R&S®FSWP-K50
Spurious Measurement
User Manual

1178707502
Version 05

ROHDE&SCHWARZ
Make ideas real

This manual describes the following R&S®FSWP models with firmware version 3.00 or higher:

- R&S®FSWP8 (1322.8003K08)
- R&S®FSWP8 (1322.8003K09)
- R&S®FSWP26 (1322.8003K26)
- R&S®FSWP26 (1322.8003K27)
- R&S®FSWP50 (1322.8003K50)
- R&S®FSWP50 (1322.8003K51)

The following firmware options are described:

- R&S FSWP-K50 (1338.3358.02)

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1178.7075.02 | Version 05 | R&S®FSWP-K50

The following abbreviations are used throughout this manual: R&S®FSWP is abbreviated as R&S FSWP.

Contents

1 Preface

1.1 About this manual

This Spurious Measurements User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSWP 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 R&S FSWP Spurious measurements application**
  Introduction to and getting familiar with the application
- **About the measurement**
  General concept of the Spurious measurement and typical applications
- **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 R&S FSWP Spurious measurements application**
  Step-by-step instructions to perform a basic Spurious measurement
- **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 Spurious Measurements**
  Remote commands required to configure and perform Spurious measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FSWP User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
  Reference material
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation overview

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

www.rohde-schwarz.com/manual/FSWP

1.2.1 Getting started manual

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

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

1.2.2 User manuals and help

The user 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.

The contents of the user manual are available as help in the R&S FSWP. The help offers quick, context-sensitive access to the complete information for the instrument and its firmware.

The user manual is also available for download or for immediate display on the Internet.

1.2.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.2.4 Instrument security procedures

Deals with security issues when working with the R&S FSWP in secure areas. It is available for download on the Internet.

1.2.5 Printed safety instructions

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

1.2.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S FSWP. 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/FSWP

1.2.7 Release notes and open source acknowledgment (OSA)

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

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

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

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

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

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

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.

Convention	Description
`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 R&S FSWP Spurious measurements application

The R&S FSWP-K50 is a firmware application that allows you to perform Spurious measurements on the R&S FSWP very quickly and easily.

As an addition to the basic Spurious measurements available in the R&S FSWP base unit, the R&S FSWP Spurious measurements application features:

- Very quick spurious measurements on predefined measurement ranges using optimized RBWs
- Simple configuration of spurious measurements
- Storage of user-defined measurement configurations
- Measurement of both the power and the frequency of detected spurs
- Analysis methods to determine spurs generated internally by the spectrum analyzer itself, and to eliminate these effects

Availability of the Spurious measurement application

Using the Spurious measurement application requires the optional Spectrum Analyzer hardware (R&S FSWP-B1).

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSWP User Manual. The latest version is available for download at the product homepage.

Installation

You can find detailed installation instructions in the "R&S FSWP Getting Started" manual or in the release notes.

2.1 Starting the R&S FSWP Spurious measurements application

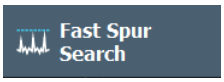
The R&S FSWP Spurious measurements application adds a new application to the R&S FSWP.

To activate the R&S FSWP Spurious measurements application

1. Press the [MODE] key on the front panel of the R&S FSWP.

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

2. Select the "Fast Spur Search" item.



The R&S FSWP opens a new measurement channel for the R&S FSWP Spurious measurements application.

The measurement is started immediately with the default settings. It can be configured in the Spurious "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see Chapter 5.1, "Configuration overview", on page 26).

Multiple Measurement Channels and Sequencer Function

When you activate an application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application.

The number of channels that can be configured at the same time depends on the available memory on the instrument.

Only one measurement can be performed at any time, namely the one in the currently active channel. However, a Sequencer function is provided that allows you to perform the configured measurements consecutively.

If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a ❁ symbol in the tab label. The result displays of the individual channels are updated in the tabs (including the "MultiView") as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

For details on the Sequencer function, see the R&S FSWP User Manual.

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 with spur detection threshold and limit offset lines
5 = Diagram footer with diagram-specific information, depending on measurement application
6 = Instrument status bar with error messages, progress bar and date/time display

Channel bar information

In the R&S FSWP Spurious measurements application, the R&S FSWP shows the following settings:

Table 2-1: Information displayed in the channel bar in the R&S FSWP Spurious measurements application

"Ref Level"	Reference level
"Spur Search"	Measurement type ("Wide", "Direct")
"RBW"	Currently used RBW during measurement
"Freq"	Currently processed center frequency during measurement
"SGL"	The measurement is set to single mode
"Meas Time"	A minimum estimate for the required measurement time; available after Spectral Overview is finished Note that the estimate includes a spurious detection sweep and spot search, assuming 10 spur candidates are found in the spurious detection sweep. If the signal to be measured does not meet the assumptions, the estimated measurement time may be too low.

The channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only

when applicable for the current measurement. For details, see the R&S FSWP 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 FSWP Spurious measurements application

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

Diagram footer information

The diagram footer (beneath the diagram) contains the following information:

- Start and stop frequency
- Number of trace points
- Range per division (x-axis)

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 measurement is displayed in the status bar. For details on the measurement process, see Chapter 3.3, "Measurement process", on page 18.

Depending on the currently running measurement (step), the following information is indicated in the status bar:

- Which measurement step is being performed
- The total number of segments required to meet the user specification and the segment currently being processed
- The total number of data acquisitions required to meet the user specification and the acquisition currently being processed

3 Measurement basics

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

3.1 Spurious emissions

Spurious emissions can be generated by a variety of processes, including:

- Instability, parasitic oscillations and resonances
- Harmonics
- Interference: RF leakage, EMI ingress from digital clocks
- Modulation: Intermodulation (IM) and cross-modulation (CM) effects
- Spurs internally generated by the test equipment (spectrum analyzer)

These spurious emissions can cause problems for the equipment manufacturer including:

- Interference with radio transmissions in adjacent bands
- Interference with other modules contained within the equipment
- Violation of regulatory limits
- Power inefficiencies due to the transmissions of non-usable frequencies

Thus, the R&S FSWP Spurious measurements application allows you to detect, measure and identify spurious signals, based on common spectrum analyzer functionality.

Residuals

Residuals are spurs that are created by the analyzer itself. These spurs are identified by the R&S FSWP Spurious measurements application automatically, and can be displayed or removed from the measured results.

3.2 Frequency plan and spur identification

You can define the main components in the signal chain of your DUT with the corresponding frequencies in a *frequency plan*. Then the R&S FSWP Spurious measurements application can calculate the frequencies for possible spurs at those frequencies and the frequencies of mixer products up to a maximum number of harmonics. After a measurement, the R&S FSWP Spurious measurements application compares the detected spurious results to the predicted frequencies. Spurs that occur at one of the predicted frequencies are identified. Thus, you get an idea of the possible source of the spurs.

Note that if several combinations of components, input frequencies and harmonics lead to the same predicted spur frequency, the spur identification with the lowest harmonic is indicated. If the frequency is still not unique, the identification with the shortest string length is indicated.

If you transfer the predicted frequencies from a frequency plan to a directed search measurement, the measurement is only performed at the frequencies specified in the plan.

For details on how to perform a measurement using a frequency plan, see Chapter 7.4, "How to perform a spurious search measurement with a DUT frequency plan", on page 83.

3.3 Measurement process

The R&S FSWP Spurious measurements application provides two different measurement types (see also Chapter 4, "Measurement types and results", on page 20):

- A measurement on a wide frequency range (wide search measurement), intended for unknown spurious scenarios.
- A detailed measurement (directed search measurement) at specific frequencies with a small span around each frequency.

Although the two measurement types use different measurement settings, the individual measurement steps are the same for both types.

The basic measurement process consists of the following steps:

1. **Spectral overview**: An initial sweep from the beginning of the first defined range to the end of the last defined range (for directed search measurement: from the first to the last span), using a large RBW and short sweep time to obtain an overview of the input signal quickly.
   The spectral overview allows the R&S FSWP Spurious measurements application to estimate the noise floor for the current user settings for the complete frequency span defined by the ranges or directed search measurements.

   Note: If the signal contains a guard interval, you can restrict the spur search to ignore a certain span around the carrier. In this case, the spectral overview contains gaps at the specified spans.
2. **Noise floor estimation**: Estimation of the noise floor from the beginning of the first defined range to the end of the last defined range (for directed search measurement: from the first to the last span), determined from the spectral overview sweep. The noise floor estimate is required to set the RBW optimally for subsequent measurement steps: Due to noise variations across the frequencies, the RBW required to achieve the user-defined spur detection threshold varies. Each range is thus split into smaller segments that use a constant RBW setting for the complete segment span. The frequency span of the segments depends on the signal and noise conditions and on the settings. As a result, a segment table is created. This table

can be analyzed and used for repeated measurements with the same settings (see Chapter 5.8, "Transferring settings between measurements", on page 53).

3. **Spurious detection:** A second sweep performed in the predefined ranges/ segments/spans according to the wide search measurement/directed search measurement configuration. The RBW determined by the noise floor estimate or, for manual RBW configuration, the user-defined RBW is used. Depending on the size of the range/span and the required RBW, multiple data acquisitions (or more precisely: FFTs) may be required.

   Within the defined and swept ranges/spans, the noise floor is displayed below the user-defined spur detection threshold. Outside the ranges/spans, no trace is available.
   Measured power values that exceed the detection threshold are possible spurs and are entered in the "Spurious Detection Table".

4. **Spot Search:** A final sweep on each of the possible spurs in the "Spurious Detection Table" to determine whether the peak is a real spur, an artifact of noise, or generated internally. The RBW for these spot searches may be reduced further compared to the spurious detection sweep: It is set such that the final spur has at least the user-defined minimum SNR (see "Minimum Spur SNR" on page 61).
   The lower RBW leads to a lower noise floor for this scan region compared to the surrounding regions. Thus, a message indicating the possibility of lower noise floors is displayed during the spot search (see "Show Messages" on page 64).
   Spurs that are found to be artifacts of noise or residuals during the spot search are removed from the "Spurious Detection Table". (Alternatively, residuals can be marked instead of removed).
   After the spot search, the "Spurious Detection Table" contains all peaks that still exceed the detection threshold, and are considered a spur. All spurs that exceed the limit line are marked red (see "Limit Offset to Detection Threshold" on page 57). The spur frequency and level are updated with more accurate values during the spot search.

4 Measurement types and results

Access: "Overview" > "Measurement Control"

Or: [MEAS CONFIG] > "Measurement Control"

There are two different Spurious measurement types for common measurement scenarios, which require different settings.

Wide Search Measurement

A wide search measurement is a measurement with a large span to detect any possible spurs in the entire frequency span of an input signal. This measurement is useful if you have little or no knowledge of the current input signal or where to expect spurs, and require an overview.

Directed Search Measurement

A directed search measurement is a measurement performed at predefined discrete frequencies with settings optimized for the current signal and noise levels at those frequencies. This measurement is targeted at determining the precise level and exact frequency of spurs that are basically known or expected.

The results of both measurements on the same signal are basically the same; however, the directed search measurement can save measurement time if the frequencies for possible spurs are known in advance. Furthermore, the directed search measurement can provide more precise results, using a larger SNR for a smaller span.

Combined Wide Search Measurement and Directed Search Measurement

Both types of measurement can be combined, if only some of the spurs found during the wide search measurement are to be analyzed further:

1. Perform a wide search measurement to obtain an overview and detect the spurs in a large frequency span.
2. Transfer the frequencies of interest to the directed search measurement configuration.
3. Perform a directed search measurement at the frequencies of interest only in a second measurement.

4.1 Evaluation methods

Access: "Overview" > "Display Config"

Or: [MEAS]

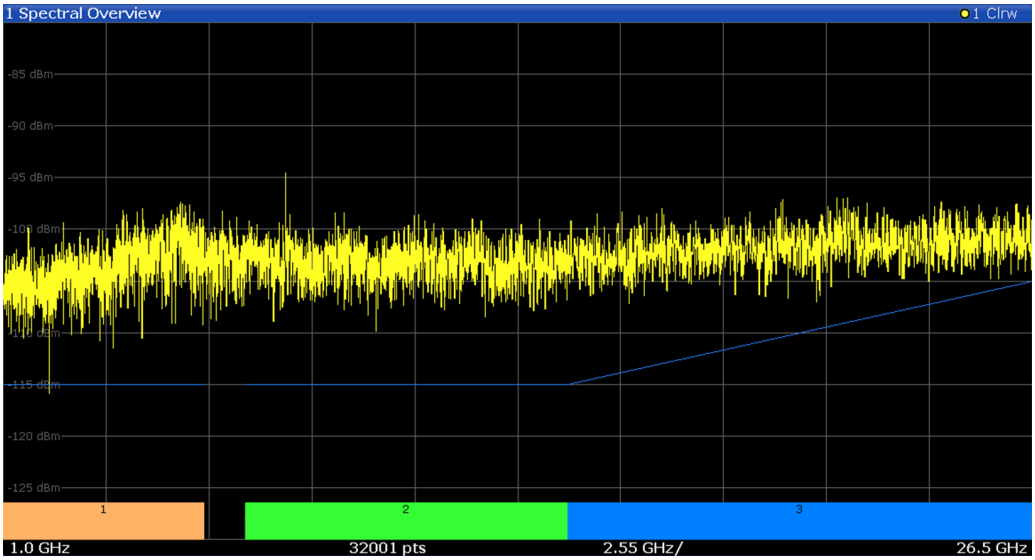
The data that was measured by the R&S FSWP Spurious measurements application can be evaluated using various different methods. All evaluation methods available for the Spurious measurements are displayed in the selection bar in SmartGrid mode.

For details on working with the SmartGrid, see the R&S FSWP Getting Started manual.

By default, the following result displays are provided for Spurious measurements:

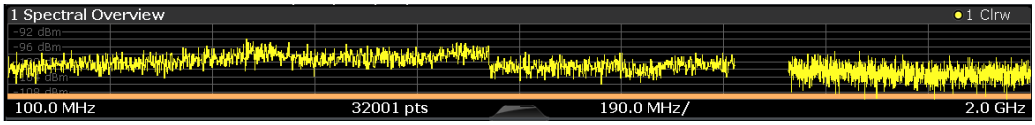
- "Spectral Overview" on page 21
- "Spurious Detection Spectrum" on page 22
- "Spurious Detection Table" on page 23

Spectral Overview
Displays a spectrum diagram of the "Spectral Overview" (see Chapter 3.3, "Measurement process", on page 18), meant to obtain an overview of the input signal and the required measurement settings. A continuous trace is shown for the entire measurement span.



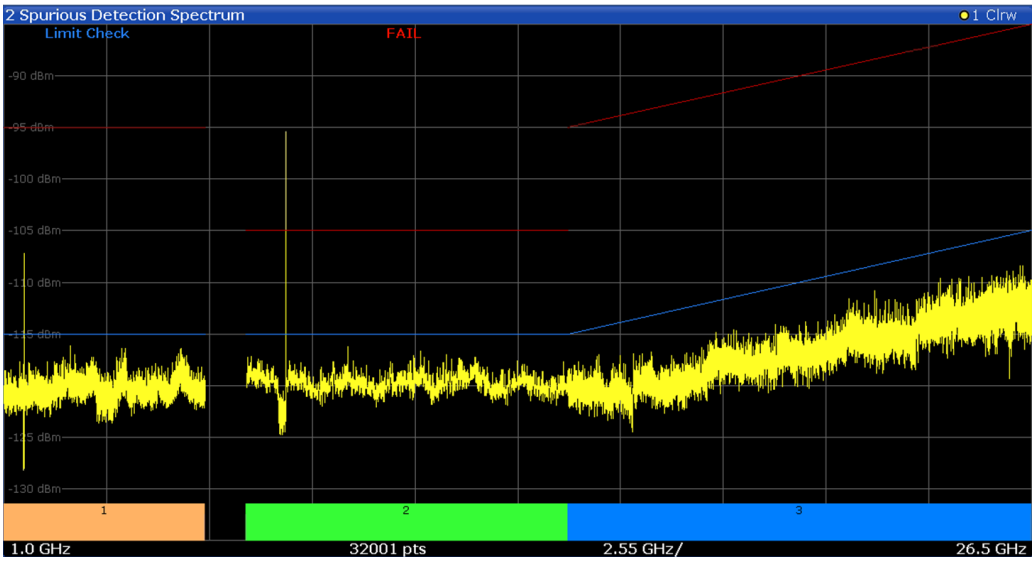
The specified detection threshold for each range/span is indicated by a blue line in the diagram (only if it is within the displayed power region, see "Detection Threshold" on page 61).

Note: If the signal contains a guard interval, you can restrict the spur search to ignore a certain span around the carrier. In this case, the spectral overview contains gaps at the specified spans.



Remote command:
LAY:ADD? '1',RIGH,SOVerview, see LAYout:ADD[:WINDow]? on page 152
Storing results:
MMEMory:STORe<n>:TRACe on page 187

Spurious Detection Spectrum
Displays the results of the spurious detection sweep (see Chapter 3.3, "Measurement process", on page 18) as a spectrum diagram for the (discrete) swept ranges. For ranges that include gaps and for directed search measurements, the diagram shows several separate trace parts, one for each measured frequency range or span.



The specified detection threshold for each range/span is indicated by a blue line in the diagram (see "Detection Threshold" on page 61).

The limit line defined as an offset to the detection threshold is indicated by a red line in the diagram (see "Limit Offset to Detection Threshold" on page 57).

Colored bars beneath the diagram indicate the specified measurement ranges (see Chapter 3.3, "Measurement process", on page 18).

(Both lines and the colored bars can be hidden, see Chapter 5.11.2, "Results settings", on page 63.)

The result of the overall limit check for the entire measurement is indicated at the top of the diagram. If any spurs exceed the defined limit line for the corresponding range or span, the limit check is failed.

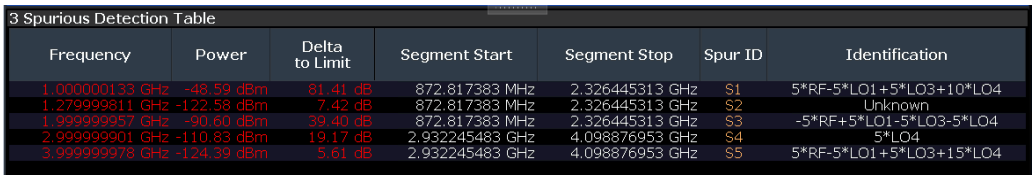
Remote command:
LAY:ADD? '1',RIGH,SDETection, see LAYout:ADD[:WINDow]? on page 152
Storing results:
MMEMory:STORe<n>:TRACe on page 187

Spurious Detection Table
Displays the numerical results of the detected spurs. Optionally, residual spurs are indicated in light gray (see "Mark Residual Spurs" on page 39). Spurs that exceed the defined limit are indicated in red (see "Limit Offset to Detection Threshold" on page 57).

During the measurement process (see Chapter 3.3, "Measurement process", on page 18), the values are updated and refined. The spurs are listed in the order they are detected, that is: in ascending order of frequency. Each spur ID is indicated in the same color as the range it was found in (see also "Spurious Detection Spectrum" on page 22).

If identification according to the DUT's frequency plan is activated and possible, the detected spurs' identification is also displayed. Note that if several combinations of components, input frequencies and harmonics lead to the same predicted spur frequency, the spur identification with the lowest harmonic is indicated. If the frequency is still not unique, the identification with the shortest value is indicated.

Note: You can configure which results to display in the table in order to use the available display space optimally or reduce the time to store the results (see Chapter 5.11.1, "Spurious detection table configuration", on page 62).


3 Spurious Detection Table

Frequency	Power	Delta to Limit	Segment Start	Segment Stop	Spur ID	Identification
1.000000133 GHz	-48.59 dBm	81.41 dB	872.817383 MHz	2.326445313 GHz	S1	5*RF-5*LO1+5*LO3+10*LO4
1.279999811 GHz	-122.58 dBm	7.42 dB	872.817383 MHz	2.326445313 GHz	S2	Unknown
1.999999957 GHz	-90.60 dBm	39.40 dB	872.817383 MHz	2.326445313 GHz	S3	-5*RF+5*LO1-5*LO3-5*LO4
2.999999901 GHz	-110.83 dBm	19.17 dB	2.932245483 GHz	4.098876953 GHz	S4	5*LO4
3.999999978 GHz	-124.39 dBm	5.61 dB	2.932245483 GHz	4.098876953 GHz	S5	5*RF-5*LO1+5*LO3+15*LO4

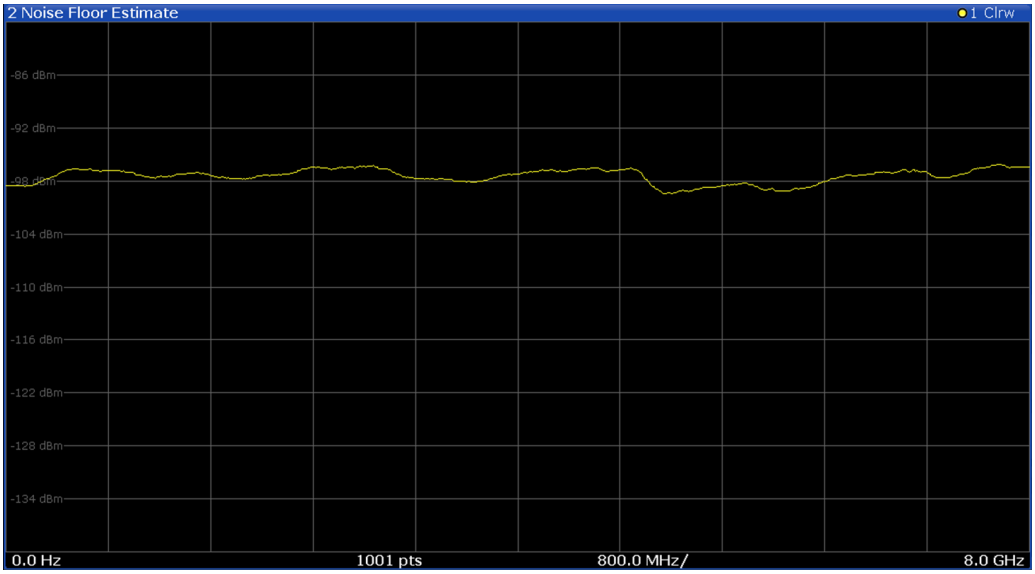
Table 4-1: Spurious Detection Table Results

Column	Description
"Frequency"	The frequency of the spur
"Power"	The power level measured at the spur
"Delta to Limit"	The difference between the measured power and the defined limit value
"RBW"	The RBW that was used in that range
"Segment Start" / "Segment Stop"	The start and stop frequency of the segment in which the spur was found; (For measurements without optimization, the values correspond to the range frequencies.)
"Spur ID"	Consecutive number of spur in the order it was found; indicated in same color as the range it was found in
"Identification"	Identified spur from the frequency plan, if available

Remote command:
`LAY:ADD? '1',RIGH,SDTable`, see `LAYout:ADD[:WINDow]?` on page 152
Storing results:
`MMEMory:STORe<n>:TABLe` on page 186

Noise Floor Estimate

Displays the noise floor estimated during the "Spectral Overview". This information helps you understand the RBWs used for the individual segments by the R&S FSWP Spurious measurements application.



Remote command:
`LAY:ADD? '1',RIGH,NESTimate`, see `LAYout:ADD[:WINDow]?` on page 152
Storing results:
`MMEMory:STORe<n>:TRACe` on page 187

Marker Table

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

This table is displayed automatically if configured accordingly.

Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Ref	Shows the reference marker that a delta marker refers to.
Trace	Shows the trace that the marker is positioned on.
X- / Y-Value	Shows the marker coordinates (usually frequency and level).

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 152
Results:

CALCulate<n>:MARKer<m>:X on page 170
CALCulate<n>:MARKer<m>:Y? on page 189

5 Configuration

Access: [MODE] > "Spurious"

Spurious measurements require a special application on the R&S FSWP.

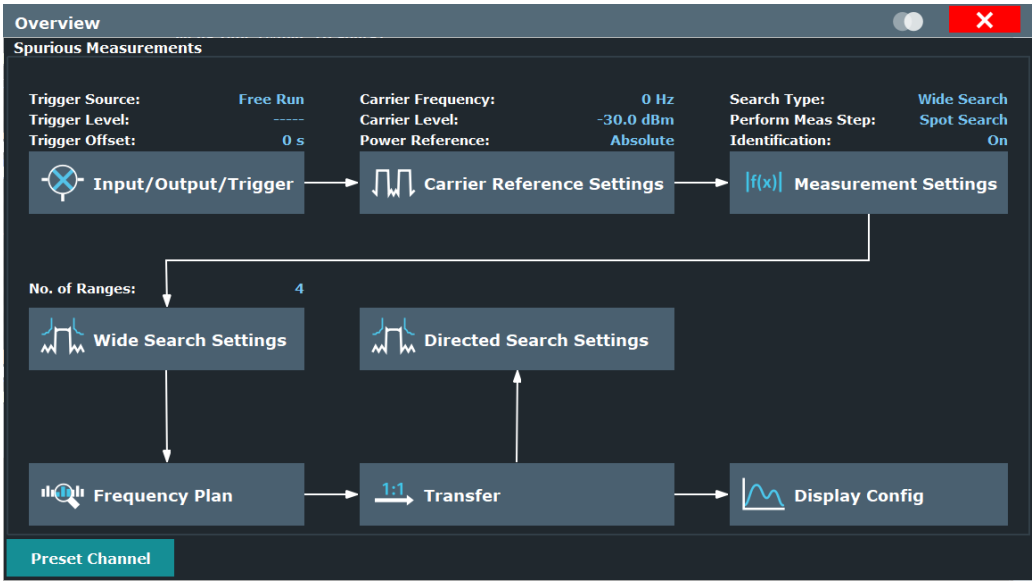
When you switch a measurement channel to the R&S FSWP Spurious measurements application the first time, a set of parameters is passed on from the currently active application. After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel.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

When you activate a measurement channel in the R&S FSWP Spurious measurements application, the "Spurious" menu is displayed and provides access to the most important configuration functions.

5.1 Configuration overview

Access: all menus

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



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 by stepping through the dialog boxes as indicated in the "Overview".

Depending on the measurement currently selected in the Measurement settings settings, the required steps in the overview differ slightly.

In particular, the "Overview" provides quick access to the following configuration dialog boxes:

1. Input/ Output/Trigger
   See Chapter 5.2, "Input / output settings", on page 28
2. Carrier Reference Settings
   See Chapter 5.5, "Carrier reference settings", on page 40
3. Measurement Settings
   See Chapter 5.4, "Measurement settings", on page 37
4. Wide Search Settings
   See Chapter 5.6, "Wide Search Measurement settings", on page 43
5. Frequency Plan
   See Chapter 5.7, "Identification settings - DUT frequency plan", on page 49
6. Transfer
   See Chapter 5.8.2, "Spur table", on page 54/ Chapter 5.8.1, "Segment table", on page 53
7. Directed Search Settings
   See Chapter 5.9, "Directed Search Measurement settings", on page 55
8. Display Configuration

See Chapter 5.10, "Display configuration", on page 62

To configure settings

► Select any button to open the corresponding dialog box. To configure a particular setting displayed in the "Overview", simply select the setting on the touch screen. The corresponding dialog box is opened with the focus on the selected setting.

For step-by-step instructions on configuring Spurious measurements, see Chapter 7, "How to perform Spurious measurements", on page 80.

Preset Channel
Select the "Preset Channel" button 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 the "Preset Channel" button with the [Preset] *key*, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSWP (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 94

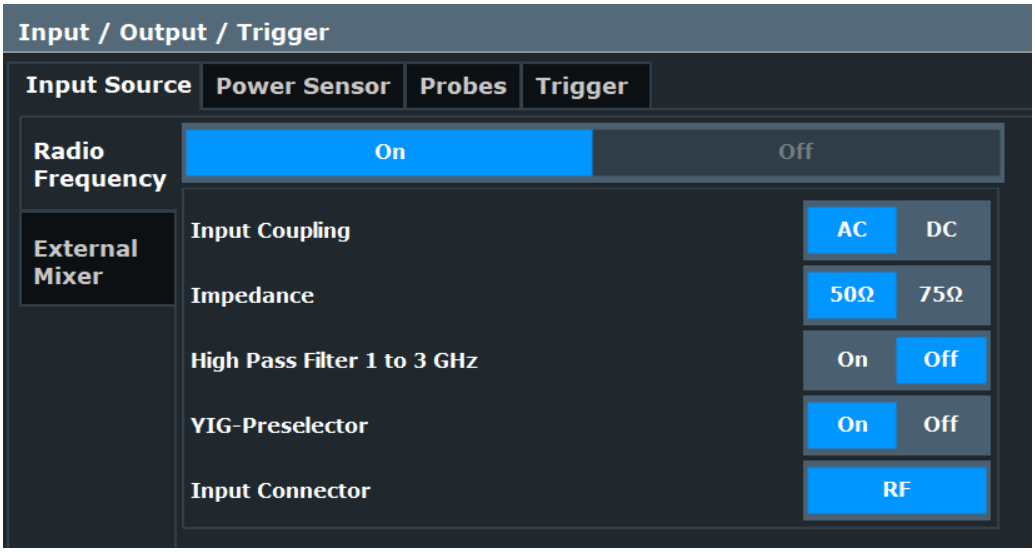
5.2 Input / output settings

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

The R&S FSWP can evaluate signals from different input sources.

5.2.1 RF input

Access: "Overview" > "Input/Output/Trigger" > "Input Source" > "Radio Frequency"



The remote commands required to configure the RF input are described in Chapter 8.3.1, "Configuring the data input", on page 94.

Radio Frequency State
Activates input from the "RF Input" connector.

Remote command:
`INPut<ip>:SELect` on page 98

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

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

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

Remote command:
`INPut<ip>:COUPling` on page 95

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

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

This value also affects the unit conversion.

Remote command:
`INPut<ip>:IMPedance` on page 97

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:
`INPut<ip>:DPATh` on page 96

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<ip>:FILTer:HPASs[:STATe]` on page 96

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the R&S FSWP.

The R&S FSWP Spurious measurements application requires the YIG-preselector at the input of the R&S FSWP to ensure that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth.

Note: Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

Remote command:
INPut<ip>:FILTer:YIG[:STATe] on page 97

Input Connector
Determines which connector the input data for the measurement is taken from.

"RF" (Default:) The "RF Input" connector

"RF Probe" The "RF Input" connector with an adapter for a modular probe
This setting is only available if a probe is connected to the "RF Input" connector.

Remote command:
INPut<ip>:CONNector on page 95

5.2.2 Power sensors

Access: "Overview" > "Input/Output/Trigger" > "Power Sensors"

The functionality to use power sensors is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSWP spectrum application.

5.2.3 Probes

Access: "Overview" > "Input/Output/Trigger" > "Probes"

The functionality to use probes (via the RF input) is the same as in the optional spectrum application.

For a comprehensive description, refer to the user manual of the optional R&S FSWP spectrum application.

5.2.4 External mixers

Access: "Overview" > "Input/Output/Trigger" > "Input Source" > "External Mixer"

Input through external mixers is available with the optional external mixer control hardware.

The features are the same as in the phase noise application. For a comprehensive description, refer to the R&S FSWP user manual.

5.2.5 General output

Access: [INPUT/OUTPUT] > "Output Config"

The R&S FSWP Spurious measurements application is able to provide a trigger output signal. The configuration of the trigger output is described in "Trigger 1/2" on page 36.

5.2.6 DC power output

Access: [INPUT/OUTPUT] > "Output Config" > "DC Config"

The configuration of the DC power supply is the same as in the phase noise application.

For a comprehensive description, refer to the R&S FSWP user manual.

5.2.7 Signal source output

Access: [INPUT/OUTPUT] > "Output Config" > "Signal Source"

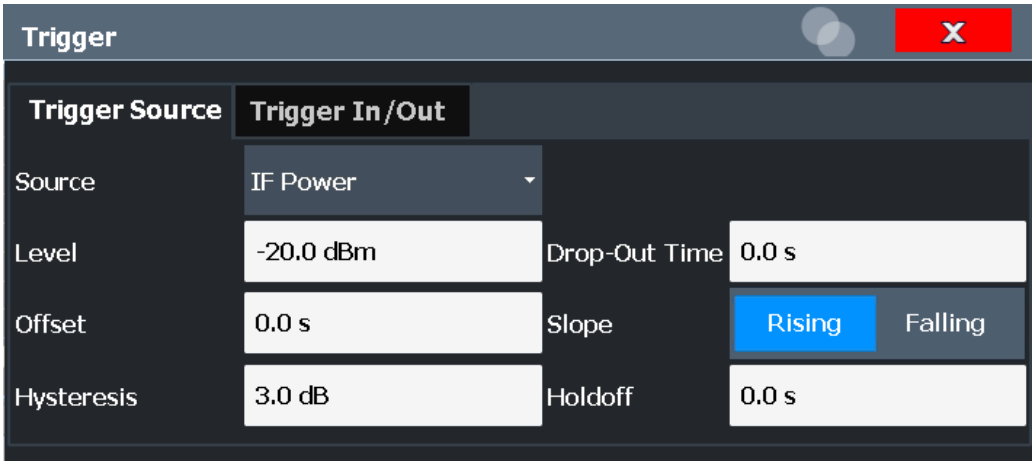
The configuration of the optional signal source is the same as in the phase noise application.

For a comprehensive description, refer to the R&S FSWP user manual.

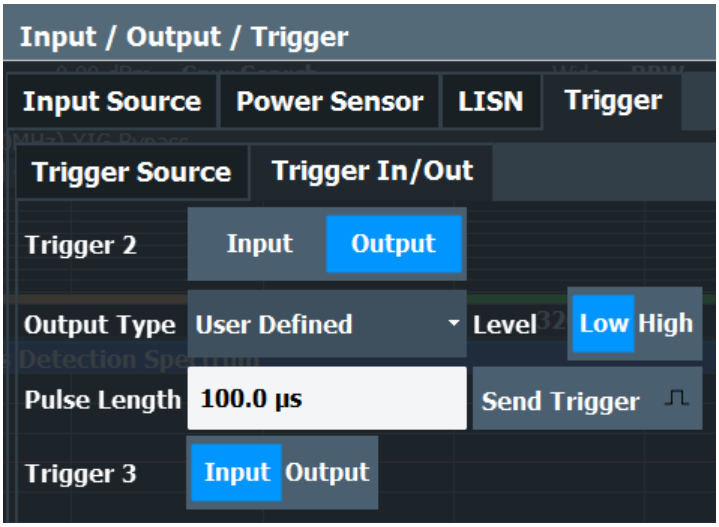
5.3 Trigger settings

Access: "Overview" > "Input/Output/Trigger" > "Trigger" tab

Trigger settings determine when the input signal is measured.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the R&S FSWP are configured in a separate tab of the dialog box.



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

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

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

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 125

Free Run ← Trigger Source ← Trigger Source
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitly.

Remote command:
TRIG:SOUR IMM, see TRIGger[:SEQuence]:SOURce on page 125

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

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the "Trigger Input / Output" connector on the front panel.

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

"External Trigger 1"
Trigger signal from the "Trigger Input / Output" connector. (front panel)

"External Trigger 2"
Trigger signal from the "Sync Trigger Input / Output" connector. (rear panel)

Remote command:
TRIG:SOUR EXT, TRIG:SOUR EXT2
See TRIGger[:SEQuence]:SOURce on page 125

IF Power ← Trigger Source ← Trigger Source
The R&S FSWP 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 data sheet.

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.

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

Remote command:
TRIG:SOUR IFP, see TRIGger[:SEQuence]:SOURce on page 125

RF Power ← Trigger Source ← Trigger Source
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 input signal must be in the frequency range between 500 MHz and 8 GHz.

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

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 125

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 123

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 122

Trigger Offset ← Trigger Source
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 122

Hysteresis ← Trigger Source
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.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 123

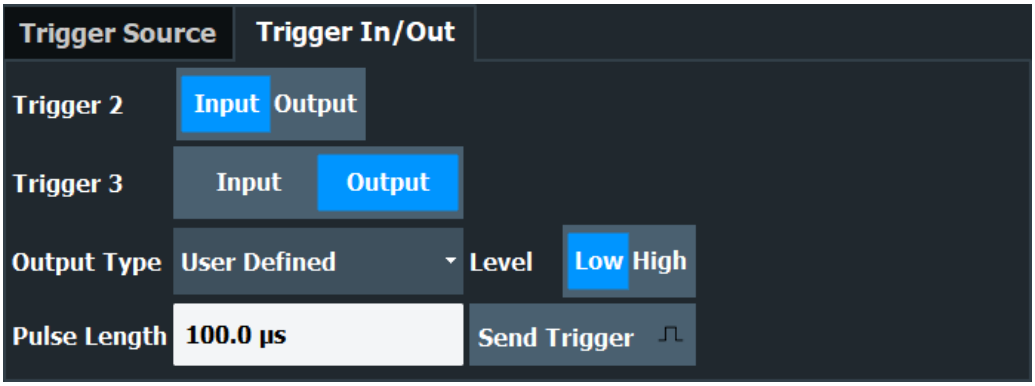
Trigger Holdoff ← Trigger Source
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 123

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

Remote command:
TRIGger[:SEQuence]:SLOPe on page 124

Trigger 1/2



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

"Trigger 1" "Trigger 1": "Trigger Input/Output" connector on the front panel

"Trigger 2" Defines the usage of the variable "Trigger Input/Output" connector on the rear panel.

"Input" The signal at the connector is used as an external trigger source by the R&S FSWP. Trigger input parameters are available in the "Trigger" dialog box.

"Output" The R&S FSWP 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<up>:TRIGger<tp>:DIRection on page 125

Output Type ← Trigger 1/2
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the R&S FSWP triggers.

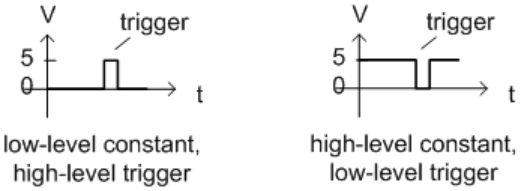
"Trigger Armed" Sends a (high level) trigger when the R&S FSWP is in "Ready for trigger" state.
This state is indicated by a status bit in the STATus:OPERation register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).

"User Defined" Sends a trigger when you select the "Send Trigger" button.
In this case, further parameters are available for the output signal.

Remote command:
OUTPut<up>:TRIGger<tp>:OTYPe on page 126

Level ← Output Type ← Trigger 1/2
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.



Remote command:
`OUTPut<up>:TRIGger<tp>:LEVel` on page 126

Pulse Length ← Output Type ← Trigger 1/2
Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:
`OUTPut<up>:TRIGger<tp>:PULSe:LENGth` on page 127

Send Trigger ← Output Type ← Trigger 1/2
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.

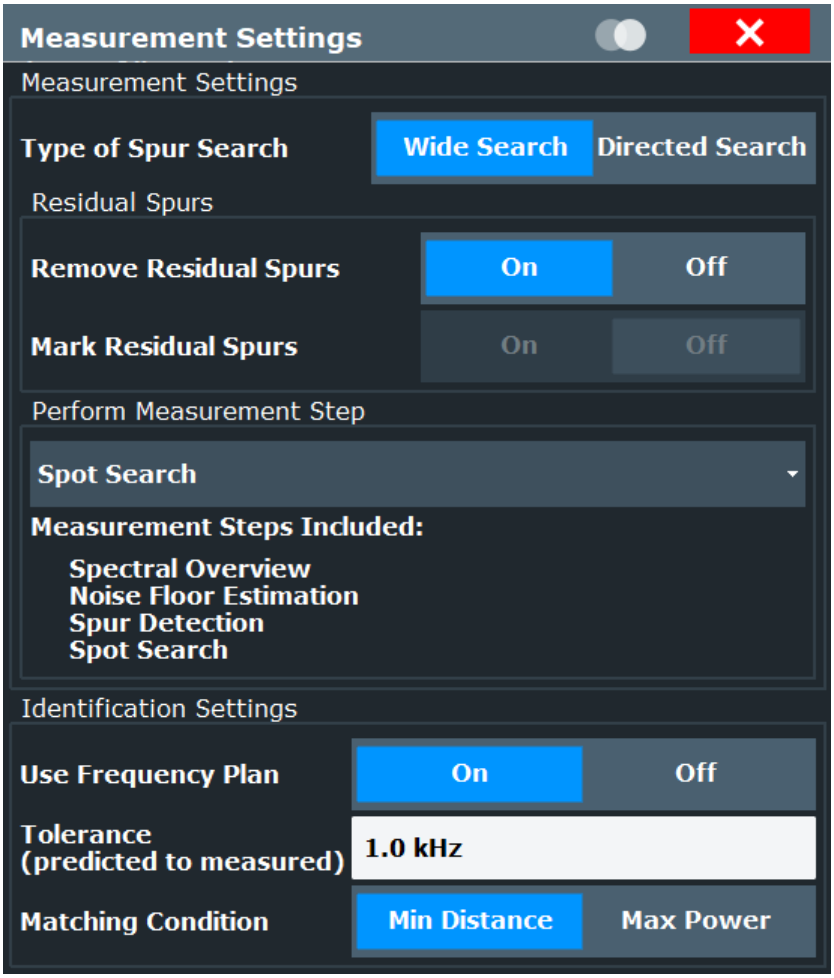
Remote command:
`OUTPut<up>:TRIGger<tp>:PULSe:IMMediate` on page 127

5.4 Measurement settings

Access: "Overview" > "Measurement Settings"

Or: [MEAS CONFIG] > "Meas Settings"

These settings control the measurement type and the steps to be processed (see Chapter 3.3, "Measurement process", on page 18), as well as basic measurement settings.



Type of Spur Search
Defines the type of measurement to be configured and performed.

"Wide Search" A measurement with a large span to detect any possible spurs in the entire frequency span of an input signal. This measurement is useful if you have little or no knowledge of the current input signal or where to expect spurs, and require an overview.

"Directed Search" A measurement performed at predefined discrete frequencies with settings optimized for the current signal and noise levels at those frequencies. This measurement is targeted at determining the precise level and exact frequency of spurs that are basically known or expected.

Remote command:
[SENSe:]SSEarch:STYPe on page 129

Use Frequency Plan for Identification
If enabled, the detected spur frequencies are compared with those defined in a frequency plan for the DUT, if available (see Chapter 5.7, "Identification settings - DUT frequency plan", on page 49 and Chapter 3.2, "Frequency plan and spur identification", on page 17). If a matching spur is identified, the spur identification is output in the Spurious Detection Table as defined in the frequency plan.

Remote command:
[SENSe:]SSEarch:FPLan on page 128

Tolerance for Identification
Provides functionality to set the frequency tolerance. This allows matching the predicted spurs to the measured spurs.

Remote command:
[SENSe:]SSEarch:FPLan:TOLerance on page 128

Matching Condition
Defines the condition for matching the measured to the predicted spurs.

Remote command:
[SENSe:]SSEarch:MSPur on page 129

Remove Residual Spurs
If enabled, residual spurs, which are generated by internal components in the R&S FSWP itself, are not included in the spur results. Note, however, if a residual spur coincides with a "true" spur from the active frequency plan, the spur may also be removed.

On the other hand, some residuals detected in the spectral overview sweep might "disappear" from the final spur results even if the "Remove Residual Spurs" setting is disabled, due to the different measurement parameters for the spectral overview sweep and the spot search.

Remote command:
[SENSe:]SSEarch:RREMove on page 129

Mark Residual Spurs
If enabled, residual spurs are indicated in the diagrams in light gray. If a residual spur coincides with a "true" spur from the active frequency plan, the identifier from the frequency plan spur is output using the residual color.

Note that some residuals detected in the spectral overview sweep might not be marked in the final spur results even if the "Mark Residual Spurs" setting is enabled, due to the different measurement parameters for the spectral overview sweep and the spot search.

Remote command:
[SENSe:]SSEarch:RMARk on page 128

Perform Measurement Step
Defines which steps of the measurement process are performed. All steps up to the selected step are performed, as indicated in the dialog box. By default, all measurement steps are performed.

For details on the measurement process steps see Chapter 3.3, "Measurement process", on page 18.

Remote command:
`[SENSe:]SSEarch:CONTrol` on page 127

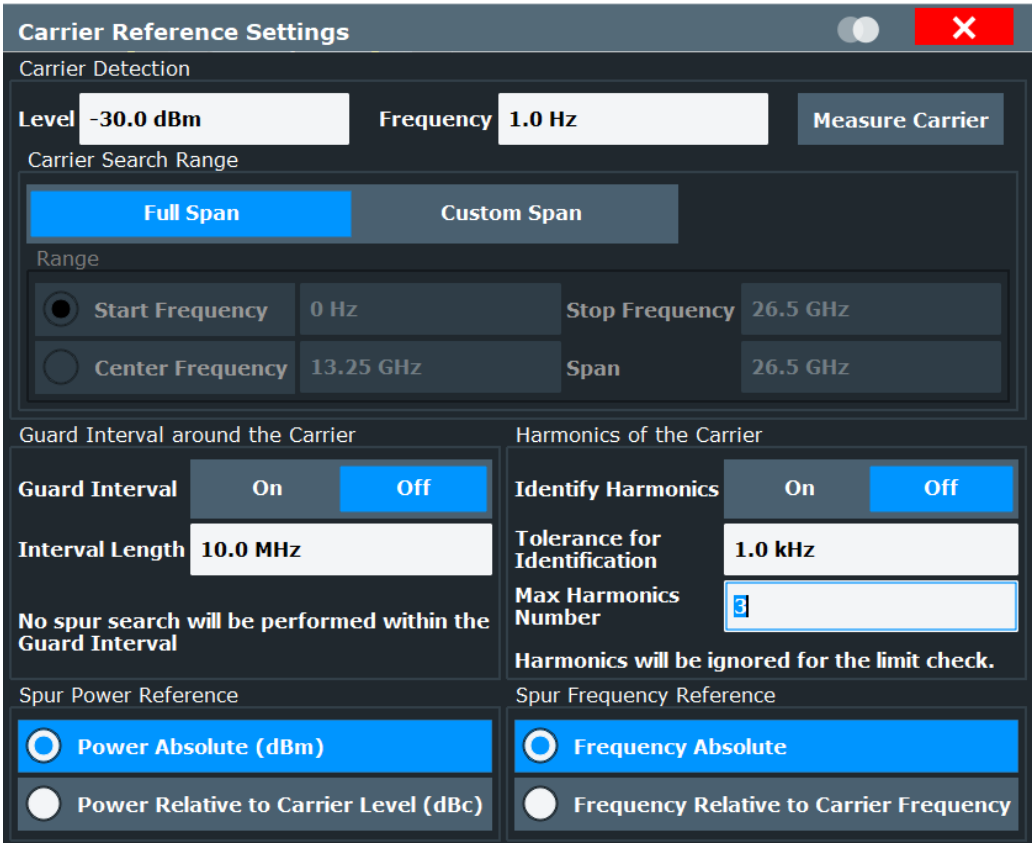
5.5 Carrier reference settings

Access: "Overview" > "Carrier Reference Settings"

The carrier, or the desired signal, is assumed to have the maximum power level in the input signal. Thus, determining the maximum peak allows for the R&S FSWP Spurious measurements application to measure power values relative to the carrier.

The maximum peak, which is also the carrier reference level, can be detected automatically by the application, or defined manually by the user.

If a carrier frequency has been measured or entered by the user, additionally the harmonics and subharmonics of this carrier frequency can be identified. The harmonics and subharmonics will be measured up to the maximum harmonics number set in this dialog and will have a higher priority than other spurs: If a carrier harmonic has the same frequency than a spur, the harmonic will be detected. Harmonics will be marker in the resulting spur list and will be excluded from the limit check.



Carrier Level
Defines or indicates the maximum peak of the signal, which is considered to be the reference carrier.

Remote command:
`[SENSe:]CREFerence:VALue` on page 133

Carrier Frequency
Defines or indicates the frequency at which the maximum peak of the signal, that is: the reference carrier, was found.

Remote command:
`[SENSe:]CREFerence:FREQuency` on page 131

Measure Carrier
Automatically detects the highest peak over the specified frequency range of the analyzer. This value is considered to be the reference carrier and is indicated in Carrier Level and Carrier Frequency.

Note: This function is identical to Auto Carrier in the "Auto Set" menu.

Remote command:
`[SENSe:]ADJust:CARRier` on page 130

Carrier Search Range ← Measure Carrier
Determines the search area for the Measure Carrier function.

"Full Span" The maximum peak in the entire measurement span is determined.

"Custom Span" The maximum peak is searched only in the range specified by Start Frequency/Stop Frequency or Center Frequency/Span.

Remote command:
`[SENSe:]CREFerence:SRANge` on page 132

Start Frequency/Stop Frequency ← Carrier Search Range ← Measure Carrier
Defines the range in which the maximum peak is searched by a start and stop frequency.

This setting is only available if the Carrier Search Range is restricted ("Custom Span").

Remote command:
`[SENSe:]CREFerence:PDETect:RANGe:STARt` on page 132
`[SENSe:]CREFerence:PDETect:RANGe:STOP` on page 132

Center Frequency/Span ← Carrier Search Range ← Measure Carrier
Defines the range in which the maximum peak is searched by a center frequency and a span.

This setting is only available if the Carrier Search Range is restricted ("Custom Span").

Remote command:
`[SENSe:]CREFerence:PDETect:RANGe:CENTer` on page 132
`[SENSe:]CREFerence:PDETect:RANGe:SPAN` on page 132

Guard Interval
Determines whether the specified guard interval is included in the spur search or not. If the guard interval is not included, the spectrum displays contain gaps at the guard intervals.

The guard interval is defined as a span around the reference carrier.

If the signal contains a guard interval, ignoring this interval in the spur search removes irrelevant spurs from the results.

See also Chapter 3.3, "Measurement process", on page 18.

Remote command:
`[SENSe:]CREFerence:GUARd:STATe` on page 131
`[SENSe:]CREFerence:GUARd:INTerval` on page 131

Spur Power Reference
Determines whether power values in all results and settings for the Spurious measurement are defined as absolute values (dBm) or relative to the Carrier Level power (dBc).

Remote command:
[SENSe:]CREFerence:PREFerence on page 131

Spur Frequency Reference
Determines whether frequency values in all results and settings for the Spurious measurement are defined as absolute values or relative to the Carrier Frequency frequency.

Remote command:
[SENSe:]CREFerence:FREFerence on page 130

Identify Harmonics
Switches the identification of harmonics on or off. Default condition is off. If harmonics identification is set on, harmonics and subharmonics will be detected for the current carrier frequency and marked in the result summary. They will be excluded from the limit check. If harmonics identification is off, harmonics and subharmonics will be marked as spurs.

Remote command:
[SENSe:]CREFerence:HARMonics:IDENtify on page 133

Tolerance for Identification
Provides functionality to set the tolerance for the harmonics identification. This allows matching the predicted harmonics to the measured spurs.

Remote command:
[SENSe:]CREFerence:HARMonics:TOLerance on page 133

Max Harmonics Number
Determines which harmonics and subharmonics number shall be measured.

Remote command:
[SENSe:]CREFerence:HARMonics:MNUMber on page 133

5.6 Wide Search Measurement settings

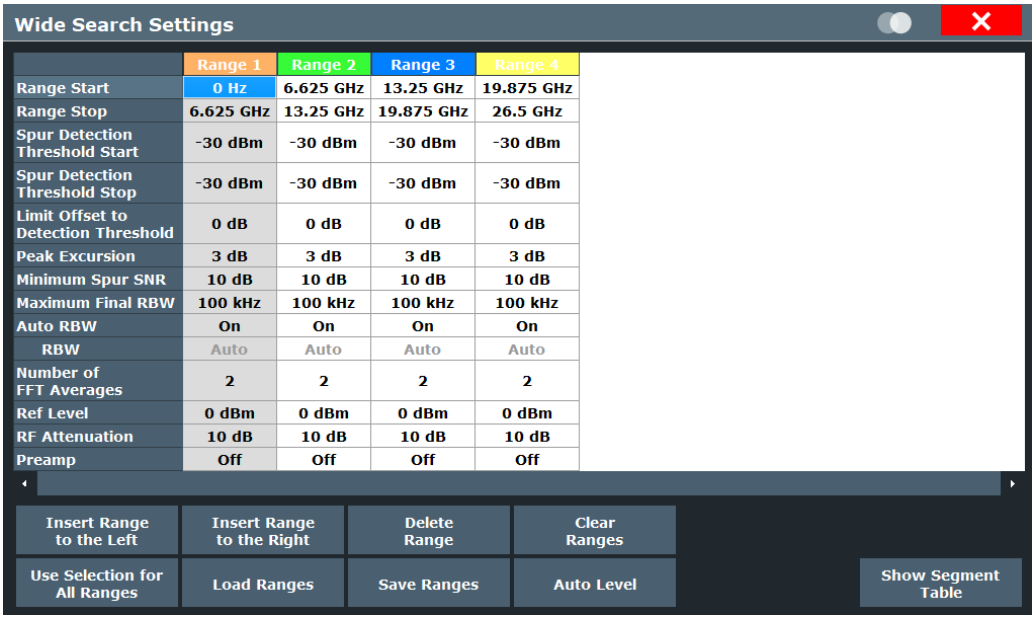
Access: "Overview" > "Wide Search Settings"

For wide search measurement, the entire available measurement span is measured by default. However, if you have some knowledge of the (expected) input signal and its characteristics, you can adapt the ranges and include additional ranges to accommodate for different signal and noise levels, or exclude frequency spans which do not require evaluation.

The initial Spectral Overview sweep performs a continuous sweep from the first range to the last, with predefined settings for a quick measurement on a wide span. The spectral overview allows the R&S FSWP Spurious measurements application to split

the user-defined ranges into smaller segments with similar signal and noise characteristics.

Depending on the user-defined "Spur Detection Threshold", the RBW is set such that the displayed noise floor is slightly below the threshold. Values that exceed the threshold are considered to be a spur and entered in the "Spurious Detection Table". Optionally, you can define a limit in relation to the threshold, against which the spur levels are checked.



By default, the entire available measurement span is split into four frequency ranges. However, you can change the number and size of ranges and the settings for each individual range. Furthermore, you can save range setups to a file and load them again later.

Each range is indicated in a different color. The same color is used to indicate the range in the spectral result displays. In the Spurious Detection Table, the same color is used to indicate the range in which a specific spur was found.

- Managing ranges 44
- Configuring individual ranges 46

5.6.1 Managing ranges

Access: "Overview" > "Wide Search Settings"

The following functions allow you to manage the range setup in general.

Insert Range to the Left/ Insert Range to the Right 45
Delete Range 45
Clear Ranges 45
Use Selection for All Ranges 45
Save Ranges 45

Insert Range to the Left/ Insert Range to the Right
Inserts a new range to the left or right of the currently focused range. The range numbers of the currently focused range and all higher ranges are increased accordingly. The maximum number of ranges is 1000.

Remote command:
`[SENSe:]LIST:RANGe<ri>:INSert` on page 136

Delete Range
Deletes the currently focused range. The range numbers are updated accordingly.

Remote command:
`[SENSe:]LIST:RANGe<ri>:DELete` on page 136

Clear Ranges
Removes all but the first range.

Remote command:
`[SENSe:]LIST:CLEar` on page 134

Use Selection for All Ranges
Copies the currently selected setting to all ranges in the table. This function is convenient if all ranges use the same setting.

Remote command:
`[SENSe:]LIST:RANGe<ri>:UARange` on page 135

Save Ranges
Saves the current range setup to a user-defined `.csv` file for later use.

Remote command:
`[SENSe:]LIST:SAVE` on page 141

Load Ranges
Loads a stored range setup from a `.csv` file. The current settings in the table are overwritten by the settings in the file!

Remote command:
`[SENSe:]LIST:LOAD` on page 135

Setting the Reference Level Automatically (Auto Level)
Automatically determines a reference level which ensures that no overload occurs at the R&S FSWP for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the R&S FSWP.

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

Remote command:
`[SENSe:]ADJust:LEVel` on page 134

Show Segment Table
Displays the segment table created for the Auto RBW function. See Chapter 5.8.1, "Segment table", on page 53 for details.

If no optimization functions are active, the segment frequency definitions correspond to the definition of the ranges.

5.6.2 Configuring individual ranges

Access: "Overview" > "Wide Search Settings"

The following settings can be configured individually for each range.

The "Frequency Offset" function is not range-specific and only available via the "Frequency" menu.

It defines an offset that applies to *all* ranges defined in the "Ranges" dialog box. The value can be positive or negative. The offset can be used to obtain a display relative to a certain frequency of interest.

Similarly, the "Ref Level Offset" function is not range-specific and only available via the "Amplitude" menu.

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

Range Start / Range Stop
Sets the start and stop frequency of the selected range. Subsequent ranges must be defined in ascending order of frequencies; however, gaps between ranges are possible.

The initial range setup is defined automatically according to the currently available measurement span.

Remote command:
[SENSe:]LIST:RANGe<ri>[:FREQuency]:STARt on page 136
[SENSe:]LIST:RANGe<ri>[:FREQuency]:STOP on page 137

Spur Detection Threshold Start/ Spur Detection Threshold Stop
Defines the threshold that the level of a peak must exceed to be recognized as a spur. The threshold value affects the RBW used for the spurious detection measurement: The RBW has to be set such that the noise level is displayed slightly below the threshold.

The threshold is indicated by a blue line in the Spectral Overview and Spurious Detection Spectrum.

Note: In some cases, the R&S FSWP cannot display the noise below the threshold line even with the lowest possible RBW. In this case, noise peaks are detected as potential spurs, which slows down the measurement. Increase the Peak Excursion to avoid detecting noise peaks as spurs.

Remote command:
[SENSe:]LIST:RANGe<ri>:THReshold:STARt on page 140
[SENSe:]LIST:RANGe<ri>:THReshold:STOP on page 140

Limit Offset to Detection Threshold
Defines a limit line as an offset to the detection threshold for each range. The limit line is indicated by a red line in the Spurious Detection Spectrum. Values that exceed this limit are indicated red in the Spurious Detection Table. If a violation occurs, the global limit check over all ranges is indicated as failed.

For all spurs to be indicated as violations, set this threshold to 0.

Note: The limit line functionality used in the R&S FSWP base unit is not supported in the R&S FSWP Spurious measurements application.

Remote command:
[SENSe:]LIST:RANGe<ri>:LOFFset on page 138

Peak Excursion
Defines the minimum level value by which the signal must rise or fall after a detected spur so that a new spur is detected.

Note: If noise peaks are detected as potential spurs, and in particular, if the noise level is displayed above the detection threshold after spurious detection, increase the peak excursion. Noise peaks are removed by the spot search, but the additional process slows down the measurement.

Remote command:
[SENSe:]LIST:RANGe<ri>:PEXCursion on page 139

Minimum Spur SNR
Defines the minimum signal-to-noise ratio (in dB) that the spur should be displayed with after the measurement is finished (see Chapter 3.3, "Measurement process", on page 18). The required RBW to achieve this SNR is determined automatically by the R&S FSWP Spurious measurements application.

Note: If the minimum SNR is not achieved for a spur during the spurious detection measurement, the RBW is reduced during the spot search. Thus, the noise drops in a small span around the spur.

Remote command:
`[SENSe:]LIST:RANGe<ri>:SNRatio` on page 140

Auto RBW
Sets the RBW for the complete range such that the noise floor is displayed slightly below the user-defined threshold. Since the noise floor may vary across the frequencies, the RBW needs to be adapted to the signal. This is done by splitting the ranges into smaller segments with similar signal and noise characteristics.

"On" The R&S FSWP Spurious measurements application divides the ranges for which "Auto RBW" is active into segments according to the noise and power levels measured in the Spectral Overview sweep. The application then adapts the RBW setting within the segments so the noise floor lies below the threshold for the displayed signal. As a result, an additional "Segment" table is created with the used RBW for each segment (see "Show Segment Table" on page 46).

"Off" The RBW becomes available for manual editing again and the segment table is deleted. The default parameter values are restored.

Remote command:
`[SENSe:]LIST:RANGe<ri>:BANDwidth:AUTO` on page 135

RBW
Defines the resolution bandwidth for this range (for spur detection sweep only).

"Auto" indicates that automatic RBW definition is selected (see "Auto RBW" on page 48)

The resolution bandwidth defines the minimum frequency separation at which the individual components of a spectrum can be distinguished. Small values result in high precision, as the distance between two distinguishable frequencies is small. Higher values decrease the precision, but increase measurement speed.

Remote command:
`[SENSe:]LIST:RANGe<ri>:BANDwidth[:RESolution]` on page 136

Maximum Final RBW
Defines the maximum RBW to be used for the spot search. Measurements with a large RBW result in a poor frequency resolution. Thus, restricting the RBW ensures a minimum resolution. However, if the maximum RBW is very low, the required noise level may be much lower than the detection threshold and the measurement is slowed down.

Remote command:
`[SENSe:]LIST:RANGe<ri>:MFRBw` on page 138

Number of FFT Averages
Defines the number of FFTs to be performed for each range or segment. The more FFTs, the more averaging is performed, so that the noise level becomes lower (using a positive peak detector). The trace becomes smoother.

However, the more FFTs are performed, the more time the complete measurement takes.

Values between 1 and 20 are allowed.

Note: If noise peaks are detected as potential spurs, additional spot searches must be performed, which slow down the measurement. In this case, try increasing the "Number of FFT Averages". Although more FFTs are required, the trace becomes smoother and fewer noise peaks are detected. Thus, the total measurement time is reduced.

Remote command:
`[SENSe:]LIST:RANGe<ri>:NFFT` on page 139

Ref. Level
Defines or indicates the reference level for the range.

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the level is set automatically for all ranges.

Remote command:
`[SENSe:]LIST:RANGe<ri>:RLEVel` on page 139

RF Attenuation
Defines or indicates the RF attenuation for the range.

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the RF attenuation is set automatically for all ranges.

Remote command:
`[SENSe:]LIST:RANGe<ri>:INPut:ATTenuation` on page 137

Preamplifier
Switches the optional preamplifier on or off (if available).

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the preamplifier state is set automatically for all ranges.

For R&S FSWP26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSWP8 or R&S FSWP13 models, the following settings are available:

"Off" Deactivates the preamplifier.

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

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

Remote command:
`[SENSe:]LIST:RANGe<ri>:INPut:GAIN:STATe` on page 137
`[SENSe:]LIST:RANGe<ri>:INPut:GAIN[:VALue]` on page 138

5.7 Identification settings - DUT frequency plan

Access: "Overview" > "Frequency Plan"

Or: [MEAS CONFIG] > "Frequency Plan"

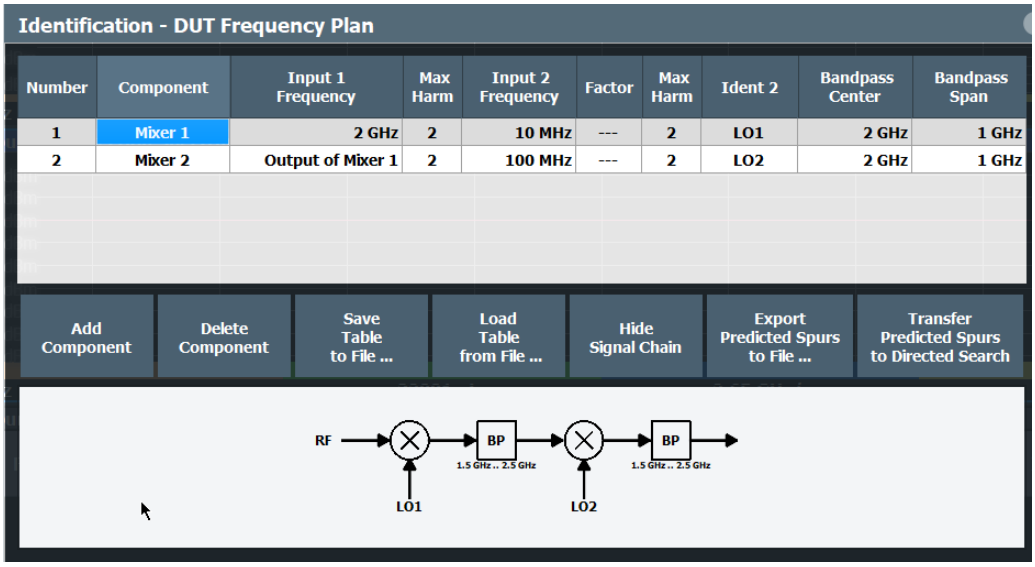
If you define the main components in the signal chain of your DUT with the corresponding frequencies, the R&S FSWP Spurious measurements application can compare the determined spurious results to this frequency plan. Spurs that occur at one of the configured frequencies, or at a harmonic of those frequencies, are identified. Thus, you can easily detect the possible source of the spurs.

Note that the frequency plan is only used if it is enabled in the Measurement settings settings.

When you close the "Frequency Plan" dialog box, the predicted frequencies are calculated. A dialog box indicates the process, which can take some time. If you quit the process, no predicted frequencies are defined.

For details see Chapter 3.2, "Frequency plan and spur identification", on page 17.

For details on how to perform a measurement using a frequency plan, see Chapter 7.4, "How to perform a spurious search measurement with a DUT frequency plan", on page 83.



Number
Consecutive row number in the frequency plan. Up to 6 rows can be defined.

Component
Type of component in the signal path. Depending on the type of component, different parameters are available.

The illustrated signal chain indicates the configured components and required parameters.

"Mixer" Mixes the input signal (RF input or the output of the previous component) with a second input frequency. Requires a name (identifier) for the second input. You can define the maximum harmonics to be considered for the mixer products.

"Amplifier" Amplifies the input signal (RF input or the output of the previous component). No further parameters required.

"Multiplier" Multiplies the input signal (RF input or the output of the previous component) by a configurable factor n.

"Divider" Divides the input signal (RF input or the output of the previous component) by a configurable factor n.

Remote command:
`[SENSe:]FPLan:COMPonent<co>:TYPE` on page 145

Input 1 Frequency
For the first component, the frequency of the input signal. By default, the defined center frequency is used.

For all subsequent components, the output frequency of the previous component is used as the input frequency.

Remote command:
`[SENSe:]FPLan:COMPonent<co>:PORT<1|2>:FREQuency` on page 144

Max Harm
For mixers only: maximum harmonic of each input frequency to be considered in calculating mixer products for spur identification. Up to 5 harmonics can be considered.

Remote command:
`[SENSe:]FPLan:COMPonent<co>:PORT<1|2>:MHARmonic` on page 144

Input 2 Frequency
Second input frequency for a mixer.

Remote command:
`[SENSe:]FPLan:COMPonent<co>:PORT<1|2>:FREQuency` on page 144

Factor
Factor n by which the input frequency is multiplied or divided.

Ident 2
Identifier for the second input frequency for mixers.

Remote command:
[SENSe:]FPLan:COMPonent<co>:IDENtity on page 143

Bandpass Center
Center of the search span that is evaluated for spur identification within the frequency plan. By default, 1 GHz is used.

Remote command:
[SENSe:]FPLan:COMPonent<co>:BCENter on page 142

Bandpass Span
Span that is evaluated for spur identification within the frequency plan. By default, 1 GHz is used.

Remote command:
[SENSe:]FPLan:COMPonent<co>:BSPan on page 142

Add Row
Adds a row (component) to the frequency plan. Up to 6 rows are allowed.

Remote command:
[SENSe:]FPLan:COMPonent<co>:ADD on page 143

Delete Row
Deletes the selected row (component) from the frequency plan.

Remote command:
[SENSe:]FPLan:COMPonent<co>:DELete on page 143

Save Table
Saves the frequency plan table to a file.

Remote command:
[SENSe:]FPLan:SAVE on page 142

Load Table
Loads a stored frequency plan table.

Remote command:
[SENSe:]FPLan:LOAD on page 141

Show Signal Chain / Hide Signal Chain
Displays or hides the signal chain diagram for the current frequency plan settings.

The graphic is useful to determine the required parameters for each component.

Export Predicted Spurs to File ...
Saves the list of predicted frequencies to a user-defined `.csv` file. The result is a comma-separated list of values with the following syntax for each predicted frequency: <freq>,<identification>

Remote command:
[SENSe:]FPLan:PREDicted:EXPort on page 143

Transfer Predicted to Directed Search Settings
Inserts the frequencies from the frequency plan in the Directed Search Measurement settings table. The Detection Mode is indicated as "Predicted" for these rows.

The "Frequency Plan" dialog box is closed. A new dialog box indicates that the predicted frequencies are being calculated, which can take some time. If you quit the process, no predicted frequencies are defined.

Remote command:
`[SENSe:]FPLan:TRANsfer` on page 150

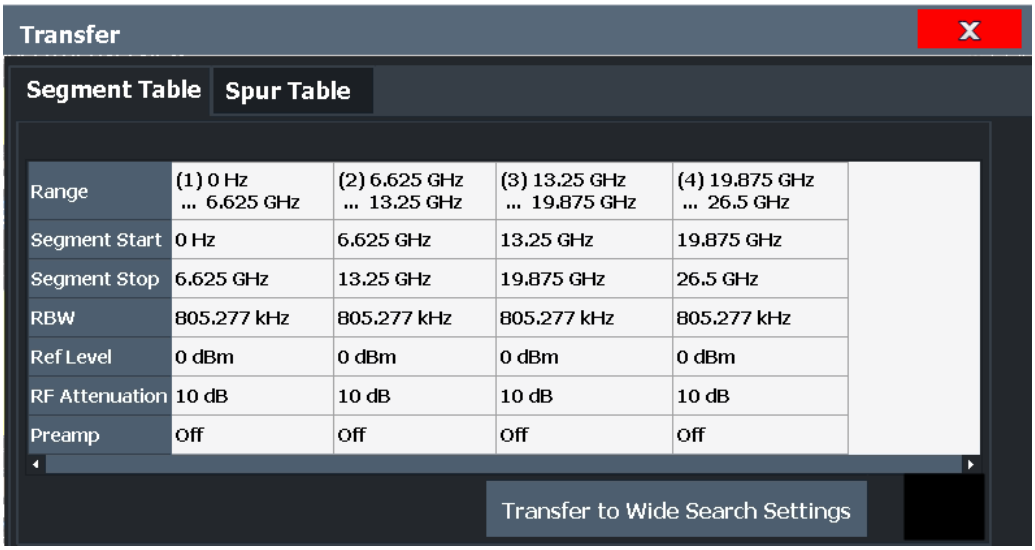
5.8 Transferring settings between measurements

5.8.1 Segment table

Access: "Overview" > "Ranges" > "Show Segment Table"

Or: [MEAS CONFIG] > "Transfer" > "Segment Table" tab

The R&S FSWP Spurious measurements application provides a function to optimize the RBW in individual ranges for speed and accuracy (see "Auto RBW" on page 48). If activated, the R&S FSWP Spurious measurements application divides the ranges for which Auto RBW is active into segments according to the noise and power levels measured in the Spectral Overview sweep. The application then adapts the RBW within the segments to optimize the measurement speed and accuracy during the subsequent spur detection sweep (see Chapter 3.3, "Measurement process", on page 18). As a result, an additional "Segment" table is created with the used RBW for each segment. This segment table can be transferred to the "Wide Search Settings" table to repeat the measurement with the same RBW and segment settings. Only the settings that differ by segment are displayed (see Chapter 5.6.2, "Configuring individual ranges", on page 46 for details on individual parameters).



Range	(1) 0 Hz ... 6.625 GHz	(2) 6.625 GHz ... 13.25 GHz	(3) 13.25 GHz ... 19.875 GHz	(4) 19.875 GHz ... 26.5 GHz
Segment Start	0 Hz	6.625 GHz	13.25 GHz	19.875 GHz
Segment Stop	6.625 GHz	13.25 GHz	19.875 GHz	26.5 GHz
RBW	805.277 kHz	805.277 kHz	805.277 kHz	805.277 kHz
Ref Level	0 dBm	0 dBm	0 dBm	0 dBm
RF Attenuation	10 dB	10 dB	10 dB	10 dB
Preamp	Off	Off	Off	Off

If the segments are transferred to the "Wide Search Settings", the RBW setting in each segment is set to "Auto Off" to prevent the application from performing a new segmentation. However, the spectral overview is still performed. Thus, you can check if the signal changed and decide whether the segmentation and RBW settings are still valid. If they are no longer valid, simply set the RBW to "Auto" mode again and segmentation is performed as usual.

Transfer to Wide Search Settings..... 54

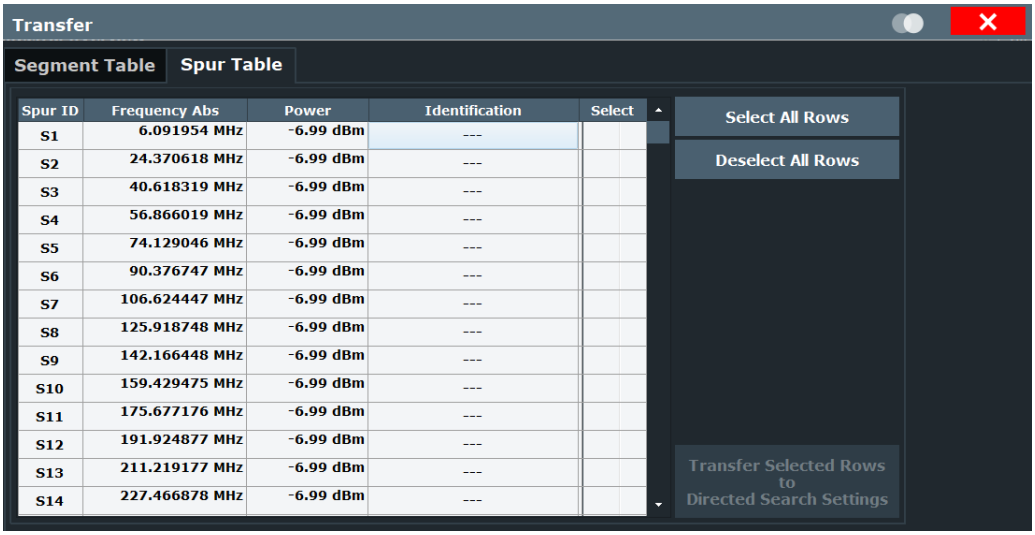
Transfer to Wide Search Settings
Stores *all* segment settings in the current "Segment" table to the "Wide Search Settings" table. Settings for individual segments cannot be transferred separately. The Auto RBW setting is deactivated.

Remote command:
`[SENSe:]TRANsfer:SEGMent` on page 150

5.8.2 Spur table

Access: "Overview" > "Transfer" > "Spur Table" tab

The frequencies from the Spurious Detection Table of a previously performed wide search measurement are listed in the "Spur Table". Individual or all frequencies in this list can be transferred to the "Directed Search Settings" table in order to perform a directed search measurement on those frequencies.



For each detected spur, the following information is provided (see also "Spurious Detection Table" on page 23):

- "Spur ID": Index of the spurs in the order they are measured (increasing frequency);
- "Frequency": Frequency at which a power level was measured that exceeds the Spur detection threshold defined in the "Range" settings (see Chapter 5.6.2, "Configuring individual ranges", on page 46)

- "Power": Power level measured at the specified frequency

Selecting individual frequencies
Frequencies whose "Select" column is checked are included in the Transfer Selected Rows to Directed Search Settings function.

Select All Rows/ Deselect all Rows
Selects or deselects all rows in the "Spur Table". Only selected frequencies are included in the Transfer Selected Rows to Directed Search Settings function.

Transfer Selected Rows to Directed Search Settings
Copies all selected frequencies to the "Directed Search Settings" table (see Chapter 5.9.2, "Configuring spur search spans", on page 60). For the missing parameters the default values are defined. The Detection Mode is indicated as "Measured" for these rows.

If all rows are selected, this function has the same effect as the Import Measured function in the "Directed Search Settings" dialog box.

Remote command:
`[SENSe:]TRANsfer:SPUR` on page 150

5.9 Directed Search Measurement settings

Access: "Overview" > "Directed Search Settings"

As opposed to the wide search measurement, a directed search measurement is not performed on a wide span of frequencies, but in small spans at predefined discrete frequencies. It assumes you already have some knowledge or expectation of where spurs may occur. This knowledge may come from a previous wide search measurement, for example. The spur detection sweep can thus be performed with settings optimized for the current signal and noise levels at those frequencies.

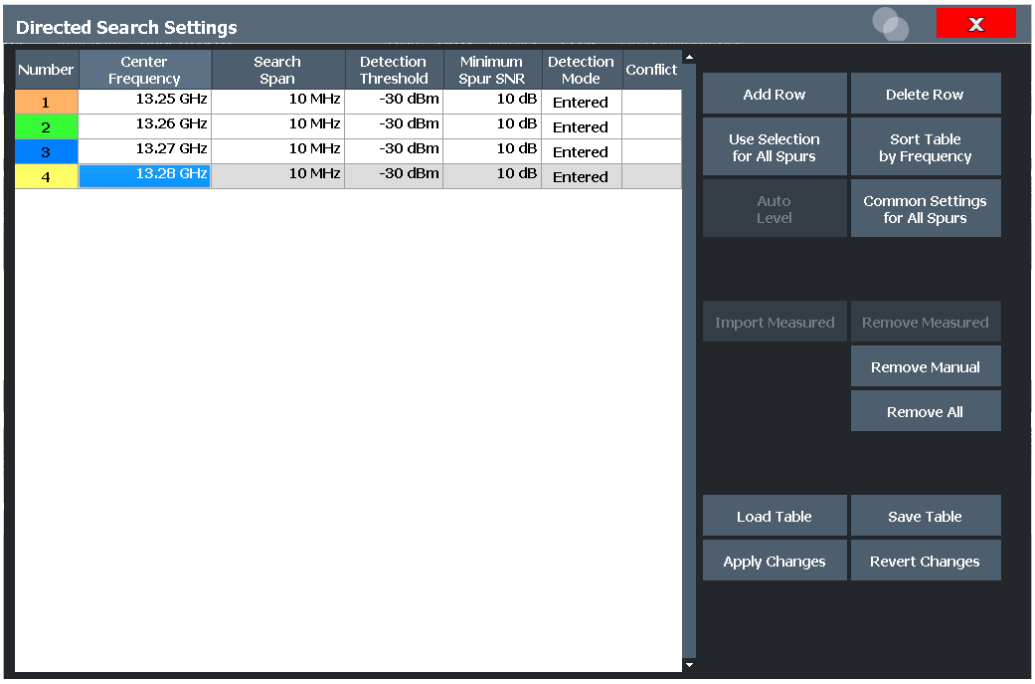
In the "Directed Search Settings" you define the frequencies at which spurs are to be expected: the search is directed to those frequencies. Furthermore, you define the criteria by which a spur is detected.

5.9.1 Managing spans

Access: "Overview" > "Directed Search Settings"

The frequency spans at which the directed search measurement takes place can be determined by the R&S FSWP Spurious measurements application during a wide

search measurement, or you can define them manually. The entire "Directed Search Settings" table can be stored and loaded for subsequent measurements.



Each span is indicated in a different color. The same color is used to indicate the span in the spectral result displays. In the Spurious Detection Table, the same color is used to indicate the span in which a specific spur was found.

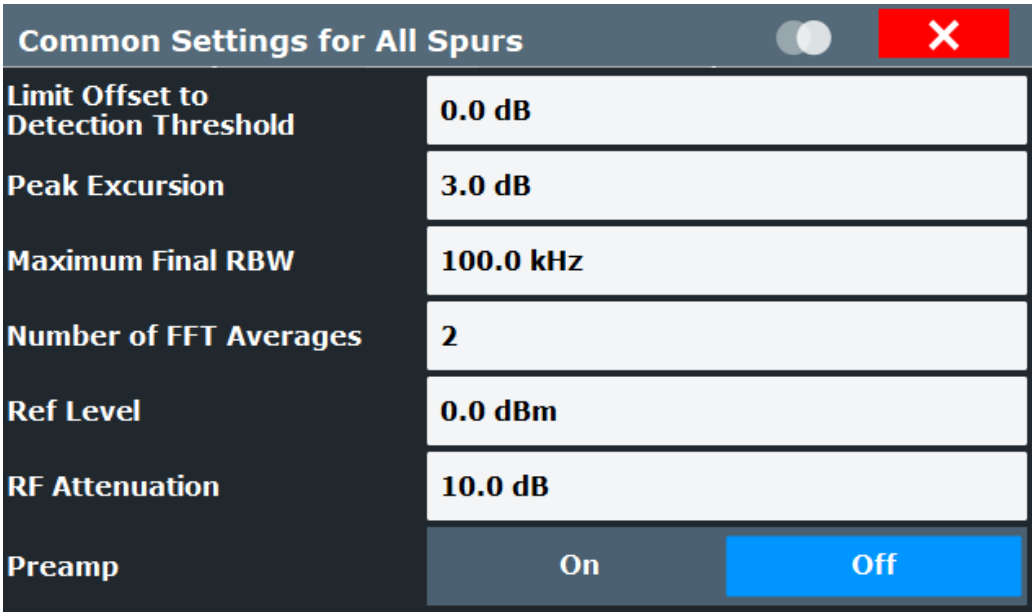
Add Row
Inserts a new row for a further span below the currently selected row in the table.

Delete Row
Deletes the currently focused row. The row numbers are updated accordingly.

Use Selection for All Spurs
Copies the currently selected setting to all spans in the table. This function is convenient if all spans use the same setting. It is not available for the Frequency setting itself.

Sort Table by Frequency
Sorts the table entries in ascending order of the defined frequency. This is especially useful for manual definition in order to ensure distinct frequency spans.

Common Settings for all Spurs
Defines common settings for all spans in the directed search measurement.



Limit Offset to Detection Threshold ← Common Settings for all Spurs
Defines a limit line as an offset to the detection threshold for all spans. Values that exceed this limit are indicated red in the Spurious Detection Table. If a violation occurs, the global limit check over all spans is indicated as failed (see also "Spurious Detection Spectrum" on page 22).

Note: The limit line functionality used in the R&S FSWP base unit is not supported in the R&S FSWP Spurious measurements application.

Remote command:
`[SENSe:]DIRected:LOFFset` on page 147

Peak Excursion ← Common Settings for all Spurs
Defines the minimum level value by which the signal must rise or fall after a detected spur so that a new spur is detected.

Remote command:
[SENSe:]DIRected:PEXCursion on page 148

Maximum Final RBW ← Common Settings for all Spurs
Defines the maximum RBW to be used for the spot search. Measurements with a large RBW result in a poor frequency resolution. Thus, restricting the RBW ensures a minimum resolution. However, if the maximum RBW is very low, the required noise level may be much lower than the detection threshold and the measurement is slowed down.

Remote command:
[SENSe:]DIRected:MFRBw on page 147

Number of FFT Averages ← Common Settings for all Spurs
Defines the number of FFTs to be performed for each range or segment. The more FFTs, the more averaging is performed, so that the noise level becomes lower (using a positive peak detector). The trace becomes smoother.

However, the more FFTs are performed, the more time the complete measurement takes.

Values between 1 and 20 are allowed.

Note: If noise peaks are detected as potential spurs, additional spot searches must be performed, which slow down the measurement. In this case, try increasing the "Number of FFT Averages". Although more FFTs are required, the trace becomes smoother and fewer noise peaks are detected. Thus, the total measurement time is reduced.

Remote command:
[SENSe:]DIRected:NFFT on page 147

Ref. Level ← Common Settings for all Spurs
Defines or indicates the reference level for the directed search measurement.

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the level is set automatically for all ranges.

Remote command:
[SENSe:]DIRected:RLEVel on page 148

RF Attenuation ← Common Settings for all Spurs
Defines or indicates the RF attenuation for the directed search measurement.

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the RF attenuation is set automatically for all ranges.

Remote command:
[SENSe:]DIRected:INPut:ATTenuation on page 146

Preamplifier ← Common Settings for all Spurs
Switches the optional preamplifier on or off (if available) for the directed search measurement.

Note: If you use the Setting the Reference Level Automatically (Auto Level) function, the preamplifier state is set automatically for all ranges.

For R&S FSWP26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSWP8 or R&S FSWP13 models, the following settings are available:

"Off" Deactivates the preamplifier.

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

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

Remote command:
`[SENSe:]DIRected:INPut:GAIN:STATe` on page 146
`[SENSe:]DIRected:INPut:GAIN[:VALue]` on page 146

Setting the Reference Level Automatically (Auto Level)
Automatically determines a reference level which ensures that no overload occurs at the R&S FSWP for the current input data. At the same time, the internal attenuators are adjusted. As a result, the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

To determine the required reference level, a level measurement is performed on the R&S FSWP.

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

Remote command:
`[SENSe:]ADJust:LEVel` on page 134

Import Measured
Automatically inserts rows for all frequencies from the spur table of a previously performed wide search measurement (if available, see Chapter 5.8.2, "Spur table", on page 54). For the missing parameters, the default values are used.

The Detection Mode is indicated as "Measured" for these rows.

Import Predicted
Automatically inserts rows for all frequencies from the frequency plan (if available, see Chapter 5.7, "Identification settings - DUT frequency plan", on page 49). For the missing parameters, the default values are used.

The Detection Mode is indicated as "Predicted" for these rows.

Remove Measured
Removes all rows that were imported from a previous wide search measurement (see "Import Measured" on page 59 and "Detection Mode" on page 61).

Remove Predicted
Removes all rows that were imported from a frequency plan (see Chapter 5.7, "Identification settings - DUT frequency plan", on page 49 and "Detection Mode" on page 61).

Remove Manual
Removes all rows that were defined manually (see "Detection Mode" on page 61).

Remove All
Deletes all rows in the "Directed Search Settings" table.

Load Table
Loads a stored search configuration from a `.csv` file. The current settings in the table are overwritten by the settings in the file!

Remote command:
`[SENSe:]DIRected:LOAD` on page 147

Save Table
Saves the current search configuration to a user-defined `.csv` file for later use.

Remote command:
`[SENSe:]DIRected:SAVE` on page 148

Apply Changes
Saves the changes to the table.

Revert Changes
Reverts the changes that have been made in the dialog box since the last time changes were applied.

5.9.2 Configuring spur search spans

In the "Directed Search Settings" you define the frequencies at which spurs are to be expected: the search is directed to those frequencies. Furthermore, you define the criteria by which a spur is detected. For each frequency, the following parameters must be defined.

Number
Sequential number of the possible spurs (read-only). If a spur is detected at the specified frequency, this number is used as a spur ID in the results (see Spurious Detection Spectrum and "Spurious Detection Table" on page 23).

Frequency
Defines the frequency at which spurs are searched for.

Remote command:
`[SENSe:]DIRected:SETTings` on page 149
`[SENSe:]DIRected:SAVE` on page 148

Search Span
Defines the span around the frequency for which a detailed measurement (spurious detection sweep and spur frequency scan, see Chapter 3.3, "Measurement process", on page 18) is performed.

Note that the frequency spans must be distinct, that is: they may not overlap.

Remote command:
`[SENSe:]DIRected:SETTings` on page 149
`[SENSe:]DIRected:SAVE` on page 148

Detection Threshold
Defines an absolute threshold that the power level must exceed for a spur to be detected (see Chapter 3.3, "Measurement process", on page 18).

Remote command:
`[SENSe:]DIRected:SETTings` on page 149
`[SENSe:]DIRected:SAVE` on page 148

Minimum Spur SNR
Defines the minimum signal-to-noise ratio (in dB) that the spur must be displayed with after the measurement is finished (see Chapter 3.3, "Measurement process", on page 18). The required RBW to achieve this SNR is determined automatically by the R&S FSWP Spurious measurements application.

Remote command:
`[SENSe:]DIRected:SETTings` on page 149
`[SENSe:]DIRected:SAVE` on page 148

Detection Mode
Indicates how the frequencies in the table were detected.

This information is useful in order to delete all manually defined or all measured (imported) frequencies in the table in one step (see Remove Measured / Remove Manual).

"Entered" Frequency settings were entered manually by the user.

"Measured" Frequency settings were imported from the results of a previous wide search measurement (see Chapter 5.8.2, "Spur table", on page 54)

Remote command:
`[SENSe:]DIRected:SAVE` on page 148

Conflict
Indicates whether a conflict between entries in the table has occurred. In particular, the frequency spans must be distinct, that is: they may not overlap. Conflicting settings are also indicated in red.

Tip: For manually defined frequencies, it may be useful to sort the entries by frequency in order to detect overlapping frequency spans. See "Sort Table by Frequency" on page 57.

5.10 Display configuration

Access: "Overview" > "Display Config"

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the R&S FSWP Spurious measurements application are displayed in the evaluation bar in SmartGrid mode.

Up to sixteen evaluation methods can be displayed simultaneously in separate windows. The evaluation methods available for Spurious are described in Chapter 4.1, "Evaluation methods", on page 20.

For details on working with the SmartGrid see the R&S FSWP Getting Started manual.

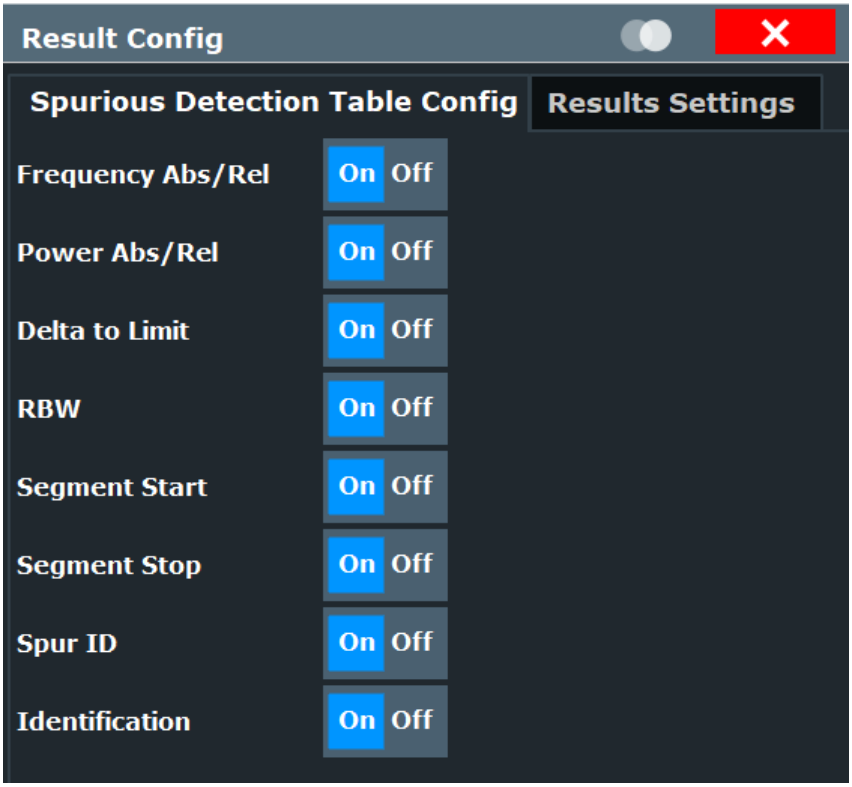
5.11 Result configuration

Access: [MEAS CONFIG] > "Result Config"

Some additional settings are available to configure the result displays of the spur detection measurements.

5.11.1 Spurious detection table configuration

Access: [MEAS CONFIG] > "Result Config" > "Table Config"



Selects the numerical results to be displayed in the "Spurious Detection Table".

Reduce the number of results to display in the table in order to use the available display space optimally or reduce the time to store the results (see `MMEMory:STORe<n>:TABLe` on page 186).

For a description of the individual results see "Spurious Detection Table" on page 23.

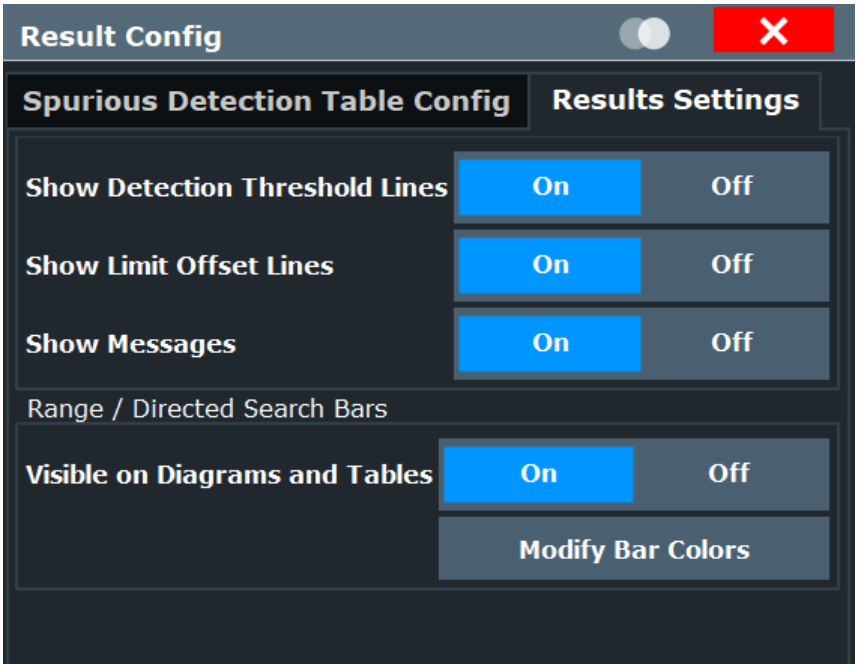
Remote command:

`CALCulate:SSEarch:TABLe:COLumn` on page 158

5.11.2 Results settings

Access: [MEAS CONFIG] > "Result Config" > "Results Settings" tab

The following settings configure the graphical results for spur detection measurements.



Show Detection Threshold Lines
Hides or displays the blue line indicating the power levels at which a spur is detected (see "Spur Detection Threshold Start/ Spur Detection Threshold Stop" on page 47 and "Detection Threshold" on page 61).

Show Limit Offset Lines
Hides or displays the red line indicating the maximum power levels that spurs must not exceed (see "Limit Offset to Detection Threshold" on page 47 and "Limit Offset to Detection Threshold" on page 57).

Show Messages
Hides or displays messages concerning the measurement result display (see step 4 in the Chapter 3.3, "Measurement process", on page 18).

Displaying Colored Range Bars
In the spectral result displays and result tables, the ranges are displayed in different colors by default so you can easily identify which range a spur was detected in. These bars can be deactivated, and you can modify the bar colors.

Modify Bar Colors ← Displaying Colored Range Bars
Opens a dialog box to define the colors for ranges. Up to ten different range colors can be specified. If more ranges are defined, the colors are repeated.

Select a range, then select the color to be assigned to that range.

5.12 Sweep settings

Access: [SWEEP]

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

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

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

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

Remote command:
`INITiate<n>:CONTinuous` on page 160

Single Sweep / Run Single
After triggering, starts the number of sweeps set in "Sweep Count". The measurement stops after the defined number of sweeps has been performed.

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

Note: Sequencer. Furthermore, the [RUN SINGLE] key controls the Sequencer, not individual sweeps. [RUN SINGLE] starts the Sequencer in single mode.
If the Sequencer is off, only the evaluation for the currently displayed channel is updated.

Remote command:
`INITiate<n>[:IMMediate]` on page 160

5.13 Adjusting settings automatically

Some settings can be adjusted by the R&S FSWP automatically according to the current measurement settings. In order to do so, a measurement is performed.

Adjusting settings automatically during triggered measurements

When you select an auto adjust function an (untriggered) measurement is performed to determine the optimal settings. The trigger source is temporarily set to "Free Run". After the measurement is completed, the original trigger source is restored.

Auto Carrier

Automatically detects the highest peak over the complete frequency range of the analyzer. This value is considered to be the reference carrier and is indicated in Carrier Level.

Note: This functionality is identical to Measure Carrier in the "Carrier Reference Level" settings.

Remote command:
`[SENSe:]ADJust:CARRier` on page 130

Setting the Reference Level Automatically (Auto Level)

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

To determine the required reference level, a level measurement is performed on the R&S FSWP.

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

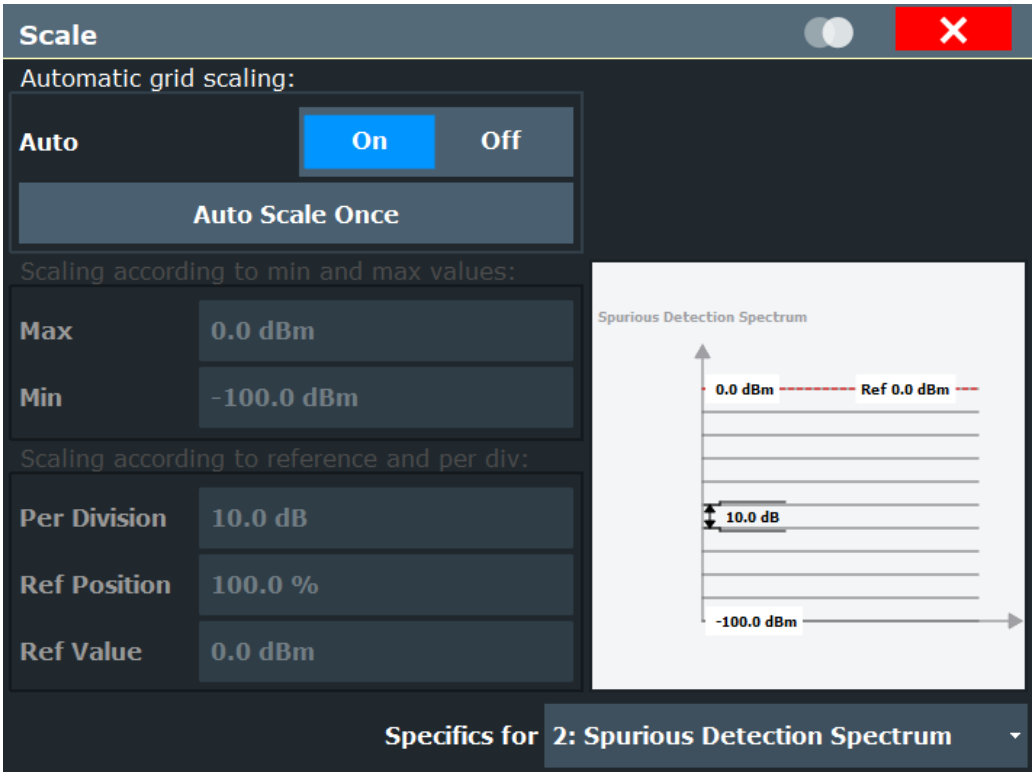
Remote command:
`[SENSe:]ADJust:LEVel` on page 134

6 Analysis

6.1 Y-Scaling

Access: [AMPT] > "Scale Config"

The scaling for the vertical axis of the spectral diagrams is highly configurable, using either absolute or relative values.



Automatic Grid Scaling
The y-axis is scaled automatically after each sweep according to the current measurement settings and results (continuously).

Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once" on page 68 button or the softkey in the [AUTO SET] menu.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`
on page 161

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 161

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 162
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 162

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 162

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 163

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 163

6.2 Trace settings

Access: [Trace]

The trace settings determine how the measured data is analyzed and displayed in the window. In the result displays for the R&S FSWP Spurious measurements application, only one (clear/write) trace is available and it cannot be configured except for the number of trace points. However, the result trace can be exported to a file (see Chapter 6.3, "Trace / table export configuration", on page 69).

Trace Points
The number of trace points that are displayed in the result diagrams. Particularly in the Spurious Detection Spectrum display, where several spur frequency scans are performed, many more sweep points are captured than can be displayed on the screen. In this case, the trace data is reduced to the defined number of trace points using the maximum peak detector.

By default, 32001 trace points are used to allow for zooming. However, if you want to export the trace data, the files may become very large.

Remote command:
`[SENSe:]MEASure:POINts` on page 179

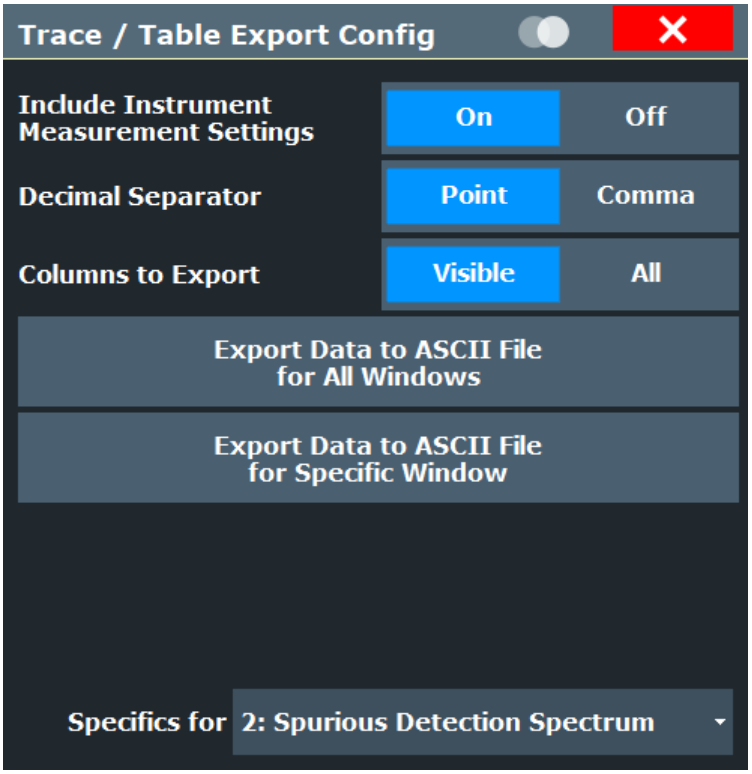
6.3 Trace / table export configuration

Access: "Trace" > "Trace/Table Export"

The R&S FSWP provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with other, external applications. In this case, you can export the measurement data to an ASCII file.

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

See the R&S FSWP User Manual for a description of the standard functions.



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 186

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 185

Columns to Export
Defines which of the Spurious Detection Table columns are to be included in the export file.

"Visible" Only the currently visible columns in the table are exported (see Chapter 5.11.1, "Spurious detection table configuration", on page 62).

"All" All columns for the table, including currently hidden ones, are exported.

Export Data to ASCII File for All Windows
Exports the data from all currently displayed traces and tables in the R&S FSWP Spurious measurements application for export to an ASCII file.

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:
`MMEMory:STORe:SPUR:MEAS` on page 186

Export Data to ASCII File for Specific Window
Exports the data from the specified window in the R&S FSWP Spurious measurements application for export to an ASCII file.

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

Remote command:
`MMEMory:STORe<n>:TABLe` on page 186
`MMEMory:STORe<n>:TRACe` on page 187

6.4 Markers

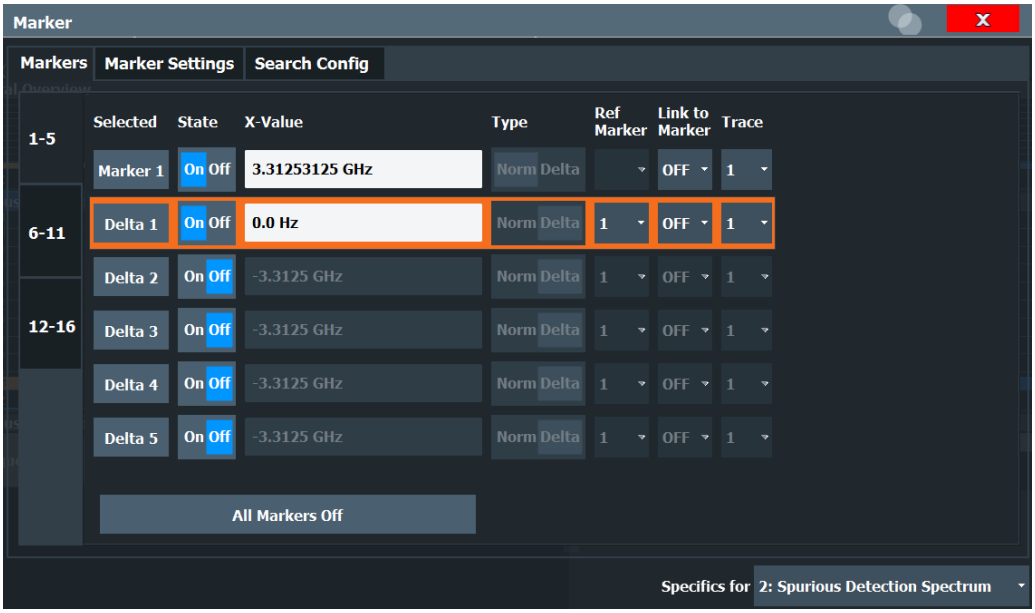
Access: [MKR]

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

6.4.1 Individual marker settings

Access: [MKR] > "Marker Config"

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



Window-specific configuration

The settings in this dialog box are specific to the selected window. To configure the settings for a different Spurious window, select the window outside the displayed dialog box, or select the window from the "Specifics for" selection list in the dialog box.

Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta

The "Marker X" softkey 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 the "Mkr Type" softkey switches on an additional delta marker 1.

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 169

`CALCulate<n>:MARKer<m>:X` on page 170

`CALCulate<n>:MARKer<m>:Y?` on page 189

CALCulate<n>:DELTamarker<m>[:STATe] on page 166
CALCulate<n>:DELTamarker<m>:X on page 167
CALCulate<n>:DELTamarker<m>:X:RELative? on page 188
CALCulate<n>:DELTamarker<m>:Y? on page 188

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 169
CALCulate<n>:DELTamarker<m>[:STATe] on page 166

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 170
CALCulate<n>:DELTamarker<m>:X on page 167

Marker Type
Toggles the marker type.

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

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

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

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

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 169
CALCulate<n>:DELTamarker<m>[:STATe] on page 166

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

Remote command:
CALCulate<n>:DELTamarker<m>:MREFerence on page 166

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
`CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` on page 168
`CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` on page 165
`CALCulate<n>:DELTamarker<m>:LINK` on page 164

Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. Currently, only one trace is available in any Spurious result display.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 169

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

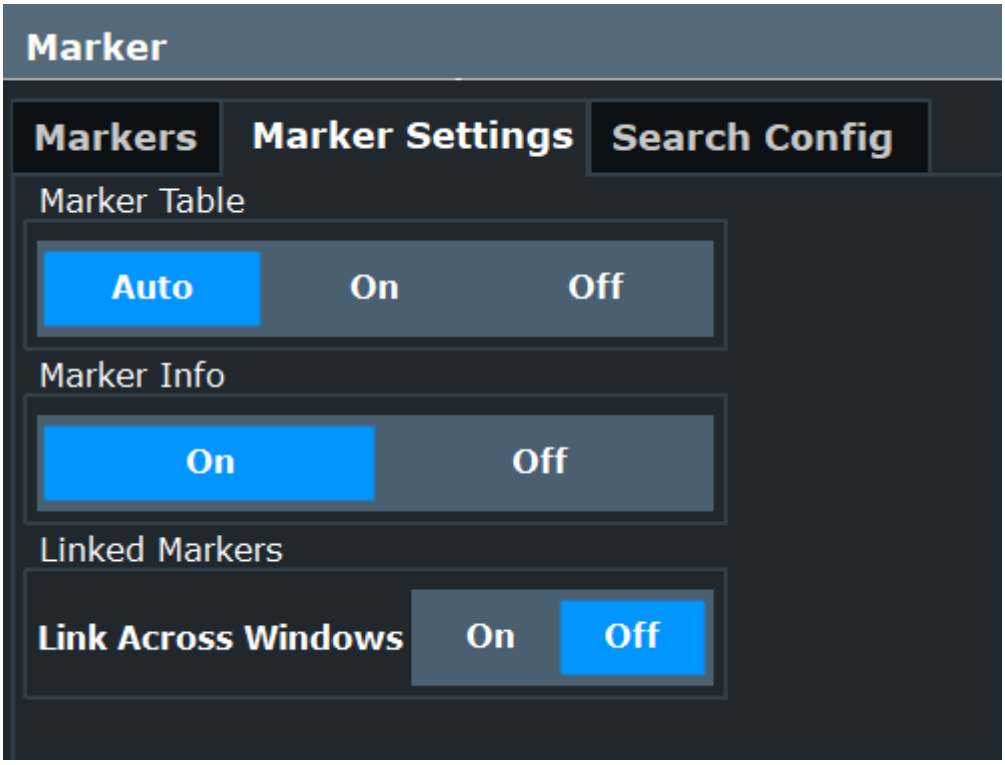
Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 169
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 166

All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 167

6.4.2 General marker settings

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



Marker Table Display
Defines how the marker information is displayed.

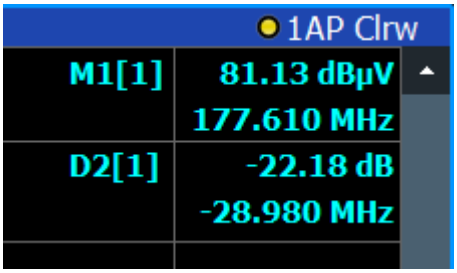
"On" Displays the marker information in a table in a separate area beneath the diagram.

"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 171

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



Remote command:
DISPlay[:WINDow<n>]:MINFo[:STATe] on page 171

Linking Markers Across Windows
If enabled, the markers in all diagrams are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

Remote command:
CALCulate<n>:MARKer:LINK on page 170

6.4.3 Marker search settings and positioning functions

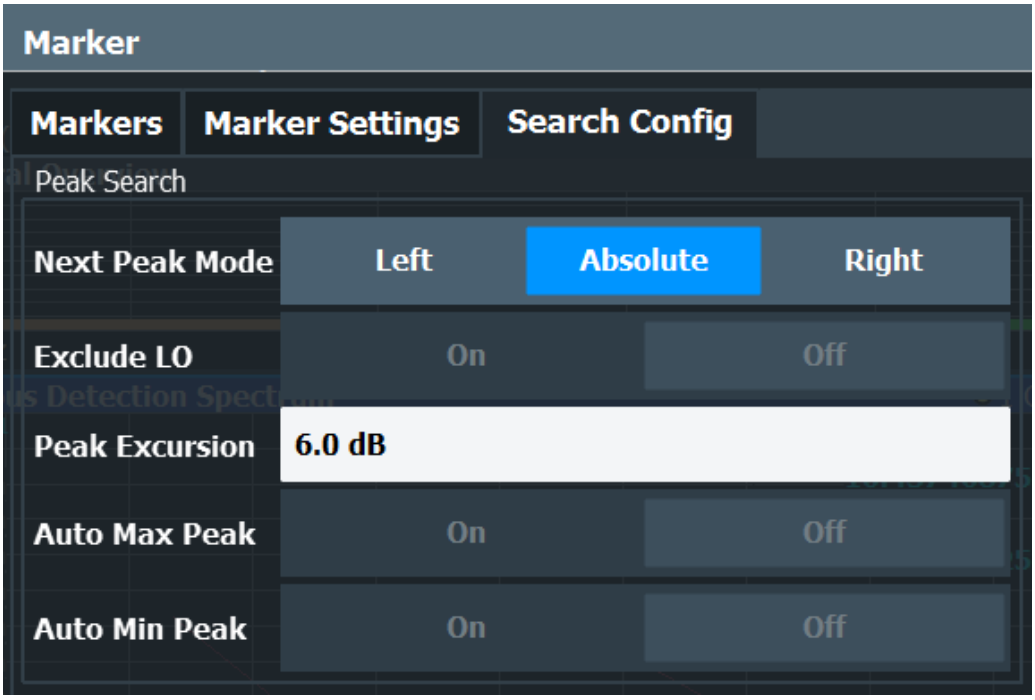
Access: [MKR TO]

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.

6.4.3.1 Marker search settings

Access: [MKR TO] > "Search Config"

Configuration settings allow you to influence the peak search results.



Search Mode for Next Peak
Selects the search mode for the next peak search.

"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 8.5.5, "Positioning the marker", on page 174

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.

Entries from 0 dB to 60 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 172

6.4.3.2 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.

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

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 175
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 177

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 175
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 175
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 175
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 177
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 178
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 177

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 176
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 178

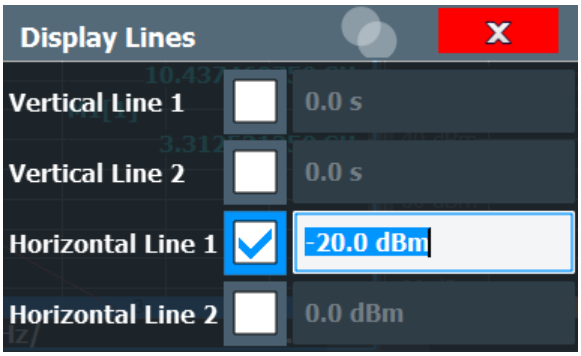
Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 176
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 176
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 176
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 178
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 178
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 178

6.5 Display line settings

Two vertical and two horizontal lines can be defined in the display.

The limit line functionality used in the R&S FSWP base unit is not supported in the R&S FSWP Spurious measurements application.



Vertical Line <x>
Activates a vertical display line in the diagram at the specified point of the x-axis, depending on the scale of the axis.

Remote command:
`CALCulate<n>:FLINe<dl>` on page 180
`CALCulate<n>:TLINe<dl>` on page 181

Horizontal Line 1/ Horizontal Line 2
Activates a horizontal display line (H1 or H2) in the diagram at the specified point of the y-axis.

Remote command:
`CALCulate<n>:DLINe<dl>` on page 179
`CALCulate<n>:DLINe<dl>` on page 179

7 How to perform Spurious measurements

The following step-by-step instructions demonstrate how to perform a Spurious measurement with the R&S FSWP Spurious measurements application.

7.1 How to perform a Wide Search Measurement

1. Press the [MODE] key on the front panel and select the "Spurious" application.
2. Select the "Overview" softkey to display the "Overview" for a Spurious measurement.
3. Select the "Input/Output/Trigger" button and configure the input source of the signal to be measured.
4. Optionally, select the "Trigger" tab to define an event that starts the measurement.
5. From the "Overview", select the "Measurement Control" button to configure the type of measurement to be performed.
   a) Select "Type of Spur Search": "Wide Search".
   b) Define what to do with the residual spurs in the results by selecting the required options.
6. From the "Overview", select the "Wide Search Settings" button to configure the measurement ranges.
   Tip: for parameters that are identical for all ranges, enter the parameter value once, then use the Use Selection for All Ranges function.
   a) Split the frequency span of the measurement into ranges for signal parts with similar characteristics. Define the ranges in ascending order of frequency. Gaps between ranges are allowed, overlapping ranges are not. Leave out parts of the signal that are not of interest. Insert ranges as necessary.
   b) Define an absolute power level as the threshold to be used as a search criterion in detecting spurs.
   Each peak above the threshold is a potential spur.
   c) Define the minimum signal-to-noise ratio a true spur must have after the measurement is finished.
   d) Optionally, define a limit for a limit check on the spurs as an offset to the spur detection threshold.
   e) Define the measurement parameters for each range as appropriate.
7. To start the measurement, press the [RUN SINGLE] key.

First the "Spectral Overview" diagram is displayed, then the "Spurious Detection Spectrum" diagram and the "Spurious Detection Table". Finally, the displays are updated with the results of the spot searches.
Which segment or span is currently being measured is indicated in the status bar information.
The spur detection threshold line is indicated by a blue line in the spectrum displays.
The limit line (if defined) is indicated by a red line in the spectrum displays.

8. If an optimization function is active and you intend to perform another wide search measurement on the same or a similar signal, check the segmentation:
   a) Select "Transfer" > "Segment Table" tab.
   b) If you want to be able to repeat the measurement, you can save the segment configuration for subsequent measurements.
      Select "Transfer to Wide Search Ranges Table".

   For the next wide search measurement, no new segmenting will take place. The spurious detection search uses the configured segments and ranges.
9. Optionally, export the trace data of the spurious detection measurement to a file.
   a) Press the [TRACE] key.
   b) Select the "Trace Export Config" softkey.
   c) Select the data to be included in the export - traces or tables only, or also measurement settings.
   d) Select "Export Data to ASCII File".
   e) Define a file name and storage location and select "OK".

7.2 How to perform a Directed Search Measurement

1. Press the [MODE] key on the front panel and select the "Spurious" application.
2. Select the "Overview" softkey to display the "Overview" for a Spurious measurement.
3. Select the "Input/Output/Trigger" button and configure the input source of the signal to be measured.
4. Optionally, select the "Trigger" tab to define an event that starts the measurement.
5. From the "Overview", select the "Measurement Control" button to configure the type of measurement to be performed.
   a) Select "Type of Spur Search": "Directed Search".
   b) Define what to do with the residual spurs in the results by selecting the required options.
6. From the "Overview", select the "Directed Search Settings" button.
7. To configure the frequencies to perform a spur search on, do one of the following:

- Load a predefined table from a file ("Load Table").
- Import frequencies from the Spurious Detection Table of a previous wide search measurement (see Chapter 7.3, "How to perform a combined Wide Search Measurement and Directed Search Measurement", on page 82).
- Define the frequencies manually:

a) Add a new row for each frequency to be measured.
b) Define the frequencies in any order.
c) Define the span around the frequency to be searched.
Note that the frequency spans must be distinct. If any spans overlap, a conflict is indicated.
d) Define an absolute power level as the threshold to be used as a search criterion in detecting spurs.
Each peak above the threshold is a potential spur.
e) Define the minimum signal-to-noise ratio a true spur must have after the measurement is finished.
f) Optionally, define a limit for a limit check on the spurs as an offset to the spur detection threshold.

8. Optionally, store the directed search settings to a file for further measurements:

a) Select "Save Table".
b) Define a file name and storage location and select "OK".

9. To start the measurement, press the [RUN SINGLE] key.

First the "Spectral Overview" diagram is displayed, then the "Spurious Detection Spectrum" diagram and the "Spurious Detection Table". Finally, the displays are updated with the results of the spot searches.
Which segment or span is currently being measured is indicated in the status bar information.
The spur detection threshold line is indicated by a blue line in the spectrum displays.
The limit line (if defined) is indicated by a red line in the spectrum displays.

7.3 How to perform a combined Wide Search Measurement and Directed Search Measurement

1. Perform a wide search measurement as described in Chapter 7.1, "How to perform a Wide Search Measurement", on page 80.
2. Select "Measurement Control" > "Type of Spur Search": "Directed Search".
3. To import the frequencies from the "Spurious Detection Table" of a previous wide search measurement, do one of the following:
   - To load all spur frequencies from the spur table, select "Directed Search Settings" > "Import Measured".

- To select individual spur frequencies to import:

a) Select "Transfer" > "Spur Table" tab.
b) Select the frequencies to be imported.
c) Select "Transfer Selected Rows to Directed Search Table".
d) Select "Directed Search Settings" to view the search frequencies.
Entries with the "Detection mode": "Measured" are imported from the "Spur Table".
e) Check the frequencies and edit the search span, detection threshold and required spur SNR parameters as required.

4. Optionally, store the directed search settings to a file for further measurements:
   a) Select "Directed Search Settings" > "Save Table".
   b) Define a file name and storage location and select "OK".
5. To start the measurement, press the [RUN SINGLE] key.

   First the "Spectral Overview" diagram is displayed, then the "Spurious Detection Spectrum" diagram and the "Spurious Detection Table". Finally, the displays are updated with the results of the spot searches.
   Which segment or span is currently being measured is indicated in the status bar information.
   The spur detection threshold line is indicated by a blue line in the spectrum displays.
   The limit line (if defined) is indicated by a red line in the spectrum displays.

7.4 How to perform a spurious search measurement with a DUT frequency plan

1. Press the [MODE] key on the front panel and select the "Spurious" application.
2. Select the "Overview" softkey to display the "Overview" for a Spurious measurement.
3. Select the "Input/Output/Trigger" button and configure the input source of the signal to be measured.
4. Optionally, select the "Trigger" tab to define an event that starts the measurement.
5. From the "Overview", select the "Measurement Control" button to configure the type of measurement to be performed.
   a) Select the "Type of Spur Search".
   "Wide Search": the complete range is search for spurs
   "Directed Search": only the specified frequencies are searched for spurs (see also step 8)
   b) Enable "Use Frequency Plan for Identification".

c) Define what to do with the residual spurs in the results by selecting the required options.

6. From the "Overview", select the "Frequency Plan" button.
7. In the "Frequency Plan" dialog box, configure the parameters for each component in the signal chain of your DUT (max. 5):
   - The component type
   - The input frequency (for the first component only)
   - The second input frequency (mixer only)
   - The maximum harmonic to be considered (mixer only)
   - The identification of the second input (mixer only)
   - The factor (for multipliers and dividers)
   - Optionally, the bandpass center and span to analyze
8. Optionally, for "Directed Search": Select "Transfer Predicted to Directed Search Settings".

   The "Frequency Plan" dialog box is closed. The predicted frequencies are calculated and inserted in the Directed Search Settings Table. A dialog box indicates the process, which can take some time. If you quit the process, no predicted frequencies are defined.
9. Optionally, configure the measurement as described in Chapter 7.1, "How to perform a Wide Search Measurement", on page 80 or Chapter 7.2, "How to perform a Directed Search Measurement", on page 81.
10. To start the measurement, press the [RUN SINGLE] key.

    First the "Spectral Overview" diagram is displayed, then the "Spurious Detection Spectrum" diagram and the "Spurious Detection Table". Finally, the displays are updated with the results of the spot searches.
    Which segment or span is currently being measured is indicated in the status bar information.
    The spur detection threshold line is indicated by a blue line in the spectrum displays.
    The limit line (if defined) is indicated by a red line in the spectrum displays.

8 Remote commands to perform Spurious measurements

The following commands are required to perform measurements in the R&S FSWP Spurious measurements application in a remote environment. It is assumed that the R&S FSWP has already been set up for remote operation in a network as described in the R&S FSWP User Manual.

Common Suffixes

In the R&S FSWP Spurious measurements application, the following common suffixes are used in remote commands:

Table 8-1: Common suffixes used in remote commands in the R&S FSWP Spurious measurements application

Suffix	Value range	Description
<m>	1 to 16	Marker (or spot noise marker)
<n>	1 to 16	Window (**in the currently selected channel**)
<t>	1 to 6	Trace
	1 to 8	Limit line
<j>	1..10	Selects an integrated measurement range.
<k>	1..8 (Limit line) 1 | 2 (Display line)	Selects a limit or display line.
<r>	1..x	Selects a half decade. The value range depends on the number of half decades. The first half decade in the measurement always has the value "1". For subsequent half decades, add "1" to get the value "x" (the fourth half decade, for example, would have the value "4").
<s>	1..6	Selects a (user defined) spot noise marker.
<x>	1..2	Selects a mixer in the test setup.

Selecting windows in multiple channels

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

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

In particular, this includes:

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

The following tasks specific to the R&S FSWP Spurious measurements application are described here:

8.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S FSWP.

Remote command examples

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

8.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**

If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSWP 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.

8.1.2 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`.

8.1.3 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.

8.1.4 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.

8.1.5 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`.

8.1.6 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.

8.1.6.1 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.

8.1.6.2 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`

8.1.6.3 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 8.1.2, "Long and short form", on page 87.

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`

8.1.6.4 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'
```

8.1.6.5 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.

8.2 Activating Spurious measurements

Spuriousmeasurements require a special application on the R&S FSWP. A measurement is started immediately with the default settings.

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

This command 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 92.

<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>

This command 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 92.

<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 92).
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 'PhaseNoise',PNO,'PNO2'`
Replaces the channel named "PhaseNoise" by a new channel of type "Phase Noise" named "PNO2".

Usage: Setting only

INSTrument:DELete <ChannelName>

This command deletes a channel.

If you delete the last channel, the default "Phase Noise" 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 'PhaseNoise'`
Deletes the channel with the name 'PhaseNoise'.

Usage: Setting only

INSTrument:LIST?

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

Return values:

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

Example: `INST:LIST?`
Result for 2 channels:
`'PNO','PhaseNoise','PNO','Phase Noise 2'`

Usage: Query only

Table 8-2: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise	PNOise	Phase Noise
Spectrum Monitor	SMONitor	Spectrum Monitor
Spectrum (R&S FSWP-B1)	SANalyzer	Spectrum
I/Q Analyzer (R&S FSWP-B1)	IQ	IQ Analyzer
Pulse Measurements (R&S FSWP-K6)	PULSe	Pulse
Analog Modulation Analysis (R&S FSWP-K7)	ADEMod	Analog Demod
Noise Figure Measurements (R&S FSWP-K30)	NOISe	Noise
Fast Spur Search (R&S FSWP-K50)	SPUR	Spurious
Transient Analysis (R&S FSWP-K60)	TA	Transient Analysis
Vector Signal Analysis (R&S FSWP-K70)	DDEM	VSA
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command 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 'PhaseNoise','PNO'`
Renames the channel with the name 'PhaseNoise' to 'PNO'.

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 91.

For a list of available channel types see `INSTrument:LIST?` on page 92.

Parameters:

<ChannelType> **SPUR**
R&S FSWP Spurious measurements application, R&S FSWP–K50

Example: `INST:SEL SPUR`

SYSTem:PRESet:CHANnel[:EXEC]

This command 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 28

8.3 Configuring Spurious measurements

8.3.1 Configuring the data input

The following commands are required to configure data input.

8.3.1.1 RF input

INPut<ip>:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer for the R&S FSWP 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.

Suffix:
<ip> 1 | 2
irrelevant

Example: `INP:ATT:PROT:RES`

INPut<ip>:CONNector <ConnType>

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

Suffix:
<ip> 1 | 2
irrelevant

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

RFPRobe
Active RF probe

*RST: RF

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

Manual operation: See "Input Connector" on page 31

INPut<ip>:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 29

INPut<ip>:DPATh <DirectPath>

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

Suffix:
<ip> 1 | 2
irrelevant

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 30

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSWP to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

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

Suffix:
<ip> 1 | 2
irrelevant

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 30

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

Enables or disables the YIG filter.

Suffix:
<ip> 1 | 2
irrelevant

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

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

Manual operation: See "YIG-Preselector" on page 30

INPut<ip>:IMPedance <Impedance>

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Impedance> 50 | 75
*RST: 50 Ω
Default unit: OHM

Example: INP:IMP 75

Manual operation: See "Impedance" on page 29

INPut<ip>:LOSCillator:SOURce <Location>

This command selects the type of local oscillator in the test setup.

Suffix:
<ip> 1..n
irrelevant

Parameters:
<Location> **EXTernal**
External local oscillator connected to the "LO AUX Input" of the R&S FSWP.

INTernal
Internal local oscillator of the R&S FSWP.

*RST: INTernal

Example: //Select external oscillator
```
CONF:PNO:MEAS RES
INP:LOSC:SOUR EXT
```

INPut<ip>:LOSCillator:SOURce:EXTernal:LEVel <Level>

This command selects the level of an external LO signal that is fed into the R&S FSWP.

Suffix:
<ip> 1..n
irrelevant

Parameters:
<Level>

HIGH
LO signal with high level characteristics.

LOW
LO signal with low level characteristics.

*RST: HIGH

Example: //Select an external LO with low signal level
```
CONF:PNO:MEAS RES
INP:LOSC:SOUR EXT
INP:LOSC:SOUR:EXT:LEV LOW
```

INPut<ip>:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSWP.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Source>

RF
Radio Frequency ("RF INPUT" connector)

*RST: RF

Manual operation: See "Radio Frequency State" on page 29

8.3.1.2 Working with power sensors

The following commands describe how to work with power sensors.

These commands require the use of a Rohde & Schwarz power sensor. For a list of supported sensors, see the data sheet.

Configuring power sensors

SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe] <State>

This command turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> Power sensor index

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

Example: `SYST:COMM:RDEV:PMET:CONF:AUTO OFF`

SYSTem:COMMunicate:RDEVice:PMETer<p>:COUNt?

This command queries the number of power sensors currently connected to the R&S FSWP.

Suffix:
<p> Power sensor index

Return values:
<NumberSensors> Number of connected power sensors.

Example: `SYST:COMM:RDEV:PMET:COUN?`

Usage: Query only

SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:
<p> Power sensor index

Parameters:
<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

Example: `SYST:COMM:RDEV:PMET2:DEF '','NRP-Z81','', '123456'`
Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".
`SYST:COMM:RDEV:PMET2:DEF?`
Queries the sensor assigned to "Power Sensor 2".
Result:
`'','NRP-Z81','USB','123456'`
The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Configuring power sensor measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE

This command zeroes the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:
<p> Power sensor index

Example: `CAL:PMET2:ZERO:AUTO ONCE;*WAI`
Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>

This command defines the reference value for relative measurements.

Suffix:
<n> Window

<p> Power sensor index

Parameters:
<RefValue> Range: -200 dBm to 200 dBm
*RST: 0
Default unit: DBM

Example: `CALC:PMET2:REL -30`
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE

This command sets the current measurement result as the reference level for relative measurements.

Suffix:
<n> Window

<p> Power sensor index

Example: `CALC:PMET2:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

CALCulate<n>:PMETer<p>:RELative:STATe <State>

This command turns relative power sensor measurements on and off.

Suffix:
<n> Window

<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:PMET2:REL:STAT ON`
Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:
<p> Power sensor index

Usage: Query only

READ:PMETer<p>?

This command initiates a power sensor measurement and queries the results.

Suffix:
<p> Power sensor index

Usage: Query only

[SENSe:]PMETer<p>:DCYCle[:STATe] <State>

This command turns the duty cycle correction on and off.

Suffix:
<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
```
PMET2:DCYC:STAT ON
```

[SENSe:]PMETer<p>:DCYCle:VALue <Percentage>

This command defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:
<p> Power sensor

Parameters:
<Percentage> Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example:
```
PMET2:DCYC:STAT ON
```
Activates the duty cycle correction.
```
PMET2:DCYC:VAL 0.5
```
Sets the correction value to 0.5%.

[SENSe:]PMETer<p>:FREQuency <Frequency>

This command defines the frequency of the power sensor.

Suffix:
<p> Power sensor index

Parameters:
<Frequency> The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz
Default unit: HZ

Example: `PMET2:FREQ 1GHZ`
Sets the frequency of the power sensor to 1 GHz.

[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>

This command selects the frequency coupling for power sensor measurements.

Suffix:
<p> Power sensor index

Parameters:
<Coupling> **CENTer**
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

Example: `PMET2:FREQ:LINK CENT`
Couples the frequency to the center frequency of the analyzer

[SENSe:]PMETer<p>:MTIMe <Duration>

This command selects the duration of power sensor measurements.

Suffix:
<p> Power sensor index

Parameters:
<Duration> SHORt | NORMal | LONG
*RST: NORMal

Example: `PMET2:MTIM SHOR`
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt <NumberReadings>

This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:
<p> Power sensor index

Parameters:
<NumberReadings> An average count of 0 or 1 performs one power reading.

Range: 0 to 256
Increment: binary steps (1, 2, 4, 8, ...)

Example: `PMET2:MTIM:AVER ON`
Activates manual averaging.
`PMET2:MTIM:AVER:COUN 8`
Sets the number of readings to 8.

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>

This command turns averaging for power sensor measurements on and off.

Suffix:
<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:MTIM:AVER ON`
Activates manual averaging.

[SENSe:]PMETer<p>:ROFFset[:STATe] <State>

This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:ROFF OFF`
Takes no offset into account for the measured power.

[SENSe:]PMETer<p>:SOFFset <SensorOffset>

Takes the specified offset into account for the measured power. Only available if `[SENSe:]PMETer<p>:ROFFset[:STATe]` is disabled.

Suffix:
<p> Power sensor index

Parameters:
<SensorOffset> Default unit: DB

Example: `PMET2:SOFF 0.001`

[SENSe:]PMETer<p>[:STATe] <State>

This command turns a power sensor on and off.

Suffix:
<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET1 ON`
Switches the power sensor measurements on.

[SENSe:]PMETer<p>:UPDate[:STATe] <State>

This command turns continuous update of power sensor measurements on and off.

If on, the results are updated even if a single sweep is complete.

Suffix:
<p> Power sensor index

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET1:UPD ON`
The data from power sensor 1 is updated continuously.

UNIT<n>:PMETer<p>:POWer <Unit>

This command selects the unit for absolute power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

Parameters:
<Unit> DBM | WATT | W | DB | PCT
*RST: DBM

Example: `UNIT:PMET:POW DBM`

UNIT<n>:PMETer<p>:POWer:RATio <Unit>

This command selects the unit for relative power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: `UNIT:PMET:POW:RAT DB`

Triggering with power sensors

[SENSe:]PMETer<p>:TRIGger:DTIMe <Time>

This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:
<p> Power sensor index

Parameters:

<Time>
Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs
Default unit: S

Example: `PMET2:TRIG:DTIMe 0.001`

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>

This command defines the trigger holdoff for external power triggers.

Suffix:

<p> Power sensor index

Parameters:

<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.

Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s
Default unit: S

Example: `PMET2:TRIG:HOLD 0.1`
Sets the holdoff time of the trigger to 100 ms

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level to allow a trigger to start the measurement.

Suffix:

<p> Power sensor index

Parameters:

<Hysteresis>
Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB
Default unit: DB

Example: `PMET2:TRIG:HYST 10`
Sets the hysteresis of the trigger to 10 dB.

[SENSe:]PMETer<p>:TRIGger:LEVel <Level>

This command defines the trigger level for external power triggers.

Suffix:

<p> Power sensor index

Parameters:

<Level> -20 to +20 dBm

Range: -20 dBm to 20 dBm
*RST: -10 dBm
Default unit: DBM

Example: `PMET2:TRIG:LEV -10 dBm`
Sets the level of the trigger

[SENSe:]PMETer<p>:TRIGger:SLOPe <Edge>

This command selects the trigger condition for external power triggers.

Suffix:

<p> Power sensor index

Parameters:

<Edge>

POSitive
The measurement starts in case the trigger signal shows a positive edge.

NEGative
The measurement starts in case the trigger signal shows a negative edge.

*RST: POSitive

Example: `PMET2:TRIG:SLOP NEG`

[SENSe:]PMETer<p>:TRIGger[:STATe] <State>

This command turns the external power trigger on and off.

Suffix:

<p> Power sensor index

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:TRIG ON`
Switches the external power trigger on

8.3.1.3 Using external mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the R&S FSWP to have an external mixer option installed and an external mixer to be connected to the R&S FSWP.

For details on working with external mixers see the R&S FSWP User Manual.

Basic settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer<x>[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

Suffix:
<x> 1..n
irrelevant

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

Example: `MIX ON`

[SENSe:]MIXer<x>:BIAS:HIGH <BiasSetting>

This command defines the bias current for the high (last) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 109).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:BIAS[:LOW] <BiasSetting>

This command defines the bias current for the low (first) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 109).

Suffix:
<x> 1..n
irrelevant

Parameters:
<BiasSetting> *RST: 0.0 A
Default unit: A

[SENSe:]MIXer<x>:LOPower <Level>

This command specifies the LO level of the external mixer's LO port.

Suffix:
<x> 1..n
irrelevant

Parameters:
<Level> Range: 13.0 dBm to 17.0 dBm
Increment: 0.1 dB
*RST: 15.5 dBm
Default unit: DBM

Example: `MIX:LOP 16.0dBm`

Mixer settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer<x>:FREQuency:HANDover <Frequency>

This command defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

This command is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 109).

Suffix:
<x> 1..n
irrelevant

Parameters:
<Frequency> Default unit: HZ

Example: MIX ON
Activates the external mixer.
MIX:FREQ:HAND 78.0299GHz
Sets the handover frequency to 78.0299 GHz.

[SENSe:]MIXer<x>:FREQuency:STARt

This command sets or queries the frequency at which the external mixer band starts.

Suffix:
<x> 1..n
irrelevant

Example: MIX:FREQ:STAR?
Queries the start frequency of the band.

[SENSe:]MIXer<x>:FREQuency:STOP

This command sets or queries the frequency at which the external mixer band stops.

Suffix:
<x> 1..n
irrelevant

Example: MIX:FREQ:STOP?
Queries the stop frequency of the band.

[SENSe:]MIXer<x>:HARMonic:BAND:PRESet

This command restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the [PRESET] function. Use this command to restore the predefined band ranges.

Suffix:
<x> 1..n
irrelevant

Example: MIX:HARM:BAND:PRES
Presets the selected waveguide band.

[SENSe:]MIXer<x>:HARMonic:BAND <Band>

This command selects the external mixer band. The query returns the currently selected band.

This command is only available if the external mixer is active (see `[SENSe:]MIXer<x>[:STATe]` on page 109).

Suffix:
<x> 1..n
irrelevant

Parameters:
<Band> KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.

Table 8-3: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)
***)** The band formerly referred to as "A" is now named "KA".		

[SENSe:]MIXer<x>:HARMonic:HIGH:STATe <State>

This command specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Suffix:
<x> 1..n

Parameters:
<State> ON | OFF
*RST: ON

Example: `MIX:HARM:HIGH:STAT ON`

[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue] <HarmOrder>

This command specifies the harmonic order to be used for the high (second) range.

Suffix:
<x> 1..n
irrelevant

Parameters:
<HarmOrder> Range: 2 to 61 (USER band); for other bands: see band definition

Example:
```
MIX:HARM:HIGH:STAT ON
MIX:HARM:HIGH 3
```

[SENSe:]MIXer<x>:HARMonic:TYPE <OddEven>

This command specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Suffix:
<x> 1..n
irrelevant

Parameters:
<OddEven> ODD | EVEN | EODD
ODD | EVEN | EODD
*RST: EVEN

Example:
```
MIX:HARM:TYPE ODD
```

[SENSe:]MIXer<x>:HARMonic[:LOW] <HarmOrder>

This command specifies the harmonic order to be used for the low (first) range.

Suffix:
<x> 1..n
irrelevant

Parameters:
<HarmOrder> Range: 2 to 61 (USER band); for other bands: see band definition
*RST: 2 (for band F)

Example:
```
MIX:HARM 3
```

[SENSe:]MIXer<x>:IF?

Queries the intermediate frequency currently used by the external mixer.

Suffix:
<x> 1..n
irrelevant

Example: `MIX:IF?`

Example: See "Programming example: working with an external mixer" on page 120.

Usage: Query only

[SENSe:]MIXer<x>:LOSS:HIGH <Average>

This command defines the average conversion loss to be used for the entire high (second) range.

Suffix:
<x> 1..n
Mixer

Parameters:
<Average> Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS:HIGH 20dB`

[SENSe:]MIXer<x>:LOSS:TABLe:HIGH <FileName>

This command defines the conversion loss table to be used for the high (second) range.

Suffix:
<x> 1..n
Mixer

Parameters:
<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S FSWP automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

[SENSe:]MIXer<x>:LOSS:TABLe[:LOW] <FileName>

This command defines the file name of the conversion loss table to be used for the low (first) range.

Suffix:
<x> 1..n
Mixer

Parameters:

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S FSWP automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (`.acl` file).

Example:

```
MIX:LOSS:TABL '101567'
MIX:LOSS:TABL?
//Result:
'101567_MAG_6_B5000_3G5.B5G'
```

[SENSe:]MIXer<x>:LOSS[:LOW] <Average>

This command defines the average conversion loss to be used for the entire low (first) range.

Suffix:

<x> 1..n
Mixer

Parameters:

<Average>
Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example:

```
MIX:LOSS 20dB
```

[SENSe:]MIXer<x>:PORTs <PortType>

This command selects the mixer type.

Suffix:

<x> 1..n
irrelevant

Parameters:

<PortType> **2 | 3**

2
Two-port mixer.

3
Three-port mixer.

*RST: 2

Example:

```
MIX:PORT 3
```

[SENSe:]MIXer<x>:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Suffix:
<x> 1..n
irrelevant

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

Conversion loss table settings

The following settings are required to configure and manage conversion loss tables.

[SENSe:]CORRection:CVL:BAND <Band>

This command defines the waveguide band for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:
<Band> K | KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.
For a definition of the frequency range for the pre-defined bands, see Table 8-3).
*RST: F (90 GHz - 140 GHz)

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:BAND KA`
Sets the band to KA (26.5 GHz - 40 GHz).

[SENSe:]CORRection:CVL:BIAS <BiasSetting>

This command defines the bias setting to be used with the conversion loss table.

Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 119.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<BiasSetting> *RST: 0.0 A
Default unit: A

Example:
```
CORR:CVL:SEL 'LOSS_TAB_4'
```
Selects the conversion loss table.
```
CORR:CVL:BIAS 3A
```

[SENSe:]CORRection:CVL:CATalog?

This command queries all available conversion loss tables saved in the `C:\R_S\INSTR\USER\cvl\` directory on the instrument.

This command is only available with option B21 (External Mixer) installed.

Return values:

<Files> 'string'
Comma-separated list of strings containing the file names.

Example: CORR:CVL:CAT?

Usage: Query only

[SENSe:]CORRection:CVL:CLEar

This command deletes the selected conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 119).

This command is only available with option B21 (External Mixer) installed.

Example:
```
CORR:CVL:SEL 'LOSS_TAB_4'
```
Selects the conversion loss table.
```
CORR:CVL:CLE
```

[SENSe:]CORRection:CVL:COMMent <Text>

This command defines a comment for the conversion loss table. Before this command can be performed, the conversion loss table must be selected (see [SENSe:]CORRection:CVL:SELect on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Text>

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:COMM 'Conversion loss table for FS_Z60'`

[SENSe:]CORRection:CVL:DATA {<Freq>, <Level>}...

This command defines the reference values of the selected conversion loss tables. The values are entered as a set of frequency/level pairs. A maximum of 50 frequency/level pairs may be entered. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Freq> The frequencies have to be sent in ascending order.
Default unit: HZ

<Level> Default unit: DB

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:DATA 1MHZ,-30DB,2MHZ,-40DB`

[SENSe:]CORRection:CVL:HARMonic <HarmOrder>

This command defines the harmonic order for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<HarmOrder> Range: 2 to 65

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:HARM 3`

[SENSe:]CORRection:CVL:MIXer <Type>

This command defines the mixer name in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Type> string

Name of mixer with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX 'FS_Z60'`

[SENSe:]CORRection:CVL:PORTs <PortType>

This command defines the mixer type in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<PortType> 2 | 3

*RST: 2

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:PORT 3`

[SENSe:]CORRection:CVL:SELect <FileName>

This command selects the conversion loss table with the specified file name. If <file_name> is not available, a new conversion loss table is created.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<FileName> String containing the path and name of the file.

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`

[SENSe:]CORRection:CVL:SNUMber <SerialNo>

This command defines the serial number of the mixer for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 119).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<SerialNo> Serial number with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX '123.4567'`

Programming example: working with an external mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
```

```
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

Configuring a conversion loss table for a user-defined band

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//--------------Configuring a new conversion loss table --------------
//Define cvl table for range 1 of band as described in previous example
// (extended V band)
SENS:CORR:CVL:SEL 'UserTable'
SENS:CORR:CVL:COMM 'User-defined conversion loss table for USER band'
SENS:CORR:CVL:BAND USER
SENS:CORR:CVL:HARM 6
SENS:CORR:CVL:BIAS -1mA
SENS:CORR:CVL:MIX 'FS_Z60'
SENS:CORR:CVL:SNUM '123.4567'
SENS:CORR:CVL:PORT 3
//Conversion loss is linear from 55 GHz to 75 GHz
SENS:CORR:CVL:DATA 55GHZ,-20DB,75GHZ,-30DB
//----------- Configuring the mixer and band settings -------------
//Use user-defined band and assign new cvl table.
SENS:MIX:HARM:BAND USER
//Define band by two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, cvl table 'UserTable'
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:TABL:LOW 'UserTable'
SENS:MIX:HARM:HIGH 8

SENS:MIX:LOSS:HIGH 30dB
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)

//--------------Performing the Measurement-----
```

```
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data (default screen configuration)
TRAC:DATA? TRACe1
```

8.3.2 Configuring triggered measurements

8.3.2.1 Configuring the triggering conditions

The following commands are required to configure a triggered measurement.

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 35

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 35

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command 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 35

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command 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 35

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command 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 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 35

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

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

*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IFP -30DBM`

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

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

*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:SLOPe <Type>

This command selects the trigger slope.

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 35

TRIGger[:SEQuence]:SOURce <Source>

This command 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

EXT | EXT2
Trigger signal from one of the "Trigger Input/Output" connectors.
Note: Connector must be configured for "Input".

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See "Trigger Source" on page 33
See "Free Run" on page 33
See "Ext. Trigger 1/2" on page 34
See "IF Power" on page 34
See "RF Power" on page 34

8.3.2.2 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 R&S FSWP.

OUTPut<up>:TRIGger<tp>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<up> irrelevant

<tp> Selects the used trigger port.
<2>: selects trigger port 2 (on the rear panel).

Parameters:

<Direction> INPut | OUTPut

INPut
Port works as an input.

OUTPut
Port works as an output.
*RST: INPut

Manual operation: See "Trigger 1/2" on page 36

OUTPut<up>:TRIGger<tp>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

This command works only if you have selected a user-defined output with `OUTPut<up>:TRIGger<tp>:OTYPe`.

Suffix:
<up> 1..n

<tp> Selects the trigger port to which the output is sent.
2 = trigger port 2 (rear)

Parameters:
<Level>

HIGH
5 V

LOW
0 V

*RST: LOW

Example:
```
OUTP:TRIG2:LEV HIGH
```

Manual operation: See "Level" on page 36

OUTPut<up>:TRIGger<tp>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:
<up> 1..n

<tp> Selects the trigger port to which the output is sent.
2 = trigger port 2 (rear panel)

Parameters:
<OutputType>

DEVice
Sends a trigger signal when the R&S FSWP 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<up>:TRIGger<tp>:LEVel`.

*RST: DEVice

Manual operation: See "Output Type" on page 36

OUTPut<up>:TRIGger<tp>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<up> Selects the trigger port to which the output is sent.
2 = trigger port 2 (rear)

<tp> 1..n

Manual operation: See "Send Trigger" on page 37

OUTPut<up>:TRIGger<tp>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<up> 1..n

<tp> Selects the trigger port to which the output is sent.
2 = trigger port 2 (rear)

Parameters:

<Length> Pulse length in seconds.
Default unit: S

Example:
```
OUTP:TRIG2:PULS:LENG 0.02
```

Manual operation: See "Pulse Length" on page 37

8.3.3 Measurement control commands

[SENSe:]SSEarch:CONTrol <Step>

Defines which steps of the measurement process are performed. All steps up to the selected step are performed. By default, all measurement steps are performed.

For details on the measurement process steps see Chapter 3.3, "Measurement process", on page 18.

Parameters:

<Step> SOVerview | NESTimate | SDETection | SPOTstep

SOVerview
Spectral overview only

NESTimate
Spectral overview and Noise Floor Estimation

SDETection
Spectral overview, Noise Floor Estimation, and Spurious Detection measurement

SPOT
Spot Search - all measurement steps are performed

*RST: SPOTstep

Example: `SENS:SSE:CONT SOV`
Performs only a spectral overview measurement.

Manual operation: See "Perform Measurement Step" on page 40

[SENSe:]SSEarch:FPLan <State>

Enables or disables the the use of the frequency plan for identification of spurs.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `SSE:FPL ON`

Manual operation: See "Use Frequency Plan for Identification" on page 39

[SENSe:]SSEarch:FPLan:TOLerance <Frequency>

Sets the frequency tolerance to match predicted spurs to measured spurs.

Parameters:
<Frequency> <numeric value>

Default unit: Hz

Example: `SENS:SSE:FPL:TOL 1KHZ`

Manual operation: See "Tolerance for Identification" on page 39

[SENSe:]SSEarch:RMARk <State>

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Residuals are not marked

ON | 1
Residuals are marked

*RST: 0

Manual operation: See "Mark Residual Spurs" on page 39

[SENSe:]SSEarch:RREMove <State>

If enabled, residual spurs, which are generated by internal components in the R&S FSWP itself, are not included in the spur results. Note, however, if a residual spur coincides with a "true" spur, the spur is also removed.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Residuals are not removed

ON | 1
Residuals are removed

*RST: 1

Manual operation: See "Remove Residual Spurs" on page 39

[SENSe:]SSEarch:STYPe <Type>

Defines the type of measurement to be configured and performed.

Parameters:

<Type> WIDE | DIRected

WIDE
A measurement with a large span to detect any possible spurs in the entire frequency span of an input signal. This measurement is useful if you have little or no knowledge of the current input signal or where to expect spurs, and require an overview.

DIRected
A measurement performed at predefined discrete frequencies with settings optimized for the current signal and noise levels at those frequencies. This measurement is targeted at determining the precise level and exact frequency of spurs that are basically already known or expected.

*RST: WIDe

Manual operation: See "Type of Spur Search" on page 38

[SENSe:]SSEarch:MSPur <Type>

Defines the condition for matching the measured to the predicted spurs.

Parameters:

<Type> DMINimum | PMAXimum

DMINimum
If multiple measured spurs are inside the tolerance range around a predicted spur, the measured spur closest to the predicted spur is identified as the predicted.

PMAXimum
If multiple measured spurs are inside the tolerance range around a predicted spur, the measured spur with the highest power will be identified as the predicted.

*RST: DMIN

Example: `SENS:SSE:MSPUr DMIN`

Manual operation: See "Matching Condition" on page 39

8.3.4 Carrier reference level commands

The following commands are required to define the maximum peak, which is also the *carrier reference level*.

[SENSe:]ADJust:CARRier

Automatically detects the highest peak over the complete frequency range of the analyzer. This value is considered to be the reference carrier and is indicated in Carrier Level.

Usage: Event

Manual operation: See "Measure Carrier" on page 42
See "Auto Carrier" on page 66

[SENSe:]CREFerence:FREFerence <Limits>

Parameters:
<Limits> ABSolute | RELative

Manual operation: See "Spur Frequency Reference" on page 43

[SENSe:]CREFerence:FREQuency <Frequency>

Defines or queries the frequency at which the maximum peak of the signal, that is: the reference carrier, was found.

Parameters:
<Frequency> Default unit: HZ

Example: `CREF:FREQ 7GHZ`

Manual operation: See "Carrier Frequency" on page 41

[SENSe:]CREFerence:GUARd:INTerval <Span>

Defines the guard interval as a span around the reference carrier.

This setting is only available for `[SENSe:]CREFerence:GUARd:STATe` OFF

Parameters:
<Span> Default unit: HZ

Example: `CREF:GUAR:STAT OFF`

Example: `CREF:GUAR:INT 1MHZ`

Manual operation: See "Guard Interval" on page 42

[SENSe:]CREFerence:GUARd:STATe <State>

Determines whether the specified guard interval is included in the spur search or not. If the guard interval is not included, the spectrum displays contain gaps at the guard intervals.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Guard interval is not included

ON | 1
Guard interval is included

*RST: 1

Example: `CREF:GUAR:STAT ON`

Manual operation: See "Guard Interval" on page 42

[SENSe:]CREFerence:PREFerence <Limits>

Parameters:
<Limits> ABSolute | RELative

*RST: ABSolute

Manual operation: See "Spur Power Reference" on page 43

[SENSe:]CREFerence:PDETect:RANGe:CENTer <Center>

Defines the center of the range in which the maximum peak is searched.

Parameters:
<Center> Default unit: HZ

Example: `CREF:PDET:RANG:CENT 10GHZ`

Manual operation: See "Center Frequency/Span" on page 42

[SENSe:]CREFerence:PDETect:RANGe:SPAN <Span>

Defines the width of the range in which the maximum peak is searched.

Parameters:
<Span> Default unit: HZ

Example: `CREF:PDET:RANG:SPAN 5GHZ`

Manual operation: See "Center Frequency/Span" on page 42

[SENSe:]CREFerence:PDETect:RANGe:STARt <Start>

Defines the beginning of the range in which the maximum peak is searched.

Parameters:
<Start> Default unit: HZ

Example: `CREF:PDET:RANG:STAR 1GHZ`

Manual operation: See "Start Frequency/Stop Frequency" on page 42

[SENSe:]CREFerence:PDETect:RANGe:STOP <Stop>

Defines the end of the range in which the maximum peak is searched.

Parameters:
<Stop> Default unit: HZ

Example: `CREF:PDET:RANG:STOP 2GHZ`

Manual operation: See "Start Frequency/Stop Frequency" on page 42

[SENSe:]CREFerence:SRANge <SearchRange>

Determines the search area for the automatic carrier measurement function.

Parameters:
<SearchRange> GMAXimum | RMAXimum

GMAXimum
Global maximum: The maximum peak in the entire measurement span is determined.

RMAXimum
Range maximum: The maximum peak is searched only in the specified range.

Example: `CREF:SRAN GMAX`

Manual operation: See "Carrier Search Range" on page 42

[SENSe:]CREFerence:VALue <MaxPeak>

Defines the maximum peak of the signal, which is considered to be the reference carrier.

Parameters:
<MaxPeak> Default unit: DBM

Manual operation: See "Carrier Level" on page 41

[SENSe:]CREFerence:HARMonics:IDENtify <State>

Enables or disables the identification of harmonics of the carrier.

Parameters:
<State>

ON | 1
HArmonics are marked

OFF | 0
Harmonics are not marked

*RST: 0

Example: `CREF:HARM:IDEN ON`

Manual operation: See "Identify Harmonics" on page 43

[SENSe:]CREFerence:HARMonics:MNUMber <MHarm>

Sets the maximum harmonics number to be measured.

Parameters:
<Number> <numeric value>

Example: `SENS:CREF:HARM:MNUM 3`

Manual operation: See "Max Harmonics Number" on page 43

[SENSe:]CREFerence:HARMonics:TOLerance <TOL>

Sets the frequency tolerance to match harmonics to measured spurs.

Parameters:

<Frequency> <numeric value>
Default unit: Hz

Example: `SENS:CREF:HARM:TOL 1KHZ`

Manual operation: See "Tolerance for Identification" on page 43

8.3.5 Wide Search Measurement settings commands

[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 R&S FSWP 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 45

[SENSe:]LIST:CLEar

Removes all but the first range from the wide search settings table.

Usage: Event

Manual operation: See "Clear Ranges" on page 45

[SENSe:]LIST:RANGe<ri>:UARange <Param>

Writes the value of the specified parameter to all of the currently defined ranges.

Suffix:
<ri> 1..n

Setting parameters:
<Param> ARBW | LOFFset | MFRBw | NFFT | PAValue | PEXCursion | RBW | RFATtenuation | RLEVel | SNRatio | TSTR | TSTP

Example: `SENS:LIST:RANG1:UAR PEXC`

Usage: Setting only

Manual operation: See "Use Selection for All Ranges" on page 45

[SENSe:]LIST:LOAD <Filename>

Loads a stored range setup from a `.csv` file. The current settings in the table are overwritten by the settings in the file!

Setting parameters:
<Filename>

Usage: Setting only

Manual operation: See "Load Ranges" on page 45

[SENSe:]LIST:RANGe<ri>:BANDwidth:AUTO <State>
[SENSe:]LIST:RANGe<ri>:BANDwidth:AUTO? <State>

Activates or deactivates automatic definition of the RBW for individual ranges. If necessary, the range is divided further into segments.

Suffix:
<ri> 1..n
Measurement range

Parameters for setting and query:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Auto RBW" on page 48

[SENSe:]LIST:RANGe<ri>:BANDwidth[:RESolution] <RBW>

Suffix:
<ri> 1..n
Measurement range

Parameters:
<RBW> Range: 1 Hz to 10 MHz
*RST: 3 MHz
Default unit: HZ

Manual operation: See "RBW" on page 48

[SENSe:]LIST:RANGe<ri>:COUNt?

Suffix:
<ri> 1..n
Measurement range

Usage: Query only

[SENSe:]LIST:RANGe<ri>:INSert <Direction>

Adds a range right or left to the selected one. If the command is used on a range that does not yet exist, the range and all with lower indices up to this one are created.

Suffix:
<ri> 1..n

Setting parameters:
<Direction> LEFT | RIGHt

Example: `SENS:LIST:RANG6:INS LEFT`

Usage: Setting only

Manual operation: See "Insert Range to the Left/ Insert Range to the Right" on page 45

[SENSe:]LIST:RANGe<ri>:DELete

Suffix:
<ri> 1..n
Measurement range

Usage: Event

Manual operation: See "Delete Range" on page 45

[SENSe:]LIST:RANGe<ri>[:FREQuency]:STARt <Start>

This command defines the start frequency of a wide search measurement range.

Subsequent ranges must be defined in ascending order of frequencies; however, gaps between ranges are possible.

Suffix:
<ri> 1..n
Measurement range

Setting parameters:
<Start> Range: 0 to max. frequency
Default unit: HZ

Manual operation: See "Range Start / Range Stop" on page 46

[SENSe:]LIST:RANGe<ri>[:FREQuency]:STOP <Stop>

This command defines the stop frequency of a wide search measurement range.

The stop frequency must be higher than the start frequency for the same range.

Suffix:
<ri> 1..n
Measurement range

Setting parameters:
<Stop> Range: 0 to max. frequency
Default unit: HZ

Manual operation: See "Range Start / Range Stop" on page 46

[SENSe:]LIST:RANGe<ri>:INPut:ATTenuation <Attenuation>

Suffix:
<ri> 1..n
Measurement range

Setting parameters:
<Attenuation> Range: 0 dB to 79 dB
Increment: 1 dB
*RST: 10 dB
Default unit: DB

Manual operation: See "RF Attenuation" on page 49

[SENSe:]LIST:RANGe<ri>:INPut:GAIN:STATe <State>

Switches the optional preamplifier on or off (if available).

Suffix:
<ri> 1..n
Measurement range

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the preamplifier off

ON | 1
Switches the preamplifier on

*RST: 0

Manual operation: See "Preamplifier" on page 49

[SENSe:]LIST:RANGe<ri>:INPut:GAIN[:VALue] <Gain>

Defines the value of the optional preamplifier (for `[SENSe:]LIST:RANGe<ri>:INPut:GAIN:STATeON`).

For R&S FSWP26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSWP8 or R&S FSWP13 models, the following settings are available:

Suffix:
<ri> 1..n
Measurement range

Setting parameters:
<Gain> all values other than 15 dB or 30 dB are rounded to the nearest of the two

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

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

*RST: 30 dB

Manual operation: See "Preamplifier" on page 49

[SENSe:]LIST:RANGe<ri>:LOFFset <LOffset>

Defines a limit line as an offset to the detection threshold for each range.

Suffix:
<ri> 1..n

Setting parameters:
<LOffset> Range: 0 to 20
*RST: 0
Default unit: DB

Manual operation: See "Limit Offset to Detection Threshold" on page 47

[SENSe:]LIST:RANGe<ri>:MFRBw <MaxFinalRBW>

Suffix:
<ri> 1..n
Measurement range

Parameters:
<MaxFinalRBW> Range: 1 Hz to 10 MHz
*RST: 1 kHz
Default unit: HZ

Manual operation: See "Maximum Final RBW" on page 48

[SENSe:]LIST:RANGe<ri>:NFFT <LOffset>

Defines the number of FFT averages to be performed for each range or segment.

Suffix:
<ri> 1..n

Setting parameters:
<LOffset> integer
Range: 1 to 20
*RST: 2
Default unit: DB

Manual operation: See "Number of FFT Averages" on page 48

[SENSe:]LIST:RANGe<ri>:PEXCursion <LOffset>

Defines the minimum level value by which the signal must rise or fall after a detected spur so that a new spur is detected.

Suffix:
<ri> 1..n

Setting parameters:
<LOffset> *RST: 6
Default unit: DB

Manual operation: See "Peak Excursion" on page 47

[SENSe:]LIST:RANGe<ri>:RLEVel <RefLevel>

Suffix:
<ri> 1..n
Measurement range

Setting parameters:
<RefLevel> Range: -130 dBm to 30 dBm (–10 dBm + RF attenuation – RF preamplifier gain)
*RST: 0 dBm
Default unit: DBM

Manual operation: See "Ref. Level" on page 49

[SENSe:]LIST:RANGe<ri>:SNRatio <Ratio>

Defines the minimum signal-to-noise ratio (in dB) that the power level must exceed for a spur to be recognized during the final spur frequency scan (see Chapter 3.3, "Measurement process", on page 18).

Suffix:
<ri> 1..n
Measurement range

Parameters:
<Ratio> *RST: 10
Default unit: DB

Manual operation: See "Minimum Spur SNR" on page 47

[SENSe:]LIST:RANGe<ri>:THReshold:STARt <Start>

Defines an absolute threshold that the power level must exceed for a peak to be detected as a true spur.

The start value must be lower than the stop value.

Suffix:
<ri> 1..n

Setting parameters:
<Start> Range: -200 dBm to 0 dBm
*RST: 0 dBm
Default unit: DBM

Manual operation: See "Spur Detection Threshold Start/ Spur Detection Threshold Stop" on page 47

[SENSe:]LIST:RANGe<ri>:THReshold:STOP <Stop>

Defines an absolute threshold that the power level must exceed for a peak to be detected as a true spur.

The stop value must be higher than the start value.

Suffix:
<ri> 1..n

Setting parameters:
<Stop> Range: -200 dBm to 0 dBm
*RST: 0 dBm
Default unit: DBM

Manual operation: See "Spur Detection Threshold Start/ Spur Detection Threshold Stop" on page 47

[SENSe:]LIST:SAVE <Filename>

Saves the current range setup to a user-defined comma-separated (`.csv`) file for later use. The values are stored in the following order for each range:

```
<No>,<Start>,<Stop>,<TNRStart>,<TNRStop>,<LimitOffset>,
<PeakExcursion>,<SNR>,<AutoRBW>,<RBW>,<MaxFinalRBW>,<Detector>,
<DetLength>,<Reserved>,<RefLevel>,<RFAttenuation>,<Preamp>
```

Setting parameters:
<Filename> String containing the path and name of the file.

Example:
```
SENS:LIST:SAVE 'C:\R_S\userdata\RangeTable.csv'
//Result:
//RangeNo,StartFreq,StopFreq,DetThreshStart,DetThreshStop,LimitOffset,Pea
1,0,2000000000,-120,-120,10,3,10,On,,1000,Positive Peak,2,Reserved,-10,0,
2,2000000000,4000000000,-120,-120,10,3,10,On,,1000,Positive Peak,2,Reserv
3,4000000000,5500000000,-120,-110,10,3,10,On,,1000,Positive Peak,2,Reserv
4,6000000000,8000000000,-110,-110,10,3,10,On,,1000,Positive Peak,2,Reserv
```

Usage: Setting only

Manual operation: See "Save Ranges" on page 45

8.3.6 Frequency plan identification commands

The following commands define a frequency plan for the DUT.

For details see Chapter 3.2, "Frequency plan and spur identification", on page 17.

Useful commands for frequency plans described elsewhere:

- `[SENSe:]FPLan:TRANsfer` on page 150

Remote commands exclusive to frequency plans:

[SENSe:]FPLan:LOAD <Filename>

Loads a stored frequency plan configuration from a `.csv` file.

Setting parameters:
<Filename>

Example: `SENS:FPL:LOAD 'C:\R_S\userdata\FreqPlan.csv'`

Usage: Setting only

Manual operation: See "Load Table" on page 52

[SENSe:]FPLan:SAVE <Filename>

Saves the current frequency plan configuration to a user-defined `.csv` file for later use. The result is a comma-separated list of values with the following syntax for each row of the frequency plan: <Num>,<Comp>,<InFreq1>,<MaxHarm1>,<InFreq2>,<Fact>,<MaxHarm2>,<Ident2>,<BandCtr>,<BandSpn>

Setting parameters:
<Filename>

Example:
```
SENS:FPL:SAV 'c:\temp\fplan1'
//Result (in file):
//Num, Comp, InFreq1, MaxHarm1, InFreq2, Fact, MaxHarm2, Ident2, BandCtr, BandSpn
1,Mixer,13250000000,2,0,2,2,LO,1000000000,1000000000
2,Mixer,0,2,0,2,2,LO,1000000000,1000000000
3,Mixer,0,2,0,2,2,LO,1000000000,1000000000
4,Mixer,0,2,0,2,2,LO,1000000000,1000000000
5,Mixer,0,2,0,2,2,LO,1000000000,1000000000
```

Usage: Setting only

Manual operation: See "Save Table" on page 52

[SENSe:]FPLan:COMPonent<co>:BCENter <CenterFreq>

Defines the center of the search span that is evaluated for spur identification within the frequency plan. By default, the defined center frequency is used.

Suffix:
<co> 1..6
Component in signal chain

Parameters:
<CenterFreq> Default unit: HZ

Example: `FPL:COMP1:BCEN 1GHZ`

Manual operation: See "Bandpass Center" on page 52

[SENSe:]FPLan:COMPonent<co>:BSPan <Span>

Defines the span that is evaluated for spur identification within the frequency plan. By default, the full measurement span is used.

Suffix:
<co> 1..6
Component in signal chain

Parameters:
<Span> Default unit: HZ

Example: `FPL:COMP1:BSP 1GHZ`

Manual operation: See "Bandpass Span" on page 52

[SENSe:]FPLan:COMPonent<co>:DELete

This command will delete the selected row from the frequency plan.

Suffix:
<co> 1..6
Component in signal chain

Example: `FPL:COMP1:DEL`

Usage: Event

Manual operation: See "Delete Row" on page 52

[SENSe:]FPLan:COMPonent<co>:ADD

Adds a new component below the selected row `<co>` in the frequency plan. If the command is executed on a row that does not yet exist, this row and all that are missing up to this row are created.

Suffix:
<co> 1..n

Example: `SENS:FPL:COMP1:ADD`

Usage: Event

Manual operation: See "Add Row" on page 52

[SENSe:]FPLan:PREDicted:EXPort <Filename>

Saves the current predicted list to a `.csv` file.

Setting parameters:
<Filename>

Example: `SENS:FPL:PRED:EXP 'PredictedSpurs.csv'`

Usage: Setting only

Manual operation: See "Export Predicted Spurs to File ..." on page 52

[SENSe:]FPLan:COMPonent<co>:IDENtity <Type>

Selects the identifier for the second input frequency for mixers.

Suffix:
<co> 1..6
Component in signal chain

Parameters:
<Type> LO | CLOCk
*RST: LO

Example:
```
FPL:COMP1:TYPE MIX
FPL:COMP1:IDEN LO
```

Manual operation: See "Ident 2" on page 51

[SENSe:]FPLan:COMPonent<co>:PORT<1|2>:FREQuency <Frequency>

Defines the frequency of the input signal.

For all components after the first one, the output frequency of the previous component is used as the input frequency.

Suffix:
<co> 1..6
Component in signal chain

<1|2> 1|2
input frequency
1: only for component 1
2: only for mixers

Parameters:
<Frequency> *RST: defined CF
Default unit: HZ

Example:
```
FPL:COMP1:PORT1:FREQ 1GHZ
FPL:COMP1:PORT2:FREQ 2GHZ
FPL:COMP2:PORT2:FREQ 2GHZ
```

Manual operation: See "Input 1 Frequency" on page 51
See "Input 2 Frequency" on page 51

[SENSe:]FPLan:COMPonent<co>:PORT<1|2>:MHARmonic <Harmonic>

Defines the maximum harmonic of each input frequency to be considered in calculating mixer products for spur identification.

Suffix:
<co> 1..6
Component in signal chain

<1|2> 1|2
input frequency for mixer

Parameters:
<Harmonic> Range: 1 to 5

Example:
```
FPL:COMP1:TYPE MIX
FPL:COMP1:PORT1:MHAR 2
FPL:COMP1:PORT2:MHAR 3
```

Manual operation: See "Max Harm" on page 51

[SENSe:]FPLan:COMPonent<co>:TYPE <Type>

Defines the type of component in the signal path. Depending on the type of component, different parameters are available.

Suffix:
<co> 1..6
Component in signal chain

Parameters:
<Type> MIXer | AMPLifier | MULTiplier | DIVider

MIXer
Mixes the input signal (RF input or the output of the previous component) with a second input frequency.

AMPLifier
Amplifies the input signal (RF input or the output of the previous component).

MULTiplier
Multiplies the input signal (RF input or the output of the previous component) by a configurable factor n.

DIVider
Divides the input signal (RF input or the output of the previous component) by a configurable factor n.

Example:
```
FPL:COMP1:TYPE MIX
```

Manual operation: See "Component" on page 51

8.3.7 Directed Search Measurement settings commands

Useful commands for Directed Search Measurement settings described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 134

Remote commands exclusive to Directed Search Measurement:

[SENSe:]DIRected:DETector <Detector>

This command defines the detector to be used for all spurs in the directed search measurement.

Setting parameters:

<Detector> POSitive | RMS | AVERage

*RST: POSitive

[SENSe:]DIRected:INPut:ATTenuation <Attenuation>

Defines the RF attenuation for the directed search measurement.

Parameters:

<Attenuation> integer

Range: 0 dB to 79 dB
*RST: 10 dB
Default unit: DB

Manual operation: See "RF Attenuation" on page 58

[SENSe:]DIRected:INPut:GAIN:STATe <State>

Switches the optional preamplifier on or off (if available) for the directed search measurement.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "Preamplifier" on page 58

[SENSe:]DIRected:INPut:GAIN[:VALue] <Gain>

Defines the gain by the optional preamplifier (if activated for the directed search measurement, see `[SENSe:]DIRected:INPut:GAIN:STATe` on page 146).

For R&S FSWP26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSWP8 or R&S FSWP13 models, different settings are available.

Setting parameters:
<Gain> 15 dB | 30 dB
All other values are rounded to the nearest of these two.
*RST: 30 dB

Example:
```
DIR:INP:GAIN:STAT ON
DIR:INP:GAIN 15DB
```

Manual operation: See "Preamplifier" on page 58

[SENSe:]DIRected:LOAD <Filename>

Loads a stored search configuration from a `.csv` file. The current settings in the table are overwritten by the settings in the file!

Setting parameters:
<Filename>

Usage: Setting only

Manual operation: See "Load Table" on page 60

[SENSe:]DIRected:LOFFset <PeakExc>

Defines a limit line as an offset to the detection threshold for each range.

Parameters:
<PeakExc> Range: 0 to 200
*RST: 0
Default unit: DB

Manual operation: See "Limit Offset to Detection Threshold" on page 57

[SENSe:]DIRected:MFRBw <MaxFinalRBW>

Parameters:
<MaxFinalRBW> Range: 1 Hz to 10 MHz
*RST: 1 kHz
Default unit: HZ

Manual operation: See "Maximum Final RBW" on page 58

[SENSe:]DIRected:NFFT <LOffset>

Defines the number of FFTs to be performed for all spurs in the directed search measurement.

Setting parameters:
<LOffset> integer
Range: 1 to 20
*RST: 2
Default unit: DB

Example: `DIR:NFFT 4`

Manual operation: See "Number of FFT Averages" on page 58

[SENSe:]DIRected:PEXCursion <PeakExc>

Defines the minimum level value by which the signal must rise or fall after a detected spur so that a new spur is detected.

Parameters:
<PeakExc>
Range: 0 to 100
*RST: 6
Default unit: DB

Manual operation: See "Peak Excursion" on page 57

[SENSe:]DIRected:RLEVel <RefLevel>

Defines the reference level for the directed search measurement.

Parameters:
<RefLevel>
(–10 dBm + RF attenuation – RF preamplifier gain)
Range: -130 dBm to max. 30 dBm
*RST: 0 dBm
Default unit: dBm

Manual operation: See "Ref. Level" on page 58

[SENSe:]DIRected:SAVE <Filename>

Saves the current directed search configuration to a user-defined `.csv` file for later use. The result is a comma-separated list of values with the following syntax for each span:

`<No>,<Frequency>,<SearchSpan>,<DetThreshold>,<SNR>,<DetectMode>`

For details on the parameters see Chapter 5.9, "Directed Search Measurement settings", on page 55).

Setting parameters:
<Filename>

Example:
```
SENS:DIR:SETT 1.0e9,10e6,-120,10,1.2e9,20e6,-110,15,1.4e9,15e6,-120,10
SENS:DIR:SAV 'c:\temp\spur1'
//Result (in file):
//Number,SpurFreq,SearchSpan,DetectThresh,MinimumSNR,DetectMode
//1,1499999671,383,-120,10,Measured
//2,1504999863,383,-30,10,Entered
```

Usage: Setting only

Manual operation: See "Save Table" on page 60
See "Frequency" on page 60
See "Search Span" on page 61
See "Detection Threshold" on page 61
See "Minimum Spur SNR" on page 61
See "Detection Mode" on page 61

[SENSe:]DIRected:SETTings {<Frequency>, <SearchSpan>, <DetThreshold>, <DesiredSpurSNR>}...

Defines the current directed search configuration, that is: all frequency spans to be measured in detail. The current configuration table is overwritten. Note that *all* entries must be defined in one command so that the R&S FSWP Spurious measurements application can detect any possible conflicts between the frequency spans.

The parameters are defined as a comma-separated list with one line per span, using the following syntax:

`<Frequency>,<SearchSpan>,<DetThreshold>,<SNR>`

For details on the parameters see Chapter 5.9, "Directed Search Measurement settings", on page 55).

Parameters:

<SearchSpan> numeric value

The span around the frequency for which a detailed measurement (spurious detection sweep and spot search) is performed. Note that the frequency spans must be distinct, that is: they may not overlap.

Default unit: HZ

<DetThreshold> numeric value

Absolute threshold that the power level must exceed for a spur to be detected.

Default unit: dBm

<DesiredSpurSNR> numeric value

Minimum signal-to-noise ratio that the power level must exceed for a spur to be detected during the spot search

Default unit: dB

Setting parameters:

<Frequency> numeric value

Center frequency for directed search measurement of the spur

Default unit: HZ

Example: `SENS:DIR:SETT 1.0e9,10e6,-120,10,`
`1.2e9,20e6,-110,15,`
`1.4e9,15e6,-120,10`
Defines three spur frequencies
`SENS:DIR:SAV 'c:\temp\spur1'`
Saves the directed search table to a file.

Manual operation: See "Frequency" on page 60
See "Search Span" on page 61
See "Detection Threshold" on page 61
See "Minimum Spur SNR" on page 61

8.3.8 Transferring settings between measurements

[SENSe:]TRANsfer:SEGMent

Usage: Event

Manual operation: See "Transfer to Wide Search Settings" on page 54

[SENSe:]TRANsfer:SPUR <Spur>...

Setting parameters:
<Spur> Comma-separated list of spur numbers (integers)

Example: `TRAN:SPUR 2,4,6`

Usage: Setting only

Manual operation: See "Transfer Selected Rows to Directed Search Settings" on page 55

[SENSe:]FPLan:TRANsfer

This command will transfer all frequencies that result out of the current frequency plan settings to the directed search settings.

Example: `FPL:TRAN`

Usage: Event

Manual operation: See "Transfer Predicted to Directed Search Settings" on page 53

8.3.9 Configuring the result displays

8.3.9.1 General window commands

The following commands are required to configure general window layout, independent of the application.

DISPlay:FORMat <Format>

This command 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>

This command 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 155).

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
```

8.3.9.2 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*.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

This command adds a window to the display in the active channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation: See "Spectral Overview" on page 21
See "Spurious Detection Spectrum" on page 22
See "Spurious Detection Table" on page 23
See "Noise Floor Estimate" on page 24
See "Marker Table" on page 24

Table 8-4: <WindowType> parameter values for Spurious Measurements application

Parameter value	Window type
SOVerview	Spectral Overview
SDETection	Spurious Detection Spectrum
SDTable	Spurious Detection Table
NESTimate	Noise Floor Estimate
MTABle	"Marker Table"

LAYout:CATalog[:WINDow]?

This command 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>

This command 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>

This command 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>

This command 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 152 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>

This command 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 151 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.

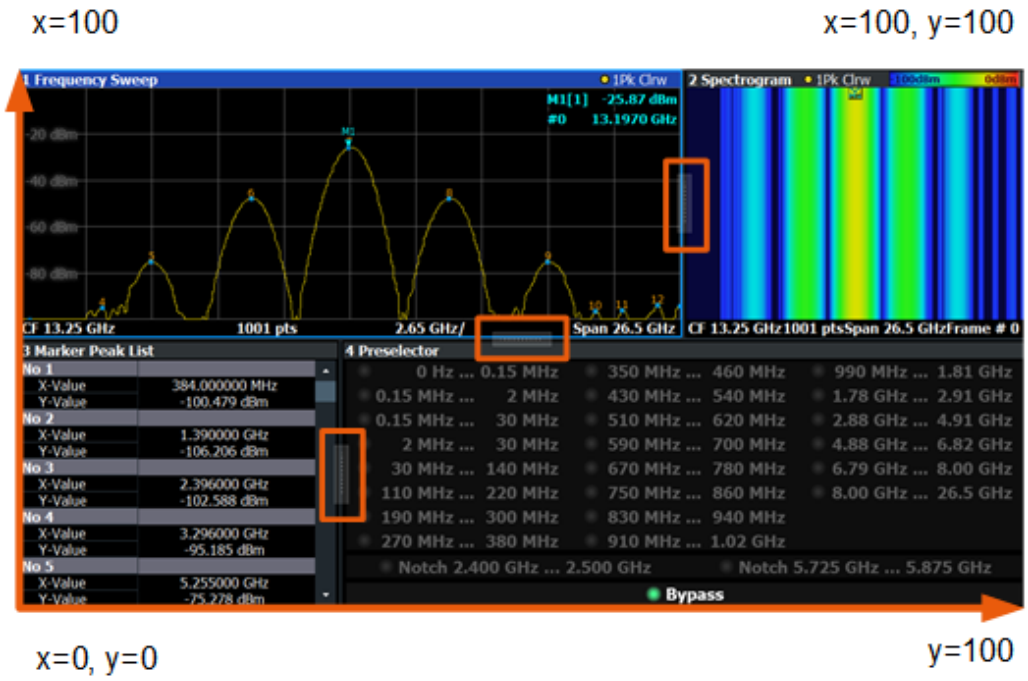


Figure 8-1: SmartGrid coordinates for remote control of the splitters

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 8-1.)
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>

This command 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.

This 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 152 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?

This command 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

This command 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>

This command 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 152 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

8.3.9.3 Configuring tables and diagrams

CALCulate:SSEarch:TABLe:COLumn <State>, <Headers>...

Select the numerical results to be displayed in the Spurious Detection Table.

For a description of the individual results see "Spurious Detection Table" on page 23.

Parameters:
<Headers> ALL | SID | STARt | STOP | RBW | FREQuency | POWer | DELTa | IDENt

ALL
All available results are displayed

STARt
Start frequency of range/span

STOP
Stop frequency of range/span

FREQuency
Spur frequency

POWer
Spur power

DELTa
Delta of spur to limit

RBW
Resolution bandwidth used for range

IDENt
Spur ID

Setting parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Hides the result

ON | 1
Displays the result

*RST: 1

Example: `CALC:SSE:TABL:COL OFF,STARt`

8.4 Performing measurements

ABORt

This command 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.

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 R&S FSWP 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 R&S FSWP 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>:CONTinuous <State>

This command 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 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: 0

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

Manual operation: See "Continuous Sweep / Run Cont" on page 65

INITiate<n>[:IMMediate]

This command 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

Manual operation: See "Single Sweep / Run Single" on page 65

INITiate:SPURious

Usage: Event

8.5 Analyzing Spurious measurements

8.5.1 Configuring the Y-Axis scaling

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

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 68
See "Auto Scale Once" on page 68

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 68

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 68

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 68

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

This command defines the vertical position of the reference level on the display grid (for all traces).

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

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Ref Position" on page 68

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 69

8.5.2 Setting up individual markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker<m>:AOFF

This command 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>

This command 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 74

CALCulate<n>:DELTamarker<ms>:LINK:TO:DELTa<md> <State>

This command links the delta source marker <ms> to any active destination delta marker <md>.

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:DELT2:LINK:TO:DELT3 ON`
Links D2 and D3.

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

This command 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 74

CALCulate<n>:DELTamarker<m>:MODE <Mode>

This command defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker. Note that this setting applies to *all* windows.

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see CALCulate<n>:DELTamarker<m>:X on page 167)!

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Mode>

ABSolute
Delta marker position in absolute terms.

RELative
Delta marker position in relation to a reference marker.

*RST: RELative

Example: CALC:DELT:MODE ABS
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREFerence <Reference>

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference>

1 to 16
Selects markers 1 to 16 as the 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 73

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command 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 72
See "Marker State" on page 73
See "Marker Type" on page 73
See "Select Marker" on page 74

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command 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>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:
<n> Window

<m> Marker

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 72
See "Marker Position X-value" on page 73

CALCulate<n>:MARKer<m>:AOFF

This command 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 74

CALCulate<n>:MARKer<ms>:LINK:TO:DELTa<md> <State>

This command links the normal source marker <ms> to any active delta destination marker <md>.

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:DELT2 ON
Links marker 4 to delta marker 2.

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

This command 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 74

CALCulate<n>:MARKer<m>[:STATe] <State>

This command 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 72
See "Marker State" on page 73
See "Marker Type" on page 73
See "Select Marker" on page 74

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command 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 74

CALCulate<n>:MARKer<m>:X <Position>

This command 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 24
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 72
See "Marker Position X-value" on page 73

8.5.3 General marker settings

The following commands control general marker functionality.

Useful commands for markers described elsewhere:

- `CALCulate<n>:DELTamarker<m>:LINK` on page 164

Remote commands exclusive to general marker functionality

CALCulate<n>:MARKer:LINK <State>

Suffix:
<n> 1..n
Window

Parameters:
<State>

Manual operation: See "Linking Markers Across Windows" on page 76

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode> **ON | 1**
Turns on the marker table.
OFF | 0
Turns off the marker table.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 75

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

This command 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 75

8.5.4 Configuring and performing a marker search

The following commands control the marker search.

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

This command defines the peak excursion (for *all* markers).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:
<n> Window

<m> irrelevant

Manual operation: See "Peak Excursion" on page 77

CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>

This command turns marker search limits on and off for *all* markers in *all* windows.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:X:SLIM ON`
Switches on search limitation.

CALCulate<n>:MARKer<m>:X:SLIMits:LEFT <SearchLimit>

This command defines the left limit of the marker search range for *all* markers in *all* windows.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<SearchLimit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: left diagram border
Default unit: HZ

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:LEFT 10MHz`
Sets the left limit of the search range to 10 MHz.

CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt <SearchLimit>

This command defines the right limit of the marker search range for *all* markers in *all* windows.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Limit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: right diagram border
Default unit: HZ

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:RIGH 20MHz`
Sets the right limit of the search range to 20 MHz.

CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe] <State>

This command adjusts the marker search range to the zoom area for *all* markers in *all* windows.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:X:SLIM:ZOOM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:RIGH 20MHz`
Sets the right limit of the search range to 20 MHz.

CALCulate<n>:THReshold <Level>

This command defines a threshold level for the marker peak search (for *all* markers in *all* windows).

Note that you must enable the use of the threshold using `CALCulate<n>:THReshold:STATe` on page 174.

Suffix:
<n> irrelevant

Parameters:
<Level> Numeric value. The value range and unit are variable.

*RST: -120 dBm
Default unit: DBM

Example: `CALC:THR:STAT ON`

Example: `CALC:THR -82DBM`
Enables the search threshold and sets the threshold value to -82 dBm.

CALCulate<n>:THReshold:STATe <State>

This command turns a threshold for the marker peak search on and off (for *all* markers in *all* windows).

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:THR:STAT ON`
Switches on the threshold line.

8.5.5 Positioning the marker

This chapter contains remote commands necessary to position the marker on a trace.

8.5.5.1 Positioning normal markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command 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 78

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next positive peak.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 78

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Peak Search" on page 78

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command 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 78

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command 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 78

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum peak value.

Suffix:
<n> Window
<m> Marker

Manual operation: See "Search Next Minimum" on page 78

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command 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 78

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command 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 78

8.5.5.2 Positioning delta markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command 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 78

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command 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 78

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Peak Search" on page 78

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command 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 78

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command 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 78

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next minimum peak value.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 78

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command 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 78

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command 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 78

8.5.6 Configuring traces

The following commands configure trace settings.

[SENSe:]MEASure:POINts <MeasurementPoints>

Defines the maximum number of trace points within a trace.

Parameters:
<MeasurementPoints>integer

Range: 101 to 32001
*RST: 32001

Manual operation: See "Trace Points" on page 69

8.5.7 Configuring display lines

The following commands configure vertical and horizontal display lines.

CALCulate<n>:DLINe<dl> <Position>

This command defines the (horizontal) position of a display line.

Suffix:
<n> Window

<dl> 1 | 2

Parameters:

<Position> The value range is variable.
You can use any unit you want, the R&S FSWP then converts the unit to the currently selected unit. If you omit a unit, the R&S FSWP uses the currently selected unit.

*RST: (state is OFF)
Default unit: DBM

Example: `CALC:DLIN2 -20dBm`
Positions the second display line at -20 dBm.

Manual operation: See "Horizontal Line 1/ Horizontal Line 2" on page 79

CALCulate<n>:DLINe<dl>:STATe <State>

This command turns a display line on and off

Suffix:

<n> Window

<dl> 1 | 2

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DLIN2:STAT ON`
Turns on display line 2.

CALCulate<n>:FLINe<dl> <Frequency>

This command defines the position of a frequency line.

Suffix:

<n> Window

<dl> 1 to 4
frequency line

Parameters:

<Frequency> Note that you can not set a frequency line to a position that is outside the current span.

Range: 0 Hz to Fmax
*RST: (STATe to OFF)
Default unit: HZ

Example: `CALC:FLIN2 120MHz`
Sets frequency line 2 to a frequency of 120 MHz.

Manual operation: See "Vertical Line <x>" on page 79

CALCulate<n>:FLINe<dl>:STATe <State>

This command turns a frequency line on and off

Suffix:
<n> Window

<dl> 1 | 2
frequency line

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:FLIN2:STAT ON`
Turns frequency line 2 on.

CALCulate<n>:TLINe<dl> <Time>

This command defines the position of a time line.

Suffix:
<n> Window

<dl> 1 to 4
time line

Parameters:
<Time> Note that you can not set a time line to a position that is higher than the current sweep time.

Range: 0 s to 1600 s
*RST: (STATe to OFF)
Default unit: S

Example: `CALC:TLIN 10ms`
Sets the first time line to 10 ms.

Manual operation: See "Vertical Line <x>" on page 79

CALCulate<n>:TLINe<dl>:STATe <State>

This command turns a time line on and off

Suffix:
<n> Window

<dl> 1 | 2
time line

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:TLIN:STAT ON`
Turns the first time line on.

8.6 Retrieving results

8.6.1 Retrieving and storing trace data

In order to retrieve the trace results in a remote environment, use the following command:

TRACe<n>[:DATA]? <ResultType>

This command queries the y-values in the selected result display.

The unit depends on the display and on the unit you have currently set.

Suffix:
<n> Window

Query parameters:
<ResultType> Determines the type of result to be returned.

TRACE1
The trace number whose values are to be returned. For Spurious result displays, only one trace is available. This parameter value is only available for graphical displays.
For each trace point, the measured or calculated value is returned. For the Magnitude Capture display, the maximum y-value for each trace point is returned.

LIST
Returns the Spurious Detection Table results, in the following order:
<spur frequency>, <power of the spur>, <delta to limit>, <RBW>, <segment start>, <segment stop>,< spur ID>, <reserved>
For details on the results see Table 4-1.

Example:
```
TRAC2:DATA? TRACE1
```
//Results (extract of 1001 values):
```
-1.244600830E+002,-1.220300903E+002,-1.220475464E+002,
-1.230028992E+002,-1.262179794E+002,-1.253178787E+002,
-1.262033005E+002,-1.268296967E+002,-1.260616837E+002,
-1.261392593E+002,-1.261168823E+002,-1.257556992E+002,
...
```

Example:
```
TRAC3:DATA? LIST
```
//Results:
```
999999875.5,-31.18,88.82,86.0,382690429.7,1687500000.0,1,0,
1999999703.8,-74.02,45.98,90.8,1687500000.0,2422851562.5,2,0,
2999999786.5,-100.57,19.43,72.6,2422851562.5,3084960937.5,3,0,
3999999443.9,-107.36,12.64,93.5,3084960937.5,4154663085.9,4,0,
4999999378.7,-112.65,7.35,66.2,4992553710.9,5018554687.5,5,0,
5999999219.2,-109.34,10.66,136.1,5360595703.1,6000000000.0,6,0
```

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.

This command 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

8.6.2 Checking the results of a limit check

CALCulate<n>:LIMit<li>:CLEar[:IMMediate]

This command deletes the result of the current limit check.

The command works on *all* limit lines in *all* measurement windows at the same time.

Suffix:
<n> Window
 irrelevant

Example: `CALC:LIM:CLE`
Deletes the result of the limit check.

CALCulate<n>:LIMit<li>:FAIL?

This command queries the result of a limit check in the specified window.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Suffix:
<n> Window
 Limit line

Return values:
<Result> **0**
PASS
1
FAIL

Example: `INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC2:LIM3:FAIL?`
Queries the result of the check for limit line 3 in window 2.

Usage: Query only

8.6.3 Exporting table and trace results to an ASCII file

Trace and table results can be exported to an ASCII file for further evaluation in other (external) applications.

FORMat[:DATA] <Format>[, <BitLength>]

This command selects the data format that is used for transmission of trace data from the R&S FSWP to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSWP. The R&S FSWP 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".
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
```

FORMat:DEXPort:DSEParator <Separator>

This command 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 70

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 70

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 187).

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

MMEMory:STORe:SPUR:MEAS <File>

This command stores the current measurement results (all enabled traces and tables of all windows) into the specified csv file.

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.

Setting parameters:
<File>

Usage: Setting only

Manual operation: See "Export Data to ASCII File for All Windows" on page 71

MMEMory:STORe<n>:TABLe <Columns>, <Filename>

Exports the selected data from the specified window as a comma-separated list of results, table row by table row, to an ASCII file.

The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined by `FORMat:DEXPort:DSEParator` on page 185.

Suffix:
<n> 1..n
Window

Setting parameters:
<Columns> SELected | ALL

Defines which columns to include in the export file.

SELected
Only the results defined by `CALCulate:SSEarch:TABLe:COLumn` on page 158 are included.

ALL
All available results are included.

<Filename> String containing the path and name of the file.

Example:
```
CALC:SSE:TABL:COL
OFF,STAR,OFF,STOP,ON,FREQ,ON,POW
MMEM:STOR:TABL SEL,'C:\TableData.csv'
```
Exports the frequency and power values only.

Usage: Setting only

Manual operation: See "Spurious Detection Table" on page 23
See "Export Data to ASCII File for Specific Window" on page 71

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command 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 R&S FSWP 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 "Spectral Overview" on page 21
See "Spurious Detection Spectrum" on page 22
See "Noise Floor Estimate" on page 24
See "Export Data to ASCII File for Specific Window" on page 71

8.6.4 Retrieving marker results

The following commands are used to retrieve the results of markers.

Remote commands exclusive to retrieving marker results

CALCulate<n>:DELTamarker<m>:X:RELative?

This command 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 72

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 72

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 24
See "Delta Marker 1 / Marker 2 / Marker 3 / ... Marker 16 / Norm / Delta" on page 72

8.7 Status reporting system

The status reporting system stores all information on the current operating state of the instrument, e.g. information on errors or limit violations which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The R&S FSWP Spurious measurements application uses only the registers provided by the base system.

For details on the common R&S FSWP status registers refer to the description of remote control basics in the R&S FSWP User Manual.

8.8 Programming examples: spurious emissions measurements

The following examples demonstrate how to perform spurious measurements using the R&S FSWP Spurious measurements application in a remote environment.

8.8.1 Performing a wide search measurement

This example demonstrates how to perform a wide search measurement 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.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the spurious measurement application
INST:SEL 'SPUR'

//Configure the carrier reference level as -50dBm
CREF:VAL -50DBM
//Define power results as relative to the carrier power
CREF:PREF REL

//---------------Configuring a Wide Search Measurement ----------
//Select the wide search measurement
SSE:STYP WIDE
//Mark residual spurs in the spur table
SSE:RMAR ON
//Perform measurement without spot search
SSE:CNTR SDET

//Define the first range from 0 Hz to 1.125 GHz.
LIST:RANG1:STAR 0
LIST:RANG1:STOP 1.125GHZ
//Define a constant spur detection threshold of -5 dBc
LIST:RANG1:THR:STAR -5
LIST:RANG1:THR:STOP -5
//Define a limit offset of 10 dB
LIST:RANG1:LOFF 10DB
//Define a peak excursion of 3 dB
LIST:RANG1:PEXC 3DB
//Define a minimum spur SNR of 10 dB
LIST:RANG1:SNR 10DB
//Use automatic RBW mode with a maximum RBW of 10 kHz.
LIST:RANG1:BAND:AUTO ON
LIST:RANG1:MFRB 10000
//Select a positive peak detector
LIST:RANG1:DET POS
//Define a "Number of FFT Averages" of 10
LIST:RANG1:NFFT 10
//Define a reference level of -20 dBm.
LIST:RANG1:RLEV -20
//Define an attenuation level of 10 dB
LIST:RANG1:INP:ATT 10

//Define the second range from 1.125 GHz to 3.375 GHz with the same settings as range 1.
LIST:RANG2:STAR 1.125GHZ
LIST:RANG2:STOP 3.375GHZ
LIST:RANG2:THR:STAR -5
```

```
LIST:RANG2:THR:STOP -5
LIST:RANG2:LOFF 10DB
LIST:RANG2:PEXC 3DB
LIST:RANG2:SNR 10DB
LIST:RANG2:BAND:AUTO ON
LIST:RANG2:MFRB 10000
LIST:RANG2:DET POS
LIST:RANG2:NFFT 10
LIST:RANG2:RLEV -20
LIST:RANG2:INP:ATT 10

//Define the third range from 3.375 GHz to 5.75 GHz with the same settings as range 1.
LIST:RANG3:STAR 3.375GHZ
LIST:RANG3:STOP 5.75GHZ
LIST:RANG3:THR:STAR -5
LIST:RANG3:THR:STOP -5
LIST:RANG3:LOFF 10DB
LIST:RANG3:PEXC 3DB
LIST:RANG3:SNR 10DB
LIST:RANG3:BAND:AUTO ON
LIST:RANG3:MFRB 10000
LIST:RANG3:DET POS
LIST:RANG3:NFFT 10
LIST:RANG3:RLEV -20
LIST:RANG3:INP:ATT 10

//Define the fourth range from 5.75 GHz to 7 GHz with the same settings as range 1.
LIST:RANG4:STAR 5.75GHZ
LIST:RANG4:STOP 7GHZ
LIST:RANG4:THR:STAR -5
LIST:RANG4:THR:STOP -5
LIST:RANG4:LOFF 10DB
LIST:RANG4:PEXC 3DB
LIST:RANG4:SNR 10DB
LIST:RANG4:BAND:AUTO ON
LIST:RANG4:MFRB 10000
LIST:RANG4:DET POS
LIST:RANG4:NFFT 10
LIST:RANG4:RLEV -20
LIST:RANG4:INP:ATT 10

//Query the number of measurement ranges in the sweep list.
LIST:RANG:COUNt?

//Save the list to repeat the measurement with same configuration
LIST:SAVE 'C:\R_S\USER\SPURIOUS_WIDEMEAS.csv'

//Add a result display for the noise floor estimation diagram
LAY:ADD:WIND? '3',BEL,NEST
```

```
//--------------Performing the Measurement-----

//Perform a spurious emission measurement and wait until the measurement has finished.
INIT:IMM; *WAI


//---------------Retrieving Results-------------
//Query the spurious detection spectrum of the measurement
TRAC2?
//Save the frequency and power results from the spurious detection
//table to a file
CALC3:SSE:TABL:COL OFF,STAR,OFF,STOP,ON,FREQ,ON,POW
MMEM:STOR3:TABL SEL; 'C:\R_S\USER\SPURIOUS_WIDEMEAS_RESULTS.csv'
```

8.8.2 Performing a directed search measurement

This example demonstrates how to perform a directed measurement 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.

The following search settings are used:

Number	Frequency	Search Span	Detection Threshold	Minimum Spur SNR
1	1 GHz	10 MHz	-120 dBm	10 dB
2	1.2 GHz	20 MHz	-110 dBm	15 dB
3	1.4 GHz	15 MHz	-120 dBm	10 dB

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the spurious measurement application
INST:SEL 'SPUR'

//Configure the carrier reference level as -50dBm
CREF:VAL -50DBM
//Define power results as relative to the carrier power
CREF:PREF REL

//---------------Configuring a Directed Search Measurement ----------
//Select the wide search measurement
SSE:STYP DIR
//Mark residual spurs in the spur table
SSE:RMAR ON
//Define a limit offset of 10 dB
DIR:LOFF 10DB
//Define a peak excursion of 3 dB
```

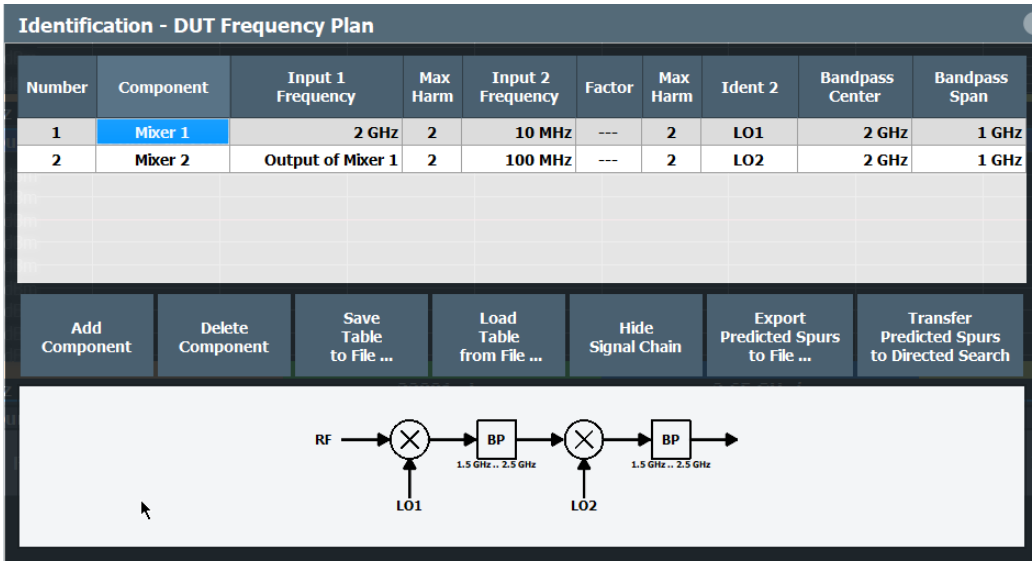
```
DIR:PEXC 3DB
//Define a reference level of -20 dBm.
DIR:RLEV -20
//Define an attenuation level of 10 dB
DIR:INP:ATT 10

//Define three frequency spans to be searched with the settings shown above:
// 1.0 GHz, 1.2 GHz, 1.4 GHz
SENS:DIR:SETT 1.0000000000,10000000,-120,10,
1.2000000000,20000000,-110,15,
1.4000000000,15000000,-120,10

//Save the list to repeat the measurement with same configuration
DIR:SAVE 'C:\R_S\USER\SPURIOUS_DIRMEAS.csv'

//Add a result display for the noise floor estimation diagram
LAY:ADD:WIND? '3',BEL,NEST

//--------------Performing the Measurement-----

//Perform a spurious emission measurement and wait until the measurement has finished.
INIT:IMM; *WAI

//---------------Retrieving Results-------------
//Query the spurious detection spectrum of the measurement
TRAC2?
//Query the result of the limit check in the spurious detection spectrum
CALC2:LIM:FAIL?
//Store all meaasurement results to a file
MMEM:STOR:SPUR:MEAS 'C:\R_S\USER\SPURIOUS_DIRMEAS_RESULTS.csv'
```

8.8.3 Performing a spurious search measurement using a frequency plan

This example demonstrates how to perform a spurious search measurement with a DUT frequency plan 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.

The following search settings are used:




```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the spurious measurement application
INST:SEL 'SPUR'

//---------------Configuring a DUT frequency plan ---------------
//Component 1: mixer 1
FPL:COMP1:TYPE MIX
FPL:COMP1:PORT1:FREQ 1GHZ
FPL:COMP1:PORT1:MHAR 5
FPL:COMP1:PORT2:FREQ 9GHZ
FPL:COMP1:PORT2:MHAR 5
FPL:COMP1:IDEN LO
FPL:COMP1:BCEN 8.5GHZ
FPL:COMP1:BSP 1GHZ

//Component 2: amplifier 1
FPL:COMP2:TYPE AMPL
FPL:COMP2:BCEN 8.5GHZ
FPL:COMP2:BSP 1GHZ

//Component 3: mixer 2
FPL:COMP3:TYPE MIX
FPL:COMP3:PORT1:MHAR 5
FPL:COMP3:PORT2:FREQ 7GHZ
FPL:COMP3:PORT2:MHAR 5
FPL:COMP3:IDEN LO
FPL:COMP3:BCEN 1GHZ
FPL:COMP3:BSP 1GHZ

//Component 4: mixer 3
```

```
FPL:COMP4:TYPE MIX
FPL:COMP4:PORT1:MHAR 5
FPL:COMP4:PORT2:FREQ 600MHZ
FPL:COMP4:PORT2:MHAR 5
FPL:COMP4:IDEN LO
FPL:COMP4:BCEN 500MHZ
FPL:COMP4:BSP 950MHZ

//Component 5: multiplier 1
FPL:COMP5:TYPE MULT
FPL:COMP5:BCEN 5GHZ
FPL:COMP5:BSP 10GHZ

//Transfer the frequency plan to the directed search table
FPL:TRAN
//Enable the use of the frequency plan in measurement control
SSE:FPL ON

//--------------Performing the Measurement-----
//Perform a spurious emission measurement and wait until the measurement has finished.
INIT:IMM; *WAI

//---------------Retrieving Results-------------
//Query the spurious detection spectrum of the measurement
TRAC3:DATA? LIST
```

Annex

A Reference: ASCII file export format

Trace and table data can be exported to a file in ASCII format for further evaluation in other applications. This reference describes in detail the format of the export files for result data.

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 keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on the measurement) which are also separated by a semicolon.

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.

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 70).

Table A-1: ASCII file format for trace and table export in the R&S FSWP Spurious measurements application

File contents	Description
Header data	
Type;R&S FSWP;	Instrument model
Version;2.50;	Firmware version
Date;01.Mar 2016;	Date of data set storage
Mode;Spurious;	Operating mode
Transducer; OFF	Transducer status
Display Start Freq;0.0;Hz Display Stop Freq;26500000000.0;Hz	Start/stop of the display range. Unit: Hz
Freq Offset;0;Hz	Frequency offset
Level Offset;0;dB	Level offset
Carrier Freq;0.0;Hz	Carrier frequency
Carrier Level;-30.00;dBm	Carrier level
Spur Search Type;Wide Search;	Measurement type (wide search measurement/directed search measurement)
Number of Windows;3;	Number of exported windows
Data section for individual window	
Window;1;Spectral Overview;	Window number and name
Data section for individual trace	

File contents	Description
Trace;0;	Trace
Trace Mode;Clear Write;	Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
x-Axis;Linear;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
Start Freq;0;Hz	
Stop Freq;26500000000;Hz	
x-Unit;Hz;	Unit of x values: Hz
y-Axis;Linear;	Scaling of y-axis linear (LIN) or logarithmic (LOG)
Max;-190;dBm	
Min;-90;dBm	
y-Unit;dBm;	Unit of y values: dBm
Values;1001;	Number of measurement points
0;-138.98028564453125000 26500000;-101.27227020263671875 53000000;-122.48052215576171875 ...;...;	Measured values: <x value>, <y1>
Trace 2;;	Next trace in same window
...	
Data section for individual window	
Window;2 ..;	Name of next window
Data section for individual trace	
Trace 1;;	First trace
...	
Data section for table result window	
Window;3;Spurious Detection Table;	Window number and name
Values;6;	Number of spurs
Frequency;Power;Segment Start;Segment Stop;RBW;Delta to Limit	Order of returned parameters for each spur
Hz;dBm;Hz;Hz;Hz;db	Units of returned parameters for each spur
6000040514.6;-138.25;6000000000.0;6000092773.4;15.2;51.75 6000109780.0;-155.61;6000092773.4;6000126922.6;14.9;34.39 ...	Values of spur parameters

List of Remote Commands (Spurious)

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