection:PNOise:FREQuency:STOP on page 206
CALCulate<n>:HOPDetection:PNOise:FREQuency:STOP on page 206

6.8 Sweep settings

Access: [SWEEP]

The sweep settings define how often data from the input signal is acquired and then evaluated.

Continuous Sweep / Run Cont....122
Single Sweep / Run Single....122
Continue Single Sweep....123
Refresh (MSRA/MSRT only)....123
Measurement Time....123
Sweep/Average Count....123
Select Frame....124

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

Note: Sequencer. If the Sequencer is active, "Continuous Sweep" only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.
Furthermore, [RUN CONT] controls the Sequencer, not individual sweeps. [RUN CONT] starts the Sequencer in continuous mode.

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

Remote command:
INITiate<n>:CONTinuous on page 256

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

Note: Sequencer. If the Sequencer is active, "Single Sweep" only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect

the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, the Sequencer sweeps a channel in single sweep mode only once.
Furthermore, [RUN SINGLE] controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.

If the Sequencer is off, only the evaluation for the currently displayed channel is updated.

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

Remote command:
INITiate<n>[:IMMediate] on page 256

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

Remote command:
INITiate<n>:CONMeas on page 255

Refresh (MSRA/MSRT only)
This function is only available if the Sequencer is deactivated and only for **MSRA/MSRT secondary applications**.

The data in the capture buffer is re-evaluated by the currently active secondary application only. The results for any other secondary applications remain unchanged.

This is useful, for example, after evaluation changes have been made or if a new sweep was performed from another secondary application. In this case, only that secondary application is updated automatically after data acquisition.

Note: To update all active secondary applications at once, use the "Refresh All" function in the "Sequencer" menu.

Remote command:
INITiate<n>:REFResh on page 257

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 FSW 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 FSW.

Remote command:
[SENSe:]MTIMe on page 221

Sweep/Average Count
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 349

Select Frame
Access: [MEAS] / [MEAS CONFIG] / [SWEEP]

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 350

6.9 Adjusting settings automatically

Access: [AUTO SET]

Some settings can be adjusted by the FSW 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)..124

Setting the Reference Level Automatically (Auto Level)
To determine the required reference level, a level measurement is performed on the FSW.

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/ 5 GHz bandwidth extension (B2000/B5000) or the optional Oscilloscope Baseband Input, the level measurement is performed on the connected oscilloscope. For B2000/B5000, y-axis scaling on the oscilloscope is limited to a minimum of 5 mV per division.

Remote command:
[SENSe:]ADJust:LEVel on page 254

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.

- Display configuration....................125
- Result configuration....................125
- Evaluation basis....................134
- Trace settings....................135
- Trace / data export configuration....................138
- Spectrogram settings....................140
- Export functions....................144
- Marker settings....................147
- Zoom functions....................155
- Analysis in MSRA/MSRT mode....................158

7.1 Display configuration

Access: "Overview" > "Display Config"

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

Up to six evaluation methods can be displayed simultaneously in separate windows. The evaluation methods available for Transient Analysis are described in Chapter 5.3, "Evaluation methods for transient analysis", on page 68.

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

7.2 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 "Specific Settings for" on page 85).

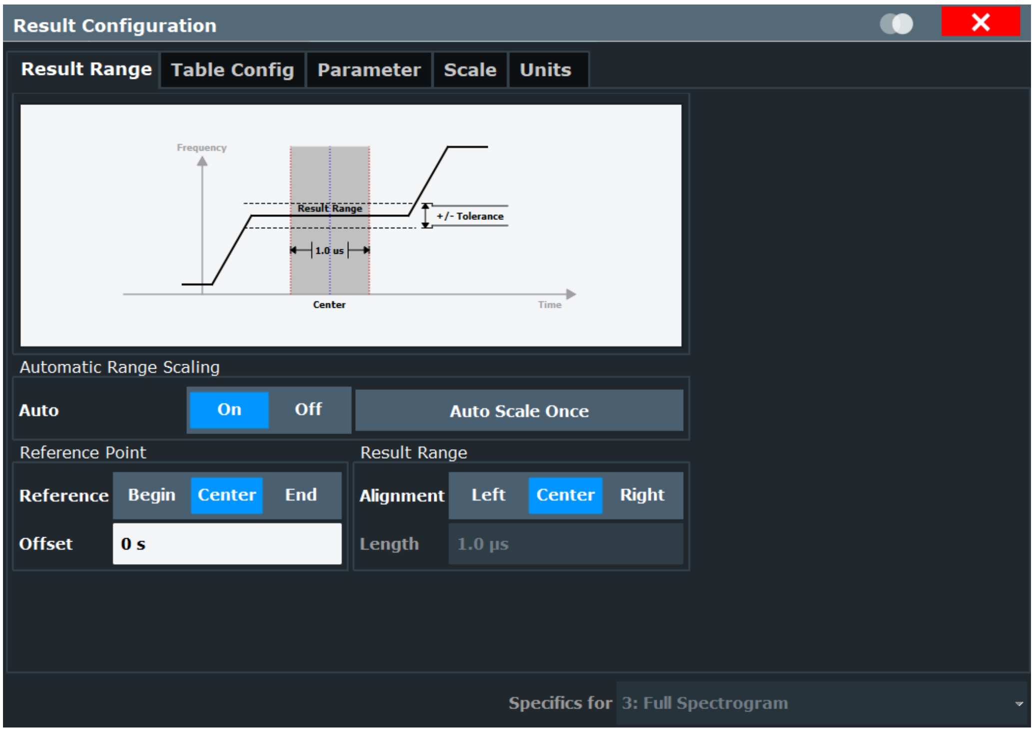
- Result range....................126
- Table configuration....................127
- Parameter configuration for result displays....................128
- Y-Axis scaling....................131
- Units....................133

7.2.1 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 46). 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 FSW-K60C/-K60H are installed.



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

Automatic Range Scaling....126
Result Range Reference Point....127
Offset....127
Alignment....127
Length....127

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 135).

"OFF" Switches automatic range scaling off

"ON" Switches automatic range scaling on

Remote command:

`CALCulate<n>:RESult:RANGe:AUTO` on page 271

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 272

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 271

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 270

Length
Defines the length or duration of the result range.

Remote command:
`CALCulate<n>:RESult:LENGth` on page 271

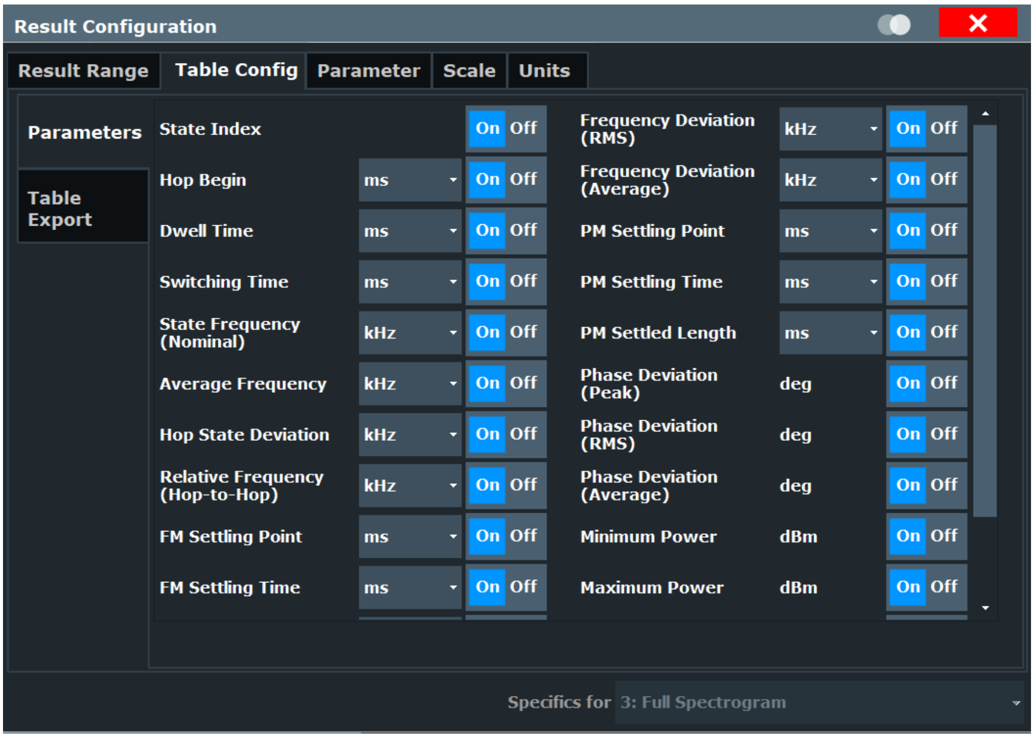
7.2.2 Table configuration

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 FSW-K60C/-K60H are installed.

Table export settings are described in "Table Export Configuration" on page 145.



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 47/ Chapter 5.2, "Chirp parameters", on page 57.

Remote command:

`CALCulate<n>:CHRDetection:TABLe:COLumn` on page 274

`CALCulate<n>:HOPDetection:TABLe:COLumn` on page 284

7.2.3 Parameter configuration for result displays

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

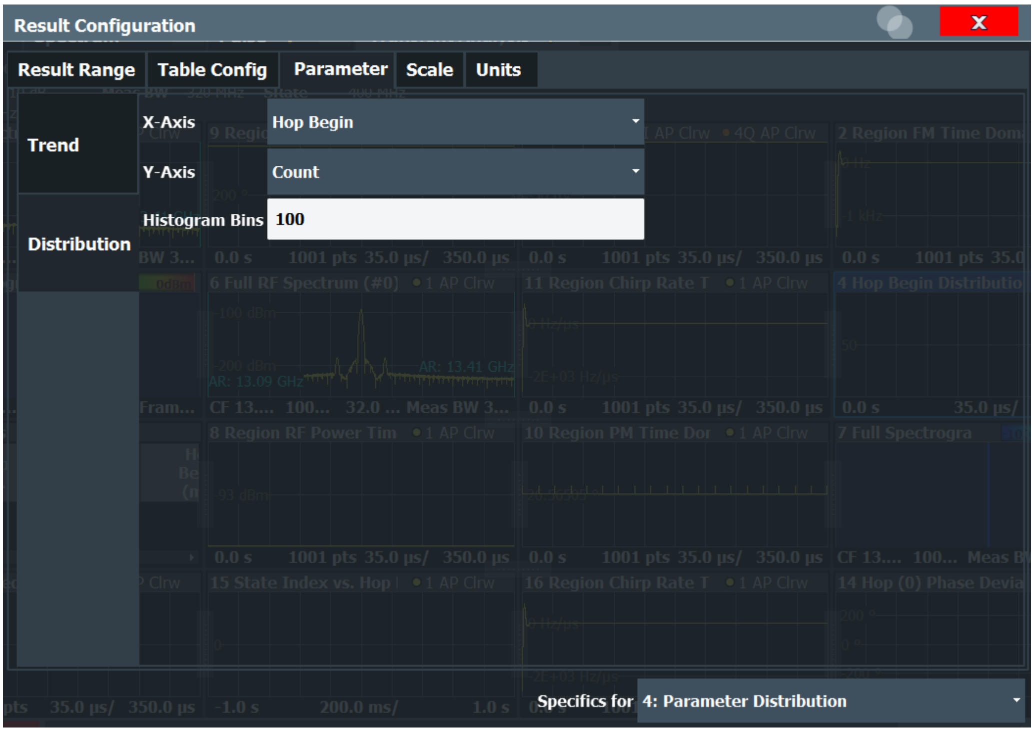
For parameter trend or distribution displays you can define which parameters are to be evaluated in each window.

- Parameter distribution configuration..128
- Parameter trend configuration..130

7.2.3.1 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 129
Y-Axis 129
Histogram Bins 129

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 47/ Chapter 5.2, "Chirp parameters", on page 57.

Remote command:
`CALCulate<n>:DISTribution:X?` on page 303

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 303

Histogram Bins

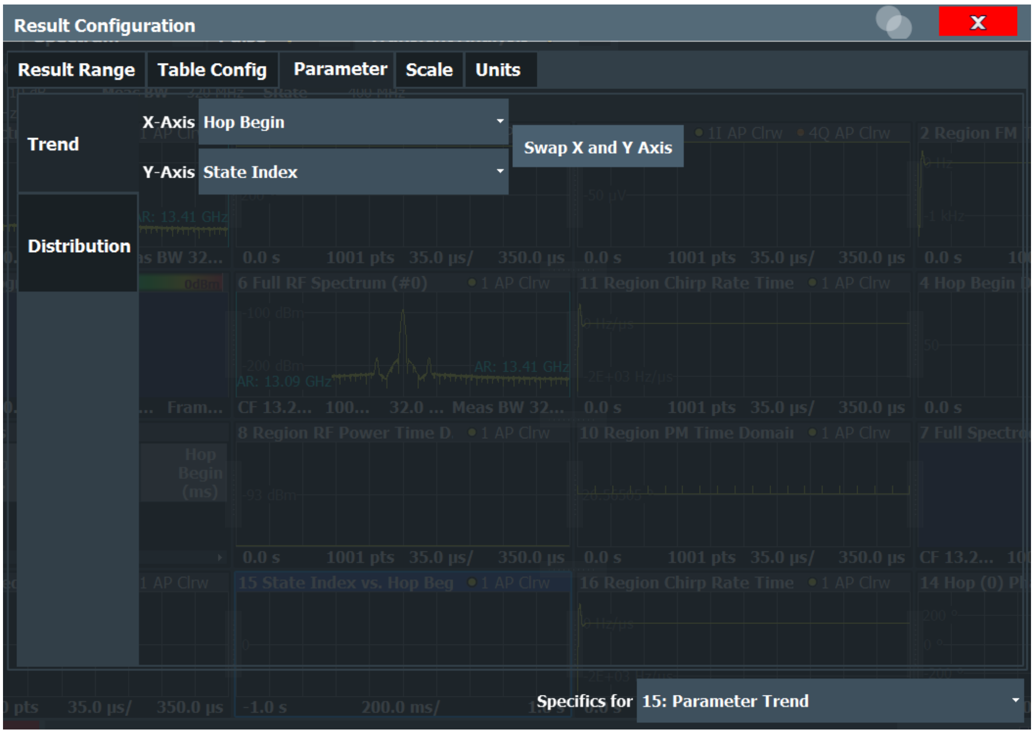
Number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Remote command:
`CALCulate<n>:DISTribution:NBINs` on page 302

7.2.3.2 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....................130
Y-Axis....................131
Swap X and Y Axis....................131

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 47/ Chapter 5.2, "Chirp parameters", on page 57.

Remote command:
`CALCulate<n>:TRENd:X?` on page 304

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 47/ Chapter 5.2, "Chirp parameters", on page 57.

Remote command:

`CALCulate<n>:TRENd:Y?` on page 304

Swap X and Y Axis

Swaps the parameters on the x-axis and y-axis in a Parameter Trend result display.

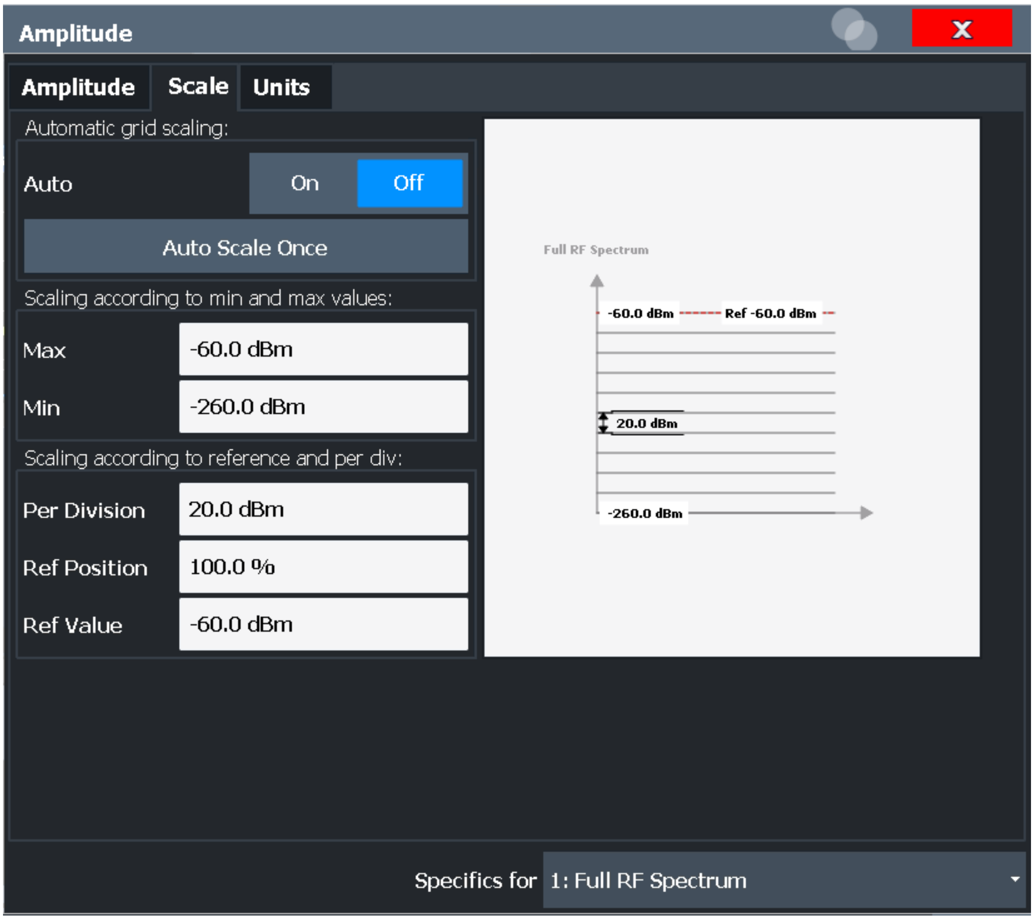
Remote command:

`CALCulate<n>:TRENd:SWAP:XY` on page 304

7.2.4 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....132
Auto Scale Once....132
Absolute Scaling (Min/Max Values)....132
Relative Scaling (Reference/ per Division)....132
└ Per Division....132
└ Ref Position....133
└ Ref Value....133
Spectrogram y-scaling....133
└ Range....133
└ Ref Level Position....133

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 132 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 343

Auto Scale Once
Automatically determines the optimal range and reference level position to be displayed for the current measurement settings.

The display is only set once; it is not adapted further if the measurement settings are changed again.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 343

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 343
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 344

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 344

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 344

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 345

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 143).

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe] on page 343

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.

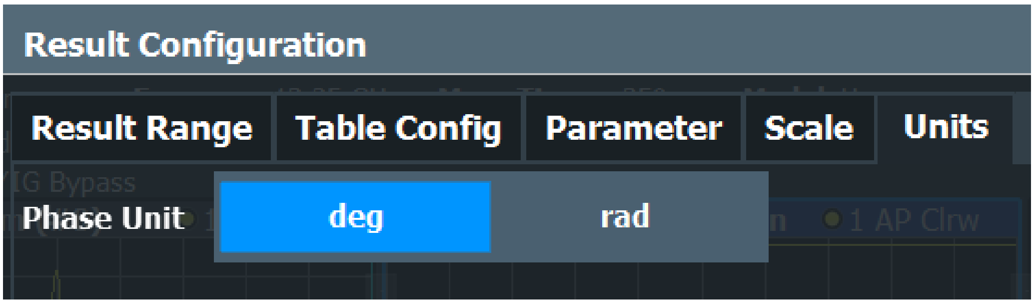
For spectrograms, this value defines the position of the reference level value within the span covered by the color map. In this case, the value is given in %, where 0 % corresponds to the maximum (right end) and 100 % to the minimum (left end) of the color map.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition on page 344

7.2.5 Units

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

The unit for phase display is configurable. This setting is described here.



Phase Unit....134

Phase Unit

Defines the unit in which phases are displayed (degree or rad).

Remote command:

`CALCulate<n>:UNIT:ANGLe` on page 342

7.3 Evaluation basis

Access: [MEAS]

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 FSW-K60C/-K60H are installed.

Full Capture / Region Analysis / Hop / Chirp....134
Select Hop / Select Chirp....135

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 FSW-K60C/-K60H are installed, see "Select Hop / Select Chirp" on page 135)
  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 269

Select Hop / Select Chirp
Defines the individual hop or chirp from the current capture buffer for which results are calculated and displayed.

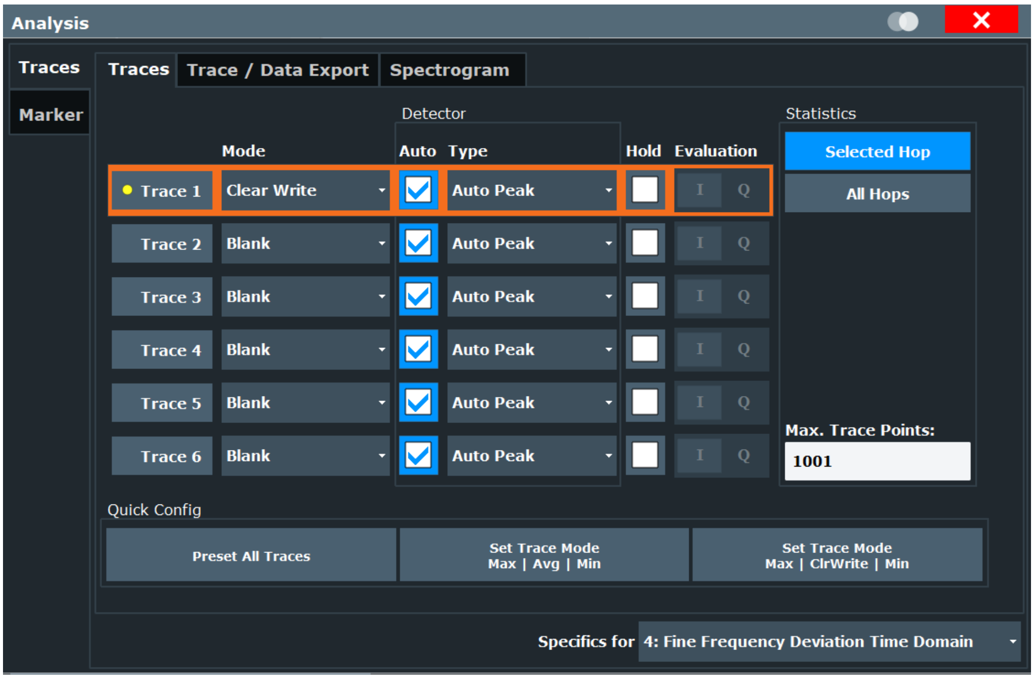
Remote command:
`CALCulate<n>:CHRDetection:SELected` on page 273
`CALCulate<n>:HOPDetection:SELected` on page 273

7.4 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 7.5, "Trace / data export configuration", on page 138.



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6....136
Mode....136
Detector....136
Hold....137
Evaluation....137
Statistical Evaluation....137
└ Selected Hop/Selected Chirp vs All Hops/All Chirps....137
└ Sweep/Average Count....137
└ Maximum number of trace points....138
Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)....138

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 347
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 FSW 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 346

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, FSW 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 348

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 347

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 346

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 4.9.3, "Trace statistics", on page 35.

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 349

Sweep/Average 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 349

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see Chapter 7.2.1, "Result range", on page 126) 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 4.9.1, "Mapping samples to measurement points with the trace detector", on page 32.

Restricting this value can improve performance during statistical evaluation of large result range lengths.

Remote command:
[SENSe:]MEASure:POINts on page 349

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 347

7.5 Trace / data export configuration

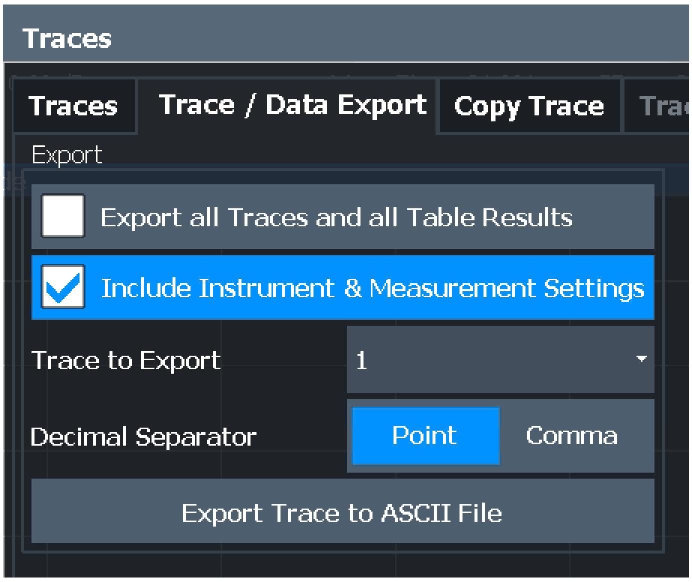
Access: "Save" > "Export" > "Export Configuration"

Or: [TRACE] > "Trace Config" > "Trace / Data Export"

The FSW 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 (e.g. saving or loading instrument settings) that are available for all FSW applications are not described here.

See the FSW base unit user manual for a description of the standard functions.



Export all Traces and all Table Results....139
Include Instrument & Measurement Settings....139
Trace to Export....139
Decimal Separator....139
Export Trace to ASCII File....140

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 451

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 450

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 450

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

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

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

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

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

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

Remote command:
`MMEMory:STORe<n>:TRACe` on page 453

7.6 Spectrogram settings

Access: [MEAS CONFIG] > "Spectrogram Config"

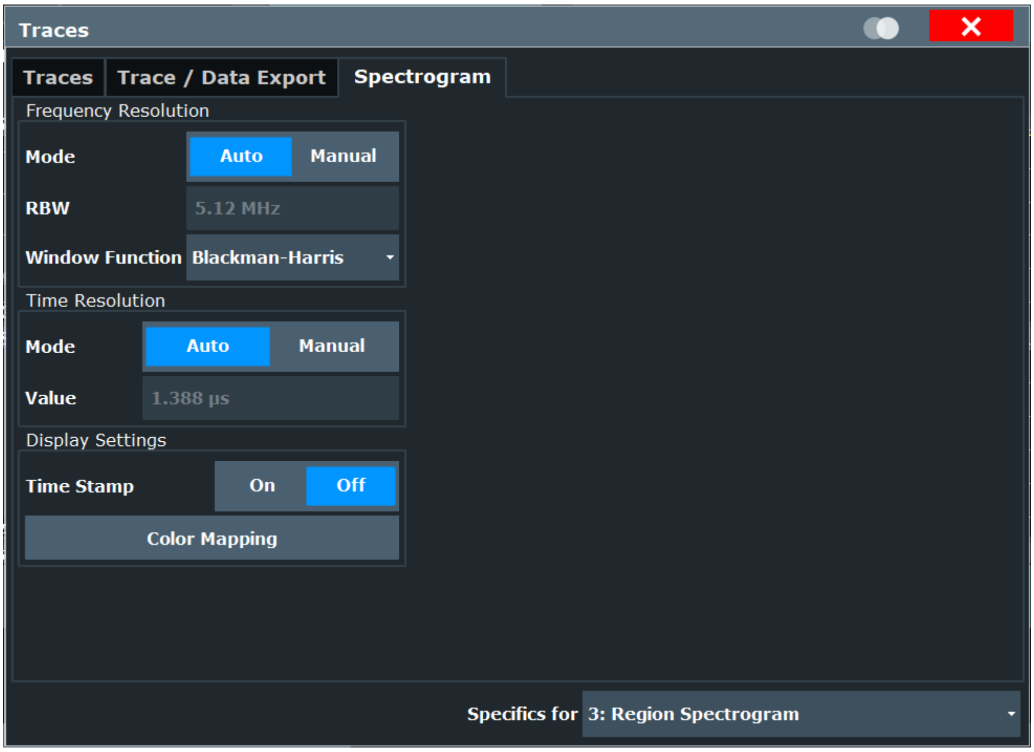
The individual settings available for spectrogram display are described here. For settings on color mapping, see Chapter 7.6.2, "Color map settings", on page 142.

- General spectrogram settings....................140
- Color map settings....................142

7.6.1 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 4.3, "Signal processing", on page 20.

Functions that are described somewhere else:

- Chapter 6.6, "Bandwidth settings", on page 115

Frequency Resolution Mode..141
Window Function..141
Time Resolution..142
Time Stamp..142
Color Mapping..142

Frequency Resolution Mode

"Auto" sets the RBW to the ABW/100. "Manual" activates an input field for the RBW.

Remote command:

`[SENSe:]BANDwidth[:WINDow<n>]:RESolution:AUTO` on page 223

Window Function

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

- Five-Term

Remote command:
[SENSe<ip>:]SWEep:FFT:WINDow:TYPE on page 354

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 352
CALCulate<n>:SGRam:TRESolution on page 351

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 353
CALCulate<n>:SGRam:TSTamp:DATA? on page 352

Color Mapping
Opens the "Color Mapping" dialog.

7.6.2 Color map settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram" > "Color Mapping"

or: [TRACE] > "Spectrogram Config" > "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.

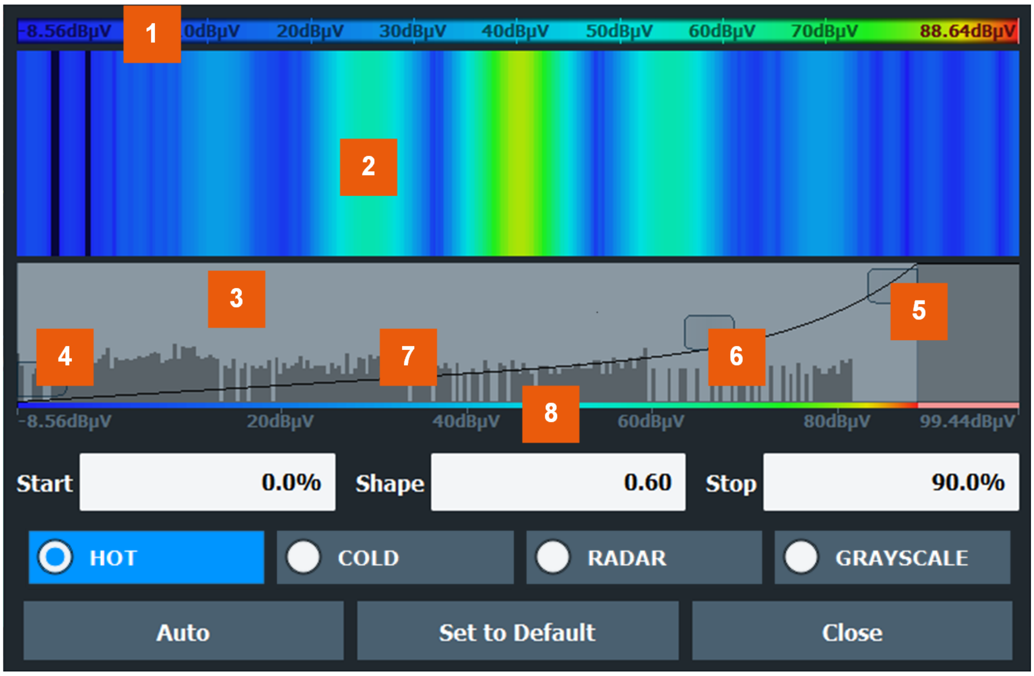


Figure 7-1: Color Mapping dialog box

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......143
Shape......143
Hot/Cold/Radar/Grayscale......144
Auto......144
Set to Default......144
Close......144

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 355
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer` on page 355

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 355

Hot/Cold/Radar/Grayscale
Sets the color scheme for the spectrogram.

Remote command:
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe] on page 356

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 354

Close
Saves the changes and closes the dialog box.

7.7 Export functions

Access: "Save" > "Export"

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

See the FSW User Manual for a description of the standard functions.

Export table to ASCII File ... 144
Table Export Configuration ... 145
└ Columns to Export ... 145
└ Decimal Separator ... 145
└ Export table to ASCII File ... 145
Export Trace to ASCII File ... 146
Trace Export Configuration ... 146
I/Q Export ... 146
└ Export Range ... 146
└ File Explorer ... 147

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.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 7.5, "Trace / data export configuration", on page 138.)

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

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

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

Remote command:
MMEMory:STORe<n>:TABLe on page 452

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 452

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 450

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.

Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu.
(See also Chapter 7.5, "Trace / data export configuration", on page 138.)

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

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

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

Remote command:
`MMEMory:STORe<n>:TABLe` on page 452

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

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

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

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

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

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

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 7.5, "Trace / data export configuration", on page 138.

I/Q Export
Opens a file selection dialog box to define an export file name to which the I/Q data is stored. This function is only available in single sweep mode.

Note: Storing large amounts of I/Q data (several Gigabytes) can exceed the available (internal) storage space on the FSW. In this case, it can be necessary to use an external storage medium.

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

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

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

Export Range ← I/Q Export
Defines the range of the I/Q data to store.

"Entire Capture"	The entire capture buffer is exported.

File Explorer ← I/Q Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

7.8 Marker settings

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

- Individual marker setup....147
- General marker settings....150
- Marker search settings and positioning functions....152

7.8.1 Individual marker setup

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

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

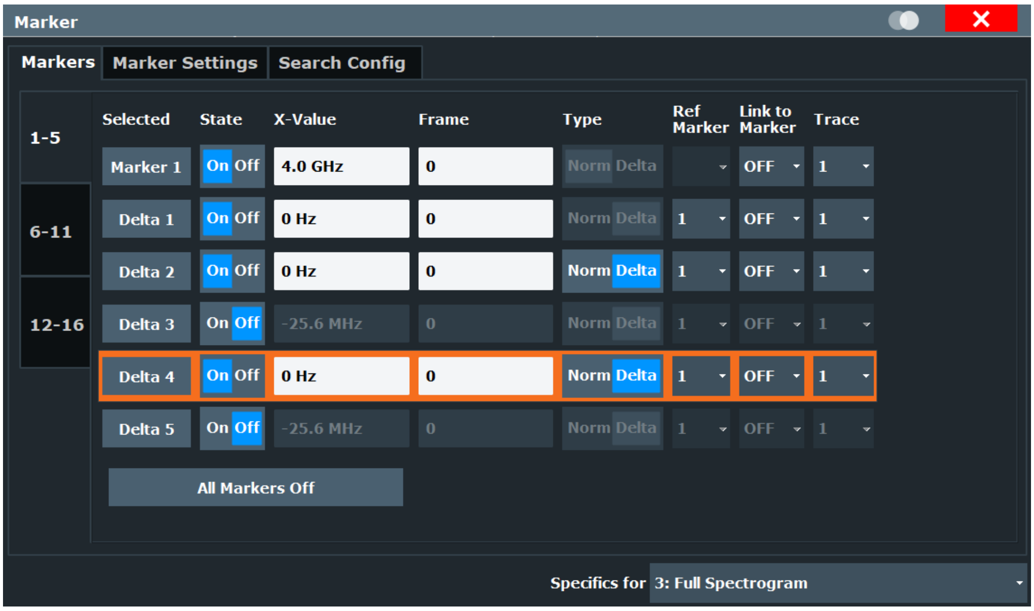


Figure 7-2: Marker settings for spectrogram display

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.

Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta....148
Selected Marker....148
Marker State....148
Marker Position X-value....148

Frame (for Spectrograms only)........149
Marker Type........149
Reference Marker........149
Linking to Another Marker........149
Assigning the Marker to a Trace........150
Select Marker........150
All Markers Off........150

Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta
"Marker X" activates the corresponding marker and opens an edit dialog box to enter the marker position ("X-value"). Pressing the softkey again deactivates the selected marker.

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.

Note: If normal marker 1 is the active marker, pressing "Mkr Type" switches on an additional delta marker 1.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 357
CALCulate<n>:MARKer<m>:X on page 358
CALCulate<n>:MARKer<m>:Y? on page 359
CALCulate<n>:DELTamarker<m>[:STATe] on page 361
CALCulate<n>:DELTamarker<m>:X on page 361
CALCulate<n>:DELTamarker<m>:X:RELative? on page 362
CALCulate<n>:DELTamarker<m>:Y? on page 362
In spectrogram display:
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe on page 374
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe on page 370

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 357
CALCulate<n>:DELTamarker<m>[:STATe] on page 361

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 358
CALCulate<n>:DELTamarker<m>:X on page 361

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 370

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 357
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 361

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 360

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).

For linked delta markers, the x-value of the delta marker is 0 Hz by default. To create a delta marker in a fixed distance to another marker, define the distance as the x-value for the linked delta marker.

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 357
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 360
`CALCulate<n>:DELTamarker<m>:LINK` on page 359

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 358

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

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 357
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 361

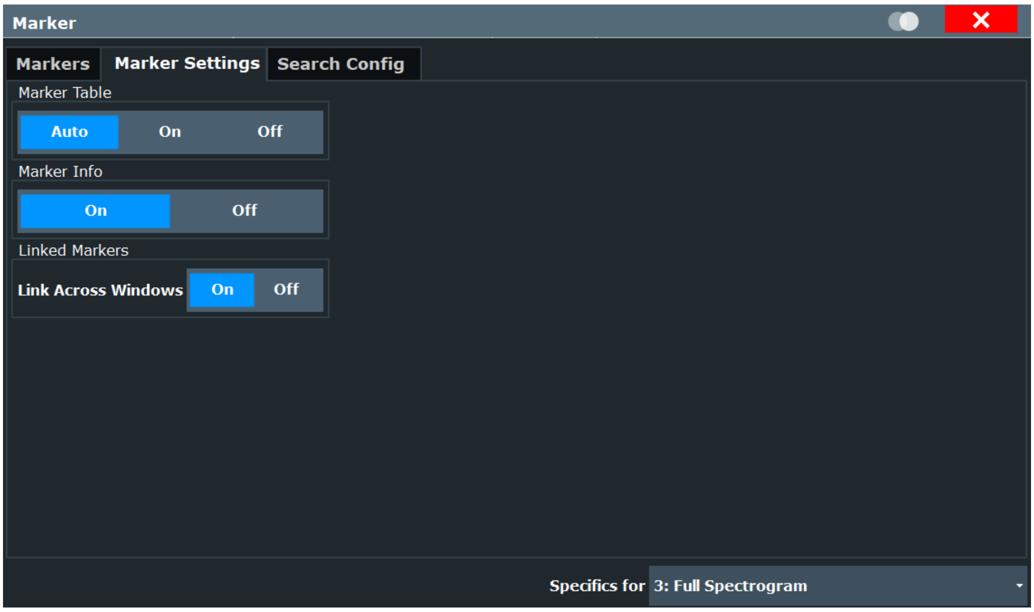
All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 357

7.8.2 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....151
Marker Info....151
Linked Markers....152
Show Marker Legend in Spectrogram....152

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.

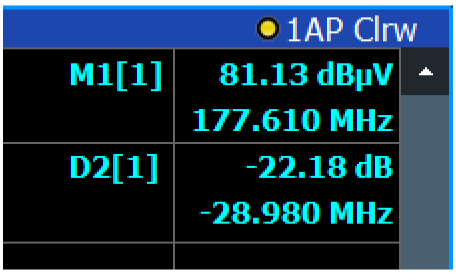
"Off" No separate marker table is displayed.
If Marker Info is active, the marker information is displayed within the diagram area.

"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 363

Marker Info

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



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 363

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 364

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 151). This setting only takes effect if a marker is active.

7.8.3 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).

- Marker search settings..152
- Positioning functions...154

7.8.3.1 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.

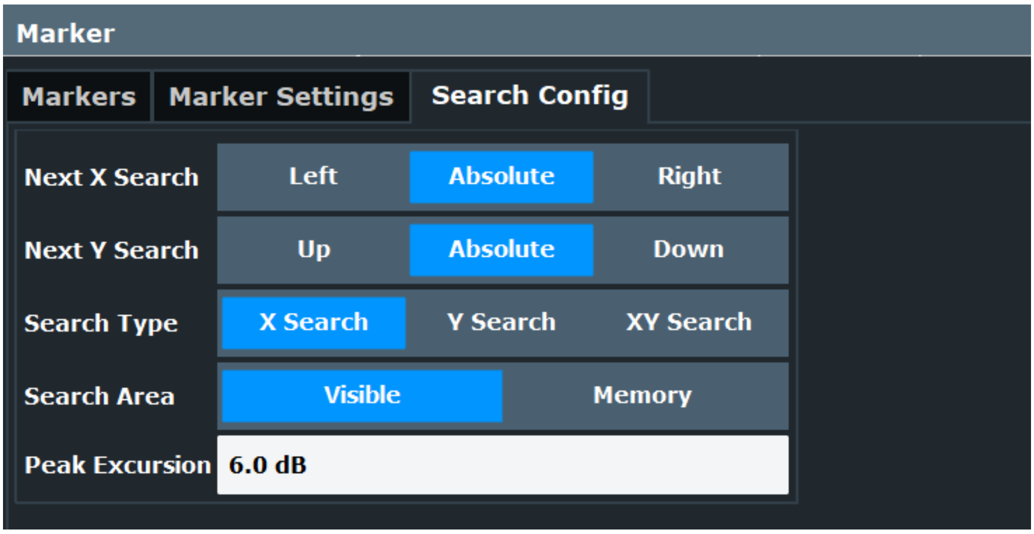


Figure 7-3: Marker search settings for spectrogram

Search Mode for Next Peak in X-Direction 153
Search Mode for Next Peak in Y-Direction 153
Marker Search Type 154
Marker Search Area 154
Peak Excursion 154

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 11.6.12.4, "Positioning the marker", on page 364

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 371
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe on page 375
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow on page 371
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow on page 376
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT on page 371
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT on page 376
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe on page 372
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe on page 376
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow on page 372
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow on page 377
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT on page 373
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT on page 377

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 11.6.12.5, "Marker search (spectrograms)", on page 369

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 370
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea on page 375

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 364

7.8.3.2 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....155
Search Minimum....155
Search Next Minimum....155

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 365
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 365
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 365
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 367
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 367
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 367

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 366
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 368

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 366
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 366
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 366
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 368
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 368
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 368

7.9 Zoom functions

Access: "Zoom" icons in toolbar

Single Zoom....156
Multi-Zoom....156
Measurement Zoom....156
└ Level Lock....157
└ X-Lock....157
└ Y-Lock....157

└ Adapt Measurement to Zoom (selected diagram)..157
Restore Original Display...157
Data shift (Pan)...158
Data Zoom...158

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 379
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA on page 378

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 381
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA
on page 379

Measurement Zoom

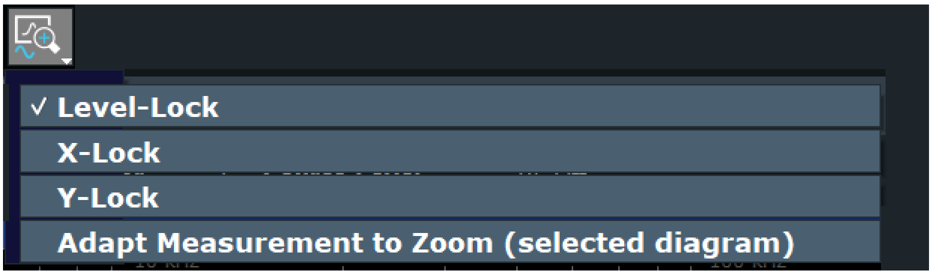
As opposed to the graphical zoom, which is merely a visual tool, the measurement zoom adapts the measurement settings such that the data you are interested in is displayed in the required detail. In measurement zoom mode, you can change the display using touch gestures. This is the default operating mode of the FSW.

For details on touch gestures see "Operating Basics" in the FSW Getting Started manual.

Note: The measurement settings are adapted to practical values based on a suitable grid for the current settings, rather than to unwieldy values that reflect precisely the pixel you happen to tap.
If the measurement zoom leads to undesirable results, you can easily return to the original measurement settings using the "UNDO" function.

When you select the "Measurement Zoom" icon, then tap in a diagram, a dotted rectangle is displayed which you can drag to define the zoom area. This allows you to define the zoom area more precisely than by spreading two fingers in the display.

The measurement zoom function provides further options in a context-sensitive menu, which is displayed when you tap the icon for about a second (or right-click it). These options concern the behavior of the firmware for subsequent touch gestures on the screen. Note that these settings remain unchanged after a channel preset.



Level Lock ← Measurement Zoom
If activated (default), the reference level (and thus the attenuation) is locked, that is: remains unchanged during touch gestures on the screen.

X-Lock ← Measurement Zoom
If activated, the x-axis of the diagram is not changed during subsequent touch gestures.

Y-Lock ← Measurement Zoom
If activated, the y-axis of the diagram is not changed during subsequent touch gestures.

Adapt Measurement to Zoom (selected diagram) ← Measurement Zoom
If you already performed a graphical zoom using the "Single Zoom" on page 156 or "Multi-Zoom" on page 156 functions, this function automatically adapts the measurement settings to maintain the currently zoomed display.

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 379
Multiple zoom:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]`
on page 381 (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 4.7, "Zooming and shifting results", on page 29.

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 4.7, "Zooming and shifting results", on page 29.

7.10 Analysis in MSRA/MSRT mode

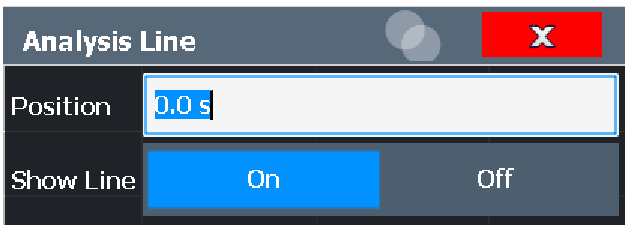
The data that was captured by the MSRA/MSRT primary can be analyzed in the Transient Analysis application.

The analysis settings and functions available in MSRA/MSRT mode are those described for common Signal and Spectrum Analyzer mode.

Analysis line settings

In addition, an analysis line can be positioned. The analysis line is a common time marker for all MSRA/MSRT applications.

To hide or show and position the analysis line, a dialog box is available. To display the "Analysis Line" dialog box, tap the "AL" icon in the toolbar (only available in MSRA/MSRT mode). The current position of the analysis line is indicated on the icon.



Position 159
Show Line 159

Position

Defines the position of the analysis line in the time domain. The position must lie within the measurement time of the multistandard measurement.

Remote command:

`CALCulate<n>:MSRA:ALINe[:VALue]` on page 382

`CALCulate<n>:RTMS:ALINe[:VALue]` on page 384

Show Line

Hides or displays the analysis line in the time-based windows. By default, the line is displayed.

Note: The window title bar always shows whether the currently defined line position lies within the analysis interval of the active secondary application, even if the analysis line display is disabled.

Remote command:

`CALCulate<n>:MSRA:ALINe:SHOW` on page 382

`CALCulate<n>:RTMS:ALINe:SHOW` on page 384

8 How to perform transient analysis

The following step-by-step instructions demonstrate how to analyze transient signal effects with the FSW-K60 option.

To perform a basic transient analysis measurement

1. Press [MODE] on the front panel and select the "Transient" application.
2. Select "Overview" to display the "Overview" for Transient Analysis.
3. Select "Input/Frontend" and then the "Frequency" tab to define the input signal's center frequency.
4. Select "Data Acquisition" to define the Data Acquisition (Full) and Analysis Region (AR) parameters for the input signal:
(In MSRA/MSRT mode, define the application data instead, see Chapter 4.11, "Transient analysis in MSRA/MSRT mode", on page 43).
   - "(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 "Result Config" 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 7.2.4, "Y-Axis scaling", on page 131.)
7. Select "Display Config" and select the displays that are of interest to you (up to 16, see Chapter 7.1, "Display configuration", on page 125).
Arrange them on the display to suit your preferences.
8. Exit the SmartGrid mode.
9. To start the measurement, select one of the following:
   - [RUN SINGLE]
   - "Single Sweep" in the "Sweep" menu

   The defined number of sweeps are performed, then the measurement is stopped. While the measurement is running, the [RUN SINGLE] key is highlighted. To abort the measurement, press [RUN SINGLE] again. The key is no longer highlighted. The results are not deleted until a new measurement is started.

10. Select "Analysis" 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 7.4, "Trace settings", on page 135).
    - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.8, "Marker settings", on page 147).
    - Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.6, "Spectrogram settings", on page 140).
11. Optionally, export the trace data of the demodulated signal to a file.
    a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
    b) Select "Export Trace to ASCII File".
    c) Define a file name and storage location and select "OK".

To detect hops in a transient measurement

This procedure requires the additional option FSW-K60H to be installed.

1. Press [MODE] on the front panel and select the "Transient" application.
2. Select "Overview" to display the "Overview" for Transient Analysis.
3. Select "Signal Description" 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 86).

    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 "Input/Frontend" and then the "Frequency" tab to define the input signal's center frequency.
5. Select "Data Acquisition" to define the Data Acquisition (Full) and Analysis Region (AR) parameters for the input signal:
    (In MSRA/MSRT mode, define the application data instead, see Chapter 4.11, "Transient analysis in MSRA/MSRT mode", on page 43).
    - "(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 "Measurement" 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 "Display Config" and select the displays that are of interest to you (up to 16, see Chapter 7.1, "Display configuration", on page 125).
Arrange them on the display to suit your preferences.
9. Exit the SmartGrid mode and select "Overview" to display the "Overview" again.
10. Select "Result Config" 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 7.2.1, "Result range", on page 126.)
    - 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 7.2.4, "Y-Axis scaling", on page 131.)
11. To start the measurement, select one of the following:
    - [RUN SINGLE]
    - "Single Sweep" in the "Sweep" menu

    The defined number of sweeps are performed, then the measurement is stopped. While the measurement is running, the [RUN SINGLE] key is highlighted. To abort the measurement, press [RUN SINGLE] again. The key is no longer highlighted. The results are not deleted until a new measurement is started.
12. Select "Analysis" 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 7.4, "Trace settings", on page 135).
    - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.8, "Marker settings", on page 147).

- Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.6, "Spectrogram settings", on page 140).

13. Optionally, export the trace data of the demodulated signal to a file.
    a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
    b) Select "Export Trace to ASCII File".
    c) Define a file name and storage location and select "OK".

To detect chirps in a transient measurement

This procedure requires the additional option FSW-K60C to be installed.

1. Press [MODE] on the front panel and select the "Transient" application.
2. Select "Overview" to display the "Overview" for Transient Analysis.
3. Select "Input/Frontend" and then the "Frequency" tab to define the input signal's center frequency.
4. Select "Data Acquisition" and define the bandwidth parameters for the input signal: (In MSRA/MSRT mode, define the application data instead, see Chapter 4.11, "Transient analysis in MSRA/MSRT mode", on page 43).
    - 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 "Signal Description" 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 86)
6. Select "Measurement" 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 "Display Config" and select the displays that are of interest to you (up to 16, see Chapter 7.1, "Display configuration", on page 125).
   Arrange them on the display to suit your preferences.
9. Exit the SmartGrid mode.
10. Select "Result Config" 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 7.2.1, "Result range", on page 126.)
- 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 7.2.4, "Y-Axis scaling", on page 131.)

11. To start the measurement, select one of the following:
    - [RUN SINGLE]
    - "Single Sweep" in the "Sweep" menu

    The defined number of sweeps are performed, then the measurement is stopped. While the measurement is running, the [RUN SINGLE] key is highlighted. To abort the measurement, press [RUN SINGLE] again. The key is no longer highlighted. The results are not deleted until a new measurement is started.
12. Select "Analysis" 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 7.4, "Trace settings", on page 135).
    - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab, see Chapter 7.8, "Marker settings", on page 147).
    - Configure the Spectrogram display or FFT parameters (on the "Spectrogram" tab, see Chapter 7.6, "Spectrogram settings", on page 140).
13. Optionally, export the trace data of the demodulated signal to a file.
    a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
    b) Select "Export Trace to ASCII File".
    c) Define a file name and storage location and select "OK".

8.1 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.
- Select "Color Mapping" in the "Spectrogram" menu.

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.

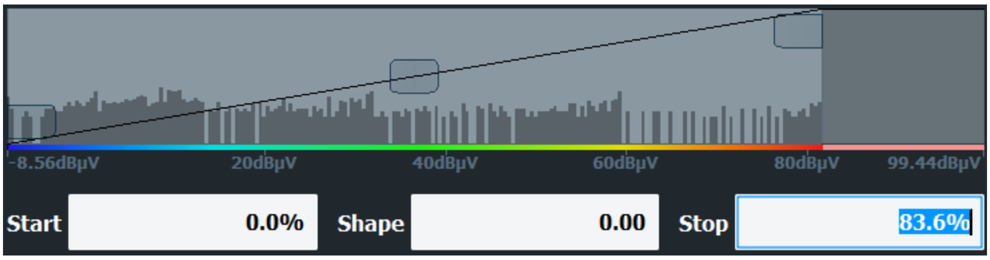
To ignore noise in a spectrogram, for example, exclude the lower power levels from the histogram.

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 FSW 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.

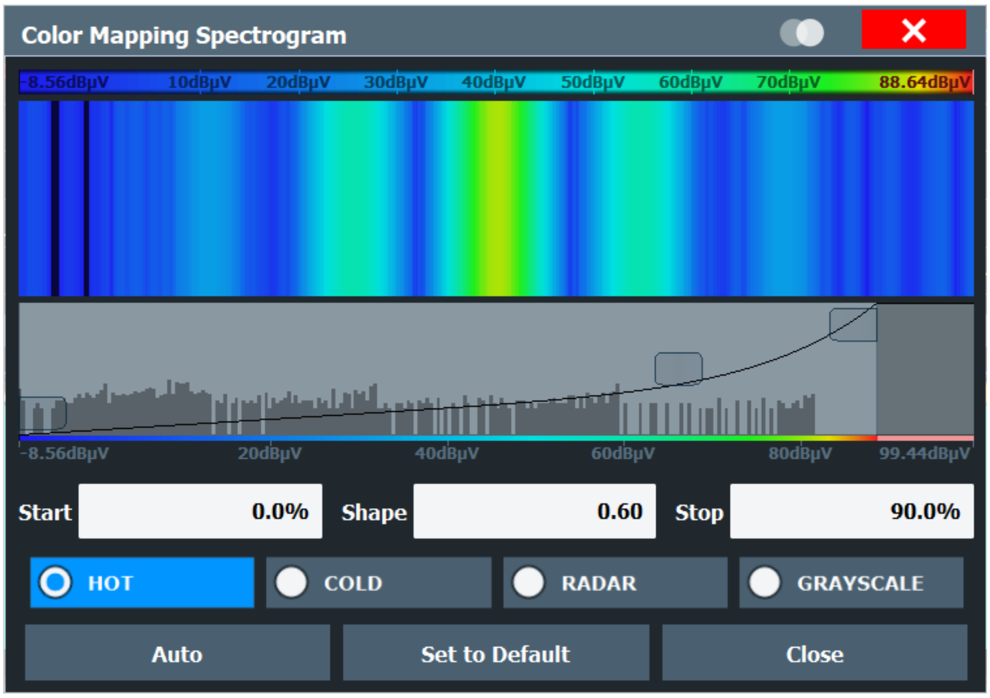
Editing the shape of the color curve

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 A.1, "Reference: ASCII file export format", on page 465.

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 FSW-K60C/-K60H are installed.

- Example: hopped FM signal....................168
- Example: chirped FM signal....................172

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:

- An FSW with application firmware R&S FSW-K60: Transient Analysis+ K60H (Hopped Transient Analysis) and bandwidth extension option FSW-B160
- A vector signal generator, e.g. R&S SMBV100A

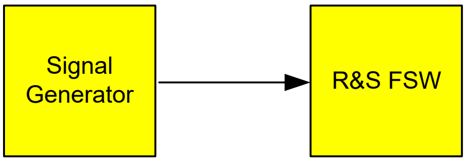


Figure 9-1: Test setup

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 FSW Transient Analysis application

To identify a hopped FM signal

1. Preset the FSW.
2. Set the center frequency to *4 GHz*.
3. Set the reference level to *-30 dBm*.

4. Select [MODE] and then "Transient Analysis".
5. Select the signal model *Hop*.
6. From the "Meas Config" 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.

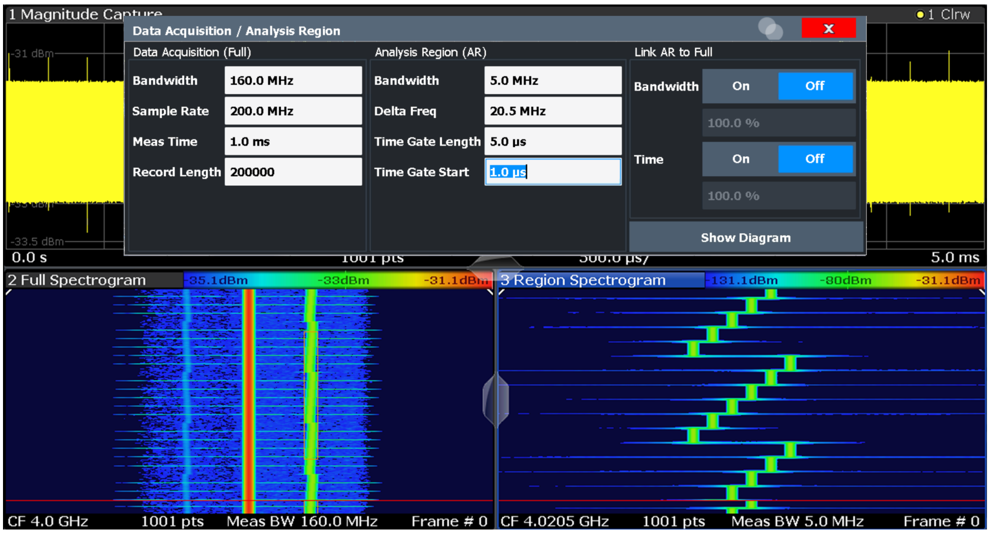


Figure 9-2: Configuring an analysis region for a hopped FM signal

a) From the "Meas Config" menu, select "Display Config".
b) Drag a second spectrogram display to the right of the existing one on the screen.
c) Exit the SmartGrid mode.
d) Press [Meas], then select "Analysis Region" to restrict the Spectrogram display to the analysis region.
By default, the analysis region corresponds to the entire capture buffer.

10. From the "Meas Config" menu, 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 Config" menu, select "Signal Description" to check them.

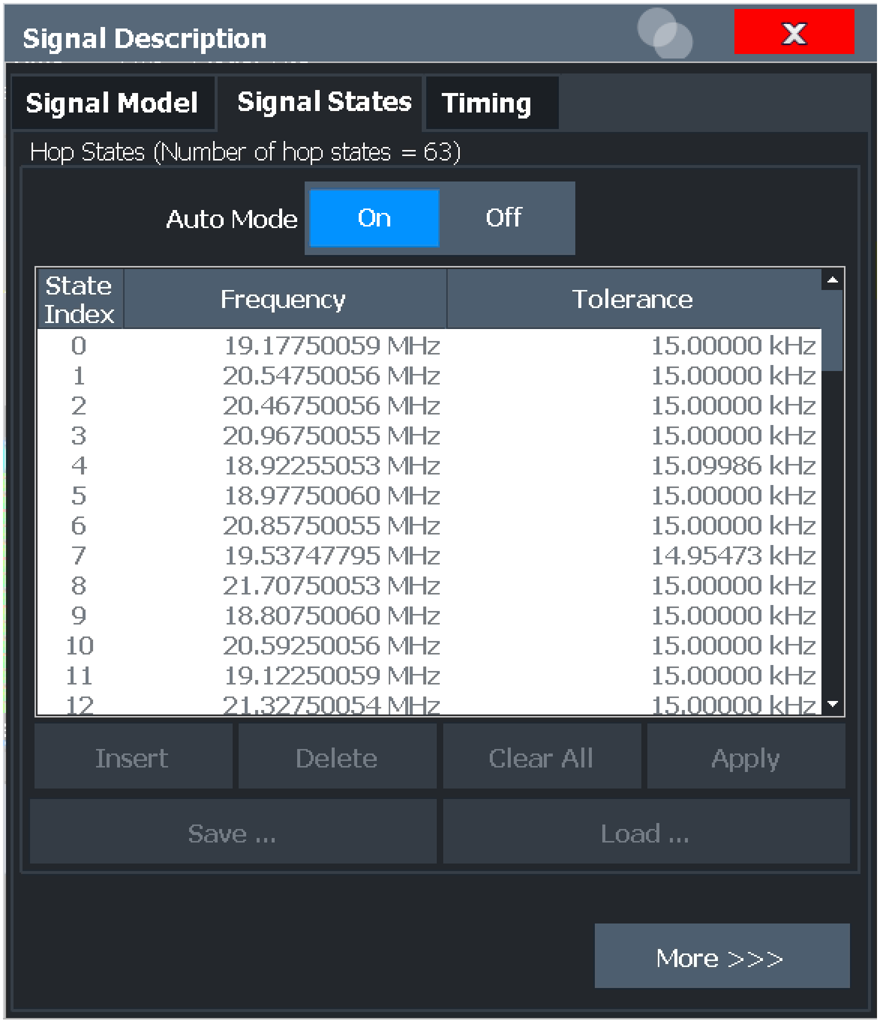


Figure 9-3: Detected hop states

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 Config" menu, select "Display Config".
2. Replace the Full Spectrogram display by a Frequency Deviation Time Domain display.
3. Exit the SmartGrid mode.
4. Select the Spectrogram display.
5. Press [Meas], then select "Hop" to restrict the Spectrogram display to a single hop.

6. Select "Select hop" and enter *7* to show the results for the hop number 7.

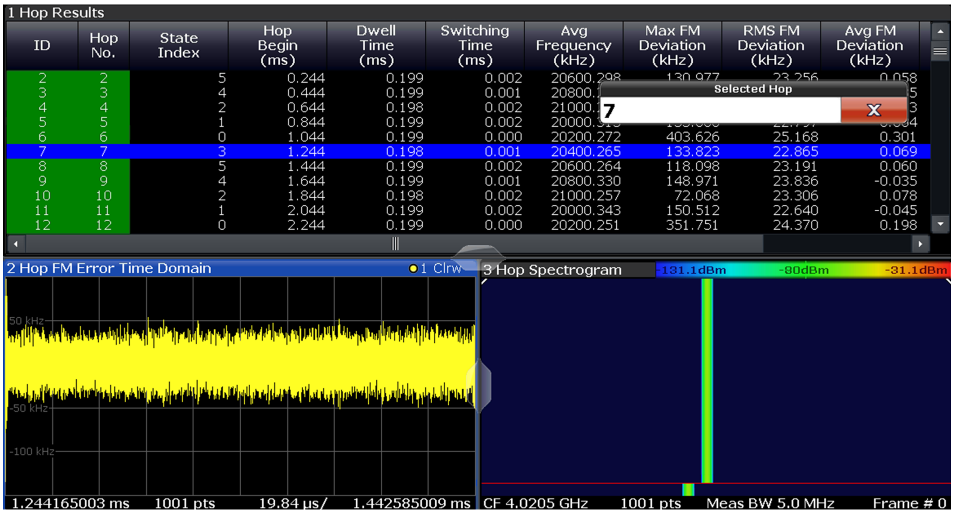


Figure 9-4: Results for a single hop

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 Config" 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.

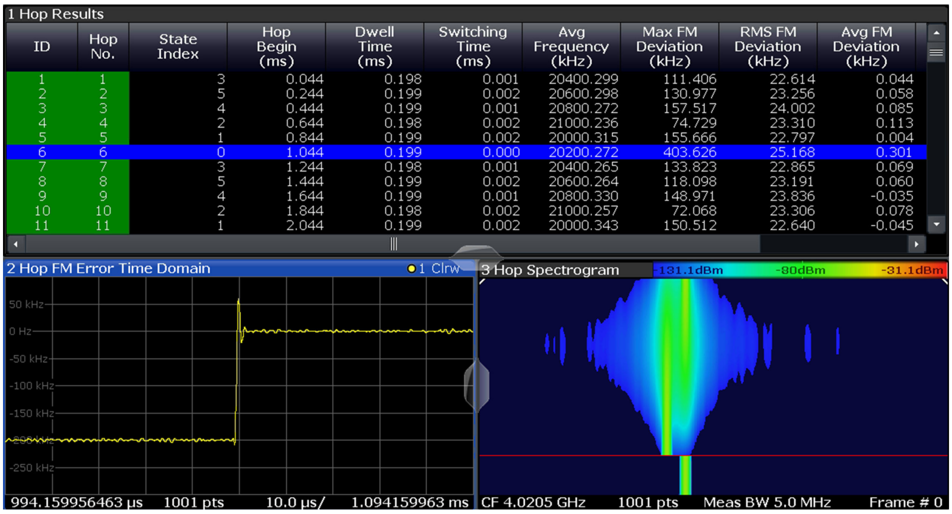


Figure 9-6: Hop displays for a result range at the beginning of the hop

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:

- An FSW with application firmware R&S FSW-K60: Transient Analysis +K60C (Chirped Transient Analysis) and bandwidth extension option FSW-B160
- A vector signal generator, e.g. R&S SMF

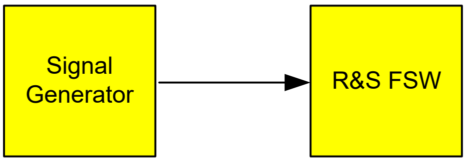


Figure 9-7: Test setup

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

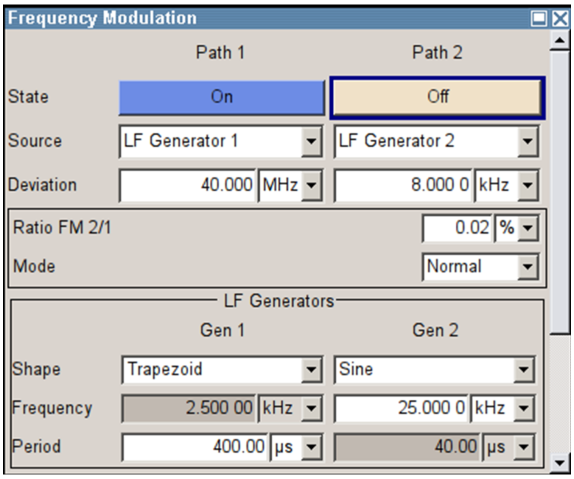


Figure 9-8: R&S® SMF frequency modulation configuration for chirped FM signal example

Settings in the R&S FSW Transient Analysis application

To detect chirps in an FM signal

1. Preset the FSW.
2. Set the center frequency to *4 GHz*.
3. Set the reference level to *-30 dBm*.
4. Select [MODE] and then "Transient Analysis".
5. Select "Signal Description > Signal Model" and select the signal model *Chirp*.
6. From the "Meas Config" 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.

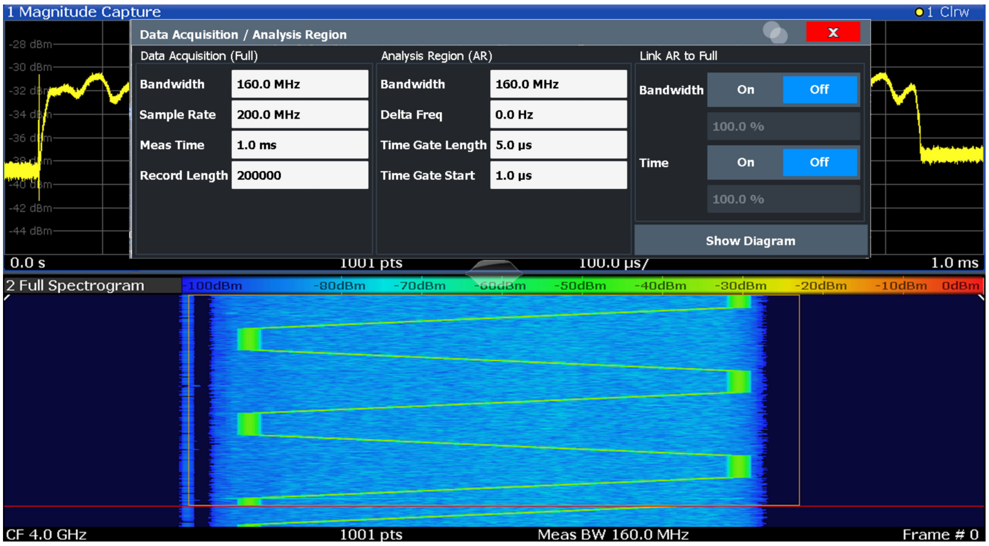


Figure 9-9: Configuring an analysis region for a chirped FM signal

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 Config" menu, select "Description" to check them.

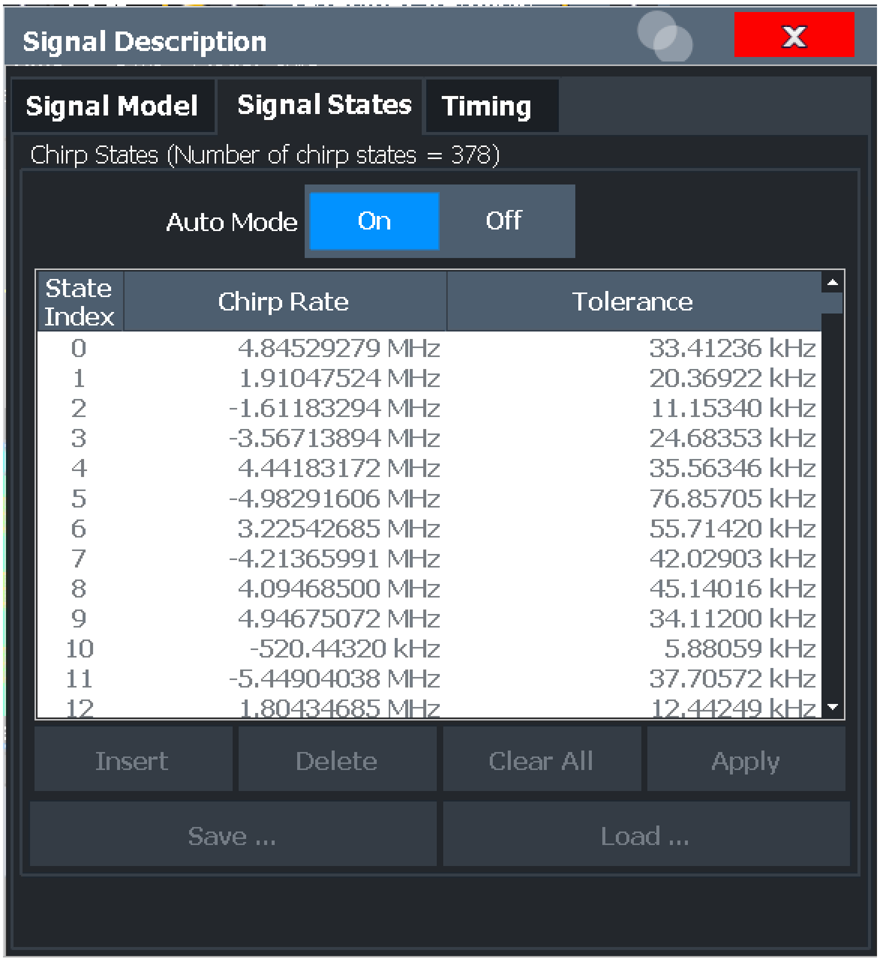


Figure 9-10: Detected chirp states

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 Config" 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.

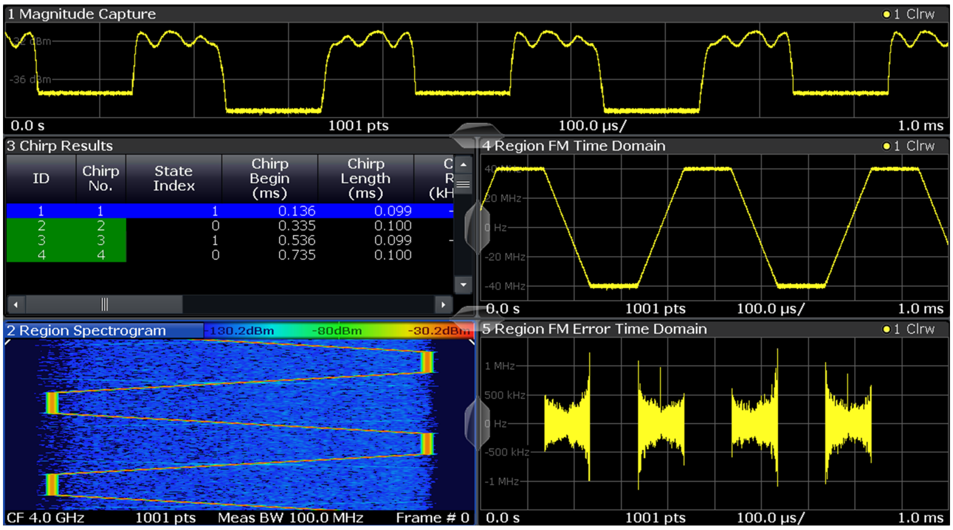


Figure 9-12: Typical display arrangement for FM linearity measurement

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 Config" 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) Press [Meas], then select "Chirp" to restrict the Frequency Deviation Time Domain display to a single chirp.
3. Enable trace averaging for the Frequency Deviation Time Domain display.
   a) Press [TRACE], then select "Trace Config".
   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 Config" 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.

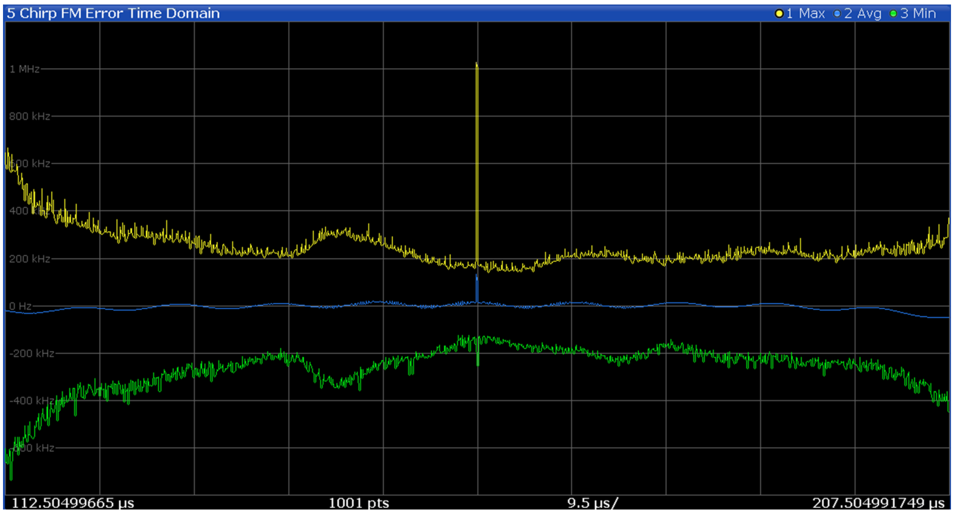


Figure 9-13: Min/average/max traces for chirp Frequency Deviation

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) Press [TRACE], then select "Trace Config".
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.

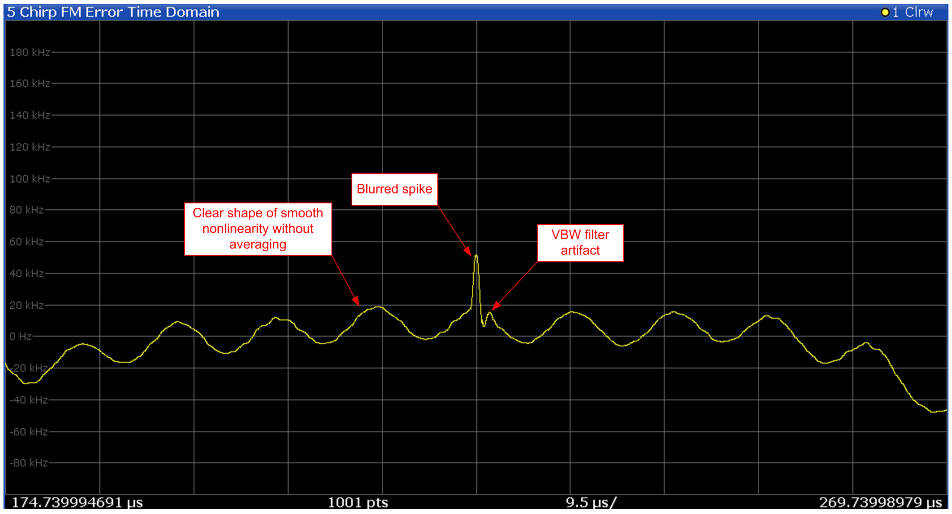


Figure 9-14: Chirp Frequency Deviation clear/write trace with 1% VBW filter

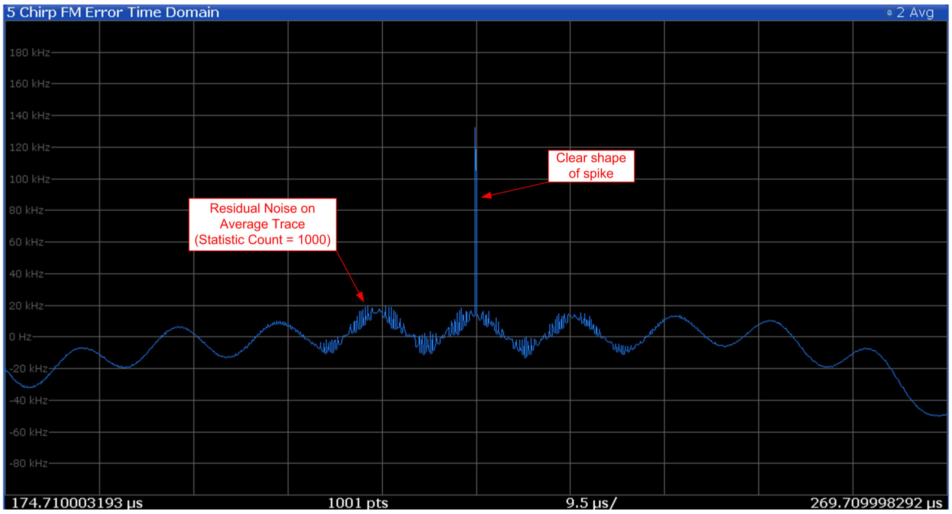


Figure 9-15: Chirp Frequency Deviation average trace (statistic count = 1000)

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....179
The desired hop/chirp states are not detected....179
Instead of one hop/chirp, several shorter hop/chirps of the same hop/chirp state are detected....179
Instead of one hop/chirp, several shorter hop/chirps of a different hop/chirp state are detected....179
One or more shorter hops/chirps are detected directly before or after the desired hop/chirp....179
Spectrogram of a selected hop/chirp is empty....179

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 86).

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 89).

Use a video filter with a smaller VBW (see "FM Video Bandwidth" on page 116).

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 89).

Use a video filter with a smaller VBW (see "FM Video Bandwidth" on page 116).

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 120).

Spectrogram of a selected hop/chirp is empty
Increase the result range length (see "Length" on page 127).

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 FSW has already been set up for remote operation in a network as described in the FSW 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 FSW 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

SCPI Recorder - automating tasks with remote command scripts

The R&S FSW Transient Analysis application also supports the SCPI Recorder functionality.

Using the SCPI Recorder functions, you can create a SCPI script directly on the instrument and then export the script for use on the controller. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, the instrument supports you by showing the corresponding command syntax for the current setting value.

For details see the "Network and Remote Operation" chapter in the FSW User Manual.

The following tasks specific to the Transient Analysis application are described here:

- Introduction...180
- Common suffixes...185
- Activating transient analysis...186
- Configuring transient analysis...190
- Capturing data and performing sweeps...254
- Analyzing transient effects..259
- Configuring an analysis interval and line (MSRA mode only)..............................381
- Configuring an analysis interval and line (MSRT mode only)..............................383
- Retrieving results..385
- Status reporting system...457
- Programming examples..457

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 FSW.

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 FSW 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.

- Numeric values 183
- Boolean 184
- Character data 185
- Character strings 185
- Block data 185

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 182.

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 FSW 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 FSW Transient Analysis application

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 16	Window (**in the currently selected channel**)

Suffix	Value range	Description
<t>	1 to 6	Trace
	1 to 8	Limit line

11.3 Activating transient analysis

Transient Analysis requires a special application on the FSW. A measurement is started immediately with the default settings.

INSTrument:CREate[:NEW]........ 186
INSTrument:CREate:REPLace........ 186
INSTrument:DELete........ 187
INSTrument:LIST?........ 187
INSTrument:REName........ 189
INSTrument[:SELect]........ 189
SYSTem:PRESet:CHANnel[:EXEC]........ 189

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

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

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 187.

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

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

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

Replaces a channel with another one.

Setting parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 187.

<ChannelName2>	String containing the name of the new channel. **Note**: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 187). Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".
Example:	`INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'` Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".
Usage:	Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

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

Setting parameters:

<ChannelName>	String containing the name of the channel you want to delete. A channel must exist to delete it.
Example:	`INST:DEL 'IQAnalyzer4'` Deletes the channel with the name 'IQAnalyzer4'.
Usage:	Setting only

INSTrument:LIST?

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

Return values:

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

Example:	`INST:LIST?`
	Result for 3 channels:
	`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage:	Query only

Table 11-2: Available channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> parameter	Default Channel name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
802.11ay (R&S FSW-K97)	EDMG	802.11ay EDMG
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
Bluetooth (R&S FSW-K8)	BTO	Bluetooth
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
Fast Spur Search (R&S FSW-K50)	SPUR	Spurious
GSM (R&S FSW-K10)	GSM	GSM
HRP UWB (R&S FSW-K149)	UWB	HRP UWB
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier "Group Delay" (R&S FSW-K17)	MCGD	MC "Group Delay"
NB-IoT (R&S FSW-K106)	NIOT	NB-IoT
Noise (R&S FSW-K30)	NOISE	Noise
5G NR (R&S FSW-K144)	NR5G	5G NR
OFDM VSA (R&S FSW-K96)	OFDMVSA	OFDM VSA
OneWeb (R&S FSW-K201)	OWEB	OneWeb
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
"Real-Time Spectrum"	RTIM	"Real-Time Spectrum"
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> parameter	Default Channel name*)
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
Verizon 5GTF Measurement Application (V5GTF, R&S FSW-K118)	V5GT	V5GT
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN
*) If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:

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

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

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

See also `INSTrument:CREate[:NEW]` on page 186.

For a list of available channel types see `INSTrument:LIST?` on page 187.

Parameters:

<ChannelType> **TA**
Transient Analysis application, R&S FSW–K60

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 85

11.4 Configuring transient analysis

The following commands are required to configure a measurement for transient analysis.

- Input/output settings....190
- Frequency....204
- Phase noise (FSW-K60P)....205
- Amplitude settings....210
- Triggering....214
- Data acquisition....221
- Bandwidth settings....223
- Selecting the signal model....224
- Configuring signal detection....225
- Configuring the measurement range....234
- Configuring demodulation....250
- Selecting the analysis region....251
- Adjusting settings automatically....254

11.4.1 Input/output settings

The FSW can analyze signals from different input sources (such as RF, power sensors etc.) and provide various types of output (such as noise or trigger signals). The following commands are required to configure data input and output.

- RF input....190
- Input from I/Q data files....194
- Configuring the 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000)....196
- Configuring the outputs....201
- Digital I/Q 40G streaming output commands....203

11.4.1.1 RF input

INPut:ATTenuation:PROTection:RESet....191
INPut:CONNector....191
INPut:COUPling....191
INPut:DPATh....192
INPut:FILTer:HPASs[:STATe]....192
INPut:FILTer:YIG[:STATe]....192

INPut:IMPedance....................193
INPut:SELect....................193
INPut:TYPE....................193

INPut:ATTenuation:PROTection:RESet

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

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

Example: `INP:ATT:PROT:RES`

INPut:CONNector <ConnType>

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

Parameters:

<ConnType>

RF
RF input connector

AIQI
Analog Baseband I connector
This setting is only available if the "Analog Baseband" interface (FSW-B71) is installed and active for input. It is not available for the FSW67 or FSW85.
For more information on the "Analog Baseband" interface (FSW-B71), see the FSW I/Q Analyzer and I/Q Input User Manual.

RFPRobe
Active RF probe

*RST: RF

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

INPut:COUPling <CouplingType>

Selects the coupling type of the RF input.

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 93

INPut:DPATh <DirectPath>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

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 94

INPut: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 FSW 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.)

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 94

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

Enables or disables the YIG filter.

Parameters:

<State> ON | OFF | 0 | 1

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 94

INPut:IMPedance <Impedance>

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

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 94

INPut:SELect <Source>

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

If no additional input options are installed, only RF input or file input is supported.

For FSW85 models with two RF input connectors, you must select the input connector to configure first using `INPut:TYPE`.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file
(selected by `INPut:FILE:PATH` on page 194)
Not available for Input2.

*RST: RF

Example: `INP:TYPE INP1`
For FSW85 models with two RF input connectors: selects the 1.00 mm RF input connector for configuration.
`INP:SEL RF`

Manual operation: See "Radio Frequency State" on page 93
See "I/Q Input File State" on page 95

INPut:TYPE <Input>

The command selects the input path.

Parameters:

<Input>

INPUT1
Selects RF input 1.
1 mm [RF Input] connector

INPUT2
Selects RF input 2.
For FSW85 models with two RF input connectors:
1.85 mm [RF2 Input] connector
For all other models: not available

*RST: INPUT1

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

Manual operation: See "Radio Frequency State" on page 93

11.4.1.2 Input from I/Q data files

The input for measurements can be provided from I/Q data files. The commands required to configure the use of such files are described here.

Useful commands for retrieving results described elsewhere:

- `INPut:SELect` on page 193

Remote commands exclusive to input from I/Q data files:

INPut:FILE:PATH... 194
MMEMory:LOAD:IQ:STReam... 195
MMEMory:LOAD:IQ:STReam:AUTO... 195
MMEMory:LOAD:IQ:STReam:LIST?.. 196
TRACe:IQ:FILE:REPetition:COUNt.. 196

INPut:FILE:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

Parameters:

<FileName> String containing the path and name of the source file.
The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be `.iq.tar`.
For `.mat` files, Matlab® v4 is assumed.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
Default unit: HZ

Example:
```
INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
```
Uses I/Q data from the specified file as input.

Example:
```
//Load an IQW file
INP:SEL:FIQ
INP:FILE:PATH 'C:\R_S\Instr\user\data.iqw'
//Define the sample rate
TRAC:IQ:SRAT 10MHz
//Define the measurement time
SENSe:SWEep:TIME  0.001001
//Start the measurement
INIT:IMM
```

Manual operation: See "Select I/Q data file" on page 95

MMEMory:LOAD:IQ:STReam <Channel>

Only available for files that contain more than one data stream from multiple channels: selects the data stream to be used as input for the currently selected channel.

Automatic mode (`MMEMory:LOAD:IQ:STReam:AUTO`) is set to OFF.

Parameters:

<Channel> String containing the channel name.

Example:
```
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'
MMEM:LOAD:IQ:STR 'Channel2'
```

MMEMory:LOAD:IQ:STReam:AUTO <State>

Only available for files that contain more than one data stream from multiple channels: automatically defines which data stream in the file is used as input for the channel.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The data stream specified by `MMEMory:LOAD:IQ:STReam` is used as input for the channel.

ON | 1
The first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

*RST: 1

MMEMory:LOAD:IQ:STReam:LIST?

Returns the available channels in the currently loaded input file.

Example:
```
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'
```

Usage: Query only

TRACe:IQ:FILE:REPetition:COUNt <RepetitionCount>

Determines how often the data stream is repeatedly copied in the I/Q data memory. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Parameters:
<RepetitionCount> integer

Example: `TRAC:IQ:FILE:REP:COUN 3`

Manual operation: See "File Repetitions" on page 96

11.4.1.3 Configuring the 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000)

The following commands are required to use the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000).

Remote commands exclusive to configuring the 2 GHz/ 5 GHz bandwidth extensions:

EXPort:WAVeform:DISPlayoff....197
SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe]....197
SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:STEP<st>[:STATe]....197
SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:DATE....198
SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:FALignment....198
SYSTem:COMMunicate:RDEVice:OSCilloscope:IDN....198
SYSTem:COMMunicate:RDEVice:OSCilloscope:LEDState....199
SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe]....199
SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe....199
SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip....200
SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?....200
SYSTem:COMMunicate:RDEVice:OSCilloscope:VFIRmware?....201
TRIGger[:SEQuence]:OSCilloscope:COUPling....201

EXPort:WAVeform:DISPlayoff <FastExport>

Enables or disables the display update on the oscilloscope during data acquisition with the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000).

Note that this command is **only executable by the oscilloscope**, not by the FSW.

As soon as the FSW-B2000/B5000 is activated, the display on the oscilloscope is turned off to improve performance during data export. As soon as the FSW closes the connection to the oscilloscope, the display is reactivated and the oscilloscope can be operated as usual. However, if the LAN connection is lost for any reason, the display of the oscilloscope remains deactivated. Use this command to re-activate it.

For details on the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000), see FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<FastExport> ON | OFF | 1 | 0

ON | 1: Disables the display update for maximum export speed.
OFF | 0: Enables the display update. The export is slower.

*RST: 1

SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe] <State>

Activates the optional 2 GHz/ 5 GHz bandwidth extension (R&S FSW-B2000/B5000).

Note: Manual operation on the connected oscilloscope, or remote operation other than by the FSW, is not possible while the B2000/B5000 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`

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:STEP<st>[:STATe] <State>

Performs the alignment of the oscilloscope itself and the oscilloscope ADC for the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000). The correction data for the oscilloscope (including the connection cable between the FSW and the oscilloscope) is recorded. As a result, the state of the alignment is returned.

Alignment is required only once after setup. If alignment was performed successfully, the alignment data is stored on the oscilloscope.

Thus, alignment need only be repeated if one of the following applies:

- A new oscilloscope is connected to the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW

- A new cable is used between the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW and the oscilloscope
- A power splitter is inserted between the "IF OUT 2 GHz/ IF OUT 5 GHz" connector of the FSW and the oscilloscope
- New firmware is installed on the oscilloscope or the FSW

Suffix:
<st> 1..n

Parameters:
<State> Returns the state of the second alignment step.

ON | 1
Alignment was successful.

OFF | 0
Alignment was not yet performed (successfully).

Example:
```
SYST:COMM:RDEV:OSC:ALIG:STEP?
//Result: 1
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:DATE <Date>

Returns the date of alignment of the "IF OUT 2 GHz/ IF OUT 5 GHz" to the oscilloscope for the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000).

Parameters:
<Date> Returns the date of alignment.

Example:
```
SYST:COMM:RDEV:OSC:ALIG:DATE?
//Result: 2014-02-28
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:ALIGnment:FALignment <State>

Performs a self-alignment on the oscilloscope before the B2000/B5000 alignment on the FSW.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
SYST:COMM:RDEV:OSC:ALIG:FAL ON
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:IDN <IDString>

Returns the identification string of the oscilloscope connected to the FSW.

Parameters:
<IDString>

Example:
```
SYST:COMM:RDEV:OSC:IDN?
//Result: Rohde&Schwarz,RTO,
1316.1000k14/200153,2.45.1.1
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:LEDState <Color>

Returns the state of the LAN connection to the oscilloscope for the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000).

Parameters:

<Color> OFF | SUCCessful | ERRor

SUCCessful
Connection to the instrument has been established successfully.

OFF
No instrument configured.

ERRor
Connection to the instrument could not be established.
Check the connection between the FSW and the oscilloscope, and make sure the IP address of the oscilloscope has been defined (see SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip on page 200).

Example:
```
SYST:COMM:RDEV:OSC:LEDS?
//Result: 'SUCC'
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:PSMode[:STATe] <State>

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the 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 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
```

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
```

SYSTem:COMMunicate:RDEVice:OSCilloscope:TCPip <Address>

Defines the TCPIP address or computer name of the oscilloscope connected to the FSW 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'`

SYSTem:COMMunicate:RDEVice:OSCilloscope:VDEVice?

Queries whether the connected instrument is supported by the 2 GHz/ 5 GHz bandwidth extension option(B2000/B5000).

For details see the 2 GHz bandwidth extension basics chapter in the FSW I/Q Analyzer and I/Q Input User Manual.

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/ 5 GHz bandwidth extension (B2000/B5000) 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

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

Manual operation: See "Coupling" on page 110

11.4.1.4 Configuring the outputs

The following commands are required to provide output from the FSW.

Configuring trigger input/output is described in Chapter 11.4.5.2, "Configuring the trigger output", on page 219.

DIAGnostic:SERVice:NSOurce....................202
OUTPut:IF[:SOURce]....................202
OUTPut:IF:IFFRequency....................202
SYSTem:SPEaker:VOLume....................203

DIAGnostic:SERVice:NSOurce <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the FSW on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 98

OUTPut:IF[:SOURce] <Source>

Defines the type of signal available at one of the output connectors of the FSW.

Parameters:

<Source>

IF
The measured IF value is available at the IF/VIDEO/DEMOD output connector.
The frequency at which the IF value is provided is defined using the `OUTPut:IF:IFFRequency` command.

IF2
The measured IF value is available at the "IF OUT 2 GHz/ IF OUT 5 GHz" output connector at a frequency of 2 GHz.
This setting is only available if the "IF OUT 2 GHz/ IF OUT 5 GHz" connector or the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000) is available.
It is automatically set if the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000) is installed and active.

*RST: IF

Example: `OUTP:IF VID`
Selects the video signal for the IF/VIDEO/DEMOD output connector.

Manual operation: See "Data Output" on page 97

OUTPut:IF:IFFRequency <Frequency>

Defines the frequency for the IF output of the FSW. The IF frequency of the signal is converted accordingly.

Is available in the time domain and if the IF/VIDEO/DEMOD output is configured for IF.

Parameters:

<Frequency> *RST: 50.0 MHz
Default unit: HZ

Manual operation: See "Data Output" on page 97

SYSTem:SPEaker:VOLume <Volume>

Defines the volume of the built-in loudspeaker for demodulated signals. This setting is maintained for all applications.

The command is available in the time domain in Spectrum mode and in Analog Modulation Analysis mode.

Parameters:

<Volume> Percentage of the maximum possible volume.

Range: 0 to 1
*RST: 0.5

Example: `SYST:SPE:VOL 0`
Switches the loudspeaker to mute.

11.4.1.5 Digital I/Q 40G streaming output commands

The following commands are only available if the Digital I/Q 40G Streaming Output option (FSW-B517/-B1017) is installed.

For details see the FSW I/Q Analyzer and I/Q Input User Manual.

OUTPut:IQHS:CDEVice?.....203
OUTPut:IQHS:MARKer.....203
OUTPut:IQHS:SRATe?.....204
OUTPut:IQHS[:STATe].....204

OUTPut:IQHS:CDEVice?

Returns a comma-separated list of information on the instrument connected to the QSFP+ connector, if available.

Example: `OUTP:IQHS:CDEV?`
Result:
`1,IQW,1525.7551k05,900987,DIG IQ 40G A,tcpip::computername::hislip0,1.9,1.1,1,1`

Usage: Query only

Manual operation: See "Connected Instrument" on page 101

OUTPut:IQHS:MARKer

Inserts marker information to the data stream during a running I/Q data output recording. Useful to mark a specific event during the measurement that you detect in the result window, for example. Then you can search for the marker information in the output data to analyze the effects at that time.

Usage: Event

Manual operation: See "Insert Marker" on page 101

OUTPut:IQHS:SRATe?

Returns the currently used sample rate to transfer data via the Digital I/Q 40G Streaming Output interface.

Usage: Query only

Manual operation: See "Output Settings Information" on page 101

OUTPut:IQHS[:STATe] <State>

Enables or disables a digital output stream to the optional QSFP+ connector, if available.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Digital I/Q 40G Streaming Out" on page 101

11.4.2 Frequency

[SENSe:]FREQuency:CENTer 204
[SENSe:]FREQuency:CENTer:STEP 205
[SENSe:]FREQuency:OFFSet 205

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

Parameters:

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

*RST: fmax/2
Default unit: Hz

Example:

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

Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency" on page 102

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

Defines the center frequency step size.

Parameters:

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

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

Example: //Set the center frequency to 110 MHz.

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

Manual operation: See "Center Frequency Stepsize" on page 102

[SENSe:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

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

Note: In MSRA/MSRT mode, the setting command is only available for the MSRA/MSRT primary application. For MSRA/MSRT secondary applications, only the query command is available.

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 102

11.4.3 Phase noise (FSW-K60P)

CALCulate<n>:CHRDetection:PNOise:FREQuency:STARt....206
CALCulate<n>:CHRDetection:PNOise:FREQuency:STOP....206
CALCulate<n>:HOPDetection:PNOise:FREQuency:STARt....206
CALCulate<n>:HOPDetection:PNOise:FREQuency:STOP....206
CALCulate<n>:CHRDetection:PNOise:REFerence....207
CALCulate<n>:HOPDetection:PNOise:REFerence....207
CALCulate<n>:CHRDetection:PNOise:LENGth....208
CALCulate<n>:HOPDetection:PNOise:LENGth....208
CALCulate<n>:CHRDetection:PNOise:OFFSet:BEGin....208
CALCulate<n>:CHRDetection:PNOise:OFFSet:END....209
CALCulate<n>:HOPDetection:PNOise:OFFSet:BEGin....209
CALCulate<n>:HOPDetection:PNOise:OFFSet:END....209

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 122

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 122

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 122

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 122

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 208 and `CALCulate<n>:CHRDetection:PNOise:OFFSet:END` on page 209).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC4:CHRD:PNO:REF EDGE`

Manual operation: See "Reference" on page 120

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 209 and `CALCulate<n>:HOPDetection:PNOise:OFFSet:END` on page 209).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: CALC4:HOPD:PNO:REF EDGE

Manual operation: See "Reference" on page 120

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 207).

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 120

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 207).

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 120

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 207).

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 120

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 207).

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 120

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 207).

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 120

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 207).

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 120

11.4.4 Amplitude settings

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

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 191
- `DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 343

Remote commands exclusive to amplitude settings:

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel.....210
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet.....210
INPut:ATTenuation.....211
INPut:ATTenuation:AUTO.....211
INPut:GAIN:STATe.....212
INPut:GAIN[:VALue].....212
INPut:EATT.....213
INPut:EATT:AUTO.....213
INPut:EATT:STATe.....213

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

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

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

Suffix:

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

Parameters:

<ReferenceLevel> The unit is variable.

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

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

Manual operation: See "Reference Level" on page 104

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

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

Suffix:

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

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 104

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

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

Parameters:

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

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

Manual operation: See "Attenuation Mode / Value" on page 104

INPut:ATTenuation:AUTO <State>

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

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 104

INPut:GAIN:STATe <State>

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

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

For FSW85 models, no preamplifier is available.

If option R&S FSW-B22 is installed, the preamplifier is only active below 7 GHz.

If option R&S FSW-B24 is installed, the preamplifier is active for all frequencies.

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 105

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 212).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> For all FSW models except for FSW85, the following settings are available:
15 dB and 30 dB
All other values are rounded to the nearest of these two.
30 dB
For older FSW43/FSW50/FSW67 models, the input signal is always ampilfied by about 30 dB when the preamplifier is active.
For FSW85 models, no preamplifier is available.

Default unit: DB

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 105

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 213).

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

Parameters:

<Attenuation> attenuation in dB

Range: see specifications document
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

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

Manual operation: See "Using Electronic Attenuation" on page 105

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 105

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 105

11.4.5 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 106.

*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

- Configuring the triggering conditions..214
- Configuring the trigger output...219

11.4.5.1 Configuring the triggering conditions

The following commands are required to configure triggered measurements.

TRIGger[:SEQuence]:DTIMe..214
TRIGger[:SEQuence]:HOLDoff[:TIME]...214
TRIGger[:SEQuence]:IFPower:HOLDoff...215
TRIGger[:SEQuence]:IFPower:HYSTeresis..215
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]......................................215
TRIGger[:SEQuence]:LEVel:IFPower..216
TRIGger[:SEQuence]:LEVel:IQPower...216
TRIGger[:SEQuence]:LEVel:RFPower...216
TRIGger[:SEQuence]:SLOPe..217
TRIGger[:SEQuence]:SOURce..217

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 110

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 110

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 111

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 111

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)
(Not available for FSW85 models with two RF input connectors.)
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 110

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 specifications document.
*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 specifications document.

*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources, you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

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 111

TRIGger[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note on external triggers:

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

Parameters:

<Source> **IMMediate**
Free Run

EXTernal
Trigger signal from the "Trigger Input" connector.
If the optional 2 GHz bandwidth extension (B2000/B5000) is installed and active, this parameter activates the "Ch3" input connector on the oscilloscope. Then the FSW 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 FSW 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 FSW triggers when the signal fed into the "EXT TRIGGER INPUT" connector on the oscilloscope meets or exceeds the specified trigger level.

EXT2
Trigger signal from the "Trigger Input/Output" connector.
For FSW85 models, Trigger 2 is not available due to the second RF input connector on the front panel. The trigger signal is taken from the "Trigger Input/Output" connector on the rear panel.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the "TRIGGER 3 INPUT/ OUTPUT" connector.
Note: Connector must be configured for "Input".

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.

*RST: IMMediate

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

Manual operation: See "Trigger Source" on page 107
See "Free Run" on page 107
See "External Trigger 1/2/3" on page 108
See "External Channel 3" on page 108
See "External Analog" on page 108
See "IF Power" on page 109
See "I/Q Power" on page 109
See "RF Power" on page 109

11.4.5.2 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 FSW.

OUTPut:TRIGger<tp>:DIRection....219
OUTPut:TRIGger<tp>:LEVel....219
OUTPut:TRIGger<tp>:OTYPe....220
OUTPut:TRIGger<tp>:PULSe:IMMediate....220
OUTPut:TRIGger<tp>:PULSe:LENGth....220

OUTPut:TRIGger<tp>:DIRection <Direction>

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

Suffix:

<tp> Selects the used trigger port.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear panel)

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 98

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.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:

<Level> **HIGH**
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 99

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.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:

<OutputType>
DEVice
Sends a trigger signal when the FSW 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

Manual operation: See "Output Type" on page 99

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.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Manual operation: See "Send Trigger" on page 100

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.
2 = trigger port 2 (front)
(Not available for FSW85 models with two RF input connectors.)
3 = trigger port 3 (rear)

Parameters:

<Length> Pulse length in seconds.
Default unit: S

Example: `OUTP:TRIG2:PULS:LENG 0.02`

Manual operation: See "Pulse Length" on page 99

11.4.6 Data acquisition

You must define how much and how data is captured from the input signal.

[SENSe:]BANDwidth:DEMod....221
[SENSe:]BWIDth:DEMod....221
[SENSe:]FREQuency:SPAN....221
[SENSe:]MTIMe....221
[SENSe:]RLENgth....222
[SENSe:]SRATe....222
TRACe:IQ:LCAPture....223

[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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Measurement Bandwidth" on page 112

[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 112

[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 222).

Parameters:

<MeasTime> Range: 18.75 us to 1.298 ms
*RST: 350 us
Default unit: S

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Measurement Time" on page 113

[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 221).

Parameters:

<SampleCount> The maximum record length is limited only by the available memory.
*RST: 140000

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Record Length" on page 113

[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 221). For information on supported sample rates and bandwidths see the specifications document.

Parameters:

<SampleRate> Range: 100 Hz to depends on installed options
*RST: maximum allowed
Default unit: HZ

Example: `SRATe 100e6`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Sample Rate" on page 113

TRACe:IQ:LCAPture <State>

The long capture buffer provides functionality to use the full I/Q memory depth of the FSW 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 FSW. 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 FSW is used. The available I/Q memory capacity is shared by all measurement channels.

Manual operation: See "Long Capture Buffer" on page 113

11.4.7 Bandwidth settings

Useful commands for bandwidth settings described elsewhere:

- `[SENSe<ip>:]SWEep:FFT:WINDow:TYPE` on page 354
- `CALCulate<n>:SGRam:TRESolution` on page 351
- `CALCulate<n>:SGRam:TRESolution:AUTO` on page 352
- `[SENSe:]MTIMe` on page 221
- `[SENSe:]BWIDth:DEMod` on page 221
- `[SENSe:]DEMod:FMVF:TYPE` on page 250

Remote commands exclusive to bandwidth settings:

[SENSe:]BWIDth[:WINDow<n>]:RESolution:AUTO....223
[SENSe:]BANDwidth[:WINDow<n>]:RESolution:AUTO....223
[SENSe:]BWIDth[:WINDow<n>]:RESolution....224
[SENSe:]BANDwidth[:WINDow<n>]:RESolution....224

[SENSe:]BWIDth[:WINDow<n>]:RESolution:AUTO <Bandwith Resolution Auto>
[SENSe:]BANDwidth[:WINDow<n>]:RESolution:AUTO <Bandwith Resolution Auto>

Switches the RBW between "Auto" and "Manual". The "Auto" mode automatically selects an optimal RBW.

Suffix:
<n> 1..n

Parameters:
<Bandwith Resolution Auto> AUTO | MANual

AUTO
Selects automatically an optimal RBW.

MANual
Enables manual input for the RBW.

Example: //Enable auto mode
`BAND:WIND2:RES:AUTO AUTO`

Manual operation: See "Frequency Resolution Mode" on page 141

[SENSe:]BWIDth[:WINDow<n>]:RESolution <Bandwidth Resolution>
[SENSe:]BANDwidth[:WINDow<n>]:RESolution <Bandwidth Resolution>

Sets the bandwidth resolution.

Suffix:
<n> 1..n

Parameters:
<Bandwidth Resolution> refer to specifications document
*RST: 5.12 MHz
Default unit: Hz

Example: //Set RBW to 1 MHz
`BAND:WIND2:RES 1000000`

Manual operation: See "RBW" on page 115

11.4.8 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 FSW-K60C/-K60H are installed.

[SENSe:]SIGNal:MODel.....224

[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 FSW-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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Hop Model / Chirp Model" on page 86

11.4.9 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 FSW-K60C/-K60H are installed.

- Chirp states.....225
- Hop states.....229

11.4.9.1 Chirp states

CALCulate<n>:CHRDetection:LENGth:AUTO.....225
CALCulate<n>:CHRDetection:LENGth:MAXimum.....226
CALCulate<n>:CHRDetection:LENGth:MINimum.....226
CALCulate<n>:CHRDetection:STATes:AUTO.....226
CALCulate<n>:CHRDetection:STATes[:DATA].....227
CALCulate<n>:CHRDetection:STATes:NUMBer?.....228
CALCulate<n>:CHRDetection:STATes:TABLe:LOAD.....228
CALCulate<n>:CHRDetection:STATes:TABLe:SAVE.....228
CALCulate<n>:CHRDetection:DETection.....228

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Auto Mode" on page 91

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 91

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 91

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Hop / Chirp Settings" on page 88

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 226 and the chirp detection mode defined using `CALCulate<n>:CHRDetection:DETection` on page 228:

	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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Frequency Offset / Chirp Rate" on page 88
See "Tolerance" on page 89

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 88

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 89

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 89
See "Saving the signal state table to a file" on page 89

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 88

11.4.9.2 Hop states

CALCulate<n>:HOPDetection:DWELl:AUTO....229
CALCulate<n>:HOPDetection:DWELl:MAXimum....229
CALCulate<n>:HOPDetection:DWELl:MINimum....230
CALCulate<n>:HOPDetection:STATes:AUTO....230
CALCulate<n>:HOPDetection:STATes[:DATA]....230
CALCulate<n>:HOPDetection:STATes:NUMBer?....231
CALCulate<n>:HOPDetection:STATes:TABLe:ADD....231
CALCulate<n>:HOPDetection:STATes:TABLe:LOAD....231
CALCulate<n>:HOPDetection:STATes:TABLe:NSTates?....232
CALCulate<n>:HOPDetection:STATes:TABLe:OFFSet....232
CALCulate<n>:HOPDetection:STATes:TABLe:REPLace....232
CALCulate<n>:HOPDetection:STATes:TABLe:SAVE....233
CALCulate<n>:HOPDetection:STATes:TABLe:STARt?....233
CALCulate<n>:HOPDetection:STATes:TABLe:STEP?....233
CALCulate<n>:HOPDetection:STATes:TABLe:TOLerance....233

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Auto Mode" on page 91

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 91

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Min Dwell Time / Max Dwell Time" on page 91

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Hop / Chirp Settings" on page 88

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Frequency Offset / Chirp Rate" on page 88
See "Tolerance" on page 89

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 88

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 90

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 89

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 88
See "No of States" on page 90

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 90

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 90

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 89
See "Saving the signal state table to a file" on page 89

CALCulate<n>:HOPDetection:STATes:TABLe:STARt?

Suffix:
<n> irrelevant

Return values:
<Start>

Usage: Query only

Manual operation: See "Start Frequency" on page 89

CALCulate<n>:HOPDetection:STATes:TABLe:STEP?

Suffix:
<n> irrelevant

Return values:
<Step>

Usage: Query only

Manual operation: See "Step Size" on page 90

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 90

11.4.10 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 FSW-K60C/-K60H are installed.

CALCulate<n>:CHRDetection:COMPensation[:STATe]....235
CALCulate<n>:CHRDetection:FDEViation:LENGth....235
CALCulate<n>:CHRDetection:FDEViation:OFFSet:BEGin....235
CALCulate<n>:CHRDetection:FDEViation:OFFSet:END....236
CALCulate<n>:CHRDetection:FDEViation:REFerence....236
CALCulate<n>:CHRDetection:FMTolerance....237
CALCulate<n>:CHRDetection:FREQuency:LENGth....237
CALCulate<n>:CHRDetection:FREQuency:OFFSet:BEGin....237
CALCulate<n>:CHRDetection:FREQuency:OFFSet:END....238
CALCulate<n>:CHRDetection:FREQuency:REFerence....238
CALCulate<n>:CHRDetection:PDEViation:LENGth....239
CALCulate<n>:CHRDetection:PDEViation:OFFSet:BEGin....239
CALCulate<n>:CHRDetection:PDEViation:OFFSet:END....239
CALCulate<n>:CHRDetection:PDEViation:REFerence....240
CALCulate<n>:CHRDetection:PMTolerance....240
CALCulate<n>:CHRDetection:POWer:LENGth....241
CALCulate<n>:CHRDetection:POWer:OFFSet:BEGin....241
CALCulate<n>:CHRDetection:POWer:OFFSet:END....241
CALCulate<n>:CHRDetection:POWer:REFerence....242
CALCulate<n>:HOPDetection:COMPensation[:STATe]....242
CALCulate<n>:HOPDetection:FDEViation:LENGth....243
CALCulate<n>:HOPDetection:FDEViation:OFFSet:BEGin....243
CALCulate<n>:HOPDetection:FDEViation:OFFSet:END....243
CALCulate<n>:HOPDetection:FDEViation:REFerence....244
CALCulate<n>:HOPDetection:FMTolerance....244
CALCulate<n>:HOPDetection:FREQuency:LENGth....245
CALCulate<n>:HOPDetection:FREQuency:OFFSet:BEGin....245
CALCulate<n>:HOPDetection:FREQuency:OFFSet:END....245
CALCulate<n>:HOPDetection:FREQuency:REFerence....246
CALCulate<n>:HOPDetection:PCOHerent[:STATe]....246
CALCulate<n>:HOPDetection:PDEViation:LENGth....247
CALCulate<n>:HOPDetection:PDEViation:OFFSet:BEGin....247
CALCulate<n>:HOPDetection:PDEViation:OFFSet:END....247
CALCulate<n>:HOPDetection:PDEViation:REFerence....248
CALCulate<n>:HOPDetection:PMTolerance....248
CALCulate<n>:HOPDetection:POWer:LENGth....249

CALCulate<n>:HOPDetection:POWer:OFFSet:BEGin..249
CALCulate<n>:HOPDetection:POWer:OFFSet:END...249
CALCulate<n>:HOPDetection:POWer:REFerence...249

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 117

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 240).

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 120

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 236).

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 120

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 236).

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 120

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 237 and CALCulate<n>:CHRDetection:FREQuency:OFFSet:END on page 238).

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 394).

PMSettling
The measurement range starts at the PM settling point (see [SENSe:]HOP:PMSettling:PMSPoint? on page 404).

Example: `CALC:CHRD:FDEV:REF CENT`

Manual operation: See "Reference" on page 120

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 118

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 242).

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 120

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 238).

Suffix:
<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:CHRD:FREQ:OFFS:BEG 3e-6`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Offset Begin / Offset End" on page 120

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 238).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Offset Begin / Offset End" on page 120

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 237 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 238).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC:CHRD:FREQ:REF CENTer`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Reference" on page 120

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 240).

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 120

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 236).

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 120

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 236).

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 120

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 237 and `CALCulate<n>:CHRDetection:FREQuency:OFFSet:END` on page 238).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC:CHRD:PDEV:REF CENT`

Manual operation: See "Reference" on page 120

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 118

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 242).

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Length" on page 120

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 242).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:CHRD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 120

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 242).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:CHRD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 120

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 237 and CALCulate<n>:CHRDetection:FREQuency:OFFSet:END on page 238).

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 394).

PMSettling
The measurement range starts at the PM settling point (see [SENSe:]HOP:PMSettling:PMSPoint? on page 404).

Example: `CALC:CHRD:POW:REF EDGE`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Reference" on page 120

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 117

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 244).

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 120

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 244).

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 120

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 244).

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 120

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 245 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 245).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC:HOPD:FDEV:REF CENT`

Manual operation: See "Reference" on page 120

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 118

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 246).

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 120

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 246).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:HOPD:FREQ:OFFS:BEG 3e-6`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset Begin / Offset End" on page 120

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 246).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:HOPD:FREQ:OFFS:END 3e-6`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset Begin / Offset End" on page 120

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 245 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 245).

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 394).

PMSettling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC:HOPD:FREQ:REF CENTer`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Reference" on page 120

CALCulate<n>:HOPDetection:PCOHerent[:STATe] <State>

Turns on the coherent phase deviation measurement.

Is only available for the FSW-K60H option.

For details see "Coherent phase deviation measurement" on page 52.

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 118

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 248).

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 120

CALCulate<n>:HOPDetection:PDEViation:OFFSet:BEGin <Time>

Defines the beginning of the measurement range for phase deviation results as an off-set in seconds from the hop start. This command is only available if the reference is `EDGE` (see `CALCulate<n>:HOPDetection:PDEViation:REFerence` on page 248).

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 120

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 248).

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 120

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 245 and `CALCulate<n>:HOPDetection:FREQuency:OFFSet:END` on page 245).

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 394).

PMSEttling
The measurement range starts at the PM settling point (see `[SENSe:]HOP:PMSettling:PMSPoint?` on page 404).

Example: `CALC:HOPD:PDEV:REF CENT`

Manual operation: See "Reference" on page 120

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 118

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 249).

Suffix:

<n> irrelevant

Parameters:

<Percent> Range: 0 to 100
*RST: 75

Example: `CALC:HOPD:POW:LENG 2e-4`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Length" on page 120

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 249).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 120

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 249).

Suffix:

<n> irrelevant

Parameters:

<Time> Default unit: S

Example: `CALC:HOPD:POW:OFFS 50`

Manual operation: See "Offset Begin / Offset End" on page 120

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 245 and CALCulate<n>:HOPDetection:FREQuency:OFFSet:END on page 245).

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 394).

PMSettling
The measurement range starts at the PM settling point (see [SENSe:]HOP:PMSettling:PMSPoint? on page 404).

Example: `CALC:HOPD:POW:REF EDGE`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Reference" on page 120

11.4.11 Configuring demodulation

[SENSe:]DEMod:FMVF:TYPE....................250

[SENSe:]DEMod:FMVF:TYPE <Filter>

Defines an additional filter applied after demodulation to filter out unwanted signals, or correct pre-emphasized input signals.

Parameters:
<Filter> Percentage of the analysis (demodulation) bandwidth

Range: 0.1 to 100
*RST: 100 (no filter applied)

Example: `SENS:DEM:FMVF:TYPE 89`

Manual operation: See "FM Video Bandwidth" on page 116

11.4.12 Selecting the analysis region

The analysis region determines which data is displayed on the screen (see also Chapter 4.6, "Analysis region", on page 26).

CALCulate<n>:AR:FREQuency:BANDwidth....251
CALCulate<n>:AR:FREQuency:DELTa....251
CALCulate<n>:AR:FREQuency:PERCent....252
CALCulate<n>:AR:FREQuency:PERCent:STATe....252
CALCulate<n>:AR:TIME:LENGth....252
CALCulate<n>:AR:TIME:PERCent....253
CALCulate<n>:AR:TIME:PERCent:STATe....253
CALCulate<n>:AR:TIME:STARt....253

CALCulate<n>:AR:FREQuency:BANDwidth <Frequency>

Suffix:

<n> 1..n
irrelevant

Parameters:

<Frequency> Default unit: HZ

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Analysis Bandwidth" on page 114

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Delta Frequency" on page 114

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 251.

Suffix:

<n> 1..n
irrelevant

Parameters:

<BWPercent> percentage of the full analysis bandwidth

Manual operation: See "Linked analysis bandwidth" on page 115

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 252).

Suffix:

<n> 1..n
irrelevant

Parameters:

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

Manual operation: See "Linked analysis bandwidth" on page 115

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Time Gate Length" on page 114

CALCulate<n>:AR:TIME:PERCent <TimePercent>

For CALCulate<n>:AR:TIME:PERCent:STATeTRUE,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 253.

Suffix:

<n>	1..n irrelevant

Parameters:

<TimePercent>	percentage of the full measurement time

Manual operation: See "Linked analysis time span" on page 115

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 253).

Suffix:

<n>	1..n irrelevant

Parameters:

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

Manual operation: See "Linked analysis time span" on page 115

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Time Gate Start" on page 114

11.4.13 Adjusting settings automatically

The following remote commands are required to adjust settings automatically in a remote environment.

[SENSe:]ADJust:LEVel....................254

[SENSe:]ADJust:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The FSW is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Example: `ADJ:LEV`

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 124

11.5 Capturing data and performing sweeps

When you activate a Real-Time Spectrum measurement channel, a measurement is started immediately with the default settings. However, you can start and stop new measurements at any time.

Capturing data in MSRA/MSRT mode

In MSRA/MSRT mode, I/Q data from the input signal is captured and stored by the MSRA/MSRT primary.

For details on the MSRA operating mode see the FSW MSRA User Manual.

For details on the MSRT operating mode see the FSW Real-Time Spectrum Application and MSRT Operating Mode User Manual.

Useful commands for configuring and performing sweeps described elsewhere:

- `[SENSe:]MTIMe` on page 221
- `[SENSe:]SWEep:COUNt` on page 349
- `[SENSe:]SWEep:COUNt:CURRent?` on page 350
- `[SENSe:]MEASure:POINts` on page 349

Remote commands exclusive to configuring and performing sweeps:

ABORt....................255
INITiate<n>:CONMeas....................255
INITiate<n>:CONTinuous....................256
INITiate<n>[:IMMediate]....................256
INITiate<n>:REFResh....................257
INITiate:SEQuencer:REFResh[:ALL]....................257
INITiate:SEQuencer:ABORt....................257

INITiate:SEQuencer:IMMediate....257
INITiate:SEQuencer:MODE....258
INITiate<n>:SYNC....258
SYSTem:SEQuencer....259

ABORt

Aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see Remote control via SCPI.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONMeas

Restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to INITiate<n>[:IMMediate], this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:
<n> irrelevant

Usage: Asynchronous command

Manual operation: See "Continue Single Sweep" on page 123

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

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

For details on synchronization see Remote control via SCPI.

If the measurement mode is changed for a channel while the Sequencer is active (see INITiate:SEQuencer:IMMediate on page 257), the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

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

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

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

Manual operation: See "Continuous Sweep / Run Cont" on page 122

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Usage: Asynchronous command

Manual operation: See "Single Sweep / Run Single" on page 122

INITiate<n>:REFResh

Updates the current measurement results to reflect the current measurement settings.

No new I/Q data is captured. Thus, measurement settings apply to the I/Q data currently in the capture buffer.

The command applies exclusively to I/Q measurements. It requires I/Q data.

Suffix:
<n> irrelevant

Example: `INIT:REFR`
Updates the IQ measurement results.

Usage: Asynchronous command

Manual operation: See "Refresh (MSRA/MSRT only)" on page 123

INITiate:SEQuencer:REFResh[:ALL]

Is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` `SYST:SEQ:OFF`) and only in MSRA/MSRT mode.

The data in the capture buffer is re-evaluated by all active MSRA/MSRT secondary applications.

Example: `SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all channels.

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 257.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Its effect is similar to the INITiate<n>[:IMMediate] command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see SYSTem:SEQuencer on page 259).

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using `*OPC`, `*OPC?` or `*WAI`, use `SINGle` Sequencer mode.

Parameters:

<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

INITiate<n>:SYNC

Suffix:

<n> 1..n

Example: `INIT:IMM;*WAI`
R&S FSW Transient Analysis application performs a sweep and program is synchronized (waits) on completion of the sweep.
`CALC:AR:FREQ:BAND 10 MHZ`
R&S FSW Transient Analysis application starts re-calculating results with a new analysis region bandwidth, but program does not wait until completion of the new calculation, it continues immediately
`INIT:SYNC`
The program now waits until any pending auto-refresh calculations are finished before continuing.

Usage: Event

SYSTem:SEQuencer <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

A detailed programming example is provided in the "Operating Modes" chapter in the FSW User Manual.

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

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

11.6 Analyzing transient effects

The following commands are required to analyze transient effects in a measured signal.

- Configuring the result display......260
- Defining the evaluation basis......269
- Configuring the result range......270
- Selecting the hop/chirp......272
- Table configuration......273
- Configuring parameter distribution displays......293
- Configuring parameter trends......303
- Configuring the Y-Axis scaling and units......342
- Configuring traces......345
- Configuring spectrograms......350
- Configuring color maps......354
- Working with markers remotely......356
- Zooming into the display......378

11.6.1 Configuring the result display

The commands required to configure the screen display in a remote environment are described here.

- General window commands......260
- Working with windows in the display......261

11.6.1.1 General window commands

The following commands are required to configure general window layout, independent of the application.

DISPlay:FORMat......260
DISPlay[:WINDow<n>]:SIZE......261
DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect......261

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format>

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

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

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

Maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 266).

Suffix:

<n> Window

Parameters:

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

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

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

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`

11.6.1.2 Working with windows in the display

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

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

(See `INSTrument[:SELect]` on page 189).

LAYout:ADD[:WINDow]? 262
LAYout:CATalog[:WINDow]? 264
LAYout:IDENtify[:WINDow]? 264
LAYout:MOVE[:WINDow] 265
LAYout:REMove[:WINDow] 265
LAYout:REPLace[:WINDow] 265
LAYout:SPLitter 266
LAYout:WINDow<n>:ADD? 267
LAYout:WINDow<n>:IDENtify? 268
LAYout:WINDow<n>:REMove 268
LAYout:WINDow<n>:REPLace 268

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

Adds a window to the display in the active channel.

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

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

Query parameters:

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

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

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

Return values:

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

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 70
See "Spectrogram" on page 71
See "RF Power Time Domain" on page 72
See "FM Time Domain" on page 73
See "I/Q Time Domain" on page 73
See "Frequency Deviation Time Domain" on page 73
See "PM Time Domain" on page 74
See "PM Time Domain (Wrapped)" on page 75
See "Phase Deviation Time Domain" on page 75
See "Chirp Rate Time Domain" on page 76
See "Hop/Chirp Results Table" on page 77
See "Hop/Chirp Statistics Table" on page 77
See "Parameter Distribution" on page 78
See "Parameter Trend" on page 79
See "Phase Noise" on page 79
See "Frequency Deviation Spectrogram" on page 80
See "Frequency Deviation Spectrum" on page 80
See "Phase Deviation Spectrum" on page 81
See "Phase Deviation Spectrogram" on page 81
See "Marker Table" on page 82

For a detailed example, see Chapter 11.11, "Programming examples", on page 457.

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 Spectrogram2)
FDSP	Frequency Deviation Spectrum2)
PDEViation	Phase Deviation "Time Domain"1)
PDIStribution	Parameter Distribution
PDSG	Phase Deviation Spectrogram2)
PDSP	Phase Deviation Spectrum2)
PMTime	"PM Time Domain"
PMWRapped	"PM Time Domain" (Wrapped)
PNO	Phase Noise2)
PTRend	Parameter Trend
1) requires additional option FSW-K60C/-K60H 2) requires additional option FSW-K60P	

Parameter value	Window type
RFSPectrum	"RF Spectrum"
CRTime	Chirp Rate "Time Domain"[1)]
MTABle	Marker table
RTABle	Results table[1)]
STABle	Statistics table[1)]
RECording	"I/Q 40G Recording" window providing "Insert Marker" function
[1)] requires additional option FSW-K60C/-K60H [2)] requires additional option FSW-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>

Return values:

<WindowName> string

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

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

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

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

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

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

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

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

Usage: Query only

LAYout: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 262 for a list of available window types.

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

Usage: Setting only

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

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

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 261 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

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

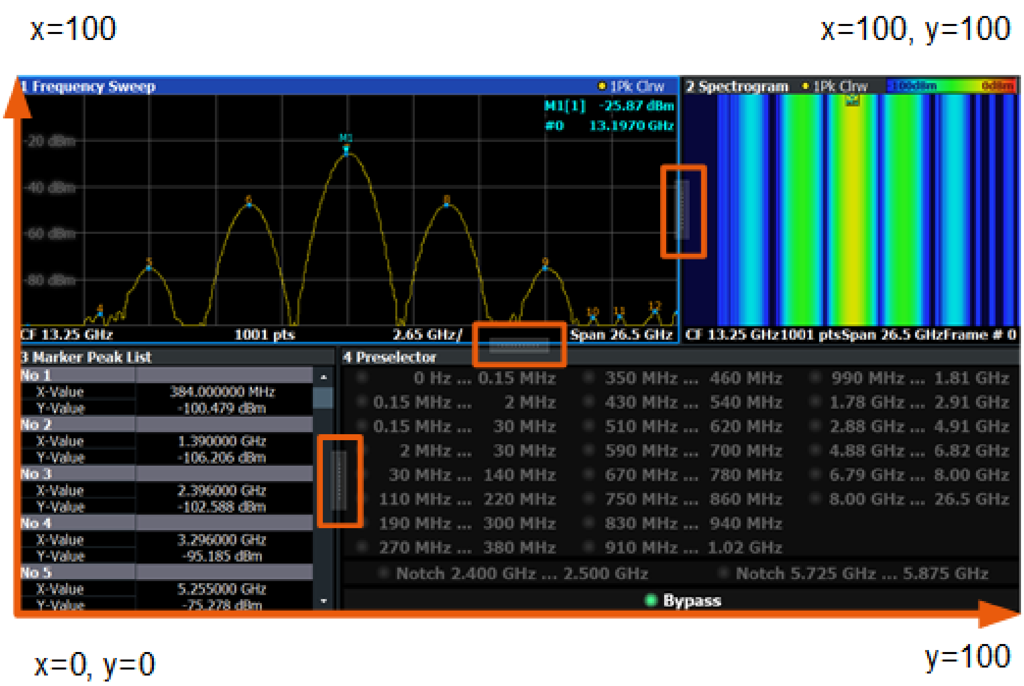


Figure 11-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

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

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

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 11-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.
Range: 0 to 100

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

Example:
```
LAY:SPL 1,4,70
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

Usage: Setting only

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

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

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

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

Suffix:

<n> Window

Query parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 262 for a list of available window types.

Return values:

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

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

Usage: Query only

LAYout:WINDow<n>:IDENtify?

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

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

Suffix:

<n> Window

Return values:

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

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

Usage: Query only

LAYout:WINDow<n>:REMove

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

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

Suffix:

<n> Window

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

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

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

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

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

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 262 for a list of available window types.

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

Usage: Setting only

11.6.2 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 FSW-K60C/-K60H are installed.

DISPlay[:WINDow<n>]:EVALuate.. 269

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 11.4.12, "Selecting the analysis region", on page 251)

HOP
an individual selected hop (see CALCulate<n>:HOPDetection:SELected on page 273)

CHIRp
an individual selected chirp (see `CALCulate<n>:CHRDetection:SELected` on page 273)

*RST: depends on result display

Example: `DISP:WIND1:EVAL HOP`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Full Capture / Region Analysis / Hop / Chirp" on page 134

11.6.3 Configuring the result range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 46).

These settings are only available if the additional options FSW-K60C/-K60H are installed.

CALCulate<n>:RESult:ALIGnment....270
CALCulate<n>:RESult:LENGth....271
CALCulate<n>:RESult:OFFSet....271
CALCulate<n>:RESult:RANGe:AUTO....271
CALCulate<n>:RESult:REFerence....272

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 272).

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Alignment" on page 127

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 271).

Suffix:
<n> irrelevant

Parameters:
<Time> Default unit: S

Example: `CALC:RES:LENG 1us`

Example: See Chapter 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Length" on page 127

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Offset" on page 127

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Automatic Range Scaling" on page 126

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Result Range Reference Point" on page 127

11.6.4 Selecting the hop/chirp

The selected hop/chirp determines which results are calculated and displayed.

These commands are only available if the additional options FSW-K60C/-K60H are installed.

CALCulate<n>:CHRDetection:SELected 273
CALCulate<n>:HOPDetection:SELected 273

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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Manual operation: See "Select Hop / Select Chirp" on page 135

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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Select Hop / Select Chirp" on page 135

11.6.5 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 FSW-K60C/-K60H are installed.

● Chirp results....................273
● Hop results....................283

11.6.5.1 Chirp results

CALCulate<n>:CHRDetection:TABLe:COLumn....................274
CALCulate<n>:CHRDetection:TABLe:FMSettling:ALL[:STATe]....................276
CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSLength....................277
CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSPoint....................277
CALCulate<n>:CHRDetection:TABLe:FMSettling:FMSTime....................277

CALCulate<n>:CHRDetection:TABLe:FREQuency:ALL[:STATe]....277
CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGFm....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:BWIDth....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:CHERror....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:FREQuency....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXFm....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSFm....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:OVERshoot....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:UNDershoot....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:AVGNonlinear....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:MAXNonlinear....278
CALCulate<n>:CHRDetection:TABLe:FREQuency:RMSNonlinear....278
CALCulate<n>:CHRDetection:TABLe:PHASe:ALL[:STATe]....279
CALCulate<n>:CHRDetection:TABLe:PHASe:AVGPm....279
CALCulate<n>:CHRDetection:TABLe:PHASe:MAXPm....279
CALCulate<n>:CHRDetection:TABLe:PHASe:RMSPm....279
CALCulate<n>:CHRDetection:TABLe:PHASe:OVERshoot....279
CALCulate<n>:CHRDetection:TABLe:PHASe:UNDershoot....279
CALCulate<n>:CHRDetection:TABLe:PMSettling:ALL[:STATe]....279
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSLength....280
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSPoint....280
CALCulate<n>:CHRDetection:TABLe:PMSettling:PMSTime....280
CALCulate<n>:CHRDetection:TABLe:POWer:ALL[:STATe]....281
CALCulate<n>:CHRDetection:TABLe:POWer:AVEPower....281
CALCulate<n>:CHRDetection:TABLe:POWer:MAXPower....281
CALCulate<n>:CHRDetection:TABLe:POWer:MINPower....281
CALCulate<n>:CHRDetection:TABLe:POWer:PWRRipple....281
CALCulate<n>:CHRDetection:TABLe:STATe:ALL[:STATe]....281
CALCulate<n>:CHRDetection:TABLe:STATe:INDex....282
CALCulate<n>:CHRDetection:TABLe:TIMing:ALL[:STATe]....282
CALCulate<n>:CHRDetection:TABLe:TIMing:BEGin....283
CALCulate<n>:CHRDetection:TABLe:TIMing:LENGth....283
CALCulate<n>:CHRDetection:TABLe:TIMing:RATE....283
CALCulate<n>:CHRDetection:TABLe:TIMing:SWITching....283

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 57.

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 11.11.2, "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 67).

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 67

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 67).

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 67

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 61).

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 61

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 62).

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 66

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 63).

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 63

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 67).

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 67

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 67).

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 68

CALCulate<n>:CHRDetection:TABLe:POWer:ALL[:STATe] <State>

If enabled, all power parameters are included in the result tables (see "Power parameters" on page 64).

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 64

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 65

CALCulate<n>:CHRDetection:TABLe:STATe:ALL[:STATe] <State>

If enabled, all state parameters are included in the result tables (see "State 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
The parameter is included.

ON | 1
The parameter is not included

*RST: ON

Usage: Setting only

Manual operation: See "State parameters" on page 60

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 60

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 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
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 60

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

11.6.5.2 Hop results

CALCulate<n>:HOPDetection:TABLe:COLumn....284
CALCulate<n>:HOPDetection:TABLe:FMSettling:ALL[:STATe]....285
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSLength....286
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSPoint....286
CALCulate<n>:HOPDetection:TABLe:FMSettling:FMSTime....286
CALCulate<n>:HOPDetection:TABLe:FREQuency:ALL[:STATe]....287
CALCulate<n>:HOPDetection:TABLe:FREQuency:AVGFm....287
CALCulate<n>:HOPDetection:TABLe:FREQuency:FMERror....287
CALCulate<n>:HOPDetection:TABLe:FREQuency:FREQuency....287
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CALCulate<n>:HOPDetection:TABLe:PHASe:MAXPm....288
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CALCulate<n>:HOPDetection:TABLe:TIMing:ALL[:STATe].. 292
CALCulate<n>:HOPDetection:TABLe:TIMing:BEGin..293
CALCulate<n>:HOPDetection:TABLe:TIMing:DWELl.. 293
CALCulate<n>:HOPDetection:TABLe:TIMing:SWITching..293

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 47.

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 11.11.3, "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 55).

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 55

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 55).

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 56

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 50).

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 50).

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 51

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 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> DEG | RAD

Defines the scaling for the phase parameters

Usage: Setting only

Manual operation: See "Phase parameters" on page 52

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 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
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 54

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 56).

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 56

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 57).

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 57

CALCulate<n>:HOPDetection:TABLe:POWer:ALL[:STATe] <State>

If enabled, all power parameters are included in the result tables (see "Power parameters" 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

Example: `CALC:HOPD:TABL:POW:ALL ON`

Usage: Setting only

Manual operation: See "Power parameters" on page 54

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 55

CALCulate<n>:HOPDetection:TABLe:STATe:ALL[:STATe] <State>

If enabled, all state parameters are included in the result tables (see "State 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

Example: `CALC:HOPD:TABL:STAT:ALL ON`

Usage: Setting only

Manual operation: See "State parameters" on page 49
See "Frequency parameters" on page 50

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 49

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 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> 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 50

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 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> S | MS | US | NS

Defines the scaling for the timing parameters

Usage: Setting only

Manual operation: See "Timing parameters" on page 49

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 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> S | MS | US | NS

Defines the scaling for the timing parameters

Manual operation: See "Switching Time" on page 50

11.6.6 Configuring parameter distribution displays

For details on the parameter distribution result displays see "Parameter Distribution" on page 78.

CALCulate<n>:DISTribution:CHIRp:FMSettling......294
CALCulate<n>:DISTribution:CHIRp:FREQuency......294
CALCulate<n>:DISTribution:CHIRp:PHASe......295
CALCulate<n>:DISTribution:CHIRp:PMSettling......296
CALCulate<n>:DISTribution:CHIRp:POWer......296
CALCulate<n>:DISTribution:CHIRp:STATe......297
CALCulate<n>:DISTribution:CHIRp:TIMing......297
CALCulate<n>:DISTribution:HOP:FMSettling......298
CALCulate<n>:DISTribution:HOP:FREQuency......299
CALCulate<n>:DISTribution:HOP:PHASe......299
CALCulate<n>:DISTribution:HOP:PMSettling......300
CALCulate<n>:DISTribution:HOP:POWer......300
CALCulate<n>:DISTribution:HOP:STATe......301
CALCulate<n>:DISTribution:HOP:TIMing......302
CALCulate<n>:DISTribution:NBINs......302
CALCulate<n>:DISTribution:X?......303
CALCulate<n>:DISTribution:Y?......303

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 57.

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 47Chapter 5.2, "Chirp parameters", on page 57.

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 129

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 78
See "X-Axis" on page 129

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 78
See "Y-Axis" on page 129

11.6.7 Configuring parameter trends

For details on the parameter trend result displays see "Parameter Trend" on page 79.

- General commands....304
- Chirp parameter trends....305
- Hop parameter trends....324

11.6.7.1 General commands

CALCulate<n>:TRENd:SWAP:XY....304
CALCulate<n>:TRENd:X?....304
CALCulate<n>:TRENd:Y?....304

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 131

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 11.6.7.2, "Chirp parameter trends", on page 305 and Chapter 11.6.7.3, "Hop parameter trends", on page 324.

Example:
```
CALC2:TREN:X?
//Result: 'FREQ'
```

Usage: Query only

Manual operation: See "Parameter Trend" on page 79
See "X-Axis" on page 130

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 11.6.7.2, "Chirp parameter trends", on page 305 and Chapter 11.6.7.3, "Hop parameter trends", on page 324.

Example:
```
CALC2:TREN:Y?
//Result: 'BEG'
```

Usage: Query only

Manual operation: See "Parameter Trend" on page 79
See "Y-Axis" on page 131

11.6.7.2 Chirp parameter trends

CALCulate<n>:TRENd:CHIRp:FMSettling ... 305
CALCulate<n>:TRENd:CHIRp:FMSettling:X ... 307
CALCulate<n>:TRENd:CHIRp:FMSettling:Y ... 307
CALCulate<n>:TRENd:CHIRp:FREQuency ... 308
CALCulate<n>:TRENd:CHIRp:FREQuency:X ... 310
CALCulate<n>:TRENd:CHIRp:FREQuency:Y ... 311
CALCulate<n>:TRENd:CHIRp:PHASe ... 312
CALCulate<n>:TRENd:CHIRp:PHASe:X ... 313
CALCulate<n>:TRENd:CHIRp:PHASe:Y ... 314
CALCulate<n>:TRENd:CHIRp:PMSettling ... 314
CALCulate<n>:TRENd:CHIRp:PMSettling:X ... 316
CALCulate<n>:TRENd:CHIRp:PMSettling:Y ... 316
CALCulate<n>:TRENd:CHIRp:POWer ... 317
CALCulate<n>:TRENd:CHIRp:POWer:X ... 318
CALCulate<n>:TRENd:CHIRp:POWer:Y ... 319
CALCulate<n>:TRENd:CHIRp:STATe ... 319
CALCulate<n>:TRENd:CHIRp:STATe:X ... 321
CALCulate<n>:TRENd:CHIRp:STATe:Y ... 321
CALCulate<n>:TRENd:CHIRp:TIMing ... 321
CALCulate<n>:TRENd:CHIRp:TIMing:X ... 323
CALCulate<n>:TRENd:CHIRp:TIMing:Y ... 323

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

11.6.7.3 Hop parameter trends

CALCulate<n>:TRENd:HOP:FMSettling.......324
CALCulate<n>:TRENd:HOP:FMSettling:X.......326
CALCulate<n>:TRENd:HOP:FMSettling:Y.......326
CALCulate<n>:TRENd:HOP:FREQuency.......327
CALCulate<n>:TRENd:HOP:FREQuency:X.......329
CALCulate<n>:TRENd:HOP:FREQuency:Y.......329
CALCulate<n>:TRENd:HOP:PHASe.......330
CALCulate<n>:TRENd:HOP:PHASe:X.......332
CALCulate<n>:TRENd:HOP:PHASe:Y.......332
CALCulate<n>:TRENd:HOP:PMSettling.......332
CALCulate<n>:TRENd:HOP:PMSettling:X.......334
CALCulate<n>:TRENd:HOP:PMSettling:Y.......334
CALCulate<n>:TRENd:HOP:POWer.......335
CALCulate<n>:TRENd:HOP:POWer:X.......336
CALCulate<n>:TRENd:HOP:POWer:Y.......337
CALCulate<n>:TRENd:HOP:STATe.......337
CALCulate<n>:TRENd:HOP:STATe:X.......339
CALCulate<n>:TRENd:HOP:STATe:Y.......339
CALCulate<n>:TRENd:HOP:TIMing.......340
CALCulate<n>:TRENd:HOP:TIMing:X.......341
CALCulate<n>:TRENd:HOP:TIMing:Y.......342

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

11.6.8 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` on page 210

Remote commands exclusive to scaling the y-axis

CALCulate<n>:UNIT:ANGLe.......... 342
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe].......... 343
DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO.......... 343
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum.......... 343
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum.......... 344
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision.......... 344
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition.......... 344
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue.......... 345

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 134

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 133

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 132
See "Auto Scale Once" on page 132

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 132

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 132

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 132

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 FSW 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 133
See "Ref Level Position" on page 133

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 133

11.6.9 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]....346
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE....346
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous....347
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]....347
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]....348
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO....348
[SENSe:]MEASure:POINts....349
[SENSe:]STATistic<n>:TYPE....349
[SENSe:]SWEep:COUNt....349
[SENSe:]SWEep:COUNt:CURRent?....350

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 137

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 FSW 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 FSW 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 136

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 137

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 136
See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 138

[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 136

[SENSe:]MEASure:POINts <MeasurementPoints>

Parameters:
<MeasurementPoints>

Manual operation: See "Maximum number of trace points" on page 138

[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 137

[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 "Sweep/Average Count" on page 123

[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

11.6.10 Configuring spectrograms

The remote commands required for the individual settings available for spectrogram displays are described here. For color mapping commands, see Chapter 11.6.11, "Configuring color maps", on page 354.

CALCulate<n>:SGRam:CLEar 350
CALCulate<n>:SGRam:FRAMe:SELect 350
CALCulate<n>:SGRam:HDEPth 351
CALCulate<n>:SGRam:TRESolution 351
CALCulate<n>:SGRam:TRESolution:AUTO 352
CALCulate<n>:SGRam:TSTamp:DATA? 352
CALCulate<n>:SGRam:TSTamp[:STATe] 353
[SENSe:][WINDow<n>:]SGRam|SPECtrogram:DETector:FUNCtion 353
[SENSe<ip>:]SWEep:FFT:WINDow:TYPE 354

CALCulate<n>:SGRam:CLEar

Suffix:
<n> 1..n
irrelevant

Usage: Event

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 124

CALCulate<n>:SGRam:HDEPth <Depth>

Defines the number of frames to be stored in the FSW memory.

Suffix:

<n> 1..n
irrelevant

Parameters:

<Depth>

Example: `CALC:SGR:SPEC 1500`
Sets the history depth to 1500.

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 269)

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 142

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 142

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 449.

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 142

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 374
- `CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 370
- `CALCulate<n>:SGRam:FRAMe:SELect` on page 350

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 142

[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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

[SENSe<ip>:]SWEep:FFT:WINDow:TYPE <ColorScheme>

Queries or sets the FFT windowing function.

Suffix:
<ip> 1..n

Parameters:
<ColorScheme> BLACkharris | P5 | FLATtop | GAUSsian | HAMMing | HANNing | RECTangular

*RST: BLACkharris

Example: `SWE:FFT:WIND:TYPE BLAC`

Example: See Chapter 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Manual operation: See "Window Function" on page 141

11.6.11 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.......... 354
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault.......... 354
DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer.......... 355
DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe.......... 355
DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer.......... 355
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe].......... 356

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 144

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 143

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 143

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 143

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 144

11.6.12 Working with markers remotely

In the Transient Analysis application, up to 16 markers or delta markers can be activated for each window simultaneously.

- Setting up individual markers....356
- General marker settings....363
- Configuring and performing a marker search....364
- Positioning the marker....364
- Marker search (spectrograms)....369

11.6.12.1 Setting up individual markers

The following commands define the position of markers in the diagram.

CALCulate<n>:MARKer<m>:AOFF....357
CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>....357
CALCulate<n>:MARKer<m>[:STATe]....357
CALCulate<n>:MARKer<m>:TRACe....358
CALCulate<n>:MARKer<m>:X....358
CALCulate<n>:MARKer<m>:Y?....359
CALCulate<n>:DELTamarker<m>:AOFF....359
CALCulate<n>:DELTamarker<m>:LINK....359
CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>....360
CALCulate<n>:DELTamarker<m>:MREFerence....360
CALCulate<n>:DELTamarker<m>[:STATe]....361

CALCulate<n>:DELTamarker<m>:TRACe....361
CALCulate<n>:DELTamarker<m>:X....361
CALCulate<n>:DELTamarker<m>:X:RELative?....362
CALCulate<n>:DELTamarker<m>:Y?....362

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 150

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 149

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148
See "Marker State" on page 148
See "Marker Type" on page 149
See "Select Marker" on page 150

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 150

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 82
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148
See "Marker Position X-value" on page 148

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 82
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148

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 149

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 149

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 149

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148
See "Marker State" on page 148
See "Marker Type" on page 149
See "Select Marker" on page 150

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148
See "Marker Position X-value" on page 148

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148

11.6.12.2 General marker settings

The following commands control general marker functionality.

DISPlay[:WINDow<n>]:MINFo[:STATe] 363
DISPlay[:WINDow<n>]:MTABle 363
CALCulate<n>:MARKer<m>:LINK 364

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 151

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 151

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 152

11.6.12.3 Configuring and performing a marker search

The following commands control the marker search.

CALCulate<n>:MARKer<m>:PEXCursion......364

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 154

11.6.12.4 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

- Positioning normal markers......364
- Positioning delta markers......366

Positioning normal markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT......365
CALCulate<n>:MARKer<m>:MAXimum:NEXT......365
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]......365

CALCulate<n>:MARKer<m>:MAXimum:RIGHt....365
CALCulate<n>:MARKer<m>:MINimum:LEFT....366
CALCulate<n>:MARKer<m>:MINimum:NEXT....366
CALCulate<n>:MARKer<m>:MINimum[:PEAK]....366
CALCulate<n>:MARKer<m>:MINimum:RIGHt....366

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 155

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 155

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

Manual operation: See "Search Next Peak" on page 155

CALCulate<n>:MARKer<m>:MINimum:LEFT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 155

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 155

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 155

CALCulate<n>:MARKer<m>:MINimum:RIGHt

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 155

Positioning delta markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT 367
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT 367
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] 367
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt 367
CALCulate<n>:DELTamarker<m>:MINimum:LEFT 368
CALCulate<n>:DELTamarker<m>:MINimum:NEXT 368
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] 368
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt 368

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 155

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 155

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

Manual operation: See "Search Next Peak" on page 155

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 155

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 155

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 155

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 155

11.6.12.5 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 365
- `CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 365
- `CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 365
- `CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 365
- `CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 366
- `CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 366
- `CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 366
- `CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 366

Remote commands exclusive to spectrogram markers

CALCulate<n>:MARKer<m>:SGRam:FRAMe....................370
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe....................370
CALCulate<n>:MARKer<m>:SGRam:SARea....................370
CALCulate<n>:MARKer<m>:SPECtrogram:SARea....................370
CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]....................371
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MAXimum[:PEAK]....................371
CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]....................371
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MINimum[:PEAK]....................371
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe....................371
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:ABOVe....................371
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELow....................371
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow....................371
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT....................371
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT....................371
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]....................372
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum[:PEAK]....................372
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVe....................372
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe....................372
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELow....................372
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow....................372
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT....................373
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT....................373

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]..373
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum[:PEAK]..373

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 "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148
See "Frame (for Spectrograms only)" on page 149

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.

Suffix:

<n>	irrelevant
<m>	irrelevant

Parameters:

<SearchArea>

VISible
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 154

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 153

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 153

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 153

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 153

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 153

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 153

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 367
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 367
- `CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 367
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 367
- `CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 368
- `CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 368
- `CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 368
- `CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 368

Remote commands exclusive to spectrogram markers

CALCulate<n>:DELTamarker<m>:SGRam:FRAMe....374
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe....374
CALCulate<n>:DELTamarker<m>:SGRam:SARea....375

CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea....375
CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]....375
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MAXimum[:PEAK]....375
CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]....375
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MINimum[:PEAK]....375
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe....375
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe....375
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELow....376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow....376
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT....376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT....376
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]....376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum[:PEAK]....376
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVe....376
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe....376
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELow....377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow....377
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT....377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT....377
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]....377
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum[:PEAK]....377

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.

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 148

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.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<SearchArea> **VISible**
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 154

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 153

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 153

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 153

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 153

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 153

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 153

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

11.6.13 Zooming into the display

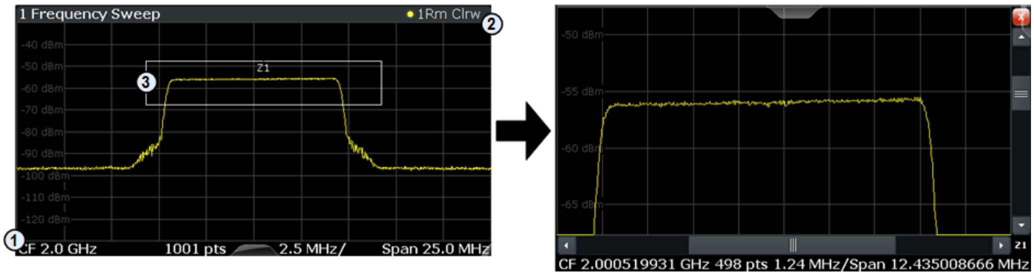
11.6.13.1 Using the single zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA.. 378
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe].. 379

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 156

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 156
See "Restore Original Display" on page 157

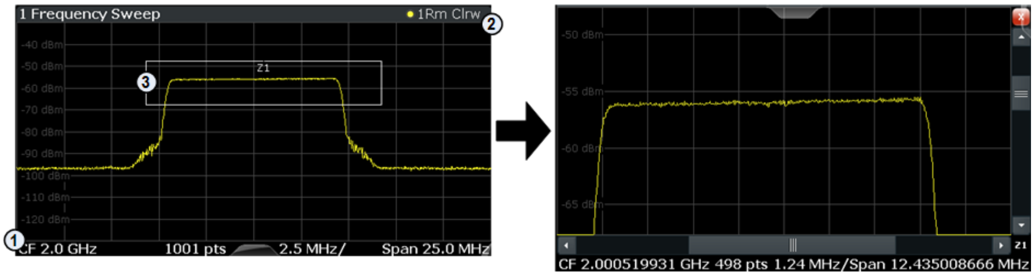
11.6.13.2 Using the multiple zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA..............................379
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]........................... 381

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 156

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 156
See "Restore Original Display" on page 157

11.7 Configuring an analysis interval and line (MSRA mode only)

In MSRA operating mode, only the MSRA primary actually captures data; the MSRA secondary applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRA secondary applications.

For the Transient Analysis secondary application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 11.4.6, "Data acquisition", on page 221. Be sure to select the correct measurement channel before executing these commands.

Useful commands related to MSRA mode described elsewhere:

- `INITiate<n>:REFResh` on page 257
- `INITiate:SEQuencer:REFResh[:ALL]` on page 257

Remote commands exclusive to MSRA secondary applications

The following commands are only available for MSRA secondary application channels:

CALCulate<n>:MSRA:ALINe:SHOW....................382
CALCulate<n>:MSRA:ALINe[:VALue]....................382
CALCulate<n>:MSRA:WINDow<n>:IVAL....................382
[SENSe:]MSRA:CAPTure:OFFSet....................383

CALCulate<n>:MSRA:ALINe:SHOW

Defines whether or not the analysis line is displayed in all time-based windows in all MSRA secondary applications and the MSRA primary application.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active secondary application remains in the window title bars.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Show Line" on page 159

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

Defines the position of the analysis line for all time-based windows in all MSRA secondary applications and the MSRA primary application.

Suffix:

<n> irrelevant

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.

Default unit: s

Manual operation: See "Position" on page 159

CALCulate<n>:MSRA:WINDow<n>:IVAL

Returns the current analysis interval for applications in MSRA operating mode.

Suffix:

<n> irrelevant

<n> 1..n
Window

Return values:

<IntStart> Analysis start = Capture offset time

Default unit: s

<IntStop> Analysis end = capture offset + capture time

Default unit: s

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for secondary applications in MSRA mode, not for the MSRA primary application. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted secondary application data. The offset must be a positive value, as the secondary application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0
Default unit: S

Manual operation: See "Capture Offset" on page 111

11.8 Configuring an analysis interval and line (MSRT mode only)

In MSRT operating mode, only the MSRT primary actually captures data; the MSRT secondary applications define an extract of the captured data for analysis, referred to as the **analysis interval**. The **analysis line** is a common time marker for all MSRT secondary applications.

For the Transient Analysis secondary application, the commands to define the analysis interval are the same as those used to define the actual data acquisition (see Chapter 11.4.6, "Data acquisition", on page 221. Be sure to select the correct measurement channel before executing these commands.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the Transient Analysis measurement.

Useful commands related to MSRT mode described elsewhere:

- `INITiate<n>:REFResh` on page 257
- `INITiate:SEQuencer:REFResh[:ALL]` on page 257

Remote commands exclusive to MSRT secondary applications

The following commands are only available for MSRT secondary application channels:

CALCulate<n>:RTMS:ALINe:SHOW ... 384
CALCulate<n>:RTMS:ALINe[:VALue] ... 384
CALCulate<n>:RTMS:WINDow<n>:IVAL ... 384
[SENSe:]RTMS:CAPTure:OFFSet ... 385

CALCulate<n>:RTMS:ALINe:SHOW

Defines whether or not the analysis line is displayed in all time-based windows in all MSRT secondary applications and the MSRT primary.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active secondary application remains in the window title bars.

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Show Line" on page 159

CALCulate<n>:RTMS:ALINe[:VALue] <Position>

Defines the position of the analysis line for all time-based windows in all MSRT secondary applications and the MSRT primary.

Suffix:
<n> irrelevant

Parameters:
<Position> Position of the analysis line in seconds. The position must lie within the measurement time (pretrigger + posttrigger) of the MSRT measurement.

Default unit: s

Manual operation: See "Position" on page 159

CALCulate<n>:RTMS:WINDow<n>:IVAL

Returns the current analysis interval for applications in MSRT operating mode.

Suffix:
<n> irrelevant

<n> 1..n
Window

Return values:
<IntStart> Analysis start = Capture offset time

Default unit: s

<IntStop> Analysis end = capture offset + capture time

Default unit: s

[SENSe:]RTMS:CAPTure:OFFSet <Offset>

This setting is only available for secondary applications in MSRT mode, not for the MSRT primary. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted secondary application data. The offset must be a positive value, as the secondary application can only analyze data that is contained in the capture buffer.

Range: - [pretrigger time] to min (posttrigger time; sweep time)
*RST: 0
Default unit: S

Manual operation: See "Capture Offset" on page 111

11.9 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

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11.9.1 Retrieving information on detected hops

The following commands return information on the currently selected or all detected hops.

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[SENSe:]HOP:FREQuency:RELFrequency:MAXimum? 399
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[SENSe:]HOP:FREQuency:RELFrequency:SDEViation? 399
[SENSe:]HOP:FREQuency:RMSFm? 400
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[SENSe:]HOP:PHASe:AVGPm:MAXimum?..........401
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[SENSe:]HOP:POWer:MAXPower:AVERage?..........407
[SENSe:]HOP:POWer:MAXPower:MAXimum?..........407
[SENSe:]HOP:POWer:MAXPower:MINimum?..........408
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[SENSe:]HOP:POWer:MINPower:AVERage?..........408
[SENSe:]HOP:POWer:MINPower:MAXimum?..........408
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[SENSe:]HOP:TIMing:DWELl:AVERage?.....412
[SENSe:]HOP:TIMing:DWELl:MAXimum?.....412
[SENSe:]HOP:TIMing:DWELl:MINimum?.....412
[SENSe:]HOP:TIMing:DWELl:SDEViation?.....412
[SENSe:]HOP:TIMing:SWITching?.....413
[SENSe:]HOP:TIMing:SWITching:AVERage?.....413
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[SENSe:]HOP:TIMing:SWITching:MINimum?.....413
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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 284).

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 230)

<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 50.

Default unit: kHz

<FreqRel>
: Relative difference in frequency between two hops.
For details see "Relative Frequency (Hop-to-Hop)" on page 51.

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 51.

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 51. 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 52. 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 53. 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 54. 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 54. 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 11.11.3, "Programming example: performing a hop detection measurement", on page 460.

Usage: Query only

Manual operation: See "State Index" on page 49
See "Hop Begin" on page 49
See "Dwell Time" on page 49
See "Switching Time" on page 50
See "State Frequency (Nominal)" on page 50
See "Average Frequency" on page 50
See "Hop State Deviation" on page 50
See "Relative Frequency (Hop-to-Hop)" on page 51
See "Frequency Deviation (Peak)" on page 51
See "Frequency Deviation (RMS)" on page 51
See "Frequency Deviation (Average)" on page 52
See "Phase Deviation (Peak)" on page 53
See "Phase Deviation (RMS)" on page 54
See "Phase Deviation (Average)" on page 54
See "Minimum Power" on page 54
See "Maximum Power" on page 55
See "Average Power" on page 55
See "Power Ripple" on page 55
See "FM settling point" on page 55
See "FM settling time" on page 56
See "FM settled length" on page 56
See "PM settling point" on page 56
See "PM settling time" on page 57
See "PM settled length" on page 57

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 77

CALCulate<n>:HOPDetection:TOTal?

Suffix:
<n> irrelevant

Return values:
<TotalHops>

Usage: Query only

Manual operation: See "Hop/Chirp Results Table" on page 77

[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 52

[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 56

[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 55

[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 56

[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 50

[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 50

[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 51

[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 51

[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 51

[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 54

[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 53

[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 54

[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 57

[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 56

[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 57

[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 55

[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 55

[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 54
See "Power Ripple" on page 55

[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 49

[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 50

[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 49

[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 49

[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 50

[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

11.9.2 Retrieving information on detected chirps

The following commands return information on the currently selected or all detected chirps.

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[SENSe:]CHIRp:POWer:AVEPower?....440
[SENSe:]CHIRp:POWer:AVEPower:AVERage?....440
[SENSe:]CHIRp:POWer:AVEPower:MAXimum?....440
[SENSe:]CHIRp:POWer:AVEPower:MINimum?....440
[SENSe:]CHIRp:POWer:AVEPower:SDEViation?....440
[SENSe:]CHIRp:POWer:MAXPower?....441
[SENSe:]CHIRp:POWer:MAXPower:AVERage?....441
[SENSe:]CHIRp:POWer:MAXPower:MAXimum?....441
[SENSe:]CHIRp:POWer:MAXPower:MINimum?....441
[SENSe:]CHIRp:POWer:MAXPower:SDEViation?....441
[SENSe:]CHIRp:POWer:MINPower?....442
[SENSe:]CHIRp:POWer:MINPower:AVERage?....442
[SENSe:]CHIRp:POWer:MINPower:MAXimum?....442
[SENSe:]CHIRp:POWer:MINPower:MINimum?....442
[SENSe:]CHIRp:POWer:MINPower:SDEViation?....442
[SENSe:]CHIRp:POWer:PWRRipple?....442
[SENSe:]CHIRp:POWer:PWRRipple:AVERage?....443
[SENSe:]CHIRp:POWer:PWRRipple:MAXimum?....443
[SENSe:]CHIRp:POWer:PWRRipple:MINimum?....443
[SENSe:]CHIRp:POWer:PWRRipple:SDEViation?....443
[SENSe:]CHIRp:STATe?....443
[SENSe:]CHIRp:STATe:AVERage?....443
[SENSe:]CHIRp:STATe:MAXimum?....443
[SENSe:]CHIRp:STATe:MINimum?....444
[SENSe:]CHIRp:STATe:SDEViation?....444
[SENSe:]CHIRp:TIMing:BEGin?....444
[SENSe:]CHIRp:TIMing:BEGin:AVERage?....444
[SENSe:]CHIRp:TIMing:BEGin:MAXimum?....444
[SENSe:]CHIRp:TIMing:BEGin:MINimum?....444
[SENSe:]CHIRp:TIMing:BEGin:SDEViation?....444
[SENSe:]CHIRp:TIMing:LENGth?....445
[SENSe:]CHIRp:TIMing:LENGth:AVERage?....445
[SENSe:]CHIRp:TIMing:LENGth:MAXimum?....445
[SENSe:]CHIRp:TIMing:LENGth:MINimum?....445
[SENSe:]CHIRp:TIMing:LENGth:SDEViation?....445

[SENSe:]CHIRp:TIMing:RATE?....445
[SENSe:]CHIRp:TIMing:RATE:AVERage?....446
[SENSe:]CHIRp:TIMing:RATE:MAXimum?....446
[SENSe:]CHIRp:TIMing:RATE:MINimum?....446
[SENSe:]CHIRp:TIMing:RATE:SDEViation?....446
[SENSe:]CHIRp:TIMing:SWITching?....446
[SENSe:]CHIRp:TIMing:SWITching:AVERage?....446
[SENSe:]CHIRp:TIMing:SWITching:MAXimum?....446
[SENSe:]CHIRp:TIMing:SWITching:MINimum?....447
[SENSe:]CHIRp:TIMing:SWITching:SDEViation?....447

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 274).

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 227)

<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 61. 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 62. 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 62. 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 63. 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 63. 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 64. 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 64. 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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Usage: Query only

Manual operation: See "State Index" on page 60
See "Chirp Begin" on page 60
See "Chirp Length" on page 61
See "Chirp Rate" on page 61
See "Chirp State Deviation" on page 61
See "Average Frequency" on page 62
See "Frequency Deviation (Peak)" on page 62
See "Frequency Deviation (RMS)" on page 62
See "Frequency Deviation (Average)" on page 63
See "Phase Deviation (Peak)" on page 63
See "Phase Deviation (RMS)" on page 64
See "Phase Deviation (Average)" on page 64
See "Minimum Power" on page 65
See "Maximum Power" on page 65
See "Average Power" on page 65
See "Power Ripple" on page 65
See "Bandwidth" on page 66
See "Frequency INL (Peak)" on page 66
See "Frequency INL (RMS)" on page 66
See "Frequency INL (Average)" on page 66
See "FM settling point" on page 67
See "FM settling time" on page 67
See "FM settled length" on page 67
See "PM settling point" on page 68
See "PM settling time" on page 68
See "PM settled length" on page 68

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 77

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 77

[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 63

[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 67

[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 67

[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 67

[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 66

[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 66

[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 61

[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 62

[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 62

[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 66

[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 62

[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 66

[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 63

[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 63

[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 64

[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 63

[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 64

[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 64

[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 64

[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 68

[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 68

[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 68

[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 65

[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 65

[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 65

[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 65

[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 60

[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 60

[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 61

[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 61

[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 61

[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

11.9.3 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 303
- `CALCulate<n>:DISTribution:Y?` on page 303

Remote commands exclusive to retrieving trace data:

CALCulate<n>:SGRam:FRAMe:COUNt?....447
CALCulate<n>:SPECtrogram:FRAMe:COUNt?....447
DISPlay[:WINDow<n>]:TRACe<t>:LENGth?....448
FORMat[:DATA]....448
TRACe<n>[:DATA]?....449
TRACe<n>[:DATA]:X?....449

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 FSW to the controlling computer.

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

Parameters:

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

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

<BitLength> Length in bits for floating-point results

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

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

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

Example: `FORM REAL,32`

TRACe<n>[:DATA]? <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 11.11.2, "Programming example: performing a chirp detection measurement", on page 458.

Example: See Chapter 11.11.3, "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

11.9.4 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 FSW User Manual.

FORMat:DEXPort:DSEParator ... 450
FORMat:DEXPort:HEADer ... 450
FORMat:DEXPort:TRACes ... 451
MMEMory:STORe<n>:SPECtrogram ... 451
MMEMory:STORe:TA:MEAS ... 452
MMEMory:STORe<n>:TABLe ... 452
MMEMory:STORe<n>:TRACe ... 453

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 139

FORMat:DEXPort:HEADer <State>

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Include Instrument & Measurement Settings" on page 139

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 453).

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 139

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.

Secure User Mode

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

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

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

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.

Secure User Mode

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

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

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

Setting parameters:

<File> path and file name

Example: `MMEM:STOR:TA:MEAS 'C:\R_S\userdata\MyMeas.csv'`

Example: See Chapter 11.11.3, "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 A.1, "Reference: ASCII file export format", on page 465.

Secure User Mode

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

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

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

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 144
See "Columns to Export" on page 145

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

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

Secure User Mode

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

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

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

Suffix:
<n> Window

Parameters:
<Trace> Number of the trace to be stored

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

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

Manual operation: See "Export Trace to ASCII File" on page 140

11.9.5 Retrieving captured I/Q data

The raw captured I/Q data is output in the form of a list.

TRACe:IQ:DATA? 454
TRACe:IQ:DATA:FORMat 454
TRACe:IQ:DATA:MEMory? 455

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.

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 FSW.

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.)

This command is not available for traces captured with the optional 2 GHz/ 5 GHz bandwidth extension (FSW-B2000/B5000).

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 448.

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

11.9.6 Exporting I/Q results to an iq-tar file

The I/Q data results can be exported to an iq-tar file. For details see Chapter 7.7, "Export functions", on page 144.

MMEMory:STORe<n>:IQ:COMMent....................456
MMEMory:STORe<n>:IQ:STATe....................456

MMEMory:STORe<n>:IQ:COMMent <Comment>

Adds a comment to a file that contains I/Q data.

Suffix:
<n> irrelevant

Parameters:
<Comment> String containing the comment.

Example:
`MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

MMEMory:STORe<n>:IQ:STATe <1>, <FileName>

Writes the captured I/Q data to a file.

By default, the contents of the file are in 32-bit floating point format.

Suffix:
<n> 1..n

Parameters:
<1>

<FileName> String containing the path and name of the target file.
The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be `.iq.tar`.
For `.mat` files, Matlab® v4 is assumed.

Example:
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores the captured I/Q data to the specified file.

Usage: Asynchronous command

11.10 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 FSW Transient Analysis application uses only the registers provided by the base system.

For details on the common FSW status registers refer to the description of remote control basics in the FSW User Manual.

11.11 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.

- Programming example: performing a basic transient analysis measurement.......457
- Programming example: performing a chirp detection measurement.................... 458
- Programming example: performing a hop detection measurement...................... 460
- Programming example: analyzing parameter distribution...................................463
- Programming example: analyzing parameter trends... 463

11.11.1 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
```

11.11.2 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'
```

11.11.3 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'
```

11.11.4 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 11.11.3, "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?
```

11.11.5 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 11.11.3, "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

A.1 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 139).

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 A-1: ASCII file format for table export

File contents	Description
Header data	
Type;FSW;	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

File contents	Description
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	
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>

List of Commands (Transient Analysis)

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]....348
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO....348
[SENSe:][WINDow<n>:]SGRam|SPECtrogram:DETector:FUNCtion....353
[SENSe:]ADJust:LEVel....254
[SENSe:]BANDwidth:DEMod....221
[SENSe:]BANDwidth[:WINDow<n>]:RESolution....224
[SENSe:]BANDwidth[:WINDow<n>]:RESolution:AUTO....223
[SENSe:]BWIDth:DEMod....221
[SENSe:]BWIDth[:WINDow<n>]:RESolution....224
[SENSe:]BWIDth[:WINDow<n>]:RESolution:AUTO....223
[SENSe:]CHIRp:FMSettling:FMSLength:AVERage?....422
[SENSe:]CHIRp:FMSettling:FMSLength:MAXimum?....423
[SENSe:]CHIRp:FMSettling:FMSLength:MINimum?....423
[SENSe:]CHIRp:FMSettling:FMSLength:SDEViation?....423
[SENSe:]CHIRp:FMSettling:FMSLength?....422
[SENSe:]CHIRp:FMSettling:FMSPoint:AVERage?....424
[SENSe:]CHIRp:FMSettling:FMSPoint:MAXimum?....424
[SENSe:]CHIRp:FMSettling:FMSPoint:MINimum?....424
[SENSe:]CHIRp:FMSettling:FMSPoint:SDEViation?....424
[SENSe:]CHIRp:FMSettling:FMSPoint?....423
[SENSe:]CHIRp:FMSettling:FMSTime:AVERage?....425
[SENSe:]CHIRp:FMSettling:FMSTime:MAXimum?....425
[SENSe:]CHIRp:FMSettling:FMSTime:MINimum?....425
[SENSe:]CHIRp:FMSettling:FMSTime:SDEViation?....425
[SENSe:]CHIRp:FMSettling:FMSTime?....424
[SENSe:]CHIRp:FREQuency:AVGFm:AVERage?....425
[SENSe:]CHIRp:FREQuency:AVGFm:MAXimum?....425
[SENSe:]CHIRp:FREQuency:AVGFm:MINimum?....425
[SENSe:]CHIRp:FREQuency:AVGFm:SDEViation?....425
[SENSe:]CHIRp:FREQuency:AVGFm?....422
[SENSe:]CHIRp:FREQuency:AVGNonlinear:AVERage?....426
[SENSe:]CHIRp:FREQuency:AVGNonlinear:MAXimum?....426
[SENSe:]CHIRp:FREQuency:AVGNonlinear:MINimum?....426
[SENSe:]CHIRp:FREQuency:AVGNonlinear:SDEViation?....426
[SENSe:]CHIRp:FREQuency:AVGNonlinear?....426
[SENSe:]CHIRp:FREQuency:BWIDth:AVERage?....427
[SENSe:]CHIRp:FREQuency:BWIDth:MAXimum?....427
[SENSe:]CHIRp:FREQuency:BWIDth:MINimum?....427
[SENSe:]CHIRp:FREQuency:BWIDth:SDEViation?....427
[SENSe:]CHIRp:FREQuency:BWIDth?....426
[SENSe:]CHIRp:FREQuency:CHERror:AVERage?....428
[SENSe:]CHIRp:FREQuency:CHERror:MAXimum?....428
[SENSe:]CHIRp:FREQuency:CHERror:MINimum?....428
[SENSe:]CHIRp:FREQuency:CHERror:SDEViation?....428
[SENSe:]CHIRp:FREQuency:CHERror?....427
[SENSe:]CHIRp:FREQuency:FREQuency:AVERage?....428
[SENSe:]CHIRp:FREQuency:FREQuency:MAXimum?....428

[SENSe:]CHIRp:FREQuency:FREQuency:MINimum?....428
[SENSe:]CHIRp:FREQuency:FREQuency:SDEViation?....428
[SENSe:]CHIRp:FREQuency:FREQuency?....428
[SENSe:]CHIRp:FREQuency:MAXFm:AVERage?....429
[SENSe:]CHIRp:FREQuency:MAXFm:MAXimum?....429
[SENSe:]CHIRp:FREQuency:MAXFm:MINimum?....429
[SENSe:]CHIRp:FREQuency:MAXFm:SDEViation?....429
[SENSe:]CHIRp:FREQuency:MAXFm?....429
[SENSe:]CHIRp:FREQuency:MAXNonlinear:AVERage?....430
[SENSe:]CHIRp:FREQuency:MAXNonlinear:MAXimum?....430
[SENSe:]CHIRp:FREQuency:MAXNonlinear:MINimum?....430
[SENSe:]CHIRp:FREQuency:MAXNonlinear:SDEViation?....430
[SENSe:]CHIRp:FREQuency:MAXNonlinear?....430
[SENSe:]CHIRp:FREQuency:OVERshoot:AVERage?....432
[SENSe:]CHIRp:FREQuency:OVERshoot:MAXimum?....432
[SENSe:]CHIRp:FREQuency:OVERshoot:MINimum?....432
[SENSe:]CHIRp:FREQuency:OVERshoot:SDEViation?....432
[SENSe:]CHIRp:FREQuency:OVERshoot?....432
[SENSe:]CHIRp:FREQuency:RMSFm:AVERage?....431
[SENSe:]CHIRp:FREQuency:RMSFm:MAXimum?....431
[SENSe:]CHIRp:FREQuency:RMSFm:MINimum?....431
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