R&S®FSPN
Spectrum Monitor
User Manual

1179454002
Version 05

ROHDE&SCHWARZ
Make ideas real

This document describes the following R&S®FSPN models with firmware version 3.02 or higher:

- R&S®FSPN8 (1322.8003K06)
- R&S®FSPN8 (1322.8003K07)
- R&S®FSPN26 (1322.8003K24)
- R&S®FSPN26 (1322.8003K25)
- R&S®FSPN50 (1322.8003K49)

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

Contents

1 Preface

1.1 About this manual

This R&S FSPN Spectrum Monitor User Manual provides all the information specific to the application and processing I/Q data. All general instrument functions and settings common to all applications are described in the main R&S FSPN User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them.

1.2 Documentation overview

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

www.rohde-schwarz.com/manual/FSPN

1.2.1 Getting started manual

Introduces the R&S FSPN 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 FSPN. 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 FSPN in secure areas. It is available for download on the internet.

1.2.5 Printed safety instructions

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

1.2.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S FSPN. 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/FSPN

1.2.7 Release notes and open source acknowledgment (OSA)

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

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

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

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/FSPN

1.2.9 Videos

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

1.3 Conventions used in the documentation

1.3.1 Typographical conventions

The following text markers are used throughout this documentation:

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

1.3.2 Conventions for procedure descriptions

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

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

1.3.3 Notes on screenshots

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

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

2 Welcome to the spectrum monitor application

The R&S FSPN Spectrum Monitor is a firmware application that adds functionality to view the captured frequency spectrum on the R&S FSPN.

It runs on the phase noise analyzer hardware and is included with the R&S FSPN.

It has the following characteristics and limitations:

- When you open a spectrum monitor, the frequency, level and input parameters are initially adopted from the phase noise application (you can change them in the spectrum monitor, of course).
- Maximum analysis bandwidth of 20 MHz and sample rate of 25 MHz (and no support of bandwidth extensions).
- Advanced data acquisition settings are unavailable.
- I/Q data import and export
- Spectrograms, general marker functionality, marker functions and limit lines
- Only external triggers are supported.
- Only evaluation of the frequency spectrum is supported.
- Trace mathematics are not available.

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

The functionality of the spectrum monitor application is limited in comparison to a full I/Q analyzer. Therefore some functions and result displays described in this user manual are not available with this version of the spectrum monitor application.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSPN User Manual. The latest version is available for download at the product homepage http://www.rohde-schwarz.com/product/FSPN.

2.1 Starting the spectrum monitor application

The Spectrum Monitor is an application on the R&S FSPN.

To activate the Spectrum Monitor application

1. Select the [MODE] key.

   A dialog box opens that contains all applications currently available on your R&S FSPN.

2. Select the "Spectrum Monitor" item.

The R&S FSPN opens a new channel for the Spectrum Monitor application.

3 Measurement and result displays

Access: "Overview" > "Display Config"

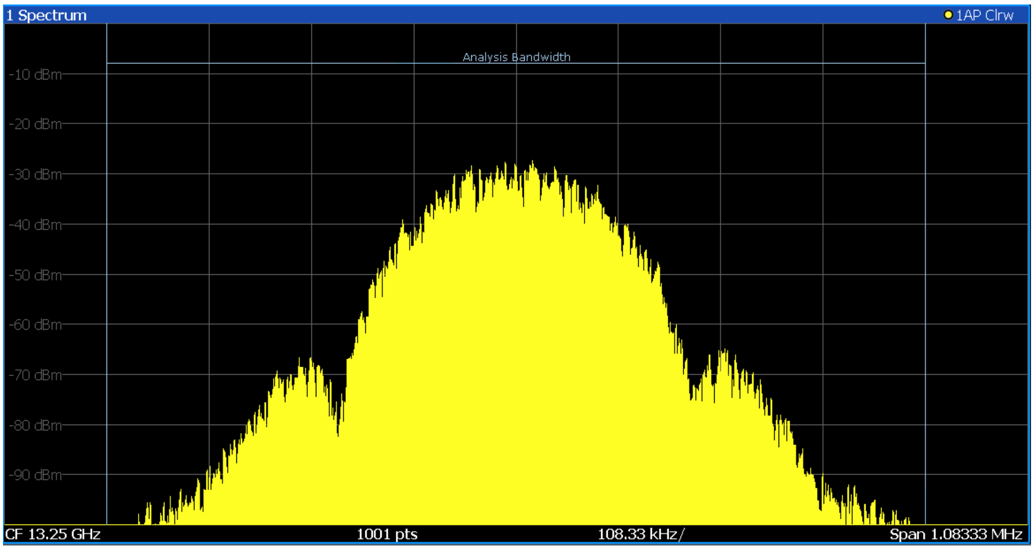
Or: [MEAS] > "Display Config"

In the Spectrum Monitor application, data that was captured by or imported to the R&S FSPN can be evaluated in various different result displays.

Result displays:

Spectrum

Displays the frequency spectrum of the captured I/Q samples.



Remote command:
`LAY:ADD:WIND? '1',RIGH,FREQ`, see `LAYout:ADD[:WINDow]?` on page 165
Results:
`TRACe<n>[:DATA]?` on page 116

Marker Table

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

This table is displayed automatically if configured accordingly.

2 Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
N1		1	13.197 GHz	-25.87 dBm	Count	13.19705
D1	N1	1	-7.942 GHz	-49.41 dB		
D2	N1	2	-3.918 GHz	-21.90 dB		
D3	N1	3	4.024 GHz	-21.99 dB		

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 165
Results:

CALCulate<n>:MARKer<m>:X on page 119
CALCulate<n>:MARKer<m>:Y? on page 119

Marker Peak List

The marker peak list determines the frequencies and levels of peaks in the spectrum or time domain. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.

3 Marker Peak List

Wnd	No	X-Value	Y-Value
2	1	1.086245 ms	-75.810 dBm
2	2	2.172490 ms	-6.797 dBm
2	3	3.258736 ms	-76.448 dBm
2	4	4.831918 ms	-76.676 dBm
2	5	6.255274 ms	-76.482 dBm
2	6	6.798397 ms	-6.800 dBm
2	7	9.233084 ms	-76.519 dBm
2	8	10.075861 ms	-76.172 dBm
2	9	11.405574 ms	-6.801 dBm

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

Remote command:

`LAY:ADD? '1',RIGH, PEAK`, see LAYout:ADD[:WINDow]? on page 165

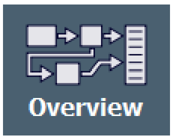
Results:

CALCulate<n>:MARKer<m>:X on page 119
CALCulate<n>:MARKer<m>:Y? on page 119

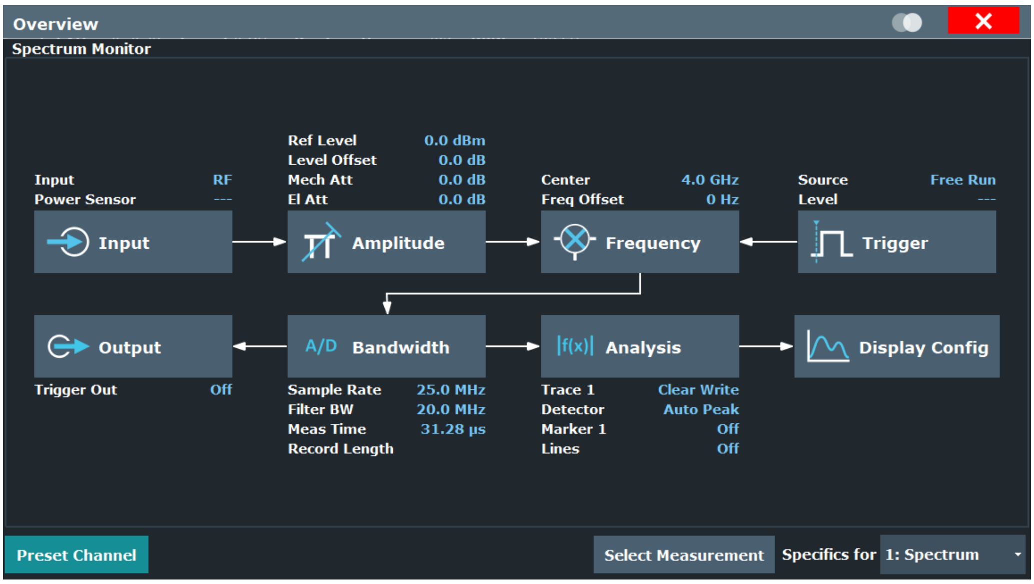
4 Configuration

The Spectrum Monitor is a special application on the R&S FSPN, which you activate using the [MODE] key on the front panel.

4.1 Configuration Overview



Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



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

The Overview varies depending on the application; for detailed descriptions see the corresponding application User Manual.

To configure settings

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

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

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

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 103

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

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

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

4.2 Import/export functions

Access: "Save"/ "Open" icon in the toolbar > "Import" / "Export"

The R&S FSPN provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with further, external applications. In this case, you can export the measurement data to a standard format file (ASCII or XML). Some of the data stored in these formats can also be re-imported to the R&S FSPN for further evaluation later, for example in other applications.

The following data types can be exported (depending on the application):

- Trace data
- Table results, such as result summaries, marker peak lists etc.
- I/Q data (in applications that process I/Q data)

The following data types can be imported (depending on the application):

- I/Q data (in applications that process I/Q data)

I/Q data can only be imported and exported in applications that process I/Q data, such as the I/Q analyzer or other optional applications.

See the corresponding user manuals for those applications for details.

These functions are only available if no measurement is running.

In particular, if Continuous Sweep / Run Cont is active, the import/export functions are not available.

Import

Access: "Save/Recall" > Import

Provides functions to import data.

I/Q Import ← Import

Opens a file selection dialog box to select an import file that contains I/Q data. This function is only available in single sweep mode and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

Input from I/Q data files is imported as it was stored, including any correction factors, for example from transducers or SnP files. Any currently configured correction factors at the time of import, however, are not applied.

Remote command:
`MMEMory:LOAD:IQ:STATe` on page 231

File Explorer ← I/Q Import ← Import

Opens the Microsoft Windows File Explorer.

Remote command:
not supported

Export

Access: "Save/Recall" > Export

Opens a submenu to configure data export.

Export Configuration ← Export

Opens the "Traces" dialog box to configure the trace and data export settings.

I/Q Export ← Export

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

It is not available in the Spectrum application, only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

For details, see the description in the R&S FSPN I/Q Analyzer User Manual ("Importing and Exporting I/Q Data").

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

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 232
`MMEMory:STORe<n>:IQ:COMMent` on page 232

File Type ← I/Q Export ← Export
The I/Q data file can be stored in one of the following supported formats:
- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.aid`

Note: Not all applications support all formats.

For details on formats, see Chapter C, "Reference: supported I/Q file formats", on page 243.

Remote command:
The file type is determined by the file extension of the file name parameter. If no file extension is provided, the file type is assumed to be `.iq.tar`. For `.mat` files, Matlab® v4 is assumed.

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

Remote command:
not supported

4.3 Configuring Data Inputs and Outputs

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

4.3.1 Inputs

The Spectrum Monitor supports several input sources.

4.3.1.1 RF Input

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

Radio Frequency State

Activates input from the "RF Input" connector.

Remote command:
`INPut:SELect` on page 123

Input Coupling

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

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

Remote command:
`INPut:COUPling` on page 121

Impedance

The R&S FSPN has an internal impedance of 50 Ω. However, some applications use other impedance values. To match the impedance of an external application to the impedance of the R&S FSPN, an *impedance matching pad* can be inserted at the input. If the type and impedance value of the used matching pad is known to the R&S FSPN, it can convert the measured units accordingly so that the results are calculated correctly.

"50Ω"	(Default:) no conversion takes place
"75Ω"	The 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)
"User"	The 50 Ω input impedance is transformed to a user-defined impedance value according to the selected "Pad Type": "Series-R" (default) or "MLP" (Minimum Loss Pad)

Remote command:
`INPut:IMPedance` on page 123
`INPut:IMPedance:PTYPe` on page 123

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.

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.)

YIG-Preselector
Enables or disables the YIG-preselector.

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

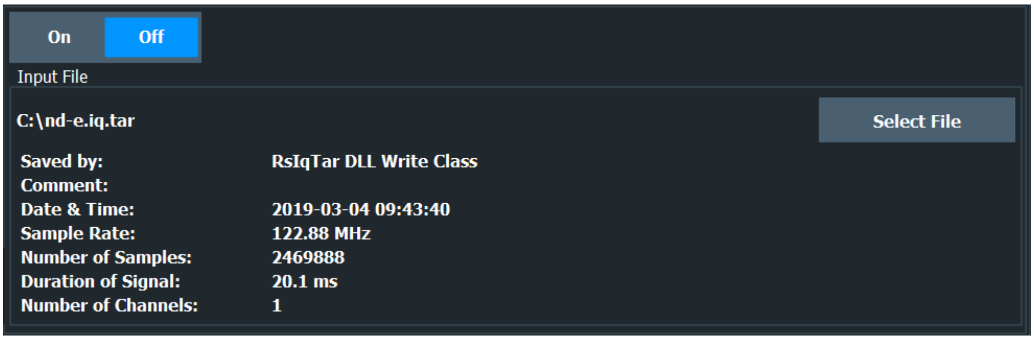
An internal YIG-preselector at the input of the R&S FSPN ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the R&S FSPN, which can lead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

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 123

4.3.1.2 Settings for Input from I/Q Data Files

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

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



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

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

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

Remote command:
`INPut:SELect` on page 123

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

The I/Q data must have a specific format (`.iq.tar`) as described in Chapter A, "I/Q data file format (iq-tar)", on page 233.

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

Remote command:
`INPut:FILE:PATH` on page 121

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

Remote command:
`TRACe:IQ:FILE:REPetition:COUNt` on page 124

4.3.1.3 Power sensors

The R&S FSPN can also analyze data from a connected power sensor.

Basics on power sensors

For precise power measurement, up to 4 power sensors can be connected to the instrument via the power sensor interface (on the front panel) or the USB connectors. Both manual operation and remote control are supported.

For a detailed list of supported sensors, see the specifications document.

Power sensors can also be used to trigger a measurement at a specified power level, e.g. from a signal generator (see "Using a power sensor as an external power trigger" on page 20).

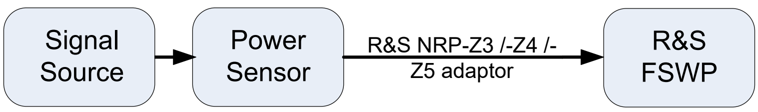


Figure 4-1: Power sensor support – standard test setup

Using the power sensor with several applications

The power sensor cannot be used from the R&S FSPN firmware and the R&S Power Viewer Plus (virtual power meter for displaying results of the R&S NRP power sensors) simultaneously.

Result display

The results of the power sensor measurements are displayed in the marker table. For each power sensor, a row is inserted. The sensor index is indicated in the "Type" column.

Using a power sensor as an external power trigger

Power sensors can be used to trigger a measurement at a specified power level, e.g. from a signal generator. For a list of supported power sensors see the specifications document.

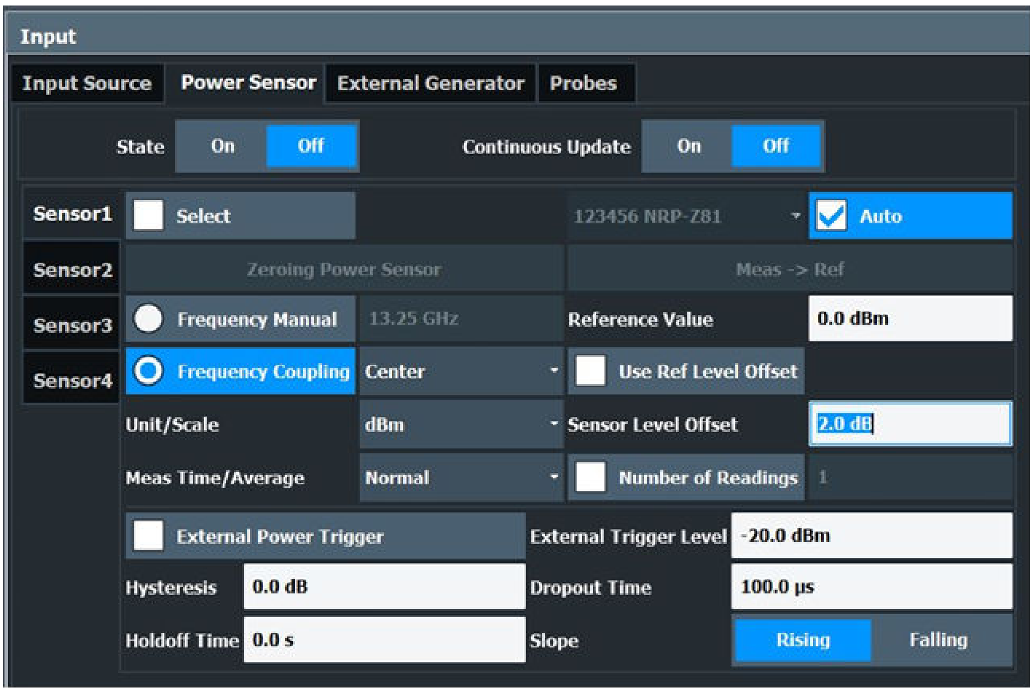
The R&S FSPN receives an external trigger signal when the defined trigger level is measured by the power sensor. Power measurement results are provided as usual.

Power sensor settings

Access: "Overview" > "Input" > "Power Sensor" tab

For details on working with power sensors, see the R&S FSPN User Manual.

Each sensor is configured on a separate tab.



State

Switches the power measurement for all power sensors on or off. Note that in addition to this general setting, each power sensor can be activated or deactivated individually by the Select setting on each tab. However, the general setting overrides the individual settings.

Continuous Value Update

If activated, the power sensor data is updated continuously during a sweep with a long sweep time, and even after a single sweep has completed.

This function cannot be activated for individual sensors.

If the power sensor is being used as a trigger (see "Using the power sensor as an external trigger" on page 24), continuous update is not possible; this setting is ignored.

Remote command:
`[SENSe:]PMETer<p>:UPDate[:STATe]` on page 132

Select

Selects the individual power sensor for usage if power measurement is generally activated (State function).

The detected **serial numbers** of the power sensors connected to the instrument are provided in a selection list. For each of the four available power sensor indexes ("Power Sensor 1"..."Power Sensor 4"), which correspond to the tabs in the configuration dialog, one of the detected serial numbers can be assigned. The physical sensor is thus assigned to the configuration setting for the selected power sensor index.

By default, serial numbers not yet assigned are automatically assigned to the next free power sensor index for which "Auto Assignment" is selected.

Alternatively, you can assign the sensors manually by deactivating the "Auto" option and selecting a serial number from the list.

Remote command:
[SENSe:]PMETer<p>[:STATe] on page 127
SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine on page 134
SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe] on page 133
SYSTem:COMMunicate:RDEVice:PMETer<p>:COUNt? on page 133

Zeroing Power Sensor
Starts zeroing of the power sensor.

For details on the zeroing process refer to the R&S FSPN User Manual.

Remote command:
CALibration:PMETer<p>:ZERO:AUTO ONCE on page 125

Frequency Manual
Defines the frequency of the signal to be measured. The power sensor has a memory with frequency-dependent correction factors. This allows extreme accuracy for signals of a known frequency.

Remote command:
[SENSe:]PMETer<p>:FREQuency on page 128

Frequency Coupling
Selects the coupling option. The frequency can be coupled automatically to the center frequency of the instrument or to the frequency of marker 1.

Remote command:
[SENSe:]PMETer<p>:FREQuency:LINK on page 128

Unit/Scale
Selects the unit with which the measured power is to be displayed. Available units are dBm, dB, W and %.

If dB or % is selected, the display is relative to the reference value that is defined with either the "Meas -> Ref" setting or the "Reference Value" setting.

Remote command:
UNIT<n>:PMETer<p>:POWer on page 134
UNIT<n>:PMETer<p>:POWer:RATio on page 135

Meas Time/Average
Selects the measurement time or switches to manual averaging mode. In general, results are more precise with longer measurement times. The following settings are recommended for different signal types to obtain stable and precise results:

"Short"	Stationary signals with high power (> -40dBm), because they require only a short measurement time and short measurement time provides the highest repetition rates.
"Normal"	Signals with lower power or modulated signals

"Long"	Signals at the lower end of the measurement range (<-50 dBm) or Signals with lower power to minimize the influence of noise
"Manual"	Manual averaging mode. The average count is set with the Average Count (Number of Readings) setting.

Remote command:
[SENSe:]PMETer<p>:MTIMe on page 129
[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] on page 129

Setting the Reference Level from the Measurement Meas -> Ref
Sets the currently measured power as a reference value for the relative display. The reference value can also be set manually via the Reference Value setting.

Remote command:
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE on page 126

Reference Value
Defines the reference value in dBm used for relative power meter measurements.

Remote command:
CALCulate<n>:PMETer<p>:RELative[:MAGNitude] on page 126

Use Ref Level Offset
If activated, takes the reference level offset defined for the analyzer into account for the measured power (see "Shifting the Display (Offset)" on page 36).

If deactivated, takes the Sensor Level Offset into account.

Remote command:
[SENSe:]PMETer<p>:ROFFset[:STATe] on page 130

Sensor Level Offset
Takes the specified offset into account for the measured power. Only available if Use Ref Level Offset is disabled.

Remote command:
[SENSe:]PMETer<p>:SOFFset on page 133

Average Count (Number of Readings)
Defines the number of readings (averages) to be performed after a single sweep has been started. This setting is only available if manual averaging is selected (Meas Time/Average setting).

The values for the average count range from 0 to 256 in binary steps (1, 2, 4, 8, …). For average count = 0 or 1, one reading is performed. The general averaging and sweep count for the trace are independent from this setting.

Results become more stable with extended average, particularly if signals with low power are measured. This setting can be used to minimize the influence of noise in the power sensor measurement.

Remote command:
[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt on page 129

Duty Cycle
Sets the duty cycle to a percent value for the correction of pulse-modulated signals and activates the duty cycle correction. With the correction activated, the sensor calculates the signal pulse power from this value and the mean power.

Remote command:
`[SENSe:]PMETer<p>:DCYCle[:STATe]` on page 127
`[SENSe:]PMETer<p>:DCYCle:VALue` on page 128

Using the power sensor as an external trigger
If activated, the power sensor creates a trigger signal when a power higher than the defined "External Trigger Level" is measured. This trigger signal can be used as an external power trigger by the R&S FSPN.

This setting is only available in conjunction with a compatible power sensor.

Remote command:
`[SENSe:]PMETer<p>:TRIGger[:STATe]` on page 132

External Trigger Level ← Using the power sensor as an external trigger
Defines the trigger level for the power sensor trigger.

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

Remote command:
`[SENSe:]PMETer<p>:TRIGger:LEVel` on page 131

Hysteresis ← Using the power sensor as an external trigger
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.

Remote command:
`[SENSe:]PMETer<p>:TRIGger:HYSTeresis` on page 131

Trigger Holdoff ← Using the power sensor as an external trigger
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:
`[SENSe:]PMETer<p>:TRIGger:HOLDoff` on page 131

Drop-Out Time ← Using the power sensor as an external trigger
Defines the time the input signal must stay below the trigger level before triggering again.

Slope ← Using the power sensor as an external trigger
Defines whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`[SENSe:]PMETer<p>:TRIGger:SLOPe` on page 132

How to work with a power sensor

The following step-by-step instructions demonstrate how to set up a power sensor. For details on individual functions and settings see "Power sensor settings" on page 20.

Power sensors can also be used to trigger a measurement at a specified power level, e.g. from a signal generator.

How to set up a power sensor

Up to 4 external power sensors can be configured separately and used for precise power measurement. All power sensors can be activated and deactivated individually.

The following procedure describes in detail how to configure and activate power sensors.

1. To display the "Power Sensor" tab of the "Input" dialog box, do one of the following:
   - Select "Input" from the "Overview".
   - Select [INPUT/OUTPUT] and then "Power Sensor Config".
2. Select the tab for the power sensor index you want to configure, e.g. "Power Sensor 1".
3. Press "Select" to analyze the power sensor data according to the current configuration when power measurement is activated.
4. From the selection list with serial numbers of connected power sensors, select the sensor you want to configure.
   To have newly connected power sensors assigned to a tab automatically (default), select "Auto".
5. Define the frequency of the signal whose power you want to measure.
   a) To define the frequency manually, select "Frequency Manual" and enter a frequency.
   b) To determine the frequency automatically, select "Frequency Coupling" and then either "Center", to use the center frequency, or "Marker", to use the frequency defined by marker 1.
6. Select the unit for the power result display.
7. Select the measurement time for which the average is calculated, or define the number of readings to average. To define the number of readings to be taken into account manually, select "Manual" and enter the number in the "Number of Readings" field.
8. To activate the duty cycle correction, select "DutyCycle" and enter a percentage as the correction value.
9. If you selected "dB" or "%" as units (relative display), define a reference value:
   a) To set the currently measured power as a reference value, press "Meas -> Ref".

b) Alternatively, enter a value manually in the "Reference Value" field.
c) Optionally, select the "Use Ref Level Offset" option to take the reference level offset set for the analyzer into account for the measured power.

10. To use the power sensor as an external power trigger, select the "External Power Trigger" option and define the trigger settings.
    For details see "How to configure a power sensor as an external (PSE) trigger" on page 26.
11. If necessary, repeat steps 3-10 for another power sensor.
12. Set the "Power Sensor State" at the top of the "Power Sensor" tab to "On" to activate power measurement for the selected power sensors.

    The results of the power measurement are displayed in the marker table (Function: "Sensor <1...4>").

How to zero the power sensor

1. To display the "Power Sensor" tab of the "Input" dialog box, do one of the following:
   - Select "Input" from the "Overview".
   - Select [INPUT/OUTPUT] and then "Power Sensor Config".
2. Select the tab that is assigned to the power sensor you want to zero.
3. Press "Zeroing Power Sensor".
   A dialog box is displayed that prompts you to disconnect all signals from the input of the power sensor.
4. Disconnect all signals sending input to the power sensor and press [ENTER] to continue.
5. Wait until zeroing is complete.
   A corresponding message is displayed.

How to configure a power sensor as an external (PSE) trigger

The following step-by-step instructions demonstrate how to configure a power sensor to be used as an external power sensor trigger.

To configure a power sensor as an external power sensor (PSE) trigger

1. Connect a compatible power sensor to the "Power Sensor" interface on the front panel of the R&S FSPN. (For details on supported sensors see "Using a power sensor as an external power trigger" on page 20).
2. Set up the power sensor as described in "How to set up a power sensor" on page 25.
3. In the "Power Sensor" tab of the "Input" dialog box, select the "External Power Trigger" option.

4. Enter the power level at which a trigger signal is to be generated ("External Trigger Level") and the other trigger settings for the power sensor trigger.
5. Press [TRIG] and then select "Trigger/ Gate Config".
6. In the "Trigger And Gate" dialog box, select "Signal Source" = "PSE".

   The R&S FSPN is configured to trigger when the defined conditions for the power sensor occur. Power measurement results are provided as usual.

4.3.1.4 Probes input

The R&S FSPN can also analyze data from a active modular probe.

You can use active modular probes in all applications that require the spectrum analyzer hardware (R&S FSPN-B1).

Using probes

Probes allow you to perform voltage measurements very flexibly and precisely on all sorts of devices to be tested, without interfering with the signal. The R&S FSPN base unit and some (optional) applications support input from probes. For information on which probes are supported, see the R&S FSPN specifications document.

Active modular probes can be connected to the "RF Input" connector on the R&S FSPN using an R&S RT-ZA9 adapter. Thus, you can perform frequency sweeps on data from all active probes directly on the RF input up to the maximum frequency of the probe and analyzer. The R&S RT-ZA9 provides an interface between the probe's BNC socket and the analyzer's N-socket. The USB connection provides the necessary supply voltages for the probe. RF probes are supported by all R&S FSPN applications, in particular the Spectrum application.

Active probes

When using active probes from the R&S RT family, consider the following:

- Active probes require operating power from the instrument and have a proprietary interface to the instrument.
- The probe is automatically recognized by the instrument, no adjustment is required.
- Connections should be as short as possible to keep the usable bandwidth high.
- Observe the operating voltage range.

Microbutton action

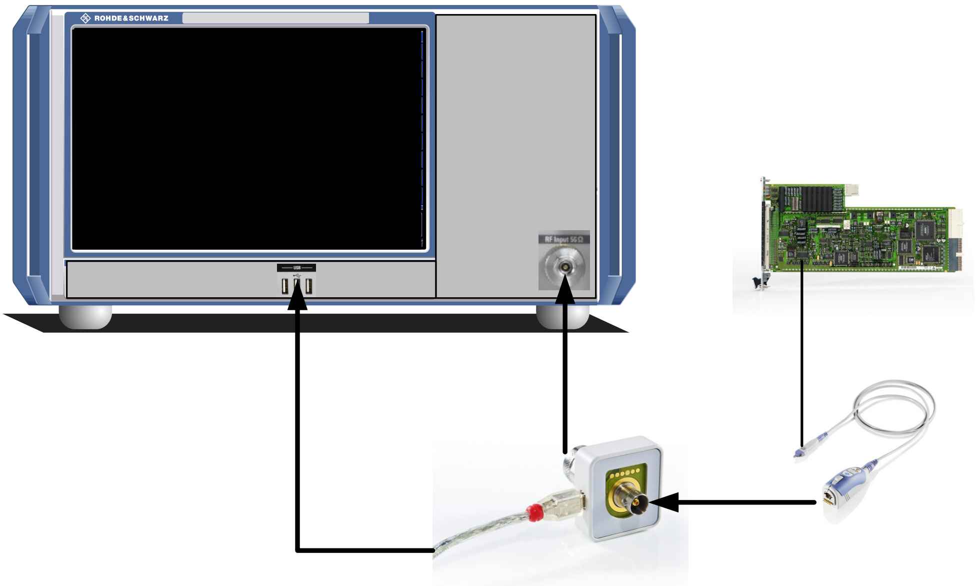
You can define an action to be performed by the R&S FSPN when the probe's microbutton (if available) is pressed. Currently, a single data acquisition via the probe can be performed simply by pressing the microbutton.

RF probes

Active modular probes can be connected to the RF Input connector on the R&S FSPN using an R&S RT-ZA9 adapter. Thus, you can perform frequency sweeps on data from all active probes with a maximum bandwidth of up to 80 MHz, depending on the installed bandwidth extension options. The R&S RT-ZA9 provides an interface between the probe's BNC socket and the analyzer's N-socket. The USB connection provides the necessary supply voltages for the probe.

To connect an active probe to the RF Input

1. Connect the R&S RT-ZA9 adapter to the RF Input connector on the R&S FSPN.
2. Connect the R&S RT-ZA9 adapter's USB cable to a USB connector on the R&S FSPN.
3. Connect the probe to the adapter.



4. In the "Input source" settings, select the "Input connector": "RF Probe".

   Probes are automatically detected when you plug them into the R&S FSPN. The detected information on the probe is displayed in the "Probes" tab of the "Input" dialog box.

To determine whether the probe has been connected properly and recognized by the R&S FSPN, use the `[SENSe:]PROBe<pb>:SETup:STATe?` remote control command.

Impedance and attenuation

The measured signal from the probe is attenuated internally by the probe's specific attenuation. For RF probes, the attenuation is compensated using a pre-defined "Probe on RF Input" transducer factor. This special transducer factor is automatically activated before the common RF data processing when you select "RF probe" as the input connector. The reference level is adjusted automatically.

A fixed impedance of 50 Ω is used for all probes to convert voltage values to power levels.

Multimode function and offset compensation for modular RF probes

The R&S RT-ZM probe family features the MultiMode function which allows you to switch between single-ended, differential, and common mode measurements without reconnecting or resoldering the probe.

Four different input voltages can be measured with the MultiMode feature:

- **P-Mode**: (pos.) Single-ended input voltage (V_p)
  Voltage between the positive input terminal and ground
- **N-Mode**: (neg.) Single-ended input voltage (V_n)
  Voltage between the negative input terminal and ground
- **DM-Mode**: Differential mode input voltage (V_{dm})
  Voltage between the positive and negative input terminal
  $$V_{dm} = V_p - V_n$$
- **CM-Mode**: Common mode input voltage (V_{cm})
  Mean voltage between the positive and negative input terminal vs. ground
  $$V_{cm} = \frac{V_p + V_n}{2}$$

The R&S FSPN supports all probe modes.

Offset compensation

The R&S RT-ZM probes feature a comprehensive offset compensation function. The compensation of DC components directly at the probe tip even in front of the active probe amplifier is possible with an extremely wide compensation range of ±16 V (±24 V for P and N modes).

The offset compensation feature is available for every MultiMode setting:

MultiMode setting	Offset compensation	Offset compensation range	Application
DM-Mode	Differential DC voltage	±16 V	Probing single-ended signals, e.g. power rails with high DC component and small AC signal.
CM-Mode	Common mode DC voltage	±16 V	Measurements of signals with high common mode levels, e.g. current measurements with a shunt resistor.

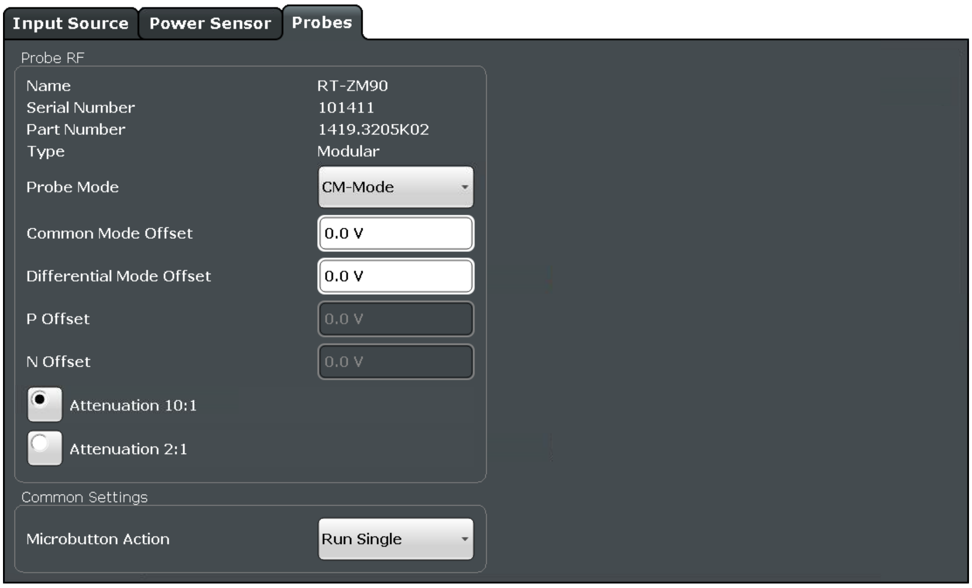
MultiMode setting	Offset compensation	Offset compensation range	Application
P-Mode	DC voltage at positive input terminal	±24 V	Measurement of single-ended AC signals with high superimposed DC component at the positive input terminal. **Note**: The maximum voltage difference between the positive and negative input terminals is 16 V.
N-Mode	DC voltage at negative input terminal	±24 V	Measurement of single ended AC signals with high superimposed DC component at the negative input terminal. **Note**: The maximum voltage difference between the positive and negative input terminals is 16 V.

If the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

Probe settings

Access: [INPUT / OUTPUT] > "Input Source Config" > "Probes"

Data input for the measurement can be provided by probes if the optional R&S RT-ZA9 adapter is used.



The detected type of probe, if any, is displayed.

For more information on using probes with an R&S FSPN, see "Using probes" on page 27.

For general information on the R&S®RT probes, see the device manuals.

Name
Probe name

Remote command:
`[SENSe:]PROBe<pb>:SETup:NAME?` on page 138

Serial Number
Serial number of the probe

Remote command:
`[SENSe:]PROBe<pb>:ID:SRNumber?` on page 136

Part Number
Rohde & Schwarz part number

Remote command:
`[SENSe:]PROBe<pb>:ID:PARTnumber?` on page 135

Type
Type of probe:

- Single-ended
- Differential
- Active Modular

Remote command:
`[SENSe:]PROBe<pb>:SETup:TYPE?` on page 140

Mode
Mode for multi-mode modular probes. Determines which voltage is measured.

"DM-mode"	Voltage between the positive and negative input terminal
"CM-mode"	Mean voltage between the positive and negative input terminal vs. ground
"P-mode"	Voltage between the positive input terminal and ground
"N-mode"	Voltage between the negative input terminal and ground

Remote command:
`[SENSe:]PROBe<pb>:SETup:PMODe` on page 138

Common Mode Offset / Diff. Mode Offset / P Offset / N Offset /
Sets the offset for the probe, depending on the used mode (CM and DM mode both use the "Common Mode Offset"). The setting is only available if a differential (R&S RT-ZD) or modular (R&S RT-ZM) probe is connected to the R&S FSPN.

If the probe is disconnected, the offset of the probe is reset to 0.0 V.

Note: If the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

Remote command:
`[SENSe:]PROBe<pb>:SETup:CMOFfset` on page 136
`[SENSe:]PROBe<pb>:SETup:DMOFfset` on page 137
`[SENSe:]PROBe<pb>:SETup:NMOFfset` on page 138
`[SENSe:]PROBe<pb>:SETup:PMOFfset` on page 139

Attenuation
Defines the attenuation applied to the input at the probe. This setting is only available for modular probes.

"10:1"	Attenuation by 20 dB
"2:1"	Attenuation by 6 dB

Remote command:
`[SENSe:]PROBe<pb>:SETup:ATTRatio` on page 136

Microbutton Action
Active Rohde & Schwarz probes (except for R&S RT-ZS10E) have a configurable microbutton on the probe head. By pressing this button, you can perform an action on the instrument directly from the probe.

Select the action that you want to start from the probe:

"Run Single"	Starts one data acquisition.
"No Action"	Prevents unwanted actions due to unintended usage of the microbutton.

Remote command:
`[SENSe:]PROBe<pb>:SETup:MODE` on page 137

4.3.2 Outputs

Access: "Overview" > "Output"

The output supported by the Spectrum Monitor are similar to those in the Phase Noise Spectrum applications.

For a comprehensive description on how to configure the DC Power sources and the Signal Source, refer to the documentation of the R&S FSPN.

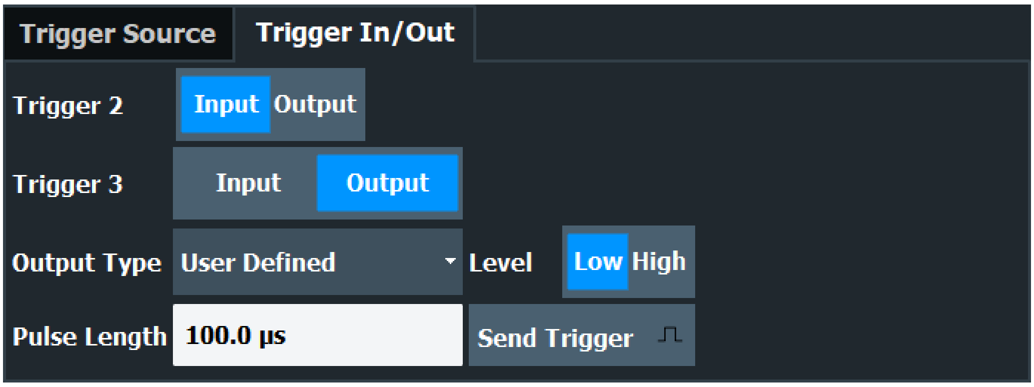
Noise Source Control
Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

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

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

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 140

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 FSPN. Trigger input parameters are available in the "Trigger" dialog box.

"Output" The R&S FSPN sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<tp>:DIRection` on page 155

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

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

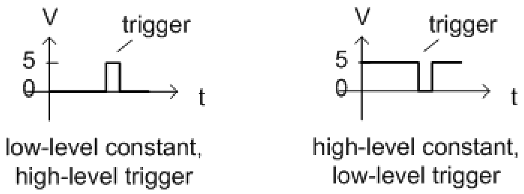
"Trigger Armed" — Sends a (high level) trigger when the R&S FSPN is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the "AUX" port (pin 9).

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

Remote command:
`OUTPut:TRIGger<tp>:OTYPe` on page 156

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:TRIGger<tp>:LEVel` on page 156

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:TRIGger<tp>:PULSe:LENGth` on page 157

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.

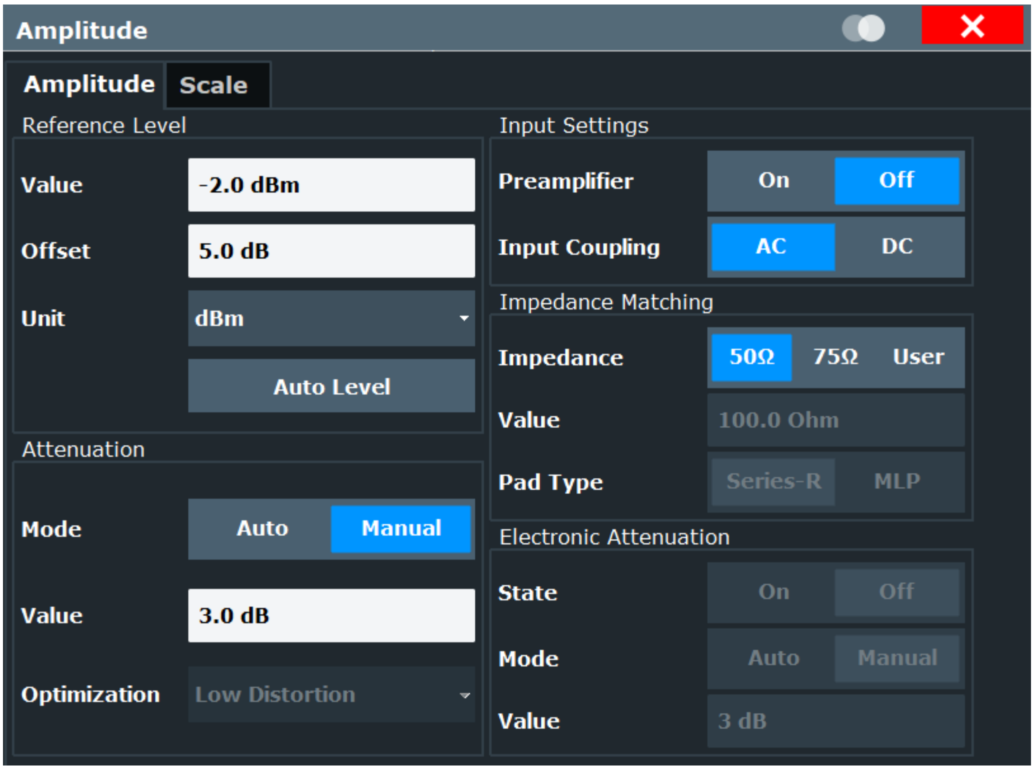
Remote command:
`OUTPut:TRIGger<tp>:PULSe:IMMediate` on page 156

4.4 Configuring the Amplitude

The amplitude is configured in the "Amplitude" dialog box.

4.4.1 Configuring Level Characteristics

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



The electronic attenuator and its settings are only available below 8 GHz.

The R&S FSPN50 features an additional mechanical attenuator.

See the R&S FSPN User Manual for further details.

Reference Level

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel`
on page 142

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 143

Unit ← Reference Level

The R&S FSPN measures the signal voltage at the RF input.

Remote command:
`INPut:IMPedance` on page 123
`CALCulate<n>:UNIT:POWer` on page 142

Attenuation Value

The RF attenuation can be set manually in 1 dB steps (down to 0 dB). Other entries are rounded to the next integer value. The range is specified in the data sheet. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "limit reached" is displayed.

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

Remote command:
`INPut:ATTenuation` on page 144

Optimization

Selects the priority for signal processing *after* the RF attenuation has been applied.

"Low distortion"
(Default:) Optimized for low distortion by avoiding intermodulation

"Low noise"	Optimized for high sensitivity and low noise levels If this setting is selected, "Low noise" is indicated in the channel information bar.

Remote command:
`INPut:ATTenuation:AUTO:MODE` on page 144

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

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

Note: In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation can provide a better signal-to-noise ratio, however.
When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation can be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

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

Remote command:
`INPut:EATT:STATe` on page 145
`INPut:EATT:AUTO` on page 145
`INPut:EATT` on page 145

Preamplifier
If the (optional) internal preamplifier hardware is installed on the R&S FSPN, a preamplifier can be activated for the RF input signal.

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

The input signal is amplified by 30 dB if the preamplifier option is activated.

Noise Cancellation
The R&S FSPN can correct the results by removing the inherent noise of the analyzer, which increases the dynamic range.

In this case, a reference measurement of the inherent noise of the analyzer is carried out. The measured noise power is then subtracted from the power in the channel that is being analyzed (first active trace only).

The inherent noise of the instrument depends on the selected center frequency, resolution bandwidth and level setting. Therefore, the correction function is disabled whenever one of these parameters is changed. A disable message is displayed on the screen. To enable the correction function after changing one of these settings, activate it again. A new reference measurement is carried out.

Noise cancellation is also available in zero span.

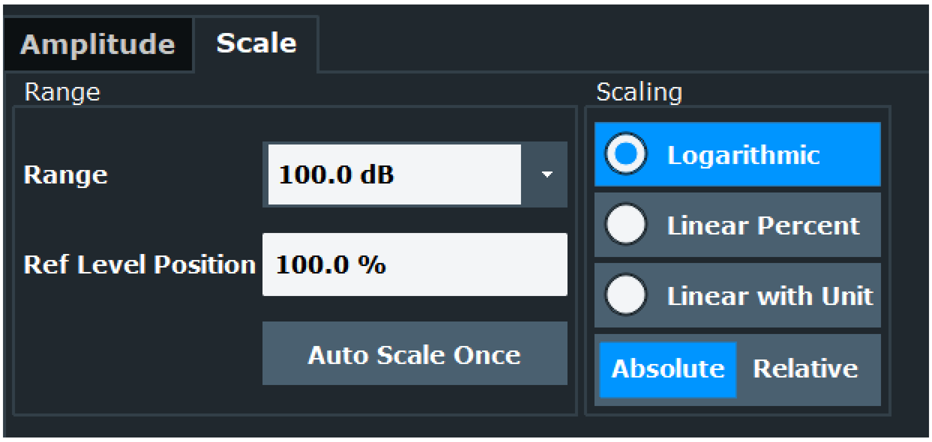
- RMS
- Average

- Sample
- Positive peak

Remote command:
[SENSe:]POWer:NCORrection on page 143

4.4.2 Scaling the Level Axis

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



Range

Defines the displayed y-axis range in dB.

The default value is 100 dB.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe] on page 147

Ref Level Position

Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %.

0 % corresponds to the lower and 100 % to the upper limit of the diagram.

Values from -120 % to +280 % are available.

Larger values are useful for small scales, such as a power range of 10 dB or 20 dB, and low signal levels, for example 60 dB below the reference level. In this case, large reference level position values allow you to see the trace again.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition on page 148

Auto Scale Once

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

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

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 147

Scaling

Defines the scaling method for the y-axis.

"Logarithmic"	Logarithmic scaling (only available for logarithmic units - dB..., and A, V, Watt)
"Linear with Unit"	Linear scaling in the unit of the measured signal
"Linear Percent"	Linear scaling in percentages from 0 to 100
"Absolute"	The labeling of the level lines refers to the absolute value of the reference level (not available for "Linear Percent")
"Relative"	The scaling is in dB, relative to the reference level (only available for logarithmic units - dB...). The upper line of the grid (reference level) is always at 0 dB.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing` on page 148
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE` on page 147

Y-Axis Max

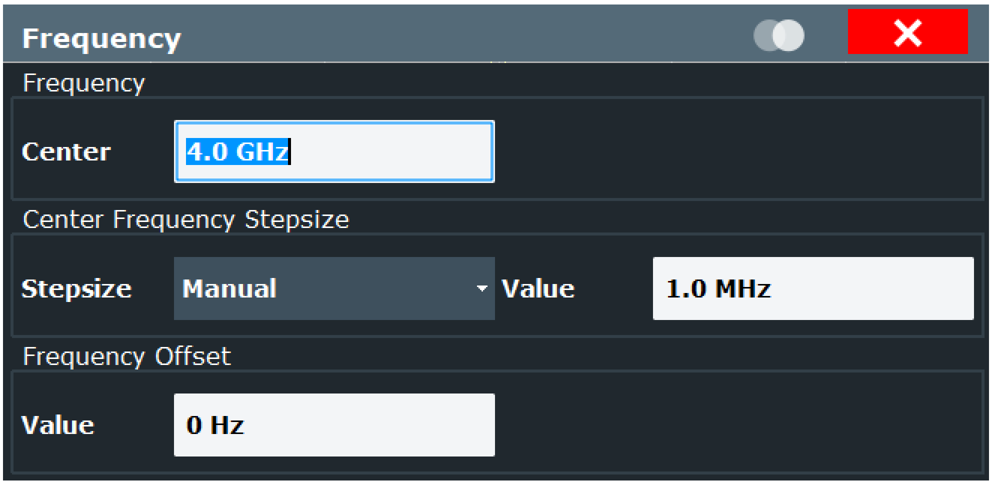
Defines the maximum value of the y-axis in the currently selected diagram in either direction (in Volts). Thus, the y-axis scale starts at -<Y-Axis Max> and ends at +<Y-Axis Max>.

This command is only available if the evaluation mode for the I/Q Analyzer is set to "I/Q-Vector" or "Real/Imag (I/Q)".

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 147

4.5 Configuring Frequency Characteristics

Access: "Overview" > "Frequency"



Center Frequency

Defines the center frequency of the signal in Hertz.

Remote command:

[SENSe:]FREQuency:CENTer on page 149

Center Frequency Stepsize

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

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

"= Center"	Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.
"Manual"	Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:

[SENSe:]FREQuency:CENTer:STEP on page 150

Frequency Offset

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

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

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

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

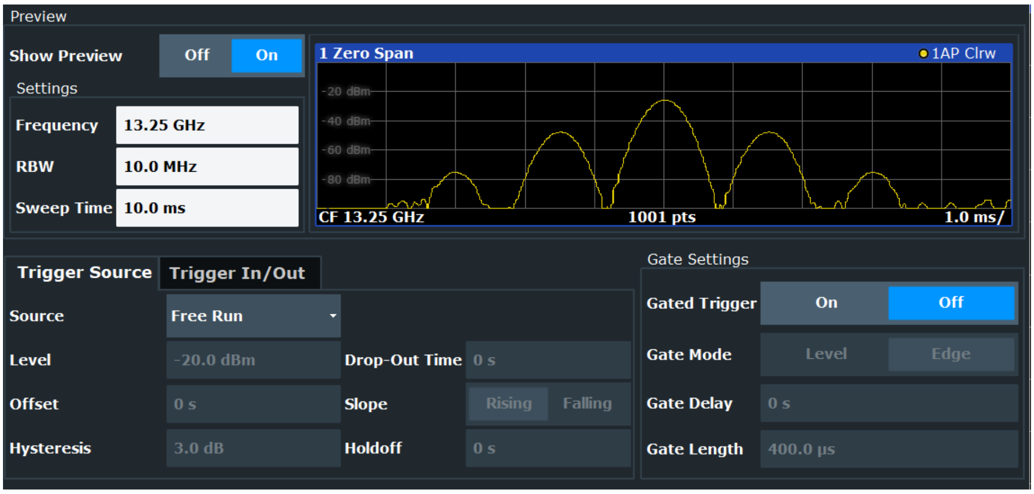
Remote command:
[SENSe:]FREQuency:OFFSet on page 150

4.6 Configuring Triggered Measurements

Access (trigger source): "Overview" > "Trigger / Gate" > "Trigger Source"

Access (trigger connectors): "Overview" > "Trigger / Gate" > "Trigger In / Out"

Trigger settings determine when the input signal is measured.



Trigger Source

Selects 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 154

Free Run ← Trigger Source

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

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 154

Ext. Trigger 1/2 ← Trigger Source

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

Note: "External Trigger 1" automatically selects the trigger signal from the "Trigger Input / Output" connector on the front panel.
In the I/Q Analyzer application, only "External Trigger 1" is supported.

For details, see the "Instrument Tour" chapter in the R&S FSPN 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.
Note: Connector must be configured for "Input" in the "Output" configuration
(See the R&S FSPN base unit user manual).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
See `TRIGger[:SEQuence]:SOURce` on page 154

IF Power ← Trigger Source

The R&S FSPN starts capturing data as soon as the trigger level is exceeded around the third intermediate frequency.

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

For measurements on a fixed frequency (e.g. zero span or I/Q measurements), the third IF represents the center frequency.

This trigger source is only available for RF input.

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

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 154

I/Q Power ← Trigger Source

This trigger source is only available in the I/Q Analyzer application and in applications that process I/Q data.

Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

The trigger bandwidth corresponds to the bandwidth setting for I/Q data acquisition.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 154

RF Power ← 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 specifications document.

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

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

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 154

Trigger Level

Defines the trigger level for the specified trigger source.

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

For time triggers, the repetition interval is defined. See "Repetition Interval" on page 43.

Remote command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 153
`TRIGger[:SEQuence]:LEVel:IQPower` on page 153

Repetition Interval

Defines the repetition interval for a time trigger.

The shortest interval is 2 ms.

Set the repetition interval to the exact pulse period, burst length, frame length or other repetitive signal characteristic. If the required interval cannot be set with the available granularity, configure a multiple of the interval that can be set. Thus, the trigger remains synchronized to the signal.

Remote command:
`TRIGger[:SEQuence]:TIME:RINTerval` on page 155

Trigger Offset

Defines the time offset between the trigger event and the start of the measurement.

Offset > 0:	Start of the measurement is delayed
Offset < 0:	Measurement starts earlier (pretrigger) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the measurement time: $Pretrigger_{max}$ = measurement $time_{max}$

Tip: To determine the trigger point in the sample (for "External" or "IF Power" trigger source), use the `TRACe:IQ:TPISample?` command.

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 151

Hysteresis
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.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 152

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

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 151

Trigger Holdoff
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 152

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

For gated measurements in "Edge" mode, the slope also defines whether the gate starts on a falling or rising edge.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 154

4.7 Data Acquisition and Bandwidth Settings

Access: "Overview" > "Bandwidth"

4.7.1 Data Acquisition

Access: "Overview" > "Bandwidth" > "Data Acquisition" tab

The data acquisition settings define which parts of the input signal are captured for further evaluation in the applications.

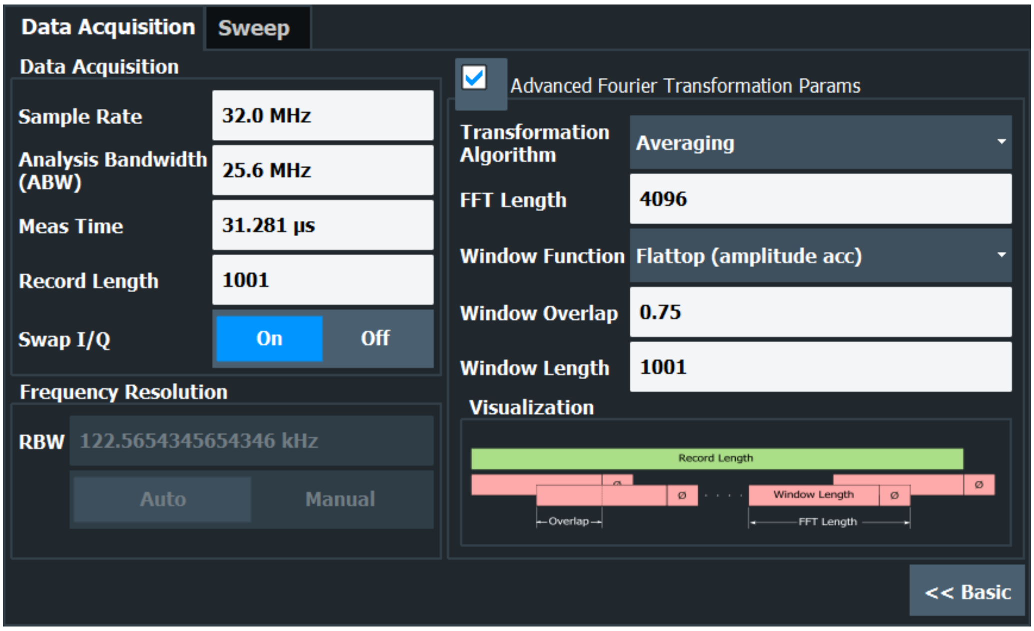


Figure 4-2: Data acquisition settings with advanced FFT parameters

Sample Rate

Defines the I/Q data sample rate of the R&S FSPN. This value depends on the defined Analysis Bandwidth.

Note: The Spectrum Monitor is limited to a maximum sample rate of 25 MHz.

The following rule applies:

sample rate = analysis bandwidth / 0.8

Remote command:
`TRACe:IQ:SRATe` on page 163

Analysis Bandwidth

Defines the flat, usable bandwidth of the final I/Q data. This value depends on the defined Sample Rate.

*analysis bandwidth = 0.8 * sample rate*

Remote command:
`TRACe:IQ:BWIDth` on page 161

Maximum Bandwidth

Defines the maximum bandwidth to be used by the R&S FSPN for I/Q data acquisition. Which options are available depends on which bandwidth extension options are installed.

"Auto" (Default:) All installed bandwidth extension options are enabled. The currently available maximum bandwidth is allowed.

Remote command:
`TRACe:IQ:WBANd[:STATe]` on page 164
`TRACe:IQ:WBANd:MBWidth` on page 163

200 MHz Filter

Activates a 200 MHz filter before the A/D converter, thus restricting the processed bandwidth to 200 MHz while using the wideband processing path in the R&S FSPN.

This is useful for signals that have a bandwidth of approximately 200 MHz (for example Docsis 3.1). In this case, the R&S FSPN can optimize signal processing for the relevant signal and filter out unwanted signal parts from adjacent channels, while taking advantage of a higher sample rate.

If the filter is active, "200 MHz" is indicated in the channel information bar.

Remote command:
`TRACe:IQ:WFILter` on page 164

Meas Time

Defines the I/Q acquisition time. By default, the measurement time is calculated as the number of I/Q samples ("Record Length") divided by the sample rate. If you change the measurement time, the Record Length is automatically changed, as well.

Remote command:
`[SENSe:]SWEep:TIME` on page 110

Record Length

Defines the number of I/Q samples to record. By default, the number of measurement points is used. The record length is calculated as the measurement time multiplied by the sample rate. If you change the record length, the Meas Time is automatically changed, as well.

Note: For the I/Q vector result display, the number of I/Q samples to record ("Record Length") must be identical to the number of trace points to be displayed ("Sweep Points"). Thus, the measurement points are not editable for this result display. If the "Record Length" is edited, the measurement points are adapted automatically.

Remote command:
`TRACe:IQ:RLENgth` on page 161
`TRACe:IQ:SET` on page 161

Swap I/Q
Activates or deactivates the inverted I/Q modulation. If the I and Q parts of the signal from the DUT are interchanged, the R&S FSPN can do the same to compensate for it.

On	I and Q signals are interchanged Inverted sideband, Q+j*I
Off	I and Q signals are not interchanged Normal sideband, I+j*Q

Remote command:
`[SENSe:]SWAPiq` on page 160

RBW
Defines the resolution bandwidth for Spectrum results. The available RBW values depend on the sample rate and record length.

Depending on the selected RBW mode, the value is either determined automatically or can be defined manually. As soon as you enter a value in the input field, the RBW mode is changed to "Manual".

If the "Advanced Fourier Transformation Params" option is enabled, advanced FFT mode is selected and the RBW cannot be defined directly.

"Auto mode" (Default) The RBW is determined automatically depending on the Sample Rate and Record Length.

"Manual mode" The RBW can be defined by the user.

"Advanced FFT mode" This mode is used if the "Advanced Fourier Transformation Params" option is enabled.
The RBW is determined by the advanced FFT parameters.

Remote command:
`[SENSe:]IQ:BWIDth:MODE` on page 157
`[SENSe:]IQ:BWIDth:RESolution` on page 158

Advanced FFT mode / Basic Settings
Shows or hides the "Advanced Fourier Transformation" parameters in the "Data Acquisition" dialog box.

Note that if the advanced FFT mode is used, the RBW settings are not available.

Transformation Algorithm ← Advanced FFT mode / Basic Settings
Defines the FFT calculation method.

"Single" One FFT is calculated for the entire record length; if the FFT Length is larger than the record length, zeros are appended to the captured data.

"Averaging" Several overlapping FFTs are calculated for each record; the results are combined to determine the final FFT result for the record. The number of FFTs to be averaged is determined by the Window Overlap and the Window Length.

Remote command:
`[SENSe:]IQ:FFT:ALGorithm` on page 158

FFT Length ← Advanced FFT mode / Basic Settings
Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

Note: If you enter the value manually, any integer value from 3 to 524288 is available.

Remote command:
`[SENSe:]IQ:FFT:LENGth` on page 159

Window Function ← Advanced FFT mode / Basic Settings
In the I/Q analyzer you can select one of several FFT window types.

The following window types are available:
- Blackman-Harris
- Flattop
- Gauss
- Rectangular
- 5-Term

Remote command:
`[SENSe:]IQ:FFT:WINDow:TYPE` on page 160

Window Overlap ← Advanced FFT mode / Basic Settings
Defines the part of a single FFT window that is re-calculated by the next FFT calculation when using multiple FFT windows.

Remote command:
`[SENSe:]IQ:FFT:WINDow:OVERlap` on page 159

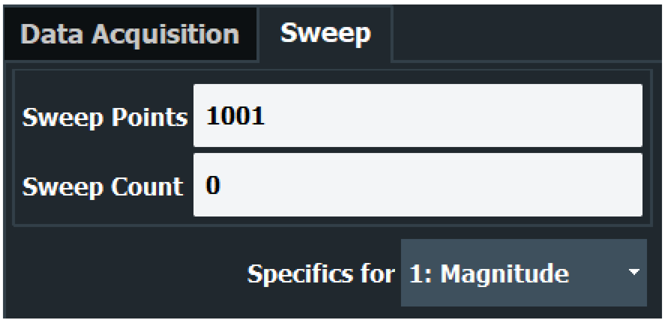
Window Length ← Advanced FFT mode / Basic Settings
Defines the number of samples to be included in a single FFT window in averaging mode. (In single mode, the window length corresponds to the "Record Length" on page 46.)

However, the window length may not be longer than the FFT Length.

Remote command:
`[SENSe:]IQ:FFT:WINDow:LENGth` on page 159

4.7.2 Sweep Settings

Access: "Overview" > "Bandwidth" > "Sweep" tab



Sweep Points

In the I/Q Analyzer application, a specific frequency bandwidth is swept for a specified measurement time. During this time, a defined number of samples (= "Record Length") are captured. These samples are then evaluated by the applications. Therefore, in this case the number of sweep points does not define the amount of data to be acquired, but rather the number of trace points that are evaluated and displayed in the result diagrams.

Remote command:
`[SENSe:]SWEep[:WINDow<n>]:POINts` on page 110

Sweep/Average Count

Defines the number of measurements to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one measurement is performed.

The sweep count is applied to all the traces in all diagrams.

If the trace modes "Average", "Max Hold" or "Min Hold" are set, this value also determines the number of averaging or maximum search procedures.

In continuous sweep mode, if "Sweep Count" = 0 (default), averaging is performed over 10 measurements. For "Sweep Count" =1, no averaging, maxhold or minhold operations are performed.

Remote command:
`[SENSe:]SWEep:COUNt` on page 109

Continuous Sweep / Run Cont

After triggering, starts the sweep and repeats it continuously until stopped. This is the default setting.

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

Remote command:
`INITiate<n>:CONTinuous` on page 106

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

Remote command:
`INITiate<n>[:IMMediate]` on page 106

Continue Single Sweep
After triggering, repeats the number of sweeps set in "Sweep Count", without deleting the trace of the last measurement.

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

Remote command:
`INITiate<n>:CONMeas` on page 105

4.8 Display Configuration

Access: "Overview" > "Display Config"

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

4.9 Transducer

4.9.1 Basics on transducer factors

The transducer allows you to manipulate the trace at discrete trace points to correct the signal coming from an input device. Transducers are often used to correct the frequency response for antennas, for example. The transducer is configured by defining transducer factors for specific trace points. A set of transducer factors defines an interpolated transducer line and can be stored on the instrument.

In the Spectrum application, the correction factor from all active transducers is calculated for each displayed trace point once in advance and is added to the result of the level measurement during the sweep. If the sweep range changes, the correction values are calculated again. If several measured values are combined in one point, only one value is taken into consideration. If the active transducer line is not defined for the entire sweep range, the missing values are replaced by zeroes.

When a transducer is used, the trace is shifted by a calculated factor. However, an upward shift reduces the dynamic range for the displayed values. Thus, the reference level can be adapted automatically to restore the original dynamic range. The reference level is shifted by the maximum transducer factor. By default, if transducers are active the reference level function is adapted automatically to obtain the best dynamic performance.

If a transducer factor is active, "TDF" is displayed in the channel bar.

Y-Axis Unit

The individual transducer factors can be defined as absolute values or relative (dB) values. However, all factors for one transducer line use the same unit. As soon as a transducer is activated, the unit of the transducer is automatically used for all the level settings and outputs. The unit cannot be changed in the amplitude settings since the R&S FSPN and the active transducer are regarded as one measuring instrument. Only for relative transducer factors (unit dB), the unit originally set on the instrument is maintained and can be changed.

When all transducers have been switched off, the R&S FSPN returns to the unit that was used before a transducer was activated.

Configuration

The R&S FSPN supports transducer lines with a maximum of 1001 data points. Eight of the transducer lines stored in the instrument can be activated simultaneously. The number of transducer lines stored in the instrument is only limited by the capacity of the storage device used.

A transducer line consists of the following data:

- A maximum of 1001 data points with a position and value
- A unit for the values
- A name to distinguish the transducer lines

Validity

The transducer factors must comply with the following rules to ensure correct operation:

- The frequencies for the data points must always be defined in ascending order. Otherwise the entry will not be accepted and an error message is displayed.
- The frequencies of the data points may exceed the valid frequency range of the R&S FSPN since only the set frequency range is taken into account for measurements. The minimum frequency of a data point is 0 Hz, the maximum frequency 200 GHz.
- The value range for the transducer factor is ±200 dB.
- Gain has to be entered as a negative value, and attenuation as a positive value.

Storing transducer factors

4.9.2 Transducer settings

Access: [Setup] > "Transducer"

Up to 8 transducer lines can be activated simultaneously in the R&S FSPN. Many more can be stored on the instrument.

Stored transducer settings

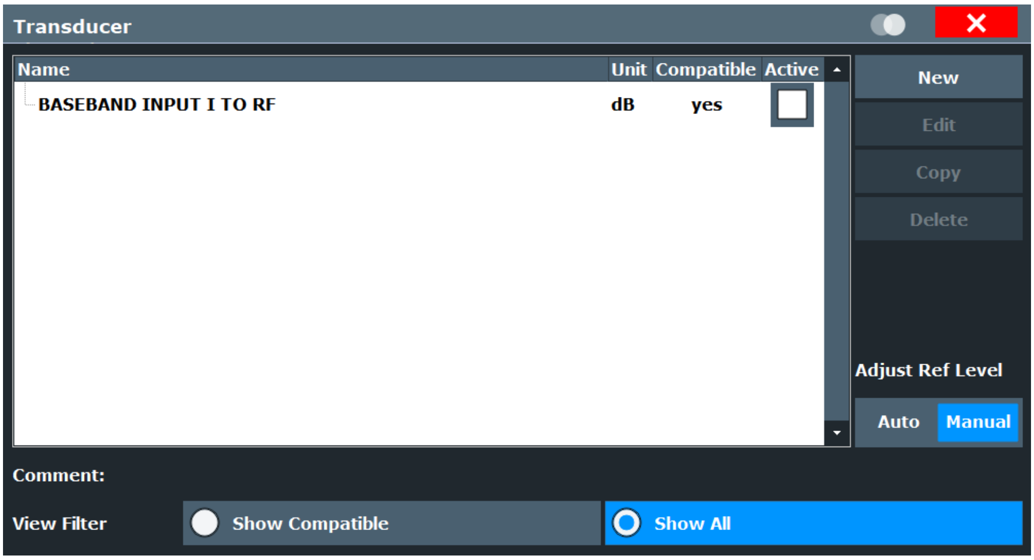
If a transducer file was in use when the save set was stored (with the save item "Current Settings" only) the R&S FSPN assumes that these transducer values should remain valid after every recall of that save set. Thus, even if the transducer file is changed and the original save set file is recalled later, the *originally stored* transducer values are recalled and applied to the measurement. In the "Edit" transducer dialog box, however, the *changed* transducer file values are displayed, as no updated transducer file was loaded.

For more information see the R&S FSPN user manual.

4.9.2.1 Transducer management

Access: [Setup] > "Transducer"

The settings required to manage all transducer lines on the instrument are described here.



For the transducer line overview, the R&S FSPN searches for all stored transducer lines with the file extension `.TDF` in the

C:\Program Files (x86)\Rohde-Schwarz\FSPN\<version>\trd directory.
The overview allows you to determine which transducer lines are available and can be used for the current measurement.

For details on settings for individual lines see Chapter 4.9.2.2, "Transducer factors", on page 54.

For instructions on configuring and working with transducers see Chapter 4.9.3, "How to configure the transducer", on page 57.

Name
The name of the stored transducer line.

Unit
The unit in which the y-values of the data points of the transducer line are defined.

The following units are available:
- dB
- dBm
- dBmV
- dBµV
- dBµV/m
- dBµA
- dBµA/m
- dBpW
- dBpT

Compatibility
Indicates whether the transducer factors are compatible with the current measurement settings.

For more information on which conditions a transducer line must fulfill to be compatible, see Chapter 4.9.1, "Basics on transducer factors", on page 50.

Activating / Deactivating
Activates/deactivates the transducer line. Up to 8 transducer lines can be active at the same time.

Remote command:
[SENSe:]CORRection:TRANsducer:SELect on page 174
[SENSe:]CORRection:TRANsducer[:STATe] on page 175

Comment
An optional description of the transducer line.

Included Transducer Lines in Overview (View Filter)
Defines which of the stored transducer lines are included in the overview. The view can be restricted to compatible transducer lines only or include all transducer lines found. Whether a line is compatible or not is indicated in the Compatibility setting.

Adjust Ref Level
Activates or deactivates the automatic adjustment of the reference level to the selected transducer factor.

"Auto" Activates the automatic adjustment. The original dynamic range is restored by shifting the reference level by the maximum transducer factor.

"Manual" Deactivates the automatic adjustment. Adjust the reference level via the "Amplitude" menu.

Remote command:
`[SENSe:]CORRection:TRANsducer:ADJust:RLEVel[:STATe]` on page 173

Create New Line
Create a new transducer line.

Remote command:
`[SENSe:]CORRection:TRANsducer:SELect` on page 174

Edit Line
Edit an existing transducer line configuration.

Copy Line
Copy the selected transducer line configuration to create a new line.

Delete Line
Delete the selected transducer line.

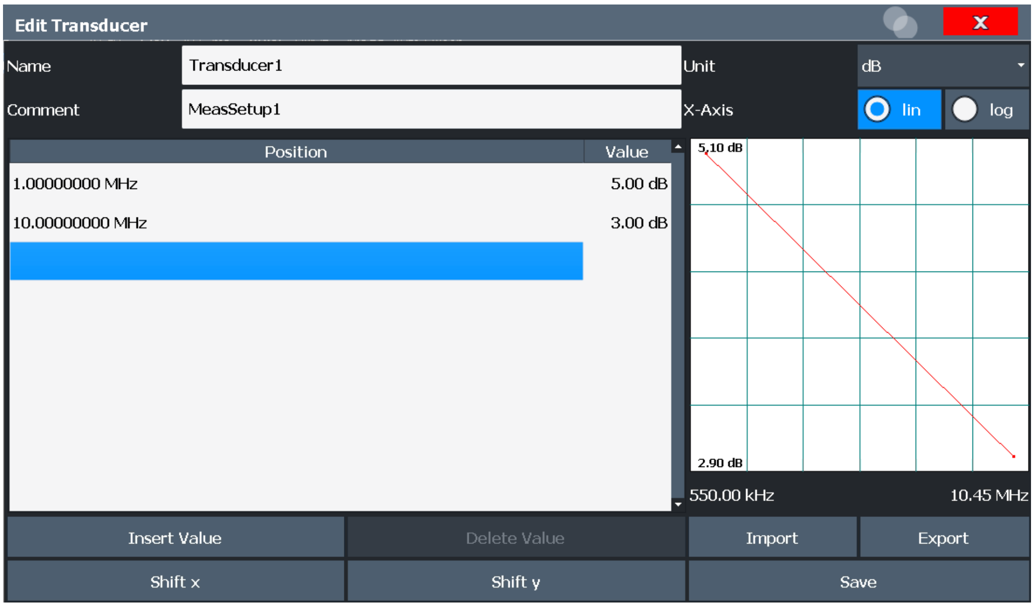
Remote command:
`[SENSe:]CORRection:TRANsducer:DELete` on page 174

4.9.2.2 Transducer factors

Access: [Setup] > "Transducer" > "Edit Line" / "Copy Line" / "New Line"

The settings and functions available for individual transducer lines are described here.

For instructions on creating and editing transducer lines see Chapter 4.9.3, "How to configure the transducer", on page 57.



Name

Defines the transducer line name. All names must be compatible with the Microsoft Windows conventions for file names. The transducer data is stored under this name (with a `.TDF` extension) in the `C:\Program Files (x86)\Rohde-Schwarz\FSPN\<version>\trd` directory.

Remote command:
`[SENSe:]CORRection:TRANsducer:SELect` on page 174

Comment

Defines an optional comment for the transducer line. The text may contain up to 40 characters.

Remote command:
`[SENSe:]CORRection:TRANsducer:COMMent` on page 173

Unit
The unit in which the y-values of the data points of the transducer line are defined.

As soon as a transducer is activated, the unit of the transducer is automatically used for all the level settings and outputs. The unit cannot be changed in the amplitude settings unless dB is used.

Remote command:
`[SENSe:]CORRection:TRANsducer:UNIT` on page 175

X-Axis Scaling
Describes the scaling of the horizontal axis on which the data points of the transducer line are defined. Scaling can be linear or logarithmic.

Remote command:
`[SENSe:]CORRection:TRANsducer:SCALing` on page 174

Data Points
Each transducer line is defined by a minimum of 2 and a maximum of 1001 data points. Each data point is defined by its position (x-axis) and value (y-value).

The data points must comply with the following rules to ensure correct operation:

- The frequencies for the data points must always be defined in ascending order. Otherwise the entry will not be accepted and the an error message is displayed.
- The frequencies of the data points may exceed the valid frequency range of the R&S FSPN since only the set frequency range is taken into account for measurements. The minimum frequency of a data point is 0 Hz, the maximum frequency 200 GHz.
- The value range for the transducer factor is ±200 dB.
- Gain has to be entered as a negative value, and attenuation as a positive value.

Remote command:
`[SENSe:]CORRection:TRANsducer:DATA` on page 174

Insert Value
Inserts a data point in the transducer line above the selected one in the "Edit Transducer" dialog box.

Delete Value
Deletes the selected data point in the "Edit Transducer" dialog box.

Shift x
Shifts the x-value of each data point horizontally by the defined shift width.

Shift y
Shifts the y-value of each data point vertically by the defined shift width.

Save
Saves the currently edited transducer line under the name defined in the "Name" field.

Remote command:
`MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 172

Import
Opens a file selection dialog box and loads the transducer factor from the selected file in `.CSV` format.

Note that a valid import file must contain a minimum of required information for the R&S FSPN. For details on the file format see Chapter 4.9.4, "Reference: transducer factor file format", on page 60.

Remote command:
`MMEMory:LOAD<n>:TFACtor` on page 172

File Explorer ← Import
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

Export
Opens a file selection dialog box and stores the currently displayed transducer factor to the defined file in `.CSV` format.

For details on the file format see Chapter 4.9.4, "Reference: transducer factor file format", on page 60.

The transducer factor can be imported again later by the R&S FSPN for use in other measurements.

Remote command:
`MMEMory:STORe<n>:TFACtor` on page 173

File Explorer ← Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

4.9.3 How to configure the transducer

Configuring the transducer is very similar to configuring transducer factors.

The transducer settings are defined in the "Transducer" dialog box which is displayed when you press [Setup] and then select "Transducer".

The following tasks are described:

- "How to find compatible transducer lines" on page 58
- "How to activate and deactivate a transducer" on page 58
- "How to edit existing transducer lines" on page 58
- "How to copy an existing transducer line" on page 58
- "How to delete an existing transducer line" on page 59
- "How to configure a new transducer line" on page 59
- "How to move the transducer line vertically or horizontally" on page 59

How to find compatible transducer lines

► In the "Transducer" dialog box, select the "View Filter" option: "Show Compatible".

All transducer lines stored on the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a transducer

1. To activate a transducer select a transducer line in the overview and select the "Active" setting for it.

   The trace is automatically recalculated for the next sweep after a transducer line is activated.

2. To deactivate a transducer line, deactivate the "Active" setting for it.

   After the next sweep, the originally measured values are displayed.

How to edit existing transducer lines

Existing transducer line configurations can be edited.

1. In the "Transducer" dialog box, select the transducer line.
2. Select "Edit".
3. Edit the line configuration as described in "How to configure a new transducer line" on page 59.
4. Save the new configuration by selecting "Save".

   The trace is automatically recalculated for the next sweep if the transducer line is active.

In order to store the changes to the transducer lines in a settings file, select the "Save" icon in the toolbar.

How to copy an existing transducer line

1. In the "Transducer" dialog box, select the transducer line.
2. Select "Copy".

   The "Edit Transducer" dialog box is opened with the configuration of the selected transducer.

3. Define a new name to create a new transducer with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new transducer line" on page 59.
5. Save the new configuration by selecting "Save".

   The new transducer line is displayed in the overview and can be activated.

How to delete an existing transducer line

1. In the "Transducer" dialog box, select the transducer line.
2. Select "Delete".
3. Confirm the message.

   The transducer line is deleted. After the next sweep, the originally measured values are displayed.

How to configure a new transducer line

1. In the "Transducer" dialog box, select "New".

   The "Edit Transducer" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.
2. Define a "Name" and, optionally, a "Comment" for the new transducer line.
3. Define the scaling for the x-axis.
4. Define the data points: minimum 2, maximum 1001:
   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.
   d) Repeat this to insert all other data points.
   To insert a data point before an existing one, select the data point and then "Insert Value".
   To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
   To delete a data point, select the entry and then "Delete Value".
5. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
   If necessary, shift the entire line vertically or horizontally by selecting "Shift x" or "Shift y" and defining the shift width.
6. Save the new configuration by selecting "Save".

   The new transducer line is displayed in the overview and can be activated.

How to move the transducer line vertically or horizontally

A configured transducer line can easily be moved vertically or horizontally. Thus, a new transducer line can be easily generated based upon an existing transducer line which has been shifted.

1. In the "Line Config" dialog box, select the transducer line.
2. Select "Edit".
3. In the "Edit Transducer Line" dialog box, select "Shift x" or "Shift y" and define the shift width.

4. Save the shifted data points by selecting "Save".

   If activated, the trace is recalculated after the next sweep.

4.9.4 Reference: transducer factor file format

Transducer factor data can be exported to a file in ASCII (CSV) format for further evaluation in other applications. Transducer factors stored in the specified ASCII (CSV) format can also be imported to the R&S FSPN for other measurements.

This reference describes in detail the format of the export/import files for transducer factors. Note that the **bold** data is **mandatory**, all other data is optional.

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 (see "Decimal Separator" on page 64).

Table 4-1: ASCII file format for transducer factor files

File contents	Description
Header data	
sep=;	Separator for individual values (required by Microsoft Excel, for example)
Type;RS_TransducerFactor;	Type of data
FileFormatVersion;1.00;	File format version
Date;01.Oct 2006;	Date of data set storage
OptionID;SpectrumAnalyzer	Application the transducer factor was created for
Name;TestTDF1	Transducer factor name
Comment;Transducer for device A	Description of transducer factor
XAxisScaling;LINEAR	Scaling of x-axis linear (LIN) or logarithmic (LOG)
YAxisUnit;LEVEL_DB	Unit of y values
YAxisScaleMode;ABSOLUTE	Scaling of y-axis (absolute or relative)
NoOfPoints;5	Number of points the line is defined by
Data section for individual data points	
100000000;-50.000000	**x- and y-values of each data point defining the line**
500000000;-30.000000	
1000000000;0.000000	
1500000000;-30.000000	
2500000000;-50.000000	

5 Analysis

General result analysis settings concerning the trace, markers, lines etc. can be configured via the "Analysis" button in the "Overview".

For more information, refer to the R&S FSPN User Manual.

Window-specific configuration

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

5.1 Configuring Standard Traces

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

You can configure the settings for up to 6 individual traces.

Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6

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

Remote command:
Selected via numeric suffix of:`TRACe<1...6>` commands
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe]` on page 179

Trace Mode

Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each measurement.
All available detectors can be selected.

"Max Hold"	The maximum value is determined over several measurements and displayed. The R&S FSPN saves the measurement result in the trace memory only if the new value is greater than the previous one. This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each measurement until all signal components are detected in a kind of envelope. This mode is not available for statistics measurements.
"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S FSPN saves the measurement result in the trace memory only if the new value is lower than the previous one. This mode is useful for example for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed, whereas a CW signal is recognized by its constant level. This mode is not available for statistics measurements.
"Average"	The average is formed over several measurements. This mode is not available for statistics measurements.
"View"	The current contents of the trace memory are frozen and displayed. **Note:** If a trace is frozen, you can change the measurement settings, apart from scaling settings, without impact on the displayed trace. The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk on the tab label. If you change any parameters that affect the scaling of the diagram axes, the R&S FSPN automatically adapts the trace data to the changed display range. Thus, you can zoom into the diagram after the measurement to show details of the trace.
"Blank"	Removes the selected trace from the display.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE on page 177

Detector

Defines the trace detector to be used for trace analysis.

The trace detector is used to combine multiple FFT window results to create the final spectrum. (Note: in previous versions of the R&S FSPN, the I/Q Analyzer always used the linear average detector.) If necessary, the trace detector is also used to reduce the number of calculated frequency points (defined by the FFT length) to the defined number of measurement points. By default, the Autopeak trace detector is used.

"Auto"	(default:) Selects the optimum detector for the selected trace and filter mode
"Type"	Defines the selected detector type.

Remote command:
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] on page 176
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO on page 176

Hold
If activated, traces in "Min Hold", "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous` on page 178

Smoothing
If enabled, the trace is smoothed by the specified value (between 1 % and 50 %). The smoothing value is defined as a percentage of the display width. The larger the smoothing value, the greater the smoothing effect.

For more information, see the R&S FSPN User Manual.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing[:STATe]` on page 179
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing:APERture` on page 177

Average Mode
Defines the mode with which the trace is averaged over several measurements.

This setting is generally applicable if trace mode "Average" is selected.

(See the chapter on ACLR power measurements in the R&S FSPN User Manual.)

"Linear"	The power level values are converted into linear units before averaging. After the averaging, the data is converted back into its original unit.
"Logarithmic"	For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.
"Power"	Activates linear power averaging. The power level values are converted into unit Watt before averaging. After the averaging, the data is converted back into its original unit.

Remote command:
`[SENSe:]AVERage<n>:TYPE` on page 180

Average Count
Determines the number of averaging or maximum search procedures If the trace modes "Average", "Max Hold" or "Min Hold" are set.

In continuous measurement mode, if sweep count = 0 (default), averaging is performed over 10 measurements. For sweep count =1, no averaging, Max Hold or Min Hold operations are performed.

Remote command:
[SENSe:]AVERage<n>:COUNt on page 180
TRACe:IQ:AVERage:COUNt on page 108

Predefined Trace Settings - Quick Config

Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

<table>
<tr><th>Function</th><th colspan="2">Trace Settings</th></tr>
<tr><td rowspan="2">Preset All Traces</td><td>Trace 1:</td><td>Clear Write</td></tr>
<tr><td>Traces 2-6:</td><td>Blank</td></tr>
<tr><td rowspan="4">Set Trace Mode
Max | Avg | Min</td><td>Trace 1:</td><td>Max Hold</td></tr>
<tr><td>Trace 2:</td><td>Average</td></tr>
<tr><td>Trace 3:</td><td>Min Hold</td></tr>
<tr><td>Traces 4-6:</td><td>Blank</td></tr>
<tr><td rowspan="4">Set Trace Mode
Max | ClrWrite | Min</td><td>Trace 1:</td><td>Max Hold</td></tr>
<tr><td>Trace 2:</td><td>Clear Write</td></tr>
<tr><td>Trace 3:</td><td>Min Hold</td></tr>
<tr><td>Traces 4-6:</td><td>Blank</td></tr>
</table>

Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)

Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] on page 179

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 115

X-Value Distribution

Defines how the x-values of the trace are determined in the frequency domain.

"Bin-Centered" The full measurement span is divided by the number of measurement points to obtain *bin*s. The x-value of the measurement point is defined as the x-value at the center of the bin (bin/2).

"Start/Stop" (Default): The x-value of the first measurement point corresponds to the starting point of the full measurement span. The x-value of the last measurement point corresponds to the end point of the full measurement span. All other measurement points are divided evenly between the first and last points.

Remote command:
FORMat:DEXPort:XDIStrib on page 182

5.2 Configuring spectrograms

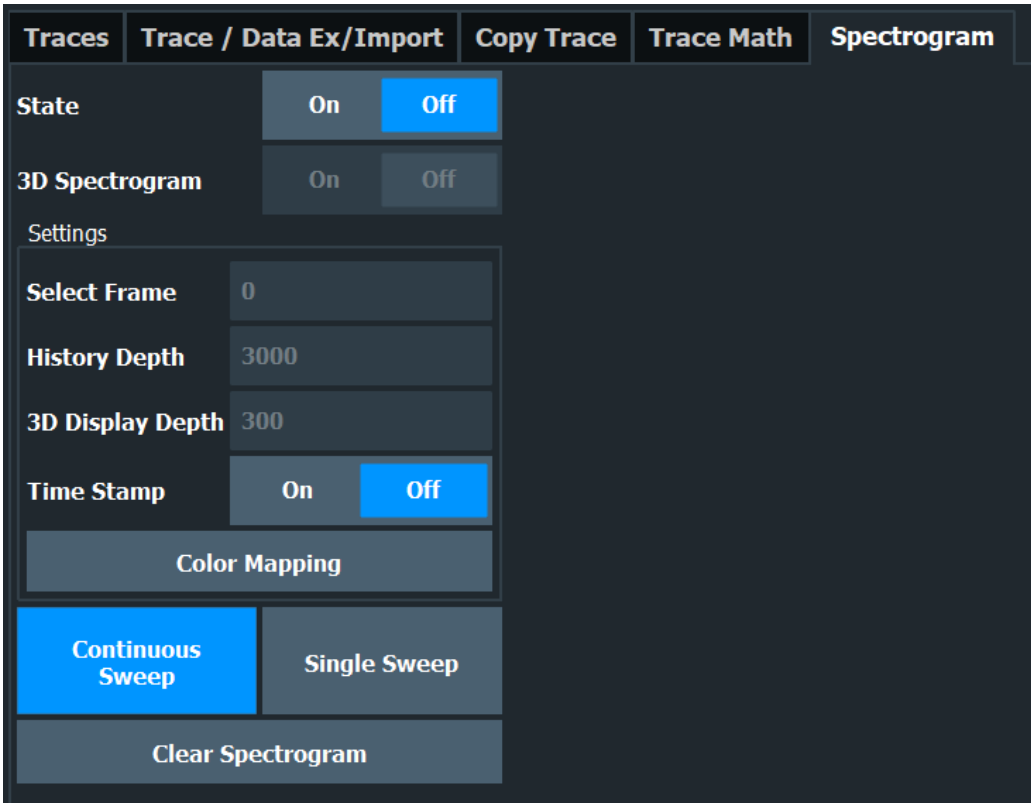
Access: "Overview" > "Analysis" > "Traces" > "Spectrogram"

The individual settings available for spectrogram display are described here. For settings on color mapping, see Chapter 5.2.2, "Color map settings", on page 67.

5.2.1 General spectrogram settings

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

This section describes general settings for spectrogram display. They are available when you press the [Trace] key and then select the "Spectrogram Config" softkey.



State
Activates and deactivates a Spectrogram subwindow.

"Split" Displays the Spectrogram as a subwindow in the original result display.

"Full" Displays the Spectrogram in a subwindow in the full size of the original result display.

"Off" Closes the Spectrogram subwindow.

Remote command:
`CALCulate<n>:SPECtrogram:LAYout` on page 185

3D Spectrogram State
Activates and deactivates a 3-dimensional spectrogram. As opposed to the common 2-dimensional spectrogram, the power is not only indicated by a color mapping, but also in a third dimension, the z-axis.

For details see the R&S FSPN User Manual.

Remote command:
`CALCulate<n>:SPECtrogram:THReedim[:STATe]` on page 186

Select Frame
Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

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

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

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

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 184

History Depth
Sets the number of frames that the R&S FSPN stores in its memory.

For an overview of the maximum number of frames depending on the number of sweep points, see the R&S FSPN User Manual.

If the memory is full, the R&S FSPN deletes the oldest frames stored in the memory and replaces them with the new data.

Remote command:
`CALCulate<n>:SPECtrogram:HDEPth` on page 185

3-D Display Depth
Defines the number of frames displayed in a 3-dimensional spectrogram.

For details see the R&S FSPN User Manual.

Time Stamp
Activates and deactivates the timestamp. The timestamp shows the system time while the measurement is running. In single sweep mode or if the measurement is stopped, the timestamp shows the time and date of the end of the measurement.

When active, the timestamp replaces the display of the frame number.

Remote command:
`CALCulate<n>:SPECtrogram:TSTamp[:STATe]` on page 187
`CALCulate<n>:SPECtrogram:TSTamp:DATA?` on page 186

Color Mapping
Opens the "Color Mapping" dialog.

For details see the R&S FSPN User Manual.

Continuous Sweep / Run Cont
After triggering, starts the sweep and repeats it continuously until stopped. This is the default setting.

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

Remote command:
`INITiate<n>:CONTinuous` on page 106

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

Remote command:
`INITiate<n>[:IMMediate]` on page 106

Clear Spectrogram
Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
`CALCulate<n>:SPECtrogram:CLEar[:IMMediate]` on page 183

5.2.2 Color map settings

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

or: [TRACE] > "Spectrogram Config" > "Color Mapping"

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

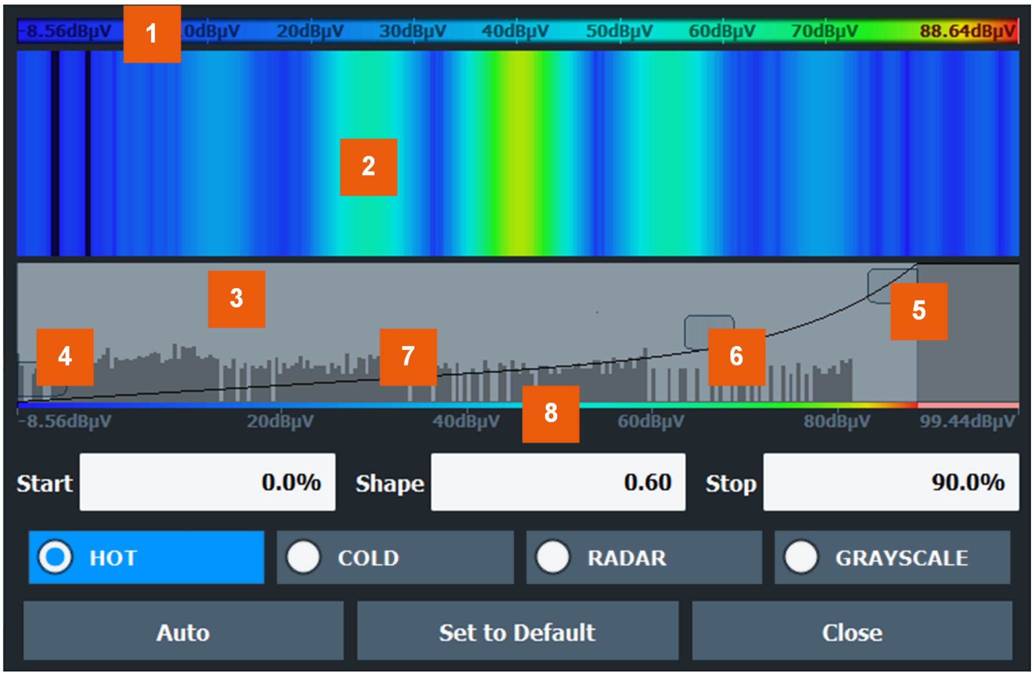


Figure 5-1: Color Mapping dialog box

1 = Color map: shows the current color distribution
2 = Preview pane: shows a preview of the spectrogram with any changes that you make to the color scheme
3 = Color curve pane: graphical representation of all settings available to customize the color scheme
4/5 = Color range start and stop sliders: define the range of the color map or amplitudes for the spectrogram
6 = Color curve slider: adjusts the focus of the color curve
7 = Histogram: shows the distribution of measured values
8 = Scale of the horizontal axis (value range)

Start / Stop

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

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer` on page 188
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer` on page 188

Shape

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

"-1 to <0"	More colors are distributed among the lower values
"0"	Colors are distributed linearly among the values
">0 to 1"	More colors are distributed among the higher values

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe` on page 188

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

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]` on page 189

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

Set to Default
Sets the color mapping to the default settings.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault` on page 188

Close
Saves the changes and closes the dialog box.

5.3 Marker Settings

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

5.3.1 Individual Marker Setup

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

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.

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

Selected Marker

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 194
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 192

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 119
`CALCulate<n>:DELTamarker<m>:X` on page 118

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 194
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 192

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 192

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 193

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> on page 191

CALCulate<n>:DELTamarker<m>:LINK on page 190

Assigning the Marker to a Trace

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

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

Remote command:

CALCulate<n>:MARKer<m>:TRACe on page 194

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 194

CALCulate<n>:DELTamarker<m>[:STATe] on page 192

All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 193

5.3.2 General Marker Settings

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

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

Marker Table Display
Defines how the marker information is displayed.

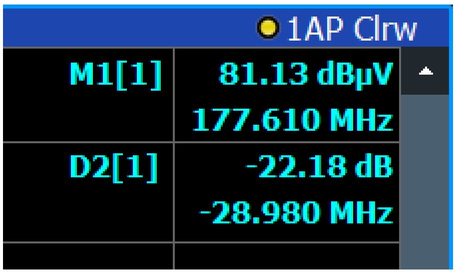
"On" Displays the marker information in a table in a separate area beneath the diagram.

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

"Auto" (Default) If more than two markers are active, the marker table is displayed automatically.
If Marker Info is active, the marker information for up to two markers is displayed in the diagram area.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 199

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



Remote command:
`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 198

Marker Stepsize
Defines the size of the steps that the marker position is moved using the rotary knob.

"Standard"	The marker position is moved in steps of (Span/1000), which corresponds approximately to the number of pixels for the default display of 1001 measurement points. This setting is most suitable to move the marker over a larger distance.
"Sweep Points"	The marker position is moved from one sweep point to the next. This setting is required for a very precise positioning if more sweep points are collected than the number of pixels that can be displayed on the screen. It is the default mode.

Remote command:
`CALCulate<n>:MARKer<m>:X:SSIZe` on page 198

Defining a Fixed Reference
Instead of using a reference marker whose position can vary depending on the measurement results, you can define a fixed reference marker for trace analysis.

Note that this function is not available in all result displays.

For "State" = "On", a vertical and a horizontal red display line are displayed, marked as "FXD". The normal marker 1 is activated and set to the peak value of the trace assigned to marker 1, and a delta marker to the next peak. The fixed reference marker is set to the position of marker 1 at the peak value. The delta marker refers to the fixed reference marker.

The "Level" and "Frequency" or "Time" settings define the position and value of the reference marker. To move the fixed reference, move the red display lines marked "FXD" in the diagram, or change the position settings in the "Marker Settings" tab of the "Marker" dialog box.

Peak Search sets the fixed reference marker to the current maximum value of the trace assigned to marker 1.

If activated, the fixed reference marker ("FXD") can also be selected as a Reference Marker instead of another marker.

Remote command:
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed[:STATe]` on page 197
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y` on page 196
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X` on page 196
`CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]` on page 196

5.3.3 Marker Search Settings and Positioning Functions

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

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.

5.3.3.1 Marker Search Settings

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

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.

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:
Find a list of remote commands in Chapter 6.7.7, "Positioning Markers", on page 203.

Exclude LO
If activated, restricts the frequency range for the marker search functions.

"On" The minimum frequency included in the peak search range is ≥ 5 × resolution bandwidth (RBW).
Due to the interference by the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the peak marker jumping to the LO signal at 0 Hz, this frequency is excluded from the peak search.

"Off" No restriction to the search range. The frequency 0 Hz is included in the marker search functions.

Remote command:
`CALCulate<n>:MARKer<m>:LOEXclude` on page 199

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 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For Analog Modulation Analysis, the unit and value range depend on the selected result display type.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 200

Auto Max Peak Search / Auto Min Peak Search
If activated, a maximum or minimum peak search is performed automatically for marker 1 after each measurement.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:AUTO` on page 205
`CALCulate<n>:MARKer<m>:MINimum:AUTO` on page 207

Search Limits
The search results can be restricted by limiting the search area or adding search conditions.

Search Limits (Left / Right) ← Search Limits
If activated, limit lines are defined and displayed for the search. Only results within the limited search range are considered.

Remote command:
`CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]` on page 201
`CALCulate<n>:MARKer<m>:X:SLIMits:LEFT` on page 200
`CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt` on page 200

Search Threshold ← Search Limits
Defines an absolute threshold as an additional condition for the peak search. If enabled, only peaks that exceed the threshold are detected.

Remote command:
`CALCulate<n>:THReshold:STATe` on page 202
`CALCulate<n>:THReshold` on page 202

Use Zoom Limits ← Search Limits
If activated, the peak search is restricted to the active zoom area defined for a single zoom.

Remote command:
`CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe]` on page 201

Search Limits Off ← Search Limits
Deactivates the search range limits.

Remote command:
`CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]` on page 201
`CALCulate<n>:THReshold:STATe` on page 202

5.3.3.2 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 207
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 204

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 206
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 206
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 206
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 203
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 204
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 203

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 208
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 205

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.

For spectrogram displays, define which frame the next minimum is to be searched in.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 208
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 208
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 208
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 205
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 204
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 205

Center Frequency = Marker Frequency
Sets the center frequency to the selected marker or delta marker frequency. A peak can thus be set as center frequency, for example to analyze it in detail with a smaller span.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:CENTer` on page 149

Reference Level = Marker Level
Sets the reference level to the selected marker level.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:REFerence` on page 142

5.3.4 Marker (Measurement) Functions

Access: "Overview" > "Analysis" > "Marker Functions"

5.3.4.1 Measuring the power in a channel (band power marker)

Access: "Overview" > "Analysis" > "Marker Functions" > "Band Power" > "Band Power Config"

or: [MKR FUNC] > "Select Marker Function" > "Band Power"

To determine the noise power in a transmission channel, you can use a noise marker and multiply the result with the channel bandwidth. However, the results are only accurate for flat noise.

Band power markers allow you to measure the integrated power for a defined span (band) around a marker (similar to ACP measurements). By default, 5 % of the current span is used. The span is indicated by limit lines in the diagram. You can easily change the span by moving the limit lines in the diagram. They are automatically aligned symmetrically to the marker frequency. They are also moved automatically if you move the marker on the screen.

The results can be displayed either as a power (dBm) or density (dBm/Hz) value and are indicated in the "marker table" for each band power marker.

Relative band power markers

The results for band power markers which are defined as *delta* markers and thus have a reference value can also be calculated as reference power values (in dB).

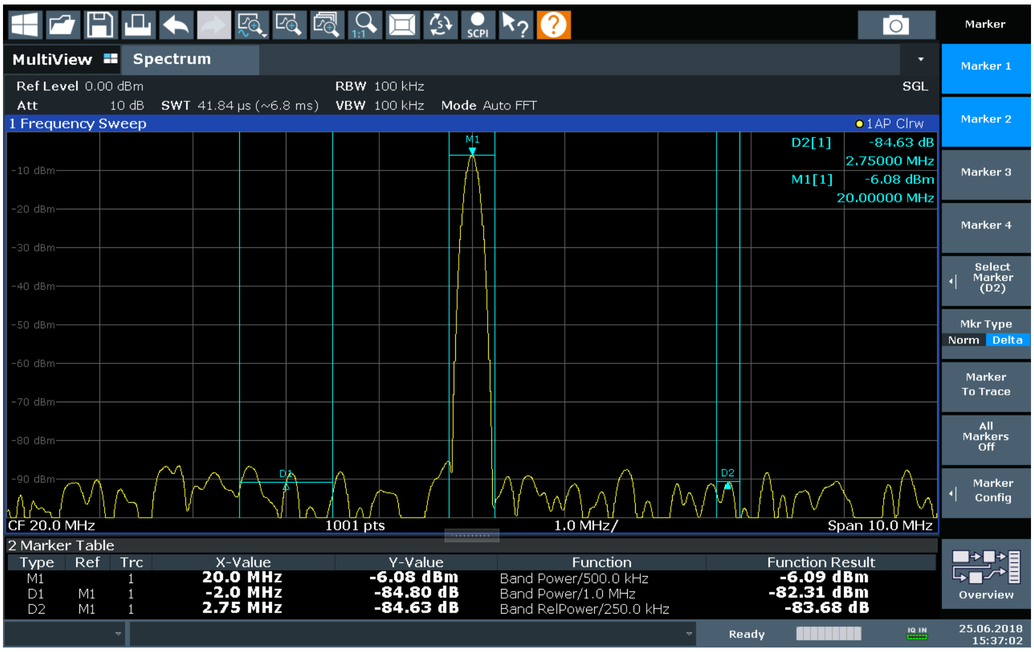
In this case, the result of the band power deltamarker is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker. The powers are subtracted logarithmically, so the result is a dB value.

[Relative band power (Delta2) in dB] = [absolute band power (Delta2) in dBm] - [absolute (band) power of reference marker in dBm]

The measured power for the reference marker may be an absolute power at a single point (if the reference marker is not a band power marker), or the power in a band (if the reference marker is a band power marker itself).

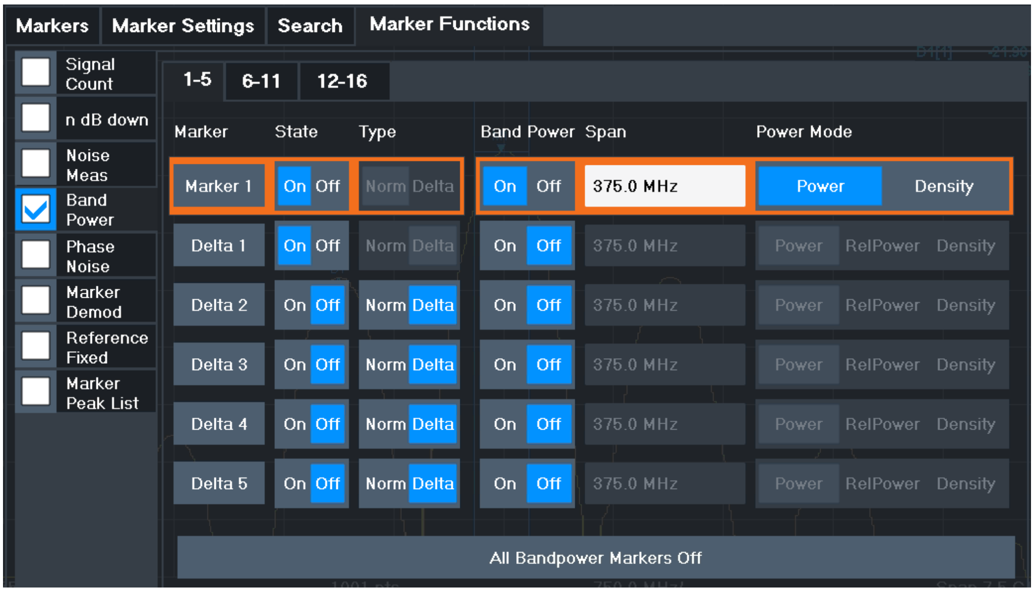
If the reference marker for the band power marker is also a delta marker, the absolute power level for the reference marker is used for calculation.

The entire band must lie within the display. If it is moved out of the display, the result cannot be calculated (indicated by "- - -" as the "Function Result"). However, the width of the band is maintained so that the band power can be calculated again when it returns to the display.



All markers can be defined as band power markers, each with a different span. When a band power marker is activated, if no marker is active yet, marker 1 is activated. Otherwise, the currently active marker is used as a band power marker (all other marker functions for this marker are deactivated).

If the detector mode for the marker trace is set to "Auto", the RMS detector is used.



Remote commands:

`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe]` on page 212

`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult?` on page 210

Band Power Measurement State

Activates or deactivates band power measurement for the marker in the diagram.

Band power markers are only available for standard frequency measurements (not zero span) in the Spectrum application.

If activated, the markers display the power or density measured in the band around the current marker position.

For details see Chapter 5.3.4.1, "Measuring the power in a channel (band power marker)", on page 77.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe]` on page 212
`CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe]` on page 210

Span

Defines the span (band) around the marker for which the power is measured.

The span is indicated by lines in the diagram. You can easily change the span by moving the limit lines in the diagram. They are automatically aligned symmetrically to the marker frequency. They are also moved automatically if you move the marker on the screen.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:SPAN` on page 211
`CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:SPAN` on page 210

Power Mode
Defines the mode of the power measurement result.

For Analog Modulation Analysis, the power mode is not editable for AM, FM, or PM spectrum results. In this case, the marker function does not determine a power value, but rather the deviation within the specified span.

"Power"	The result is an absolute power level. The power unit depends on the Unit setting.
"Relative Power"	This setting is only available for a delta band power marker. The result is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker (see "Reference Marker" on page 70). The powers are subtracted logarithmically, so the result is a dB value. *[Relative band power (Delta2) in dB] = [absolute band power (Delta2) in dBm] - [absolute (band) power of reference marker in dBm]* For details see "Relative band power markers" on page 78
"Density"	The result is a power level in relation to the bandwidth, displayed in dBm/Hz.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:MODE` on page 211
`CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE` on page 209

Switching All Band Power Measurements Off
Deactivates band power measurement for all markers.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe]` on page 212
`CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe]` on page 210

5.3.4.2 Marker peak list

Access: "Overview" > "Analysis" > "Marker Functions" > "Marker Peak List"

Or: [MKR FUNC] > "Marker Peak List"

A common measurement task is to determine peak values, i.e. maximum or minimum signal levels. The R&S FSPN provides various peak search functions and applications:

- Setting a marker to a peak value once (Peak Search)
- Searching for a peak value within a restricted search area (Search Limits)
- Creating a "marker table" with all or a defined number of peak values for one measurement ("Marker Peak List")
- Updating the marker position to the current peak value automatically after each measurement (Auto Peak Search)
- Creating a fixed reference marker at the current peak value of a trace (Fixed Reference)

Peak search limits

The peak search can be restricted to a search area. The search area is defined by limit lines which are also indicated in the diagram. In addition, a minimum value (threshold) can be defined as a further search condition.

When is a peak a peak? - Peak excursion

During a peak search, noise values are detected as a peak if the signal is very flat or does not contain many peaks. Therefore, you can define a relative threshold ("Peak Excursion"). The signal level must increase by the threshold value before falling again before a peak is detected. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of peak excursion settings (example)

The following figure shows a trace to be analyzed.

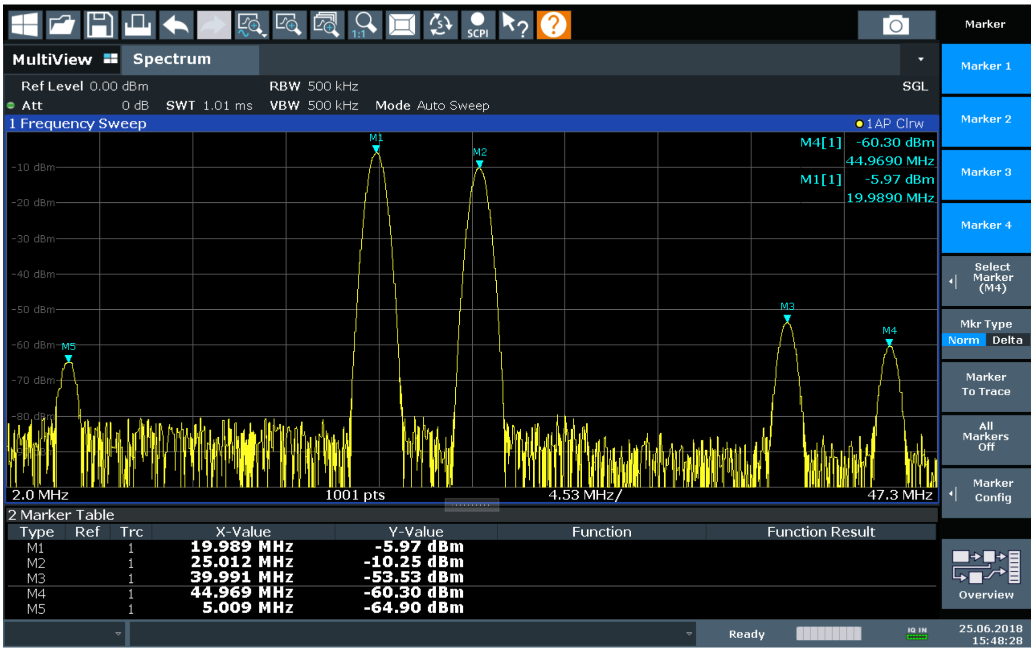


Figure 5-2: Trace example

The following table lists the peaks as indicated by the marker numbers in the diagram above, as well as the minimum decrease in amplitude to either side of the peak:

Marker #	Min. amplitude decrease to either side of the signal
1	80 dB
2	80 dB
3	55 dB

Marker #	Min. amplitude decrease to either side of the signal
4	39 dB
5	32 dB

To eliminate the smaller peaks M3, M4 and M5 in the example above, a peak excursion of at least 60 dB is required. In this case, the amplitude must rise at least 60 dB before falling again before a peak is detected.

Marker peak list

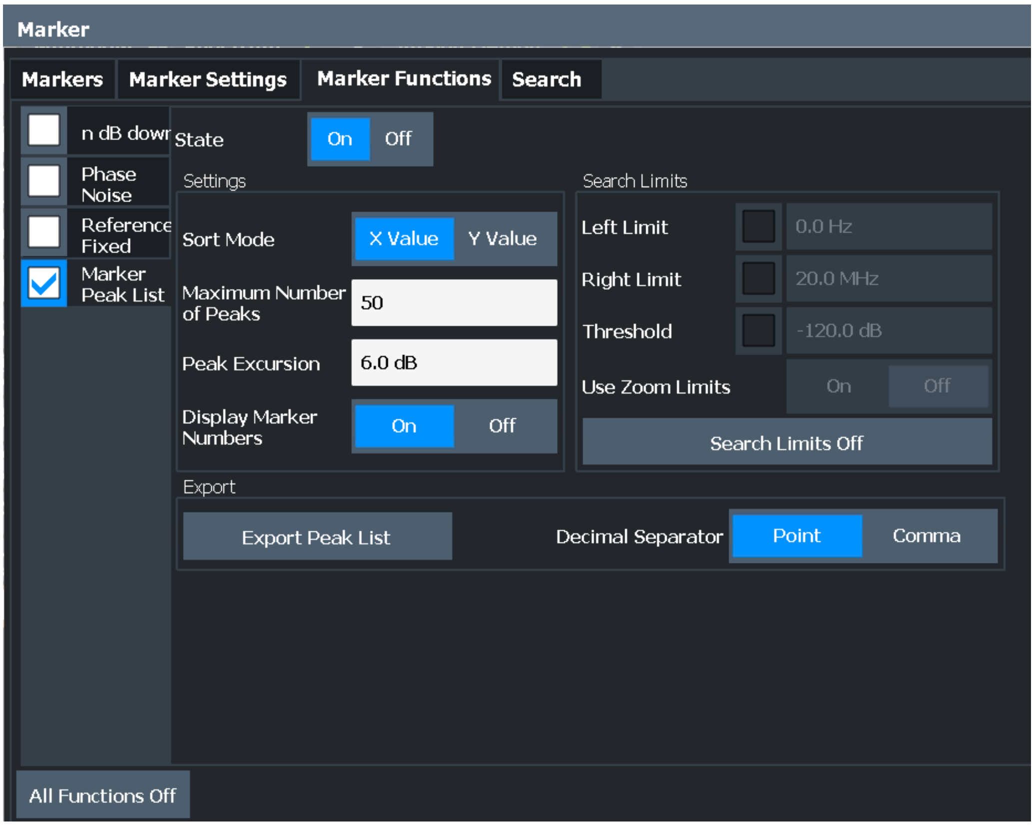
The marker peak list determines the frequencies and levels of peaks in the spectrum. It is updated automatically after each measurement. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.

Automatic peak search

A peak search can be repeated automatically after each measurement to keep the maximum value as the reference point for a phase noise measurement. Automatic peak search is useful to track a drifting source. The delta marker 2, which shows the phase noise measurement result, keeps the delta frequency value. Therefore, the phase noise measurement leads to reliable results in a certain offset although the source is drifting.

Using a peak as a fixed reference marker

Some results are analyzed in relation to a peak value, for example a carrier frequency level. In this case, the maximum level can be determined by an initial peak search and then be used as a reference point for further measurement results.



Remote commands:

`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe` on page 214

`TRAC? LIST,`

See `TRACe<n>[:DATA]?` on page 116

Peak List State

Activates/deactivates the marker peak list. If activated, the peak list is displayed and the peaks are indicated in the trace display.

For each listed peak, the frequency/time ("X-value") and level ("Y-Value") values are given.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe` on page 214

Sort Mode

Defines whether the peak list is sorted according to the x-values or y-values. In either case, the values are sorted in ascending order.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT on page 214

Maximum Number of Peaks
Defines the maximum number of peaks to be determined and displayed.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE on page 214

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 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For Analog Modulation Analysis, the unit and value range depend on the selected result display type.

Remote command:
CALCulate<n>:MARKer<m>:PEXCursion on page 200

Display Marker Numbers
By default, the marker numbers are indicated in the diagram so you can find the peaks from the list. However, for large numbers of peaks, the marker numbers can decrease readability; in this case, deactivate the marker number display.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] on page 212

Export Peak List
The peak list can be exported to an ASCII file (.DAT) for analysis in an external application.

Remote command:
MMEMory:STORe<n>:PEAK on page 215
FORMat:DEXPort:DSEParator on page 115

5.3.4.3 Deactivating all marker functions

Access: "Overview" > "Analysis" > "Marker Functions" > "All Functions Off"

All special marker functions can be deactivated in one step.

Remote command:

5.4 Limit lines

Limit lines help you analyze a measurement trace.

5.4.1 Basics on limit lines

Limit lines are used to define amplitude curves or spectral distribution boundaries in the result diagram which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). When transmitting information in TDMA systems (e.g. GSM), the amplitude of the bursts in a time slot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The R&S FSPN supports limit lines with a maximum of 200 data points. Eight of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the instrument is only limited by the capacity of the storage device used.

Limit line data can also be exported to a file in ASCII (CSV) format for further evaluation in other applications. Limit lines stored in the specified ASCII (CSV) format can also be imported to the R&S FSPN for other measurements.

Compatibility

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.

Validity

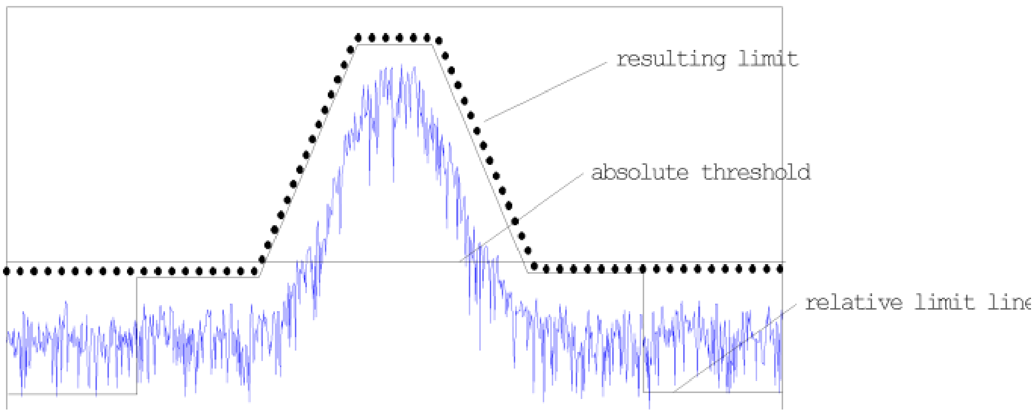
Only limit lines that fulfill the following conditions can be activated:

- Each limit line must consist of a minimum of 2 and a maximum of 200 data points.
- The frequencies/times for each data point must be defined in ascending order; however, for any single frequency or time, two data points may be entered (to define a vertical segment of a limit line).
- Gaps in frequency or time are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies or times need not necessarily be selectable in R&S FSPN. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is -1000 s to +1000 s.

Figure 5-3: Example for an upper limit line

Thresholds

If the y-axis for the limit line data points uses relative scaling, an additional absolute **threshold** can be defined for the limit check. In this case, both the threshold value and the relative limit line must be exceeded before a violation occurs.



Offsets and Shifting

A configured limit line can easily be moved vertically or horizontally. Two different methods to do so are available:

- An **offset** moves the entire line in the diagram without editing the configured values or positions of the individual data points. This option is only available if relative scaling is used.
  Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally or vertically.

- Defining a **shift** width for the values or position of the individual data points changes the line configuration, thus changing the position of the line in the diagram.

Limit Check Results

A limit check is automatically performed as soon as any of the limit lines is activated ("Visibility" setting). Only the specified "Traces to be Checked" are compared with the active limit lines. The status of the limit check for each limit line is indicated in the diagram. If a violation occurs, the limit check status is set to "MARG" for a margin violation, or to"Fail" for a limit violation.

Figure 5-4: Margin violation for limit check

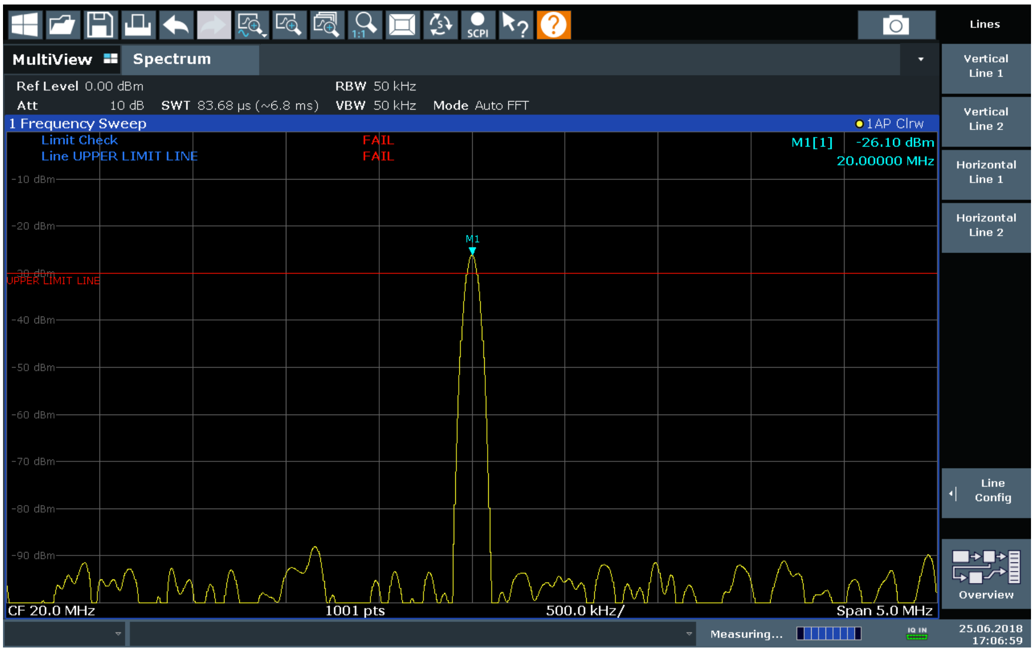


Figure 5-5: Limit violation for limit check

5.4.2 Limit line settings and functions

Stored limit line settings

When storing and recalling limit line settings, consider the information provided in the Data Management chapter of the R&S FSPN User Manual.

5.4.2.1 Limit line management

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

For the limit line overview, the R&S FSPN searches for all stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. The overview allows you to determine which limit lines are available and can be used for the current measurement.

For details on settings for individual lines see Chapter 5.4.2.2, "Limit line details", on page 90.

Name
The name of the stored limit line.

Unit
The unit in which the y-values of the data points of the limit line are defined.

Compatibility
Indicates whether the limit line definition is compatible with the current measurement settings.

Visibility
Displays or hides the limit line in the diagram. Up to 8 limit lines can be visible at the same time. Inactive limit lines can also be displayed in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:STATe` on page 225
`CALCulate<n>:LIMit<li>:UPPer:STATe` on page 230
`CALCulate<n>:LIMit<li>:ACTive?` on page 219

Traces to be Checked
Defines which traces are automatically checked for conformance with the limit lines. As soon as a trace to be checked is defined, the assigned limit line is active. One limit line can be activated for several traces simultaneously. If any of the "Traces to be Checked" violate any of the active limit lines, a message is indicated in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 227

Comment
An optional description of the limit line.

X-Offset
Shifts a limit line that has been specified for relative frequencies or times (x-axis) horizontally.

This setting does not have any effect on limit lines that are defined by absolute values for the x-axis.

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:OFFSet` on page 221

Y-Offset
Shifts a limit line that has relative values for the y-axis (levels or linear units such as volt) vertically.

This setting does not have any effect on limit lines that are defined by absolute values for the y-axis.

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:OFFSet` on page 224
`CALCulate<n>:LIMit<li>:UPPer:OFFSet` on page 229

Create New Line
Creates a new limit line.

Edit Line
Edit an existing limit line configuration.

Copy Line
Copy the selected limit line configuration to create a new line.

Remote command:
`CALCulate<n>:LIMit<li>:COPY` on page 222

Delete Line
Delete the selected limit line configuration.

Remote command:
`CALCulate<n>:LIMit<li>:DELete` on page 222

Disable All Lines
Disable all limit lines in one step.

Remote command:
`CALCulate<n>:LIMit<li>:STATe` on page 226

5.4.2.2 Limit line details

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines" > "New" / "Edit" / "Copy To"

Name
Defines the limit line name. All names must be compatible with Windows conventions for file names. The limit line data is stored under this name (with a `.LIN` extension).

Remote command:
`CALCulate<n>:LIMit<li>:NAME` on page 226

Comment
Defines an optional comment for the limit line.

Remote command:
`CALCulate<n>:LIMit<li>:COMMent` on page 219

Threshold
Defines an absolute threshold value (only for relative scaling of the y-axis).

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:THReshold` on page 225
`CALCulate<n>:LIMit<li>:UPPer:THReshold` on page 230

Data Points
Each limit line is defined by a minimum of 2 and a maximum of 200 data points. Each data point is defined by its position (x-axis) and value (y-value). Data points must be defined in ascending order. The same position can have two different values.

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol[:DATA]` on page 220
`CALCulate<n>:LIMit<li>:LOWer[:DATA]` on page 223
`CALCulate<n>:LIMit<li>:UPPer[:DATA]` on page 228

Insert Value
Inserts a data point in the limit line above the selected one in the "Edit Limit Line" dialog box.

Delete Value
Deletes the selected data point in the "Edit Limit Line" dialog box.

Shift x
Shifts the x-value of each data point horizontally by the defined shift width (as opposed to an additive offset defined for the entire limit line, see "X-Offset" on page 89).

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:SHIFt` on page 221

Shift y
Shifts the y-value of each data point vertically by the defined shift width (as opposed to an additive offset defined for the entire limit line, see "Y-Offset" on page 90).

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:SHIFt` on page 224
`CALCulate<n>:LIMit<li>:UPPer:SHIFt` on page 229

Save
Saves the currently edited limit line under the name defined in the "Name" field.

5.4.3 How to define limit lines

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

The following tasks are described here:

- "How to find compatible limit lines" on page 92
- "How to activate and deactivate a limit check" on page 92
- "How to edit existing limit lines" on page 92
- "How to copy an existing limit line" on page 93
- "How to delete an existing limit line" on page 93
- "How to configure a new limit line" on page 93
- "How to move the limit line vertically or horizontally" on page 94

How to find compatible limit lines

► In the "Line Config" dialog box, select the "View Filter" option: "Show Compatible".

All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder of the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a limit check

A limit check is automatically performed as soon as any of the limit lines is activated.

1. To activate a limit check:
   Select the "Check Traces" setting for a limit line in the overview and select the trace numbers to be included in the limit check. One limit line can be assigned to several traces.

   The specified traces to be checked are compared with the active limit lines. The status of the limit check is indicated in the diagram.

2. To deactivate a limit line, deactivate all "Traces to be Checked" for it.
   To deactivate all limit lines at once, select "Disable All Lines".

   The limit checks for the deactivated limit lines are stopped and the results are removed form the display.

How to edit existing limit lines

Existing limit line configurations can be edited.

1. In the "Line Config" dialog box, select the limit line.
2. Select "Edit".
3. Edit the line configuration as described in "How to configure a new limit line" on page 93.
4. Save the new configuration by selecting "Save".

   If the limit line is active, the edited limit line is displayed in the diagram.

How to copy an existing limit line

1. In the dialog box, select the limit line.
2. Select "Line Config" "Copy To".
3. Define a new name to create a new limit with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new limit line" on page 93.
5. Save the new configuration by selecting "Save".

   The new limit line is displayed in the overview and can be activated.

How to delete an existing limit line

1. In the "Line Config" dialog box, select the limit line.
2. Select "Delete".
3. Confirm the message.

   The limit line and the results of the limit check are deleted.

How to configure a new limit line

1. In the "Line Config" dialog box, select "New".

   The "Edit Limit Line" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.
2. Define a "Name" and, optionally, a "Comment" for the new limit line.
3. Define the x-axis configuration:
   - Time domain or frequency domain
   - Absolute or relative limits
   - Linear or logarithmic scaling
4. Define the y-axis configuration:
   - Level unit
   - Absolute or relative limits
   - Upper or lower limit line
5. Define the data points: minimum 2, maximum 200:
   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.

d) Repeat this to insert all other data points.
To insert a data point before an existing one, select the data point and then "Insert Value".
To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
To delete a data point, select the entry and then "Delete Value".

6. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
If necessary, shift the entire line vertically or horizontally by selecting "Shift x" or "Shift y" and defining the shift width.
7. Optionally, define a "Margin" at a fixed distance to the limit line.
The margin must be within the valid value range and is not displayed in the diagram or preview area.
8. Optionally, if the y-axis uses relative scaling, define an absolute "Threshold" as an additional criteria for a violation.
9. Save the new configuration by selecting "Save".

The new limit line is displayed in the overview and can be activated.

How to move the limit line vertically or horizontally

A configured limit line can easily be moved vertically or horizontally. Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.

1. In the "Line Config" dialog box, select the limit line.
2. To shift the complete limit line parallel in the horizontal direction, select "X-Offset" and enter an offset value.
To shift the complete limit line parallel in the vertical direction, select "Y-Offset" and enter an offset value.
3. To shift the individual data points of a limit line by a fixed value (all at once):
   a) Select "Edit".
   b) In the "Edit Limit Line" dialog box, select "Shift x" or "Shift y" and define the shift width.
   c) Save the shifted data points by selecting "Save".

If activated, the limit line is shifted in the diagram.

6 Remote Commands for the Spectrum Monitor

The following commands are specific to performing measurements in the Spectrum Monitor application in a remote environment. The R&S FSPN must already be set up for remote operation in a network as described in the R&S FSPN user manual.

6.1 Introduction

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

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

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

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

Remote command examples

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

6.1.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- *Command usage*

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

- *Parameter usage*
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
  Parameters required only for setting are indicated as "Setting parameters".
  Parameters required only to refine a query are indicated as "Query parameters".
  Parameters that are only returned as the result of a query are indicated as "Return values".
- *Conformity*
  Commands that are taken from the SCPI standard are indicated as "SCPI confirmed". All commands used by the R&S FSPN follow the SCPI syntax rules.
- *Asynchronous commands*
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an "Asynchronous command".
- *Reset values (*RST)*
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as "*RST" values, if available.
- *Default unit*
  The default unit is used for numeric values if no other unit is provided with the parameter.
- *Manual operation*
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

6.1.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

6.1.3 Numeric suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

6.1.4 Optional keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

If an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

6.1.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

6.1.6 SCPI parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters can have different forms of values.

6.1.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

With unit: `SENSe:FREQuency:CENTer 1GHZ`

Without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. for discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.
- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

6.1.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "`ON`" or the numeric value 1. The "off" state (logically untrue) is represented by "`OFF`" or the numeric value 0.

Querying Boolean parameters

When you query Boolean parameters, the system returns either the value 1 ("`ON`") or the value 0 ("`OFF`").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

6.1.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 6.1.2, "Long and short form", on page 96.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

6.1.6.4 Character strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELete 'Spectrum'`

6.1.6.5 Block data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.2 Common suffixes

In the Spectrum Monitor, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the Spectrum Monitor

Suffix	Value range	Description
<m>	1 to 16	Marker
<n>	1 to 6	Window (**in the currently selected channel**)
<t>	1 to 6	Trace
	1 to 8	Limit line

6.3 Activating Spectrum Monitor Measurements

A measurement is started immediately with the default settings when the channel is activated.

CALCulate<n>:IQ:MODE <EvalMode>

This command defines whether the captured I/Q data is evaluated directly, or if it is converted (via FFT) to spectral or time data first.

It is currently only available for I/Q Analyzer secondary applications in multistandard mode (not the MSRA primary application).

Suffix:
<n> irrelevant

Parameters:
<EvalMode> **TDOMain**
Evaluation in time domain (zero span).
FDOMain
Evaluation in frequency domain.
IQ
Evaluation using I/Q data.

INSTrument:CREate:DUPLicate

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

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

Usage: Event

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

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

Parameters:
<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 102.

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

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

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

Replaces a channel with another one.

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

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 102.

<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 102). 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 ":", "*", "?".
Usage:	Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

Setting parameters:

<ChannelName>	String containing the name of the channel you want to delete. A channel must exist to delete it.
Usage:	Setting only

INSTrument:LIST?

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

Return values:

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

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:

<ChannelName1>	String containing the name of the channel you want to rename.
<ChannelName2>	String containing the new channel name. Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs. Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".
Usage:	Setting only

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

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

Also see

- `INSTrument:CREate[:NEW]` on page 101

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 102.

<ChannelName> String containing the name of the channel.

Example:
```
INST IQ
INST 'MyIQSpectrum'
```
Selects the channel named 'MyIQSpectrum' (for example before executing further commands for that channel).

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 14

TRACe:IQ:EVAL <State>

Turns I/Q data analysis on and off.

Before you can use this command, you have to turn on the I/Q data acquisition using `INST:CRE:NEW IQ` or `INST:CRE:REPL`, or using the `TRACe:IQ[:STATe]` command to replace the current channel while retaining the settings.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`TRAC:IQ ON`
Enables I/Q data acquisition
`TRAC:IQ:EVAL ON`
Enables the I/Q data analysis mode.

TRACe:IQ[:STATe] <State>

Executing this command also has the following effects:

- The sweep, amplitude, input and trigger settings from the measurement are retained.
- All measurements are turned off.
- All traces are set to "Blank" mode.
- The I/Q data analysis mode is turned off (`TRAC:IQ:EVAL OFF`).

Note: To turn trace display back on or to enable the evaluation functions of the I/Q Analyzer, execute the `TRAC:IQ:EVAL ON` command (see TRACe:IQ:EVAL on page 103).

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`TRAC:IQ ON`
Switches on I/Q data acquisition

6.4 Performing Measurements

ABORt

Aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see Remote control via SCPI.

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 FSPN 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 FSPN on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONMeas

Restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

Suffix:
<n> irrelevant

Example:

`INIT:CONT OFF`
Switches to single measurement mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the measurement counter to 20 measurements.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 measurements.
`INIT:CONM;*WAI`
Continues the measurement (next 20 measurements) and waits for the end.
Result: Averaging is performed over 40 measurements.

Usage: Asynchronous command

Manual operation: See "Continue Single Sweep" on page 50

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

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 49

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

With measurement count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the 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

Example:
`INIT:CONT OFF`
Switches to single measurement mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Sets the measurement counter to 20 measurements.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 measurements.

Usage: Asynchronous command

Manual operation: See "Single Sweep / Run Single" on page 50

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 107.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 110).

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using `*OPC`, `*OPC?` or `*WAI`, use `SINGle` Sequencer mode.

Parameters:

<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

INITiate:SEQuencer:REFResh[:ALL]

Is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA secondary applications.

Example:

`SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INIT:SEQ:REFR`
Refreshes the display for all channels.

[SENSe:]AVERage:COUNt <AverageCount>
TRACe:IQ:AVERage:COUNt <NumberSets>

This command defines the number of I/Q data sets that the averaging is based on.

Parameters:

<NumberSets>

Range: 0 to 32767
*RST: 0

Example:
`TRAC:IQ ON`
Switches on acquisition of I/Q data.
`TRAC:IQ:AVER ON`
Enables averaging of the I/Q measurement data
`TRAC:IQ:AVER:COUN 10`
Selects averaging over 10 data sets
`TRAC:IQ:DATA?`
Starts the measurement and reads out the averaged data.

Manual operation: See "Average Count" on page 63

[SENSe:]AVERage<n>[:STATe<t>] <State>
TRACe:IQ:AVERage[:STATe] <State>

This command turns averaging of the I/Q data on and off.

If averaging is on, the maximum amount of I/Q data that can be recorded is 512kS (524288 samples).

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`TRAC:IQ ON`
Switches on acquisition of I/Q data.
`TRAC:IQ:AVER ON`
Enables averaging of the I/Q measurement data.
`TRAC:IQ:AVER:COUN 10`
Selects averaging over 10 data sets.
`TRAC:IQ:DATA?`
Starts the measurement and reads out the averaged data.

[SENSe:]SWEep:COUNt <SweepCount>

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

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

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

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

Manual operation: See "Sweep/Average Count" on page 49

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Return values:
<CurrentCount>

Example: `SWE:COUNt 64`
Sets sweep count to 64
`INIT:CONT OFF`
Switches to single sweep mode
`INIT`
Starts a sweep (without waiting for the sweep end!)
`SWE:COUN:CURR?`
Queries the number of started sweeps

Usage: Query only

[SENSe:]SWEep[:WINDow<n>]:POINts

This command defines the number of measurement points to analyze after a measurement.

Suffix:
<n>

Example: `SWE:POIN 251`

Manual operation: See "Sweep Points" on page 49

[SENSe:]SWEep:TIME <Time>

Defines the measurement time. It automatically decouples the time from any other settings.

Parameters:
<Time> refer to specifications document
*RST: depends on current settings (determined automatically)
Default unit: S

Manual operation: See "Meas Time" on page 46

SYSTem:SEQuencer <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSPN User Manual.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

6.5 Retrieving Results

6.5.1 Retrieving Captured I/Q Data

The captured I/Q data is output in the form of a list, three different formats can be selected for this list (see `TRACe:IQ:DATA:FORMat` on page 112).

TRACe:IQ:DATA?

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

Corresponds to:

`INIT:IMM;*WAI;:TRACe:IQ:DATA:MEMory?`

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Note: Using the command with the *RST values for the TRACe:IQ:SET command, the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, binary format: 2 kBytes

Return values:

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.
The number of samples depends on TRACe:IQ:SET. In ASCII format, the number of results is 2* the number of samples.
The data format depends on TRACe:IQ:DATA:FORMat on page 112.

Default unit: V

Example:
`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
`FORMat REAL,32`
Selects format of response data
`TRAC:IQ:DATA?`
Starts measurement and reads results

Usage: Query only

TRACe:IQ:DATA:FORMat <Format>

Selects the order of the I/Q data.

For details see Chapter B, "Reference: format description for I/Q data files", on page 241.

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

Queries the I/Q data currently stored in the capture buffer of the R&S FSPN.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved.

In this case, the command returns the same results as TRACe:IQ:DATA?. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

(See TRACe:IQ:SET, TRACe:IQ:SRATe on page 163 and [SENSe:]SWEep:TIME on page 110)

Query parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values

*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values

*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
By default, the first half of the list contains the I values, the second half the Q values. The order can be configured using TRACe:IQ:DATA:FORMat.
The data format of the individual values depends on FORMat[:DATA] on page 114.

Default unit: V

Example:
`TRAC:IQ:STAT ON`
Enables acquisition of I/Q data
`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096`
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 100
Number of Samples = 4096
`INIT;*WAI`
Starts measurement and wait for sync
`FORMat REAL,32`
Determines output format
To read the results:
`TRAC:IQ:DATA:MEM?`
Reads all 4096 I/Q data
`TRAC:IQ:DATA:MEM? 0,2048`
Reads 2048 I/Q data starting at the beginning of data acquisition
`TRAC:IQ:DATA:MEM? 2048,1024`
Reads 1024 I/Q data from half of the recorded data
`TRAC:IQ:DATA:MEM? 100,512`
Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

Example:
// Perform a single I/Q capture.
`INIT;*WAI`
// Determine output format (binary float32)
`FORMat REAL,32`
// Read 1024 I/Q samples starting at sample 2048.
`TRAC:IQ:DATA:MEM? 2048,1024`

Usage: Query only

6.5.2 Retrieving I/Q Trace Data

FORMat[:DATA] <Format>[, <BitLength>]

Selects the data format that is used for transmission of trace data from the R&S FSPN to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSPN. The R&S FSPN automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

REAL
Floating-point numbers (according to IEEE 754) in the "definite length block format".

<BitLength>

Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 64
See "Export Peak List" on page 84

FORMat:DEXPort:FORMat <FileFormat>

Determines the format of the ASCII file to be imported or exported. Depending on the external program that creates the data file or evaluates it, a comma-separated list (CSV) or a plain data format (DAT) file is required.

Parameters:

<FileFormat> CSV | DAT
*RST: DAT

Example: `FORM:DEXP:FORM CSV`

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on `FORMat[:DATA]` on page 114.

Suffix:

<n> Window

Query parameters:

<ResultType> Selects the type of result to be returned.
See Table 6-2.

Example: `TRAC? TRACE3`
Queries the data of trace 3.

Manual operation: See "Spectrum" on page 11

Table 6-2: Return values for result type parameters

Parameter	Result display / measurement	Results
`TRACE1` | ... | `TRACE6`	Returns the sweep point values as shown in the result display. For the auto peak detector, the command returns positive peak values only. (To retrieve negative peak values, define a second trace with a negative peak detector.)	
	"Magnitude" "Spectrum"	Magnitude of the I and Q values (I+jQ) for each sweep point (=1001 values)

Parameter	Result display / measurement	Results
	"Real/Imag (I/Q)"	First the real parts for each trace point, then the imaginary parts ($I_1,...,I_{1001}$, $Q_1,...,Q_{1001}$).
	"I/Q Vector"	The I and Q values for each trace point are returned (1001 pairs of I and Q values).
`LIST`	SEM measurements	Peak list evaluation, one peak per range is returned.
	Spurious emission measurements	Peak list evaluation For each peak, the command returns 11 values in the following order: • <No>: range number • <StartFreq>,<StopFreq>: start and stop frequency of the range • <RBW>: resolution bandwidth • <PeakFreq>: frequency of the peak in a range • <PowerAbs>: absolute power of the peak in dBm • <PowerRel>: power of the peak in relation to the channel power in dBc • <PowerDelta>: distance from the peak to the limit line in dB, positive values indicate a failed limit check • <LimitCheck>: state of the limit check (0 = PASS, 1 = FAIL) • <Unused1>,<Unused2>: reserved (0.0)
`SPURious`	Peak list evaluation of Spurious Emission measurements.	
`SPECtrogram | SGRam`	For every frame in the spectrogram, the command returns the power levels that have been measured, one for each sweep point. The number of frames depends on the size of the history depth. The power level depends on the configured unit. Only `REAL,32` format is supported.	

TRACe<n>[:DATA]:MEMory? <Trace>,<OffsSwPoint>,<NoOfSwPoints>

Queries the previously captured trace data for the specified trace from the memory. As an offset and number of sweep points to be retrieved can be specified, the trace data can be retrieved in smaller portions, making the command faster than the `TRAC:DATA?` command. This is useful if only specific parts of the trace data are of interest.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as `TRAC:DATA? TRACE1`.

Suffix:

<n> Window

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

<OffsSwPoint> The offset in sweep points related to the start of the measurement at which data retrieval is to start.

<NoOfSwPoints> Number of sweep points to be retrieved from the trace.

Return values:

<SweepPointValues>

Example: `TRAC:DATA:MEM? TRACE1,25,100`
Retrieves 100 sweep points from trace 1, starting at sweep point 25.

Usage: Query only

TRACe<n>[:DATA]:X? <TraceNumber>

Queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements.

Suffix:
<n> Window

Query parameters:
<TraceNumber> Trace number.
TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

Return values:
<X-Values>

Example: `TRAC3:X? TRACE1`
Returns the x-values for trace 1 in window 3.

Usage: Query only

6.5.3 Retrieving Marker Results

CALCulate<n>:DELTamarker<m>:X <Position>

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:
<n> Window

<m> Marker

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker Position X-value" on page 70

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

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.
Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 11
See "Marker Peak List" on page 12
See "Marker Position X-value" on page 70

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:
<Result> Default unit: DBM

Usage: Query only

Manual operation: See "Marker Table" on page 11
See "Marker Peak List" on page 12

MMEMory:STORe<n>:LIST <FileName>

Exports the SEM and spurious emission list evaluation to a file.

The file format is *.dat.

Suffix:
<n> Window

Parameters:
<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:LIST 'test'`
Stores the current list evaluation results in the `test.dat` file.

6.6 Configuring Spectrum Monitor Measurements

6.6.1 Configuring Input Sources

INPut:ATTenuation:PROTection:RESet

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

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

Example: `INP:ATT:PROT:RES`

INPut:COUPling <CouplingType>

Selects the coupling type of the RF input.

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 17

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

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

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

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

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

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

For details, see Table C-1.

Parameters:

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

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

Default unit: HZ

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

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

Manual operation: See "Select I/Q data file" on page 19

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

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

Requires an additional high-pass filter hardware option.

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

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
INP:FILT:HPAS ON
```
Turns on the filter.

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

Enables or disables the YIG filter.

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

Manual operation: See "YIG-Preselector" on page 18

INPut:IMPedance <Impedance>

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

Parameters:

<Impedance> 50 | 75

numeric value
User-defined impedance from 50 Ohm to 100000000 Ohm (=100 MOhm)
User-defined values are only available for the Spectrum application, the I/Q Analyzer, and some optional applications.

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 17
See "Unit" on page 36

INPut:IMPedance:PTYPe <PadType>

Defines the type of matching pad used for impedance conversion for RF input.

Parameters:

<PadType> SRESistor | MLPad

SRESistor
Series-R

MLPad
Minimum Loss Pad

*RST: SRESistor

Example:
```
INP:IMP 100
INP:IMP:PTYP MLP
```

Manual operation: See "Impedance" on page 17

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSPN.

Parameters:

<Source> **RF**
Radio Frequency ("RF INPUT" connector)
*RST: RF

Manual operation: See "Radio Frequency State" on page 17
See "I/Q Input File State" on page 18

INPut:UPORt:STATe <State>

Toggles the control lines of the user ports for the **AUX PORT** connector. This SUB-D male connector is located on the rear panel of the R&S FSPN.

Parameters:

<State> **ON | 1**
User port is switched to INPut
OFF | 0
User port is switched to OUTPut
*RST: 1

INPut:UPORt[:VALue]

Queries the control lines of the user ports.

For details see `OUTPut:UPORt[:VALue]` on page 141.

Return values:

<Level> bit values in hexadecimal format
TTL type voltage levels (max. 5V)
Range: #B00000000 to #B00111111

Example:
```
INP:UPOR?
//Result: #B00100100
```
Pins 5 and 7 are active.

TRACe:IQ:FILE:REPetition:COUNt <RepetitionCount>

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

Parameters:

<RepetitionCount> integer

Example: `TRAC:IQ:FILE:REP:COUN 3`

Manual operation: See "File Repetitions" on page 19

6.6.2 Configuring Power Sensors

CALibration:PMETer<p>:ZERO:AUTO ONCE

Zeroes the power sensor.

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

Suffix:
<p>   Power sensor index

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

Usage: Event

Manual operation: See "Zeroing Power Sensor" on page 22

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

Turns relative power sensor measurements on and off.

Suffix:
<n> Window

<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

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

Defines the reference value for relative measurements.

Suffix:
<n> Window

<p> Power sensor index

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

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

Manual operation: See "Reference Value" on page 23

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

Sets the current measurement result as the reference level for relative measurements.

Suffix:
<n> Window

<p> Power sensor index

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

Usage: Event

Manual operation: See "Setting the Reference Level from the Measurement Meas -> Ref" on page 23

FETCh:PMETer<p>?

Queries the results of power sensor measurements.

Suffix:
<p> Power sensor index

Usage: Query only

READ:PMETer<p>?

Initiates a power sensor measurement and queries the results.

Suffix:
<p> Power sensor index

Usage: Query only

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

Turns a power sensor on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

Manual operation: See "Select" on page 21

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

Turns the duty cycle correction on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `PMET2:DCYC:STAT ON`

Manual operation: See "Duty Cycle" on page 24

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

Defines the duty cycle for the correction of pulse signals.

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

Suffix:
<p> Power sensor

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

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

Manual operation: See "Duty Cycle" on page 24

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

Defines the frequency of the power sensor.

Suffix:
<p> Power sensor index

Parameters:
<Frequency> The available value range is specified in the specifications document 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.

Manual operation: See "Frequency Manual" on page 22

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

Selects the frequency coupling for power sensor measurements.

Suffix:
<p> Power sensor index

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

	*RST: CENTer
Example:	`PMET2:FREQ:LINK CENT` Couples the frequency to the center frequency of the analyzer
Manual operation:	See "Frequency Coupling" on page 22

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

Selects the duration of power sensor measurements.

Suffix:

<p>	Power sensor index

Parameters:

<Duration>	SHORt | NORMal | LONG *RST: NORMal
Example:	`PMET2:MTIM SHOR` Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.
Manual operation:	See "Meas Time/Average" on page 22

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

Sets the number of power readings included in the averaging process of power sensor measurements.

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

Suffix:

<p>	Power sensor index

Parameters:

<NumberReadings>	An average count of 0 or 1 performs one power reading. Range: 0 to 256 Increment: binary steps (1, 2, 4, 8, ...)

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

Manual operation:	See "Average Count (Number of Readings)" on page 23

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

Turns averaging for power sensor measurements on and off.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

Manual operation: See "Meas Time/Average" on page 22

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

Includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

Manual operation: See "Use Ref Level Offset" on page 23

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

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>

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

Manual operation: See "Trigger Holdoff" on page 24

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

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.

Manual operation: See "Hysteresis" on page 24

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

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

Manual operation: See "External Trigger Level" on page 24

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

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`

Manual operation: See "Slope" on page 24

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

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

Manual operation: See "Using the power sensor as an external trigger" on page 24

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

Turns continuous update of power sensor measurements on and off.

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

Suffix:
<p> Power sensor index

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

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

Manual operation: See "Continuous Value Update" on page 21

[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`

Manual operation: See "Sensor Level Offset" on page 23

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

Turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> Power sensor index

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

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

Manual operation: See "Select" on page 21

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

Queries the number of power sensors currently connected to the R&S FSPN.

Suffix:
<p> Power sensor index

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

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

Usage: Query only

Manual operation: See "Select" on page 21

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

Assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

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

Suffix:
<p> Power sensor index

Parameters:
<Placeholder> Currently not used

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

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

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

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

Manual operation: See "Select" on page 21

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

Selects the unit for absolute power sensor measurements.

Suffix:
<n> irrelevant

<p> Power sensor index

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

Example: `UNIT:PMET:POW DBM`

Manual operation: See "Unit/Scale" on page 22

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

Selects the unit for relative power sensor measurements.

Suffix:

<n>	irrelevant
<p>	Power sensor index

Parameters:

<Unit>	DB | PCT *RST: DB

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

Manual operation: See "Unit/Scale" on page 22

6.6.3 Configuring Probes

[SENSe:]PROBe<pb>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<pb>	1..n Selects the connector: 3 = RF

Return values:
<PartNumber>

Example: //Query part number
`PROB3:ID:PART?`

Usage: Query only

Manual operation: See "Part Number" on page 31

[SENSe:]PROBe<pb>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:

<pb>	1..n Selects the connector: 3 = RF

Return values:

<SerialNo>

Example: //Query serial number
`PROB3:ID:SRN?`

Usage: Query only

Manual operation: See "Serial Number" on page 31

[SENSe:]PROBe<pb>:SETup:ATTRatio <AttenuationRatio>

Defines the attenuation applied to the input at the probe. This setting is only available for modular probes.

Suffix:

<pb>	1..n Selects the connector: 3 = RF

Parameters:

<AttenuationRatio>	**10** Attenuation by 20 dB (ratio= 10:1) **2** Attenuation by 6 dB (ratio= 2:1) *RST: 10 Default unit: DB

Manual operation: See "Attenuation" on page 32

[SENSe:]PROBe<pb>:SETup:CMOFfset <CMOffset>

Sets the common mode offset. The setting is only available if a differential probe in CM-mode is connected to the R&S FSPN.

If the probe is disconnected, the common mode offset of the probe is reset to 0.0 V.

Note that if the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

For details see the R&S FSPN User Manual.

Suffix:
<pb> 1..n
Selects the connector:
3 = RF

Parameters:
<CMOffset> Offset of the mean voltage between the positive and negative input terminal vs. ground

Range: -16 V to +16 V
Default unit: V

Manual operation: See "Common Mode Offset / Diff. Mode Offset / P Offset / N Offset /" on page 31

[SENSe:]PROBe<pb>:SETup:DMOFfset <DMOffset>

Sets the DM-mode offset. The setting is only available if a modular probe in DM-mode is connected to the R&S FSPN.

If the probe is disconnected, the DM-mode offset of the probe is reset to 0.0 V.

Note that if the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

For details see the R&S FSPN User Manual.

Suffix:
<pb> 1..n
Selects the connector:
3 = RF

Parameters:
<DMOffset> Voltage offset between the positive and negative input terminal

Default unit: V

Manual operation: See "Common Mode Offset / Diff. Mode Offset / P Offset / N Offset /" on page 31

[SENSe:]PROBe<pb>:SETup:MODE <Mode>

Suffix:
<pb> 1..n
Selects the connector:
3 = RF

Parameters:
<Mode> RSINgle | NOACtion

RSINgle
Run single: starts one data acquisition.

NOACtion
Nothing is started on pressing the micro button.

Manual operation: See "Microbutton Action" on page 32

[SENSe:]PROBe<pb>:SETup:NAME?

Queries the name of the probe.

Suffix:

<pb> 1..n
Selects the connector:
3 = RF

Return values:

<Name> String containing the name of the probe.

Example: //Query name of the probe
`PROB3:SET:NAME?`

Usage: Query only

Manual operation: See "Name" on page 31

[SENSe:]PROBe<pb>:SETup:NMOFfset <NMOffset>

Sets the N-mode offset. The setting is only available if a modular probe in N-mode is connected to the R&S FSPN. The maximum voltage difference between the positive and negative input terminals is 16 V.

If the probe is disconnected, the N-mode offset of the probe is reset to 0.0 V.

Note that if the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

For details see the R&S FSPN User Manual.

Suffix:

<pb> 1..n
Selects the connector:
3 = RF

Parameters:

<NMOffset> The voltage offset between the negative input terminal and ground.
Default unit: V

Manual operation: See "Common Mode Offset / Diff. Mode Offset / P Offset / N Offset /" on page 31

[SENSe:]PROBe<pb>:SETup:PMODe <Mode>

Determines the mode of a multi-mode modular probe.

For details see the R&S FSPN User Manual.

Suffix:

<pb> 1..n
Selects the connector:
3 = RF

Parameters:

<Mode> CM | DM | PM | NM

DM
Voltage between the positive and negative input terminal

CM
Mean voltage between the positive and negative input terminal vs. ground

PM
Voltage between the positive input terminal and ground

NM
Voltage between the negative input terminal and ground

Example: `SENS:PROB:SETU:PMOD PM`
Sets the probe to P-mode.

Manual operation: See "Mode" on page 31

[SENSe:]PROBe<pb>:SETup:PMOFfset <PMOffset>

Sets the P-mode offset. The setting is only available if a modular probe in P-mode is connected to the R&S FSPN. The maximum voltage difference between the positive and negative input terminals is 16 V.

If the probe is disconnected, the P-mode offset of the probe is reset to 0.0 V.

Note that if the offset for DM-mode or CM-mode is changed, the offsets for the P-mode and N-mode are adapted accordingly, and vice versa.

For details see the R&S FSPN User Manual.

Suffix:

<pb> 1..n
Selects the connector:
3 = RF

Parameters:

<PMOffset> The voltage offset between the positive input terminal and ground.

Default unit: V

Manual operation: See "Common Mode Offset / Diff. Mode Offset / P Offset / N Offset /" on page 31

[SENSe:]PROBe<pb>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not detected).

Suffix:

<pb>	1..n Selects the connector: 3 = RF

Return values:

<State>	DETected | NDETected
Example:	//Query connector state `PROB3:SET:STAT?`
Usage:	Query only

[SENSe:]PROBe<pb>:SETup:TYPE?

Queries the type of the probe.

Suffix:

<pb>	1..n Selects the connector: 3 = RF

Return values:

<Type>	String containing one of the following values: –"None" (no probe detected) –"active differential" –"active single-ended" –"active modular"
Example:	//Query probe type `PROB3:SET:TYPE?`
Usage:	Query only
Manual operation:	See "Type" on page 31

6.6.4 Configuring Outputs

DIAGnostic:SERVice:NSOurce <State>

Turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S FSPN on and off.

Parameters:

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

ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 33

OUTPut:UPORt[:VALue] <Value>

Sets the control lines of the user ports.

The assignment of the pin numbers to the bits is as follows:

Bit	7	6	5	4	3	2	1	0
Pin	N/A	N/A	5	3	4	7	6	2

Bits 7 and 6 are not assigned to pins and must always be 0.

The user port is written to with the given binary pattern.

Parameters:

<Value> bit values in hexadecimal format

TTL type voltage levels (max. 5V)

Range: #B00000000 to #B00111111

Example: `OUTP:UPOR #B00100100`
Sets pins 5 and 7 to 5 V.

OUTPut:UPORt:STATe <State>

Toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S FSPN.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
User port is switched to INPut

ON | 1
User port is switched to OUTPut

Example: `OUTP:UPOR:STAT ON`

6.6.5 Configuring Level Characteristics

CALCulate<n>:MARKer<m>:FUNCtion:REFerence

Matches the reference level to the power level of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Example: `CALC:MARK2:FUNC:REF`
Sets the reference level to the level of marker 2.

Manual operation: See "Reference Level = Marker Level" on page 77

CALCulate<n>:UNIT:POWer <Unit>

Selects the power unit.

The unit applies to all power-based measurement windows with absolute values.

In addition, the unit of the reference level is adapted to the same unit.

Suffix:

<n> irrelevant

Parameters:

<Unit> *RST: dBm

Example: `CALC:UNIT:POW DBM`
Sets the power unit to dBm.

Manual operation: See "Unit" on page 36

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

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

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<ReferenceLevel>	The unit is variable. Range: see specifications document *RST: 0 dBm Default unit: DBM
Example:	`DISP:TRAC:Y:RLEV -60dBm`
Manual operation:	See "Reference Level" on page 35

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

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

Suffix:

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

Parameters:

<Offset>	Range: -200 dB to 200 dB *RST: 0dB Default unit: DB
Example:	`DISP:TRAC:Y:RLEV:OFFS -10dB`
Manual operation:	See "Shifting the Display (Offset)" on page 36

[SENSe:]POWer:NCORrection <State>

Turns noise cancellation on and off.

If noise cancellation is on, the R&S FSPN performs a reference measurement to determine its inherent noise and subtracts the result from the channel power measurement result (first active trace only).

For more information see "Noise Cancellation" on page 37.

Parameters:

<State>	ON | OFF | 1 | 0 *RST: 0
Example:	`POW:NCOR ON`
Manual operation:	See "Noise Cancellation" on page 37

[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 FSPN is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

Example: `ADJ:LEV`

6.6.6 Configuring the Attenuator

INPut:ATTenuation <Attenuation>

Defines the total attenuation for RF input.

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

Parameters:

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

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

Manual operation: See "Attenuation Value" on page 36

INPut:ATTenuation:AUTO:MODE <OptMode>

Selects the priority for signal processing *after* the RF attenuation has been applied.

Parameters:

<OptMode>
LNOise | LDIStortion

LNOise
Optimized for high sensitivity and low noise levels

LDIStortion
Optimized for low distortion by avoiding intermodulation

*RST: LDIStortion (WLAN application: LNOise)

Example: `INP:ATT:AUTO:MODE LNO`

Manual operation: See "Optimization" on page 36

INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

Requires the electronic attenuation hardware option.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

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

Manual operation: See "Using Electronic Attenuation" on page 37

INPut:EATT:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Requires the electronic attenuation hardware option.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 37

INPut:EATT <Attenuation>

Defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 145).

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

Requires the electronic attenuation hardware option.

Parameters:

<Attenuation> attenuation in dB

Range: see specifications document
Increment: 1 dB
*RST: 0 dB (OFF)
Default unit: DB

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

Manual operation: See "Using Electronic Attenuation" on page 37

6.6.7 Configuring the Preamplifier

INPut:GAIN:STATe <State>

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

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 146).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 30 dB

Default unit: DB

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```
Switches on 30 dB preamplification.

6.6.8 Scaling the Y-Axis

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe] <Range>

Defines the display range of the y-axis (for all traces).

Note that the command works only for a logarithmic scaling. You can select the scaling with `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing`.

Suffix:

<n> — Window

<w> — subwindow
Not supported by all applications

<t> — irrelevant

Parameters:

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

Example: `DISP:TRAC:Y 110dB`

Manual operation: See "Range" on page 38
See "Y-Axis Max" on page 39

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again (for all traces).

Suffix:

<n> — Window

<t> — irrelevant

Manual operation: See "Auto Scale Once" on page 39

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MODE <Mode>

Selects the type of scaling of the y-axis (for all traces).

When the display update during remote control is off, this command has no immediate effect.

Suffix:

<n> — Window

<w> subwindow

<t> irrelevant

Parameters:
<Mode> **ABSolute**
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example: `DISP:TRAC:Y:MODE REL`

Manual operation: See "Scaling" on page 39

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition <Position>

Defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSPN adjusts the scaling of the y-axis accordingly.

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:
<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display
Default unit: PCT

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Ref Level Position" on page 38

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y:SPACing <ScalingType>

Selects the scaling of the y-axis (for all traces, <t> is irrelevant).

Suffix:
<n> Window

<w> subwindow

<t> Trace

Parameters:
<ScalingType> **LOGarithmic**
Logarithmic scaling.

LINear
Linear scaling in %.

LDB
Linear scaling in the specified unit.

PERCent
Linear scaling in %.

*RST: LOGarithmic

Example: `DISP:TRAC:Y:SPAC LIN`
Selects linear scaling in %.

Manual operation: See "Scaling" on page 39

6.6.9 Configuring the Frequency

CALCulate<n>:MARKer<m>:FUNCtion:CENTer

Matches the center frequency to the frequency of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Suffix:
<n> Window

<m> Marker

Example: `CALC:MARK2:FUNC:CENT`
Sets the center frequency to the frequency of marker 2.

Manual operation: See "Center Frequency = Marker Frequency" on page 77

[SENSe:]FREQuency:CENTer <Frequency>

Defines the center frequency.

CW, pulsed and VCO measurements:

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

Transient measurement:

This command defines the center frequency of the transient measurement.

Parameters:

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

*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency" on page 40

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

Defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 149.

Parameters:

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

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

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

Manual operation: See "Center Frequency Stepsize" on page 40

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

Couples or decouples the center frequency step size to the span.

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:
```
FREQ:CENT:STEP:AUTO ON
```
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:OFFSet <Offset>

Defines a frequency offset.

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

See also "Frequency Offset" on page 40.

Parameters:

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

Example: `FREQ:OFFS 1GHZ`

Manual operation: See "Frequency Offset" on page 40

6.6.10 Configuring Trigger

*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

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 44

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the measurement.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative measurement time to 30 s.

*RST: 0 s
Default unit: S

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 43

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 44

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

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

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis" on page 44

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

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

In the Spectrum Monitor, only `EXTernal1` is supported.

Parameters:

<TriggerLevel> — Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: `TRIG:LEV 2V`

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> — For details on available trigger levels and trigger bandwidths, see the specifications document.
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IFP -30DBM`

Manual operation: See "Trigger Level" on page 43

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> — Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: DBM

Example: `TRIG:LEV:IQP -30DBM`

Manual operation: See "Trigger Level" on page 43

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

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

*RST: -20 dBm

Default unit: DBM

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:SLOPe <Type>

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 44

TRIGger[:SEQuence]:SOURce <Source>

Selects the trigger source.

Note on external triggers:

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

Parameters:

<Source>

IMMediate
Free Run

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

VIDeo
Video mode is available in the time domain and only in the Spectrum application.

*RST: IMMediate

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

Manual operation:
See "Trigger Source" on page 41
See "Free Run" on page 41
See "Ext. Trigger 1/2" on page 42
See "IF Power" on page 42
See "I/Q Power" on page 42
See "RF Power" on page 43

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

Defines the repetition interval for the time trigger.

Parameters:

<Interval> numeric value

Range: 2 ms to 5000 s
*RST: 1.0 s
Default unit: S

Example: `TRIG:SOUR TIME`
Selects the time trigger input for triggering.
`TRIG:TIME:RINT 5`
The measurement starts every 5 s.

Manual operation: See "Repetition Interval" on page 43

6.6.11 Configuring Trigger Output

OUTPut:TRIGger<tp>:DIRection <Direction>

Selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<tp>

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 33

OUTPut:TRIGger<tp>:LEVel <Level>

Defines the level of the (TTL compatible) signal generated at the trigger output.

Works only if you have selected a user-defined output with `OUTPut:TRIGger<tp>:OTYPe`.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:
<Level> **HIGH**
5 V

LOW
0 V

*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 34

OUTPut:TRIGger<tp>:OTYPe <OutputType>

Selects the type of signal generated at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S FSPN has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user-defined trigger signal. For more information, see `OUTPut:TRIGger<tp>:LEVel`.

*RST: DEVice

Manual operation: See "Output Type" on page 33

OUTPut:TRIGger<tp>:PULSe:IMMediate

Generates a pulse at the trigger output.

Suffix:
<tp> 1..n
Selects the trigger port to which the output is sent.

Manual operation: See "Send Trigger" on page 34

OUTPut:TRIGger<tp>:PULSe:LENGth <Length>

Defines the length of the pulse generated at the trigger output.

Suffix:

<tp> Selects the trigger port to which the output is sent.

Parameters:

<Length> Pulse length in seconds.

Default unit: S

Example: `OUTP:TRIG2:PULS:LENG 0.02`

Manual operation: See "Pulse Length" on page 34

6.6.12 Configuring Data Acquisition

Useful commands for data acquisition described elsewhere

- [SENSe:]SWEep:COUNt on page 109
- [SENSe:]SWEep[:WINDow<n>]:POINts on page 110
- [SENSe:]SWEep:TIME on page 110

[SENSe:]IQ:BWIDth:MODE <Mode>

Defines how the resolution bandwidth is determined.

Parameters:

<Mode> AUTO | MANual | FFT

AUTO
(Default) The RBW is determined automatically depending on the sample rate and record length.

MANual
The user-defined RBW is used and the (FFT) window length (and possibly the sample rate) are adapted accordingly. The RBW is defined using the `[SENSe:]IQ:BWIDth:RESolution` command.

FFT
The RBW is determined by the FFT parameters.

*RST: AUTO

Example:
`IQ:BAND:MODE MAN`
Switches to manual RBW mode.
`IQ:BAND:RES 120000`
Sets the RBW to 120 kHz.

Manual operation: See "RBW" on page 47

[SENSe:]IQ:BWIDth:RESolution <Bandwidth>

Defines the resolution bandwidth manually if `[SENSe:]IQ:BWIDth:MODE` is set to `MAN`.

Defines the resolution bandwidth. The available RBW values depend on the sample rate and record length.

Parameters:
<Bandwidth> refer to specifications document

*RST: RBW: AUTO mode is used
Default unit: HZ

Example:
`IQ:BAND:MODE MAN`
Switches to manual RBW mode.
`IQ:BAND:RES 120000`
Sets the RBW to 120 kHz.

Manual operation: See "RBW" on page 47

[SENSe:]IQ:FFT:ALGorithm <Method>

Defines the FFT calculation method.

Parameters:
<Method>

SINGle
One FFT is calculated for the entire record length; if the FFT length is larger than the record length (see `[SENSe:]IQ:FFT:LENGth` and `TRACe:IQ:RLENgth`), zeros are appended to the captured data.

AVERage
Several overlapping FFTs are calculated for each record; the results are averaged to determine the final FFT result for the record.
The user-defined window length and window overlap are used.
See `[SENSe:]IQ:FFT:WINDow:LENGth` and `[SENSe:]IQ:FFT:WINDow:OVERlap`.

*RST: AVER

Example: `IQ:FFT:ALG SING`

Manual operation: See "Transformation Algorithm" on page 47

[SENSe:]IQ:FFT:LENGth <NoOfBins>

Defines the number of frequency points determined by each FFT calculation. The more points are used, the higher the resolution in the spectrum becomes, but the longer the calculation takes.

Parameters:

<NoOfBins> integer value

Range: 3 to 524288
*RST: 4096

Example: `IQ:FFT:LENG 2048`

Manual operation: See "FFT Length" on page 48

[SENSe:]IQ:FFT:WINDow:LENGth <NoOfFFT>

Defines the number of samples to be included in a single FFT window when multiple FFT windows are used.

Parameters:

<NoOfFFT> integer value

Range: 3 to 4096
*RST: record length

Example: `IQ:FFT:WIND:LENG 500`

Manual operation: See "Window Length" on page 48

[SENSe:]IQ:FFT:WINDow:OVERlap <Rate>

Defines the part of a single FFT window that is re-calculated by the next FFT calculation.

Parameters:

<Rate> double value

Percentage rate

Range: 0 to 1
*RST: 0.75

Example: `IQ:FFT:WIND:OVER 0.5`
Half of each window overlaps the previous window in FFT calculation.

Manual operation: See "Window Overlap" on page 48

[SENSe:]IQ:FFT:WINDow:TYPE <Function>

In the I/Q Analyzer you can select one of several FFT window types.

Parameters:

<Function>

BLACkharris
Blackman-Harris

FLATtop
Flattop

GAUSsian
Gauss

RECTangular
Rectangular

P5
5-Term

*RST: FLAT

Example: `IQ:FFT:WIND:TYPE GAUS`

Manual operation: See "Window Function" on page 48

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for secondary applications in MSRA mode, not for the MSRA primary application. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset> This parameter defines the time offset between the capture buffer start and the start of the extracted secondary application data. The offset must be a positive value, as the secondary application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0
Default unit: S

[SENSe:]SWAPiq <State>

Defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S FSPN can do the same to compensate for it.

Parameters:

<State>

ON | 1
I and Q signals are interchanged
Inverted sideband, Q+j*I

OFF | 0
I and Q signals are not interchanged
Normal sideband, I+j*Q

*RST: 0

Manual operation: See "Swap I/Q" on page 47

TRACe:IQ:BWIDth

Defines or queries the bandwidth of the resampling filter.

The bandwidth of the resampling filter depends on the sample rate.

Parameters:

<Bandwidth> Default unit: HZ

Manual operation: See "Analysis Bandwidth" on page 46

TRACe:IQ:RLENgth <NoOfSamples>

Sets the record length for the acquired I/Q data.

Increasing the record length also increases the measurement time.

Note: Alternatively, you can define the measurement time using the `SENS:SWE:TIME` command.

Parameters:

<NoOfSamples> Number of samples to record.

*RST: 1001

Example: `TRAC:IQ:RLEN 256`

Manual operation: See "Record Length" on page 46

TRACe:IQ:SET <NORM>, <0>, <SampleRate>, <TriggerMode>, <TriggerSlope>, <PretriggerSamp>, <NumberSamples>

Sets up the R&S FSPN for I/Q measurements.

If you do not use this command to set up I/Q measurements, the R&S FSPN will use its current settings for I/Q measurements.

If the I/Q Analyzer has not been turned on previously, the command also switches to the I/Q Analyzer.

Note: If you use the default settings with TRACe:IQ:DATA??, the following minimum buffer sizes for the response data are recommended:

ASCII format: 10 kBytes

Binary format: 2 kBytes

Parameters:

<NORM> This value is always NORM.

<0> Default unit: HZ
This value is always 0.

<SampleRate> Sample rate for the data acquisition.
Range: 100 Hz to 20 GHz, continuously adjustable
*RST: 32000000
Default unit: HZ

<TriggerMode> Selection of the trigger source used for the measurement.
IMMediate | EXTernal | EXT2 | EXT3 | IFPower
For IMM mode, gating is automatically deactivated.
*RST: IMM

<TriggerSlope> Used trigger slope.
POSitive | NEGative
*RST: POS

<PretriggerSamp> Defines the trigger offset in terms of pretrigger samples. Negative values correspond to a trigger delay.
This value also defines the interval between the trigger signal and the gate edge in samples.
Range: -1399999999 to 1399999999
*RST: 0

<NumberSamples> Number of measurement values to record (including the pretrigger samples).
*RST: 1001

Example:
```
TRAC:IQ:SET NORM,0,32MHz,EXT,POS,0,2048
```
Reads 2048 I/Q-values starting at the trigger point.
sample rate = 32 MHz
trigger = External
slope = Positive
```
TRAC:IQ:SET NORM,0,4 MHz,EXT,POS,1024,512
```
Reads 512 I/Q-values from 1024 measurement points before the trigger point.
filter type = NORMAL
sample rate = 4 MHz
trigger = External
slope = Positive

Manual operation: See "Record Length" on page 46

TRACe:IQ:SRATe <SampleRate>

Sets the final user sample rate for the acquired I/Q data. Thus, the user sample rate can be modified without affecting the actual data capturing settings on the R&S FSPN.

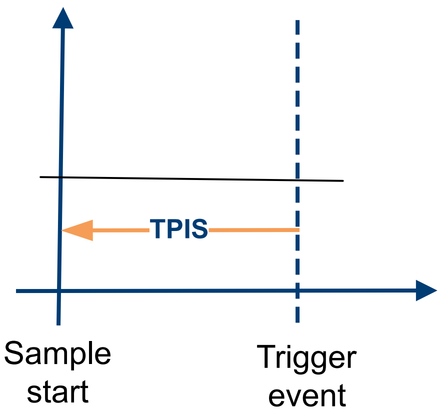
Parameters:

<SampleRate> *RST: 32 MHz
Default unit: HZ

Manual operation: See "Sample Rate" on page 45

TRACe:IQ:TPISample?

Queries the time offset from the sample start to the trigger event (trigger point in sample = TPIS). Since the R&S FSPN usually samples with a much higher sample rate than the specific application actually requires, the trigger point determined internally is much more precise than the one determined from the (downsampled) data in the application. Thus, the TPIS indicates the offset from the sample start to the actual trigger event.



This value can only be determined in triggered measurements using external or IFPower triggers, otherwise the value is 0.

Return values:

<TPIS> numeric value
Default unit: s

Example: `TRAC:IQ:TPIS?`
Result for a sample rate of 1 MHz: between 0 and 1/1 MHz, i.e. between 0 and 1 µs (the duration of 1 sample).

Usage: Query only

TRACe:IQ:WBANd:MBWidth <Limit>

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

Manual operation: See "Maximum Bandwidth" on page 46

TRACe:IQ:WBANd[:STATe] <State>

Determines whether the wideband provided by bandwidth extension options is used or not (if installed).

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Maximum Bandwidth" on page 46

TRACe:IQ:WFILter <State>

Activates a 200 MHz filter before the A/D converter, thus restricting the processed bandwidth to 200 MHz while using the wideband processing path in the R&S FSPN. For prerequisites see manual operation.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "200 MHz Filter" on page 46

6.6.13 Configuring the Result Display

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

Maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 168).

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`

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
```
LAY:ADD? '1',LEFT,MTAB
```
Result:
```
'2'
```
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation:
See "Spectrum" on page 11
See "Marker Table" on page 11
See "Marker Peak List" on page 12

Table 6-3: <WindowType> parameter values for IQ Analyzer application

Parameter value	Window type
FREQ	"Spectrum"
MAGN	"Magnitude"
MTABle	"Marker table"
PEAKlist	"Marker peak list"
PHASe	"Phase vs. time"
RIMAG	"Real/Imag (I/Q)"
VECT	"I/Q Vector"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 165 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command does not work, but does not return an error.

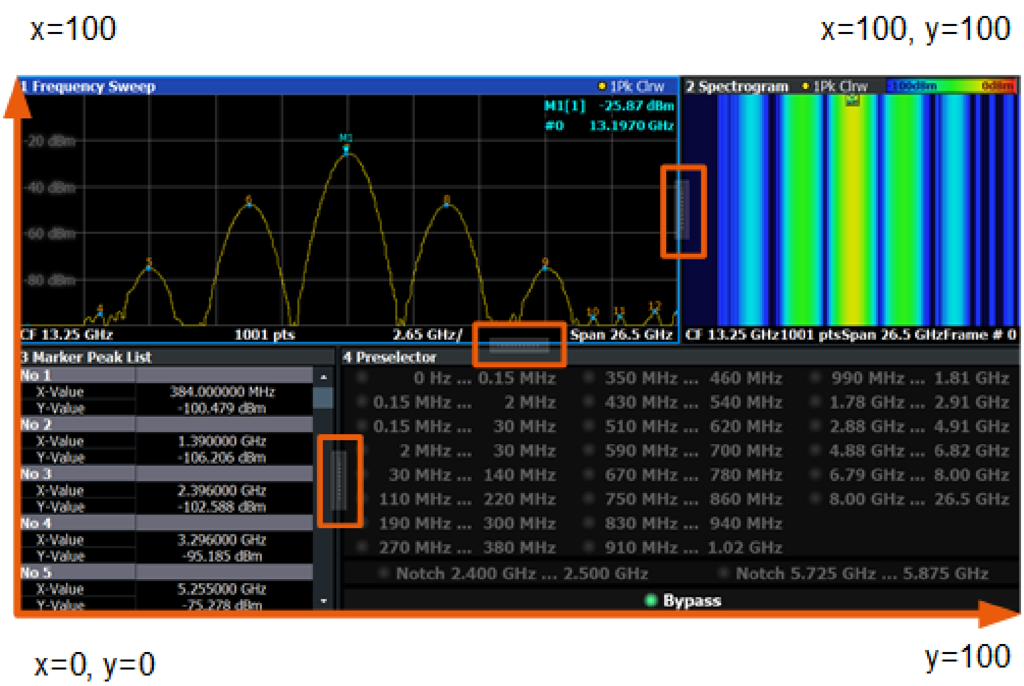


Figure 6-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 6-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Table"') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 165 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> — Window

Setting parameters:
<WindowType> — Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 165 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

6.6.14 Transducer

Before making any changes to a transducer factor or set, you have to select one by name with `[SENSe:]CORRection:TRANsducer:SELect`.

Compared to manual configuration of transducers, any changes made to a transducer factor or set via remote control are saved after the corresponding command has been sent.

Designing a transducer factor

```
//Select a transducer factor
CORR:TRAN:SEL 'Transducer1'
//Define a comment for the transducer factor
CORR:TRAN:COMM 'Correction values for device x'
//Define the transducer factor unit
CORR:TRAN:UNIT 'DB'
//Select the scale of the frequency axis
CORR:TRAN:SCAL LOG
//Define the data points of the transducer factor
CORR:TRAN:DATA 1MHZ,-10,10MHZ,-10,100MHZ,-15,1GHZ,-15
//Turn on the transducer
CORR:TRAN ON
//Automatically adjust the reference level
CORR:TRAN:ADJ:RLEV ON
```

Managing a transducer set

```
//Select or create a transducer set
CORR:TSET:SEL 'Transducer Set'
//Define a comment for the transducer set
CORR:TSET:COMM 'Transducer set example'
//Define a unit for the transducer set
CORR:TSET:UNIT 'DB'
//Turn the transducer break on
CORR:TSET:BRE ON
```

```
//Define the first transducer range
CORR:TSET:RANG1 150KHZ,1MHZ,'Transducer 1','Transducer 3'
CORR:TSET:RANG2 1MHZ,10MHZ,'Transducer 3','Transducer 4'
CORR:TSET:RANG3 10MHZ,30MHZ,'Transducer 3'
//Turn on the transducer set
CORR:TSET ON
```

Useful commands to use transducers described elsewhere:

- `MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 172

MMEMory:LOAD<n>:TFACtor <FileName>

Loads the transducer factor from the selected file in `.CSV` format.

Suffix:

<n> irrelevant

Parameters:

<FileName> String containing the path and name of the `CSV` import file.

Example: `MMEM:LOAD:TFAC 'C:\TEST.CSV'`

Manual operation: See "Import" on page 57

MMEMory:SELect[:ITEM]:TRANsducer:ALL <State>

This command includes or excludes transducer factors when storing or loading a configuration file.

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

Example: `MMEM:SEL:TRAN:ALL ON`

Manual operation: See "Save" on page 56

MMEMory:STORe<1|2>:STATe <1>, <FileName>

This command saves the current instrument configuration in a *.dfl file.

Suffix:
<1|2> irrelevant

Parameters:
<1>

<FileName> String containing the path and name of the target file.
The file extension is .dfl.

Example: `MMEM:STOR:STAT 1,'Save'`
Saves the current instrument settings in the file `Save.dfl`.

MMEMory:STORe<n>:TFACtor <FileName>, <TransdName>

Exports transducer factor data to an ASCII (CSV) file.

For details on the file format see Chapter 4.9.4, "Reference: transducer factor file format", on page 60.

Suffix:
<n> irrelevant

Parameters:
<FileName> Name of the transducer factor to be exported.

<TransdName> Name of the transducer factor to be exported.

Example: `MMEM:STOR:TFAC 'C:\TEST', 'Transducer1'`
Stores the transducer factor named "Transducer1" in the file `TEST.CSV`.

Manual operation: See "Export" on page 57

[SENSe:]CORRection:TRANsducer:ADJust:RLEVel[:STATe] <State>

This command turns an automatic adjustment of the reference level to the transducer on and off.

Before you can use the command, you have to select and turn on a transducer.

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

Manual operation: See "Adjust Ref Level" on page 54

[SENSe:]CORRection:TRANsducer:COMMent <Comment>

This command defines the comment for the selected transducer factor.

Before you can use the command, you have to select and turn on a transducer.

Parameters:
<Comment> *RST: (empty comment)

Manual operation: See "Comment" on page 55

[SENSe:]CORRection:TRANsducer:DATA {<Frequency>, <Level>}...

This command configures transducer factors for specific trace points. A set of transducer factors defines an interpolated transducer line and can be stored on the instrument. You can define up to 1001 points.

Parameters:

<Frequency> The unit for <Frequency> is Hz, which may or may not be omitted. Frequencies have to be sorted in ascending order.

Default unit: Hz

<Level> The unit for <Level> depends on `[SENSe:]CORRection:TRANsducer:UNIT`.

Example:

```
SENSe1:CORRection:TRANsducer:UNIT 'DB'
// Frequency Span 0 Hz to 4 Ghz
SENSe1:CORRection:TRANsducer:DATA 0,8,2GHz,5,4GHz,3
```

Manual operation: See "Data Points" on page 56

Table 6-4: Created transducer points in example

Frequency	Level
0 Hz	8 dB
2 GHz	5 dB
4 GHz	3 dB

[SENSe:]CORRection:TRANsducer:DELete

This command deletes the currently selected transducer factor.

Before you can use the command, you have to select a transducer.

Example: `CORR:TRAN:DEL`

Manual operation: See "Delete Line" on page 54

[SENSe:]CORRection:TRANsducer:SCALing <ScalingType>

This command selects the frequency scaling of the transducer factor.

Parameters:

<ScalingType> LINear | LOGarithmic

*RST: LINear

Manual operation: See "X-Axis Scaling" on page 56

[SENSe:]CORRection:TRANsducer:SELect <Name>

This command selects a transducer factor.

Parameters:

<Name> String containing the name of the transducer factor.
If the name does not exist yet, the R&S FSPN creates a transducer factor by that name.

Example: `CORR:TRAN:SEL 'FACTOR1'`

Manual operation: See "Activating / Deactivating" on page 53
See "Create New Line" on page 54
See "Name" on page 55

[SENSe:]CORRection:TRANsducer:UNIT <Unit>

This command selects the unit of the transducer factor.

Before you can use the command, you have to select and turn on a transducer.

Parameters:

<Unit> string as defined in table below
*RST: DB

Example: `CORR:TRAN:UNIT 'DBUV'`

Manual operation: See "Unit" on page 56

String	Unit
'DB'	dB
'DBM'	dBm
'DBMV'	dBmV
'DBUV'	dBμV
'DBUA'	dBμA
'DBPW'	dBpW
'DBPT'	dBpT

[SENSe:]CORRection:TRANsducer[:STATe] <State>

This command turns the selected transducer factor on or off.

Before you can use the command, you have to select a transducer.

Parameters:

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

Manual operation: See "Activating / Deactivating" on page 53

6.7 Analyzing Results

6.7.1 Configuring Standard Traces

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

Couples and decouples the detector to the trace mode.

Suffix:

<n>	Window
<t>	Trace

Parameters:

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

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 62

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

Suffix:

<n>	Window

<t> Trace

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 62

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing:APERture <Aperture>

Defines the degree (aperture) of the trace smoothing, if `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing[:STATe]` `TRUE`.

Suffix:

<n> Window

<w> subwindow

<t> Trace

Parameters:

<Aperture> Range: 1 to 50
*RST: 2
Default unit: PCT

Example: `DISP3:TRAC2:SMO:APER 5`
Defines an aperture of 5% for trace 2 in window 3

Manual operation: See "Smoothing" on page 63

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE <Mode>

Selects the trace mode. If necessary, the selected trace is also activated.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:

<Mode>

WRITe
(default:) Overwrite mode: the trace is overwritten by each sweep.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSPN saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSPN saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

`INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 61

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE:HCONtinuous <State>

Turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Suffix:

<n> Window

<w> subwindow

<t> Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:

`DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 63

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing[:STATe] <State>

Turns trace smoothing for a particular trace on and off.

If enabled, the trace is smoothed by the value specified using `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:SMOothing:APERture` on page 177.

For more information see the R&S FSPN User Manual.

Suffix:

<n>	Window
<w>	subwindow
<t>	Trace

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off **ON | 1** Switches the function on
Example:	`DISP3:TRAC2:SMO ON` Turns on trace smoothing for trace 2 in window 3
Manual operation:	See "Smoothing" on page 63

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] <State>

Turns a trace on and off.

The measurement continues in the background.

Suffix:

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

Parameters:

<State>	ON | OFF | 0 | 1 **OFF | 0** Switches the function off **ON | 1** Switches the function on
Example:	`DISP:TRAC3 ON`
Manual operation:	See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 61 See "Trace 1/ Trace 2/ Trace 3/ Trace 4 (Softkeys)" on page 64

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:X:SPACing <Scale>

Selects the scaling of the x-axis.

Suffix:

<n>	Window
<w>	subwindow
<t>	

Parameters:

<Scale>

LOGarithmic
Logarithmic scaling.

LINear
Linear scaling.

*RST: LINear

Example: `DISP:TRAC:X:SPAC LOG`

[SENSe:]AVERage<n>:TYPE <Mode>

Selects the trace averaging mode.

Suffix:

<n> 1..n
Window

Parameters:

<Mode>

LOGarithmic
The logarithmic power values are averaged.

LINear
The power values are averaged before they are converted to logarithmic values.

POWer
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

Example: `AVER:TYPE LIN`
Switches to linear average calculation.

Manual operation: See "Average Mode" on page 63

[SENSe:]AVERage<n>:COUNt <AverageCount>

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

In case of continuous sweep mode, the application calculates the moving average over the average count.

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

Suffix:
<n> irrelevant

Parameters:
<AverageCount> If you set an average count of 0 or 1, the application performs one single measurement in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

Manual operation: See "Average Count" on page 63

6.7.2 Exporting and Importing Traces

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

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 116).

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

FORMat:DIMPort:TRACes <Selection>

Selects the data to be included in a data import file (see MMEMory:LOAD<n>:TRACe on page 182).

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for import, namely the one specified by the MMEMory:LOAD<n>:TRACe on page 182 command.

ALL
Imports several traces at once, overwriting the existing trace data for any active trace in the result display with the same trace number. Data from the import file for currently not active traces is not imported.
The <trace> parameter for the MMEMory:LOAD<n>:TRACe on page 182 command is ignored.

*RST: SINGle

MMEMory:LOAD<n>:TRACe <Trace>, <FileName>

Imports trace data from the specified window to an ASCII file.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored
(This parameter is ignored for FORMat:DIMPort:TRACesALL).

<FileName> String containing the path and name of the import file.

FORMat:DEXPort:XDIStrib <XDistribution>

Defines how the x-values of the trace are determined in the frequency domain.

Parameters:

<XDistribution> STARtstop | BINCentered

BINCentered
The full measurement span is divided by the number of measurement points to obtain *bin*s. The x-value of the measurement point is defined as the x-value at the center of the bin (bin/2).

STARtstop
(Default): The x-value of the first measurement point corresponds to the starting point of the full measurement span. The x-value of the last measurement point corresponds to the end point of the full measurement span. All other measurement points are divided evenly between the first and last points.

Example: `FORM:DEXP:XDIS BINC`

Manual operation: See "X-Value Distribution" on page 64

6.7.3 Configuring Spectrograms

CALCulate<n>:SGRam:CLEar[:IMMediate]
CALCulate<n>:SPECtrogram:CLEar[:IMMediate]

Resets the spectrogram and clears the history buffer.

Suffix:
<n> Window

Example: //Reset the result display and clear the memory
`CALC:SGR:CLE`

Manual operation: See "Clear Spectrogram" on page 67

CALCulate<n>:SGRam:CONTinuous <State>
CALCulate<n>:SPECtrogram:CONTinuous <State>

Determines whether the results of the last measurement are deleted before starting a new measurement in single sweep mode.

This setting applies to all spectrograms in the channel.

Suffix:
<n> Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
`INIT:CONT OFF`
Selects single sweep mode.
`INIT;*WAI`
Starts the sweep and waits for the end of the sweep.
`CALC:SGR:CONT ON`
Repeats the single sweep measurement without deleting the results of the last measurement.

CALCulate<n>:SGRam:FRAMe:COUNt <Frames>
CALCulate<n>:SPECtrogram:FRAMe:COUNt <Frames>

Defines the number of frames to be recorded in a single sweep.

This value applies to all spectrograms in the channel.

Suffix:
<n> Window

Parameters:
<Frames> The maximum number of frames depends on the history depth.

Range: 1 to history depth
Increment: 1
*RST: 1

Example:
//Select single sweep mode
`INIT:CONT OFF`
//Set the number of frames to 200
`CALC:SGR:FRAM:COUN 200`

CALCulate<n>:SGRam:FRAMe:SELect <Frame> | <Time>
CALCulate<n>:SPECtrogram:FRAMe:SELect <Frame> | <Time>

Selects a specific frame for further analysis.

The command is available if no measurement is running or after a single sweep has ended.

Suffix:
<n> Window

Parameters:
<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.
Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.

Example:
`INIT:CONT OFF`
Stop the continuous sweep.
`CALC:SGR:FRAM:SEL -25`
Selects frame number -25.

Manual operation: See "Select Frame" on page 66

CALCulate<n>:SGRam:HDEPth <History>
CALCulate<n>:SPECtrogram:HDEPth <History>

Defines the number of frames to be stored in the R&S FSPN memory.

Suffix:
<n> Window

Parameters:
<History> The maximum number of frames depends on the number of sweep points.
Range: 781 to 20000
Increment: 1
*RST: 3000

Example:
//Set the history depth to 1500
`CALC:SGR:SPEC 1500`

Manual operation: See "History Depth" on page 66

CALCulate<n>:SGRam:LAYout <State>
CALCulate<n>:SPECtrogram:LAYout <State>

This command selects the state and size of spectrograms.

The command is available for result displays that support spectrograms.

Suffix:
<n> Window

Example: `CALC4:SPEC:LAY FULL`
Shows the spectrogram in window 4. The corresponding trace diagram is hidden.

Manual operation: See "State" on page 66

CALCulate<n>:SGRam:THReedim[:STATe] <State>
CALCulate<n>:SPECtrogram:THReedim[:STATe] <State>

Activates or deactivates a 3-dimensional spectrogram for the selected result display.

Suffix:
<n> — Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:SPEC:THR:STAT ON`

Manual operation: See "3D Spectrogram State" on page 66

CALCulate<n>:SGRam:TSTamp:DATA? <Frames>
CALCulate<n>:SPECtrogram:TSTamp:DATA? <Frames>

Queries the starting time of the frames.

The return values consist of four values for each frame. If the "Spectrogram" is empty, the command returns '0,0,0,0'. The times are given as delta values, which simplifies evaluating relative results; however, you can also calculate the absolute date and time as displayed on the screen.

The frame results themselves are returned with `TRAC:DATA? SGR`

Suffix:
<n> — Window

Query parameters:
<Frames>

CURRent
Returns the starting time of the current frame.

ALL
Returns the starting time for all frames. The results are sorted in descending order, beginning with the current frame.

Return values:
<Seconds> — Number of seconds that have passed since 01.01.1970 until the frame start

<Nanoseconds> — Number of nanoseconds that have passed *in addition to the <Seconds>* since 01.01.1970 until the frame start.

<Reserved> The third value is reserved for future uses.

<Reserved> The fourth value is reserved for future uses.

Example: `CALC:SGR:TST:DATA? ALL`
Returns the starting times of all frames sorted in a descending order.

Usage: Query only

Manual operation: See "Time Stamp" on page 67

CALCulate<n>:SGRam:TSTamp[:STATe] <State>
CALCulate<n>:SPECtrogram:TSTamp[:STATe] <State>

Activates and deactivates the time stamp.

If the time stamp is active, some commands do not address frames as numbers, but as (relative) time values:

- `CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe` on page 194
- `CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 195
- `CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 184

Suffix:
<n> 1..n
Window

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: //Activates the time stamp
`CALC:SGR:TST ON`

Manual operation: See "Time Stamp" on page 67

CALCulate<n>:SGRam[:STATe] <State>
CALCulate<n>:SPECtrogram[:STATe] <State>

Turns the spectrogram on and off.

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:SGR ON`
Activates the Spectrogram result display.

DISPlay[:WINDow<n>]:SGRam:COLor:DEFault
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault

Restores the original color map.

Suffix:
<n> Window

Manual operation: See "Set to Default" on page 69

DISPlay[:WINDow<n>]:SGRam:COLor:LOWer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer <Percentage>

Defines the starting point of the color map.

Suffix:
<n> Window

Parameters:
<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:LOW 10`
Sets the start of the color map to 10%.

Manual operation: See "Start / Stop" on page 68

DISPlay[:WINDow<n>]:SGRam:COLor:SHAPe <Shape>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe <Shape>

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

Suffix:
<n> Window

Parameters:
<Shape> Shape of the color curve.

Range: -1 to 1
*RST: 0

Manual operation: See "Shape" on page 68

DISPlay[:WINDow<n>]:SGRam:COLor:UPPer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer <Percentage>

Defines the end point of the color map.

Suffix:
<n> Window

Parameters:

<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:UPP 95`
Sets the start of the color map to 95%.

Manual operation: See "Start / Stop" on page 68

DISPlay[:WINDow<n>]:SGRam:COLor[:STYLe] <ColorScheme>
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe] <ColorScheme>

Selects the color scheme.

Parameters:

<ColorScheme>

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

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

RADar
Uses a color range from black over green to light turquoise with shades of green in between.

GRAYscale
Shows the results in shades of gray.

*RST: HOT

Example: `DISP:WIND:SPEC:COL GRAY`
Changes the color scheme of the spectrogram to black and white.

Manual operation: See "Hot/Cold/Radar/Grayscale" on page 69

MMEMory:STORe<n>:SPECtrogram <FileName>

Exports spectrogram data to an ASCII file.

The file contains the data for every frame in the history buffer. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Note that, depending on the size of the history buffer, the process of exporting the data can take a while.

Suffix:

<n> Window

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:SGR 'Spectrogram'`
Copies the spectrogram data to a file.

6.7.4 Individual Marker Setup

CALCulate<n>:DELTamarker<m>:AOFF

Turns off *all* delta markers.

Suffix:

<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:LINK <State>

Links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Tip: to link any marker to a different marker than marker 1, use the `CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>` or `CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>` commands.

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 71

CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>

Links the delta source marker <ms> to any active destination marker <md> (normal or delta marker).

In I/Q Analyzer mode, if <md> is the reference marker for the delta marker <ms>, the relative distance (delta) between the two markers is maintained when you move the normal marker.

In other applications, the delta marker is set to the same horizontal position as the marker <md>, and if <md> is moved along the x-axis, <ms> follows to the same horizontal position.

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 71

CALCulate<n>:DELTamarker<m>:MODE <Mode>

Defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker. Note that this setting applies to *all* windows.

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see `CALCulate<n>:DELTamarker<m>:X` on page 118)!

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Mode> **ABSolute**
Delta marker position in absolute terms.

RELative
Delta marker position in relation to a reference marker.

*RST: RELative

Example: `CALC:DELT:MODE ABS`
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREFerence <Reference>

Selects a reference marker for a delta marker other than marker 1.

Suffix:

<n> Window

<m> Marker

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 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 70

CALCulate<n>:DELTamarker<m>[:STATe] <State>

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 70
See "Marker Type" on page 70
See "Select Marker" on page 71

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

Selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Trace>	Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:MARKer<m>:AOFF

Turns off all markers.

Suffix:

<n>	Window
<m>	Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Manual operation: See "All Markers Off" on page 72

CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>

Links the normal source marker <ms> to any active destination marker <md> (normal or delta marker).

If you change the horizontal position of marker <md>, marker <ms> changes its horizontal position to the same value.

Suffix:

<n>	Window
<ms>	source marker, see Marker
<md>	destination marker, see Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 71

CALCulate<n>:MARKer<m>[:STATe] <State>

Turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 70
See "Marker Type" on page 70
See "Select Marker" on page 71

CALCulate<n>:MARKer<m>:TRACe <Trace>

Selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:

<n> Window

<m> Marker

Parameters:

<Trace>

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

Manual operation: See "Assigning the Marker to a Trace" on page 71

CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe <Frame>

Positions a delta marker on a particular frame. The frame is relative to the position of marker 1.

The command is available for the spectrogram.

Suffix:

<n> Window

<m> Marker

Parameters:

<Frame> Selects a frame either by its frame number or time stamp.
The frame number is available if the time stamp is off. The range depends on the history depth.
The time stamp is available if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.
Default unit: S

Example:
`CALC:DELT4:SGR:FRAM -20`
Sets fourth deltamarker 20 frames below marker 1.
`CALC:DELT4:SGR:FRAM 2 s`
Sets fourth deltamarker 2 seconds above the position of marker 1.

CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe <Frame> | <Time>

Positions a marker on a particular frame.

Suffix:

<n> Window

<m> Marker

Parameters:

<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.
Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on.
The number is the (negative) distance to frame 0 in seconds.
The range depends on the history depth.

Example:
`CALC:MARK:SGR:FRAM -20`
Sets the marker on the 20th frame before the present.
`CALC:MARK2:SGR:FRAM -2s`
Sets second marker on the frame 2 seconds ago.

6.7.5 General Marker Settings

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]

Moves the fixed reference marker to the peak power.

Suffix:

<n>	Window
<m>	Marker

Example: `CALC:DELT:FUNC:FIX:RPO:MAX`
Sets the reference point level for delta markers to the peak of the selected trace.

Manual operation: See "Defining a Fixed Reference" on page 73

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X <RefPoint>

Defines the horizontal position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<RefPoint> Numeric value that defines the horizontal position of the reference.
For frequency domain measurements, it is a frequency in Hz.
For time domain measurements, it is a point in time in s.
*RST: Fixed Reference: OFF
Default unit: HZ

Example: `CALC:DELT:FUNC:FIX:RPO:X 128 MHz`
Sets the frequency reference to 128 MHz.

Manual operation: See "Defining a Fixed Reference" on page 73

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y <RefPointLevel>

Defines the vertical position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<RefPoint> Numeric value that defines the vertical position of the reference. The unit and value range is variable.

*RST: Fixed Reference: OFF
Default unit: DBM

Example: `CALC:DELT:FUNC:FIX:RPO:Y -10dBm`
Sets the reference point level for delta markers to -10 dBm.

Manual operation: See "Defining a Fixed Reference" on page 73

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y:OFFSet <Offset>

Defines a level offset for the fixed delta marker reference point.

Suffix:

<n> Window

<m> Marker

Parameters:

<Offset> Numeric value

*RST: 0
Default unit: dB

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed[:STATe] <State>

Activates or deactivates a marker that defines a fixed reference point for relative marker analysis.

If necessary, the command activates a marker and positions it on the peak power.

Subsequently, you can change the coordinates of the fixed reference independent of the marker. The fixed reference is independent of the trace and is applied to all active delta markers.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT:FUNC:FIX ON`
Switches on the measurement with fixed reference value for all delta markers.
`CALC:DELT:FUNC:FIX:RPO:X 128 MHZ`
Sets the frequency reference to 128 MHz.
`CALC:DELT:FUNC:FIX:RPO:Y 30 DBM`
Sets the reference level to +30 dBm.

Manual operation: See "Defining a Fixed Reference" on page 73

CALCulate<n>:MARKer<m>:X:SSIZe <StepSize>

Selects the marker step size mode for *all* markers in *all* windows.

It therefore takes effect in manual operation only.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<StepSize> **STANdard**
the marker moves from one pixel to the next
POINts
the marker moves from one sweep point to the next
*RST: POINts

Example: `CALC:MARK:X:SSIZ STAN`
Sets the marker step size to one pixel.

Manual operation: See "Marker Stepsize" on page 72

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

Turns the marker information in all diagrams on and off.

Suffix:

<n> irrelevant

Parameters:

<State> **ON | 1**
Displays the marker information in the diagrams.
OFF | 0
Hides the marker information in the diagrams.
*RST: 1

Example: `DISP:MINF OFF`
Hides the marker information.

Manual operation: See "Marker Info" on page 72

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

Turns the marker table on and off.

Suffix:

<n> irrelevant

Parameters:

<DisplayMode>

ON | 1
Turns on the marker table.

OFF | 0
Turns off the marker table.

AUTO
Turns on the marker table if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 72

6.7.6 Marker Search

CALCulate<n>:MARKer<m>:LOEXclude <State>

Turns the suppression of the local oscillator during automatic marker positioning on and off (for *all* markers in *all* windows).

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `CALC:MARK:LOEX ON`

Manual operation: See "Exclude LO" on page 74

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB

Suffix:
<n>

<m> irrelevant

Example: `CALC:MARK:PEXC 10dB`
Defines peak excursion as 10 dB.

Manual operation: See "Peak Excursion" on page 74

CALCulate<n>:MARKer<m>:X:SLIMits:LEFT <SearchLimit>

Defines the left limit of the marker search range for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<SearchLimit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.
*RST: left diagram border
Default unit: HZ

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:LEFT 10MHz`
Sets the left limit of the search range to 10 MHz.

Manual operation: See "Search Limits (Left / Right)" on page 75

CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt <SearchLimit>

Defines the right limit of the marker search range for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<Limit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.
*RST: right diagram border
Default unit: HZ

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:RIGH 20MHz`
Sets the right limit of the search range to 20 MHz.

Manual operation: See "Search Limits (Left / Right)" on page 75

CALCulate<n>:MARKer<m>:X:SLIMits:ZOOM[:STATe] <State>

Adjusts the marker search range to the zoom area for *all* markers in *all* windows.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:X:SLIM:ZOOM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:RIGH 20MHz`
Sets the right limit of the search range to 20 MHz.

Manual operation: See "Use Zoom Limits" on page 75

CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>

Turns marker search limits on and off for *all* markers in *all* windows.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Suffix:

<n> irrelevant

<m> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:X:SLIM ON`
Switches on search limitation.

Manual operation: See "Search Limits (Left / Right)" on page 75
See "Search Limits Off" on page 75

CALCulate<n>:THReshold <Level>

Defines a threshold level for the marker peak search (for *all* markers in *all* windows).

Note that you must enable the use of the threshold using `CALCulate<n>:THReshold:STATe` on page 202.

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.

Manual operation: See "Search Threshold" on page 75

CALCulate<n>:THReshold:STATe <State>

Turns a threshold for the marker peak search on and off (for *all* markers in *all* windows).

Suffix:
<n> irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:THR:STAT ON`
Switches on the threshold line.

Manual operation: See "Search Threshold" on page 75
See "Search Limits Off" on page 75

6.7.7 Positioning Markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

Moves a marker to the next positive peak value.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> 1..n
Window

<m> 1..n
Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

Moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

Moves a delta marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

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 76

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

Moves a delta marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

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 76

CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>

Turns an automatic marker peak search for a trace maximum on and off (using marker 1). The R&S FSPN performs the peak search after each sweep.

Suffix:

<n> Window

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:MAX:AUTO ON`
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

Manual operation: See "Auto Max Peak Search / Auto Min Peak Search" on page 75

CALCulate<n>:MARKer<m>:MAXimum:LEFT

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:MARKer<m>:MAXimum:NEXT

Moves a marker to the next positive peak.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

Moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n>	Window
<m>	Marker

Manual operation: See "Search Next Peak" on page 76

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

Moves a marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

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 76

CALCulate<n>:MARKer<m>:MINimum:AUTO <State>

Turns an automatic marker peak search for a trace minimum on and off (using marker 1). The R&S FSPN performs the peak search after each sweep.

Suffix:

<n>	Window
<m>	irrrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:MIN:AUTO ON`
Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

Manual operation: See "Auto Max Peak Search / Auto Min Peak Search" on page 75

CALCulate<n>:MARKer<m>:MINimum:LEFT

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:MARKer<m>:MINimum:NEXT

Moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:MARKer<m>:MINimum:RIGHt

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:

<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 76

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

Moves a marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

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 76

6.7.8 Band Power Marker

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE <Mode>

Selects the way the results for a band power delta marker are displayed.

Suffix:

<n> Window

<m> Marker

Parameters:

<Mode>

POWer
Result is displayed as an absolute power. The power unit depends on the `CALCulate<n>:UNIT:POWer` setting.

DENSity
Result is displayed as a density in dBm/Hz.

RPOWer
This setting is only available for a delta band power marker.
The result is the difference between the absolute power in the band around the delta marker and the absolute power for the reference marker. The powers are subtracted logarithmically, so the result is a dB value.
[Relative band power (Delta2) in dB] = [absolute band power (Delta2) in dBm] - [absolute (band) power of reference marker in dBm]
For details see "Relative band power markers" on page 78.

*RST: POWer

Manual operation: See "Power Mode" on page 80

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:RESult?

Queries the results of the band power measurement.

Suffix:

<n> Window

<m> Marker

Return values:

<Power> Signal power over the delta marker bandwidth.

Usage: Query only

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:SPAN <Span>

Defines the bandwidth around the delta marker position.

Suffix:

<n> Window

<m> Marker

Parameters:

<Span> Frequency. The maximum span depends on the marker position and R&S FSPN model.

*RST: 5% of current span
Default unit: Hz

Manual operation: See "Span" on page 79

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe] <State>

Turns delta markers for band power measurements on and off.

If neccessary, the command also turns on a reference marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Band Power Measurement State" on page 79
See "Switching All Band Power Measurements Off" on page 80

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult?

Queries the results of the band power measurement.

Suffix:

<n> Window

<m> Marker

Return values:
<Power> Signal power over the marker bandwidth.

Example: Activate the band power marker:
`CALC:MARK:FUNC:BPOW:STAT ON`
Select the density mode for the result:
`CALC:MARK:FUNC:BPOW:MODE DENS`
Query the result:
`CALC:MARK:FUNC:BPOW:RES?`
Response:
`20dBm/Hz`

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:SPAN <Span>

Defines the bandwidth around the marker position.

Suffix:
<n> Window

<m> Marker

Parameters:
<Span> Frequency. The maximum span depends on the marker position and R&S FSPN model.
*RST: 5% of current span
Default unit: Hz

Example: `CALC:MARK:FUNC:BPOW:SPAN 2MHz`
Measures the band power over 2 MHz around the marker.

Manual operation: See "Span" on page 79

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:MODE <Mode>

Selects the way the results for a band power marker are displayed.

(Note: relative power results are only availabe for delta markers, see .`CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE` on page 209

Suffix:
<n> Window

<m> Marker

Parameters:
<Mode> **POWer**
Result is displayed as an absolute power. The power unit depends on the `CALCulate<n>:UNIT:POWer` setting.
DENSity
Result is displayed as a density in dBm/Hz.

*RST: POWer

Example: `CALC:MARK4:FUNC:BPOW:MODE DENS`
Configures marker 4 to show the measurement results in dBm/Hz.

Manual operation: See "Power Mode" on page 80

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe] <State>

Turns markers for band power measurements on and off.

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:MARK4:FUNC:BPOW:STAT ON`
Activates or turns marker 4 into a band power marker.

Manual operation: See "Band Power Measurement State" on page 79
See "Switching All Band Power Measurements Off" on page 80

6.7.9 Marker Peak List

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] <State>

Turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

Suffix:
<n> Window

<m> Marker

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF`
Removes the peak labels from the diagram

Manual operation: See "Display Marker Numbers" on page 84

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:COUNt?

Queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

Suffix:

<n> irrelevant

<m> irrelevant

Return values:

<NumberOfPeaks>

Example: `CALC:MARK:FUNC:FPE:COUN?`
Queries the number of peaks.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks[:IMMediate] <Peaks>

Initiates a peak search.

Suffix:

<n> Window

<m> Marker

Parameters:

<Peaks> This parameter defines the number of peaks to find during the search.
Note that the actual number of peaks found during the search also depends on the peak excursion you have set with `CALCulate<n>:MARKer<m>:PEXCursion`.

Range: 1 to 200

Example: `CALC:MARK:PEXC 5`
Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.
`CALC:MARK:FUNC:FPE 10`
Initiates a search for 10 peaks on the current trace.

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE <MaxNoPeaks>

Defines the maximum number of peaks that the R&S FSPN looks for during a peak search.

Suffix:

<n> Window

<m> Marker

Parameters:

<MaxNoPeaks> Maximum number of peaks to be determined.

Range: 1 to 500
*RST: 50

Example: `CALC:MARK:FUNC:FPE:LIST:SIZE 10`
The marker peak list will contain a maximum of 10 peaks.

Manual operation: See "Maximum Number of Peaks" on page 84

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT <SortMode>

Selects the order in which the results of a peak search are returned.

Suffix:

<n> Window

<m> Marker

Parameters:

<SortMode>

X
Sorts the peaks according to increasing position on the x-axis.

Y
Sorts the peaks according to decreasing position on the y-axis.

*RST: X

Example: `CALC:MARK:FUNC:FPE:SORT Y`
Sets the sort mode to decreasing y values

Manual operation: See "Sort Mode" on page 83

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STATe <State>

Turns a peak search on and off.

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:MARK:FUNC:FPE:STAT ON`
Activates marker peak search

Manual operation: See "Peak List State" on page 83

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:X?

Queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Suffix:
<n> irrelevant

<m> irrelevant

Return values:
<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:Y?

Queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with `CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT`.

Suffix:
<n> irrelevant

<m> irrelevant

Return values:
<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

MMEMory:STORe<n>:PEAK <FileName>

Exports the marker peak list to a file.

Suffix:
<n> Window

Parameters:
<FileName> String containing the path,name and extension of the target file.

Example: `MMEM:STOR:PEAK 'test.dat'`
Saves the current marker peak list in the file `test.dat`.

Manual operation: See "Export Peak List" on page 84

6.7.10 Display Lines

CALCulate<n>:DLINe<dl> <Position>

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 FSPN then converts the unit to the currently selected unit. If you omit a unit, the R&S FSPN uses the currently selected unit.

*RST: (state is OFF)
Default unit: DBM

Example: `CALC:DLIN2 -20dBm`
Positions the second display line at -20 dBm.

CALCulate<n>:DLINe<dl>:STATe <State>

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>

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.

CALCulate<n>:FLINe<dl>:STATe <State>

Turns a frequency line on and off

Suffix:

<n> Window

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>

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.

CALCulate<n>:TLINe<dl>:STATe <State>

Turns a time line on and off

Suffix:
<n> Window

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.

6.7.11 Limit Lines

CALCulate<n>:LIMit<li>:ACTive?

Queries the names of *all* active limit lines.

Suffix:

<n>	irrelevant
	irrelevant

Return values:

<LimitLines>	String containing the names of all active limit lines in alphabetical order.

Example: `CALC:LIM:ACT?`
Queries the names of all active limit lines.

Usage: Query only

Manual operation: See "Visibility" on page 89

CALCulate<n>:LIMit<li>:CLEar[:IMMediate]

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>:COMMent <Comment>

Defines a comment for a limit line.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Comment>	String containing the description of the limit line.

Manual operation: See "Comment" on page 91

CALCulate<n>:LIMit<li>:CONTrol[:DATA] <LimitLinePoints>...

Defines the horizontal definition points of a limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<LimitLinePoints> Variable number of x-axis values.
Note that the number of horizontal values has to be the same as the number of vertical values set with `CALCulate<n>:LIMit<li>:LOWer[:DATA]` or `CALCulate<n>:LIMit<li>:UPPer[:DATA]`. If not, the R&S FSPN either adds missing values or ignores surplus values.

*RST: -
Default unit: HZ

Manual operation: See "Data Points" on page 91

CALCulate<n>:LIMit<li>:CONTrol:DOMain <SpanSetting>

Selects the domain of the limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<SpanSetting> FREQuency | TIME

FREQuency
For limit lines that apply to a range of frequencies.

TIME
For limit lines that apply to a period of time.

*RST: FREQuency

Example: `CALC:LIM:CONT:DOM FREQ`
Select a limit line in the frequency domain.

CALCulate<n>:LIMit<li>:CONTrol:MODE <Mode>

Selects the horizontal limit line scaling.

Suffix:

<n> irrelevant

 Limit line

Parameters:
<Mode> **ABSolute**
Limit line is defined by absolute physical values (Hz or s).
RELative
Limit line is defined by relative values related to the center frequency (frequency domain) or the left diagram border (time domain).
*RST: ABSolute

CALCulate<n>:LIMit<li>:CONTrol:OFFSet <Offset>

Defines an offset for a complete limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Offset> Numeric value.
The unit depends on the scale of the x-axis.
*RST: 0
Default unit: HZ

Manual operation: See "X-Offset" on page 89

CALCulate<n>:LIMit<li>:CONTrol:SHIFt <Distance>

Moves a complete limit line horizontally.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Distance> Numeric value.
The unit depends on the scale of the x-axis.
Default unit: HZ

Manual operation: See "Shift x" on page 91

CALCulate<n>:LIMit<li>:CONTrol:SPACing <InterpolMode>

Selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Suffix:

<n>	Window
	Limit line

Parameters:

<InterpolMode>	LINear | LOGarithmic *RST: LIN

Example: `CALC:LIM:CONT:SPAC LIN`

CALCulate<n>:LIMit<li>:COPY <Line>

Copies a limit line.

Suffix:

<n>	Window
	Limit line

Parameters:

<Line>	**1 to 8** number of the new limit line **<name>** String containing the name of the limit line.

Example:

`CALC:LIM1:COPY 2`
Copies limit line 1 to line 2.
`CALC:LIM1:COPY 'FM2'`
Copies limit line 1 to a new line named FM2.

Manual operation: See "Copy Line" on page 90

CALCulate<n>:LIMit<li>:DELete

Deletes a limit line.

Suffix:

<n>	Window
	Limit line

Manual operation: See "Delete Line" on page 90

CALCulate<n>:LIMit<li>:FAIL?

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

CALCulate<n>:LIMit<li>:LOWer[:DATA] <LimitLinePoints>...

Defines the vertical definition points of a lower limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S FSPN either adds missing values or ignores surplus values.
*RST: Limit line state is OFF
Default unit: DBM

Manual operation: See "Data Points" on page 91

CALCulate<n>:LIMit<li>:LOWer:MARGin <Margin>

Defines an area around a lower limit line where limit check violations are still tolerated.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Margin> **numeric value**
*RST: 0
Default unit: dB

CALCulate<n>:LIMit<li>:LOWer:MODE <Mode>

Selects the vertical limit line scaling.

Suffix:

<n> Window

 Limit line

Parameters:

<Mode> **ABSolute**
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

CALCulate<n>:LIMit<li>:LOWer:OFFSet <Offset>

Defines an offset for a complete lower limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:

<n> Window

 Limit line

Parameters:

<Offset> Numeric value.
*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 90

CALCulate<n>:LIMit<li>:LOWer:SHIFt <Distance>

Moves a complete lower limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:

<n> Window

 Limit line

Parameters:
<Distance> Defines the distance that the limit line moves.
Default unit: DB

Manual operation: See "Shift y" on page 91

CALCulate<n>:LIMit<li>:LOWer:SPACing <InterpolType>

Selects linear or logarithmic interpolation for the calculation of a lower limit line from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolType> LINear | LOGarithmic
*RST: LIN

CALCulate<n>:LIMit<li>:LOWer:STATe <State>

Turns a lower limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<li>:NAME` on page 226.

Suffix:
<n> irrelevant

 Limit line

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Visibility" on page 89

CALCulate<n>:LIMit<li>:LOWer:THReshold <Threshold>

Defines a threshold for relative limit lines.

The R&S FSPN uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:
<n> irrelevant

 Limit line

Parameters:

<Threshold> Numeric value.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 227.

*RST: -200 dBm
Default unit: DBM

Manual operation: See "Threshold" on page 91

CALCulate<n>:LIMit<li>:NAME <Name>

Selects a limit line that already exists or defines a name for a new limit line.

Suffix:

<n> Window

 Limit line

Parameters:

<Name> String containing the limit line name.

*RST: REM1 to REM8 for lines 1 to 8

Manual operation: See "Name" on page 90

CALCulate<n>:LIMit<li>:STATe <State>

Turns the limit check for a specific limit line on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see `CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 227).

Suffix:

<n> irrelevant

 Limit line

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Manual operation: See "Disable All Lines" on page 90

CALCulate<n>:LIMit<li>:TRACe<t> <TraceNumber>

Links a limit line to one or more traces.

Note that this command is maintained for compatibility reasons only. Limit lines no longer need to be assigned to a trace explicitly. The trace to be checked can be defined directly (as a suffix) in the new command to activate the limit check (see `CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 227).

Suffix:

<n>	Window
	Limit line
<t>	irrelevant

Example: `CALC:LIM2:TRAC 3`
Assigns limit line 2 to trace 3.

CALCulate<n>:LIMit<li>:TRACe<t>:CHECk <State>

Turns the limit check for a specific trace on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Suffix:

<n>	Window
	Limit line
<t>	Trace

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:LIM3:TRAC2:CHEC ON`
Switches on the limit check for limit line 3 on trace 2.

Manual operation: See "Traces to be Checked" on page 89

CALCulate<n>:LIMit<li>:UNIT <Unit>

Defines the unit of a limit line.

Suffix:

<n>	irrelevant
	Limit line

Parameters:

<Unit> DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | (unitless)

If you select a dB-based unit for the limit line, the command automatically turns the limit line into a relative limit line.

*RST: DBM

CALCulate<n>:LIMit<li>:UPPer[:DATA] <LimitLinePoints>...

Defines the vertical definition points of an upper limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S FSPN either adds missing values or ignores surplus values.

*RST: Limit line state is OFF
Default unit: DBM

Manual operation: See "Data Points" on page 91

CALCulate<n>:LIMit<li>:UPPer:MARGin <Margin>

Defines an area around an upper limit line where limit check violations are still tolerated.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

CALCulate<n>:LIMit<li>:UPPer:MODE <Mode>

Selects the vertical limit line scaling.

Suffix:

<n> Window

 Limit line

Parameters:
<Mode> **ABSolute**
Limit line is defined by absolute physical values.
The unit is variable.
RELative
Limit line is defined by relative values related to the reference level (dB).
*RST: ABSolute

CALCulate<n>:LIMit<li>:UPPer:OFFSet <Offset>

Defines an offset for a complete upper limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Offset> Numeric value.
*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 90

CALCulate<n>:LIMit<li>:UPPer:SHIFt <Distance>

Moves a complete upper limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Distance> Defines the distance that the limit line moves.

Manual operation: See "Shift y" on page 91

CALCulate<n>:LIMit<li>:UPPer:SPACing <InterpolType>

Selects linear or logarithmic interpolation for the calculation of an upper limit line from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolType> LINear | LOGarithmic
*RST: LIN

CALCulate<n>:LIMit<li>:UPPer:STATe <State>

Turns an upper limit line on and off.

Before you can use the command, you have to select a limit line with CALCulate<n>:LIMit<li>:NAME on page 226.

Suffix:
<n> irrelevant

 Limit line

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Visibility" on page 89

CALCulate<n>:LIMit<li>:UPPer:THReshold <Limit>

Defines an absolute limit for limit lines with a relative scale.

The R&S FSPN uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Limit> Numeric value.
The unit depends on CALCulate<n>:LIMit<li>:UNIT on page 227.
*RST: -200
Default unit: dBm

Manual operation: See "Threshold" on page 91

MMEMory:COPY <FileName>, <FileName>

This command copies one or more files to another directory.

Parameters:

<FileName>	String containing the path and file name of the source file.
<FileName>	String containing the path and name of the target file. The path may be relative or absolute.

MMEMory:LOAD<n>:LIMit <FileName>

Loads the limit line from the selected file in `.CSV` format.

Suffix:

<n>	irrelevant

Parameters:

<FileName>	String containing the path and name of the `CSV` import file.

Example: `MMEM:LOAD:LIM 'C:\TEST.CSV'`

MMEMory:STORe<n>:LIMit <FileName>, <LimitLineName>

Exports limit line data to an ASCII (CSV) file.

Suffix:

<n>	irrelevant

Parameters:

<FileName>	String containing the path and name of the target file.
<LimitLineName>	Name of the limit line to be exported.

Example: `MMEM:STOR:LIM 'C:\TEST', 'UpperLimitLine'`
Stores the limit line named "UpperLimitLine" in the file `TEST.CSV`.

6.8 Importing and Exporting I/Q Data

MMEMory:LOAD:IQ:STATe 1, <FileName>

Restores I/Q data from a file.

Setting parameters:

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

Example: `MMEM:LOAD:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Loads IQ data from the specified file.

Usage: Setting only

Manual operation: See "I/Q Import" on page 15

MMEMory:STORe<n>:IQ:COMMent <Comment>

Adds a comment to a file that contains I/Q data.

Suffix:
<n> irrelevant

Parameters:
<Comment> String containing the comment.

Example: `MMEM:STOR:IQ:COMM 'Device test 1b'`
Creates a description for the export file.
`MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores I/Q data and the comment to the specified file.

Manual operation: See "I/Q Export" on page 15

MMEMory:STORe<n>:IQ:STATe <1>, <FileName>

Writes the captured I/Q data to a file.

By default, the contents of the file are in 32-bit floating point format.

Suffix:
<n> 1..n

Parameters:
<1>

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

Example: `MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores the captured I/Q data to the specified file.

Usage: Asynchronous command

Manual operation: See "I/Q Export" on page 15

Annex

A I/Q data file format (iq-tar)

I/Q data is packed in a file with the extension .iq.tar. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

The iq-tar container packs several files into a single .tar archive file. Files in .tar format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of .tar files is that the archived files inside the .tar file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the .tar file first.

Sample iq-tar files

Some sample iq-tar files are provided in the C:\R_S\INSTR\USER\Demo\ directory on the R&S FSPN.

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. xyz.xml
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. xyz.complex.float32
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. open_IqTar_xml_file_in_web_browser.xslt
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

A.1 I/Q parameter XML file specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. `iq-tar` uses an "ordered XML schema". For your own implementation of the `iq-tar` file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSPN</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

A.1.1 Minimum data elements

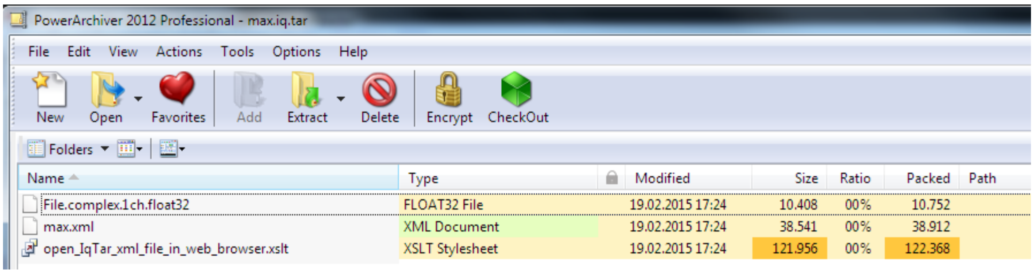
The following data elements are the minimum required for a valid `iq-tar` file. They are always provided by an `iq-tar` file export from a Rohde & Schwarz product. If not specified otherwise, it must be available in all `iq-tar` files used to import data to a Rohde & Schwarz product.

Element	Possible Values	Description
<RS_IQ_TAR_FileFormat>	-	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition.
<Name>	string	Optional: describes the device or application that created the file.
<Comment>	string	Optional: contains text that further describes the contents of the file.
<DateTime>	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).
<Samples>	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also <Format> element.
<Clock>	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
<Format>	complex | real | polar	Specifies how the binary data is saved in the I/Q data binary file (see <DataFilename> element). Every sample must be in the same format. The format can be one of the following: ● `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● `real`: Real number (unitless) ● `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`
<DataType>	int8 | int16 | int32 | float32 | float64	Specifies the binary format used for samples in the I/Q data binary file (see <DataFilename> element and Chapter A.2, "I/Q data binary file", on page 238). The following data types are allowed: ● `int8`: 8 bit signed integer data ● `int16`: 16 bit signed integer data ● `int32`: 32 bit signed integer data ● `float32`: 32 bit floating point data (IEEE 754) ● `float64`: 64 bit floating point data (IEEE 754)
<ScalingFactor>	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the <ScalingFactor>. For polar data only the magnitude value has to be multiplied. For multi-channel signals the <ScalingFactor> must be applied to all channels. The attribute `unit` must be set to "`V`". The <ScalingFactor> must be > 0. If the <ScalingFactor> element is not defined, a value of 1 V is assumed.

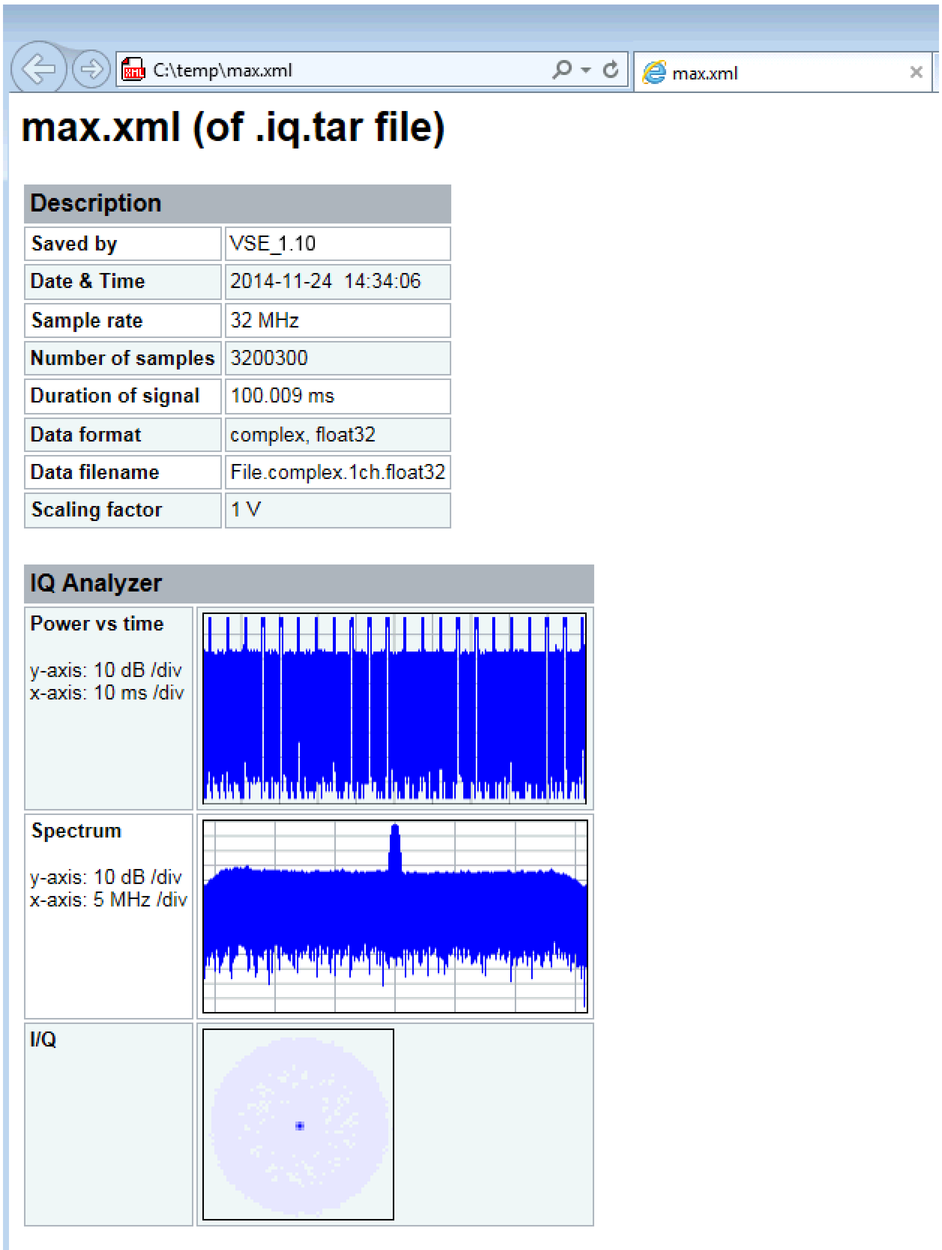
Element	Possible Values	Description
`<NumberOfChannels>`	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter A.2, "I/Q data binary file", on page 238). If the `<NumberOfChannels>` element is not defined, one channel is assumed.
`<DataFilename>`		Contains the filename of the I/Q data binary file that is part of the `iq-tar` file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
`<UserData>`	xml	Optional: contains user, application or device-specific XML data which is not part of the `iq-tar` specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
`<PreviewData>`	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an `iq-tar` file (e.g. R&S FSPN). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

A.1.2 Example

The following example demonstrates the XML description inside the `iq-tar` file. Note that this preview is not supported by all web browsers.



Open the xml file in a web browser. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.




```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
```

```
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

<UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>
```

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	**Numerical value**	**Numerical value x ScalingFactor**
Minimum (negative) int16 value	$- 2^{15} = - 32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1= 32767$	0.999969482421875 V

A.2 I/Q data binary file

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `<Format>` element and `<DataType>` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `<NumberOfChannels>` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                    // Real sample 0
I[1],                    // Real sample 1
I[2],                    // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                // Real and imaginary part of complex sample 0
I[1], Q[1],                // Real and imaginary part of complex sample 1
I[2], Q[2],                // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],            // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],            // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],            // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],          // Channel 0, Complex sample 0
I[1][0], Q[1][0],          // Channel 1, Complex sample 0
I[2][0], Q[2][0],          // Channel 2, Complex sample 0

I[0][1], Q[0][1],          // Channel 0, Complex sample 1
I[1][1], Q[1][1],          // Channel 1, Complex sample 1
I[2][1], Q[2][1],          // Channel 2, Complex sample 1

I[0][2], Q[0][2],          // Channel 0, Complex sample 2
I[1][2], Q[1][2],          // Channel 1, Complex sample 2
I[2][2], Q[2][2],          // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

Example: PreviewData in XML

```
  <PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
```

```
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
              <float>-111</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-67</float>
              <float>-69</float>
              ...
              <float>-70</float>
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </Spectrum>
        <IQ>
          <Histogram width="64" height="64">0123456789...0</Histogram>
        </IQ>
      </Channel>
    </ArrayOfChannel>
  </PreviewData>
```

B Reference: format description for I/Q data files

This section describes how I/Q data is transferred to the memory during remote control (see `TRACe:IQ:DATA:FORMat` command).

For details on the format of the individual values, see Chapter D, "Formats for returned values: ASCII format and binary format", on page 269.

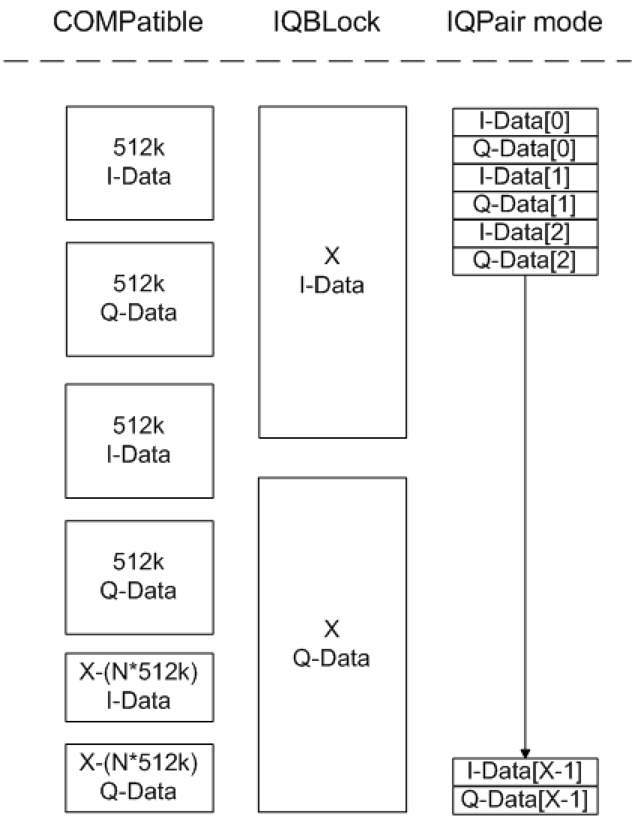


Figure B-1: I/Q data formats

Note: 512k corresponds to 524288 samples

For maximum performance, the formats "Compatible" or "IQPair" should be used. Furthermore, for large amounts of data, the data should be in binary format to improve performance.

In binary format, the number of I- and Q-data can be calculated as follows:

$$\#\,of\ I-Data = \#\,of\ Q-Data = \frac{\#\,of\ DataBytes}{8}$$

For the format "QBLock", the offset of Q-data in the output buffer can be calculated as follows:

$$Q - Data - Offset = \frac{(\#\ of\ DataBytes)}{2} + LengthIndicatorDigits$$

with "LengthIndicatorDigits" being the number of digits of the length indicator including the #. In the example above (#41024…), this results in a value of 6 for "LengthIndicatorDigits" and the offset for the Q-data results in 512 + 6 = 518.

C Reference: supported I/Q file formats

Various file types are supported for I/Q data import and export. The most important characteristics for each format are described here.

For best performance and to ensure comprehensive meta data is available, use the iq.tar format. This is a widely used file format for Rohde & Schwarz products.

Table C-1: Characteristics of data file formats

File format	File extension	Comment
IQ.tar	`.iq.tar`	An `IQ.tar` file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the `IQ.tar` file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows a preview of the I/Q data in a web browser, and inclusion of user-specific data. Several streams of data can be provided in one file.
IQW	`.iqw`	A binary file format containing one channel of complex IQ data. The file contains float32 data in a binary format (interleaved IQIQ or in blocks, IIIQQQ). The file does not contain any additional information as a header. This format requires setting the sample rate and measurement time or record length manually.
CSV	`.csv`	A file containing I/Q data as comma-separated values (CSV). Additional metadata can be included.
Simple CSV	`.csv`	(Import only) Simple CSV contains I/Q data only, without any header or meta data. That is, the file contains only (I,Q) data pairs, separated by commas. Several streams of data can be provided in one file. This format requires setting the sample rate and measurement time or record length manually.
Matlab® v4	`.mat`	A file containing I/Q data in Matlab® file format v4. Channel-related information is stored in matlab variables with names starting with '`ChX_`'. '`X`' represents the number of the channel with a lower bound of 1, e.g. the variable `Ch1_ChannelName` contains the name of the first channel. The corresponding data is contained in `ChX_Data`. Optional user data can be saved to variables named `UserDataX`, where '`X`' starts at 0. The variable `UserData_Count` contains the number of `UserData` variables. For compatibility reasons user data needs to be saved as a 2xN char array, where the first row contains the key of the user data and the second row the actual value. Both rows must have the same column count and are therefore right-padded with white spaces. Variables can be written to the `*.mat` files in arbitrary order. **Limitations**: In general, the file format is limited to a maximum of 2 GB. A maximum of 100000000 values can be stored in a single variable, e.g. 50000000 complex data samples.
Matlab® v7.3	`.mat`	A file containing I/Q data in Matlab® file format v7.3.
Simple Matlab®	`.mat`	(Import only) Simple Matlab® format contains I/Q data only, without any meta data. That is, the file contains only variables (double, double) for the corresponding channel data. This format requires setting the sample rate and measurement time or record length manually.

File format	File extension	Comment
AMMOS intermediate frequency data format	.aid	Format used to transmit real or complex baseband signals. The IF signal is sent along with information that characterizes the datastream and datastream source. All datastreams have a frame-based structure, consisting of a global frame header coupled with a data-type specific frame body (i.e. the frame payload).
wv	.wv	(Import only) Proprietary file format used by Rohde & Schwarz signal generators to store waveform data. A waveform file contains a header and raw I/Q samples.

C.1 I/Q data file format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An `iq-tar` file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the `iq-tar` file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to include user-specific data and to preview the I/Q data in a web browser (not supported by all web browsers).

The `iq-tar` container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.

Sample iq-tar files

Some sample `iq-tar` files are provided in the `C:\R_S\INSTR\USER\Demo\` directory on the R&S FSPN.

An application note on converting Rohde & Schwarz I/Q data files is available from the Rohde & Schwarz website:

1EF85: Converting R&S I/Q data files

Contained files

An `iq-tar` file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`

Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an `iq-tar` file.

- **I/Q data binary file**, e.g. `xyz.complex.float32`
Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an `iq-tar` file.

Optionally, an `iq-tar` file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser (not supported by all web browsers).
A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

C.1.1 I/Q parameter XML file specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. `iq-tar` uses an "ordered XML schema". For your own implementation of the `iq-tar` file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSPN</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
```

```
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

C.1.1.1 Minimum data elements

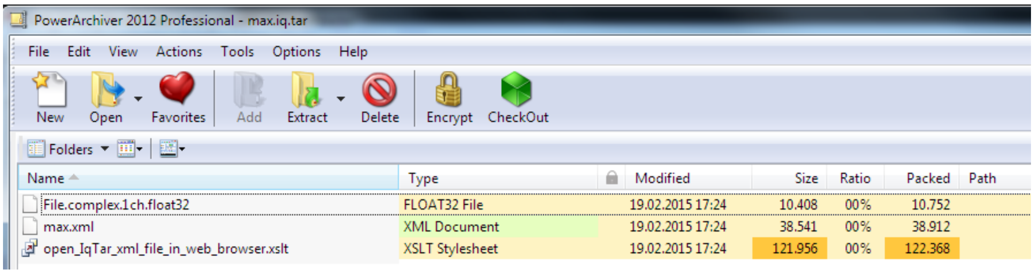
The following data elements are the minimum required for a valid `iq-tar` file. They are always provided by an `iq-tar` file export from a Rohde & Schwarz product. If not specified otherwise, it must be available in all `iq-tar` files used to import data to a Rohde & Schwarz product.

Element	Possible Values	Description
`<RS_IQ_TAR_FileFormat>`	-	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition.
`<Name>`	string	Optional: describes the device or application that created the file.
`<Comment>`	string	Optional: contains text that further describes the contents of the file.
`<DateTime>`	yyyy-mm-ddThh:mm:ss	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).
`<Samples>`	integer	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also `<Format>` element.
`<Clock>`	double	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
`<Format>`	complex | real | polar	Specifies how the binary data is saved in the I/Q data binary file (see `<DataFilename>` element). Every sample must be in the same format. The format can be one of the following: ● `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● `real`: Real number (unitless) ● `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`
`<DataType>`	int8 | int16 | int32 | float32 | float64	Specifies the binary format used for samples in the I/Q data binary file (see `<DataFilename>` element and Chapter A.2, "I/Q data binary file", on page 238). The following data types are allowed: ● `int8`: 8 bit signed integer data ● `int16`: 16 bit signed integer data ● `int32`: 32 bit signed integer data ● `float32`: 32 bit floating point data (IEEE 754) ● `float64`: 64 bit floating point data (IEEE 754)

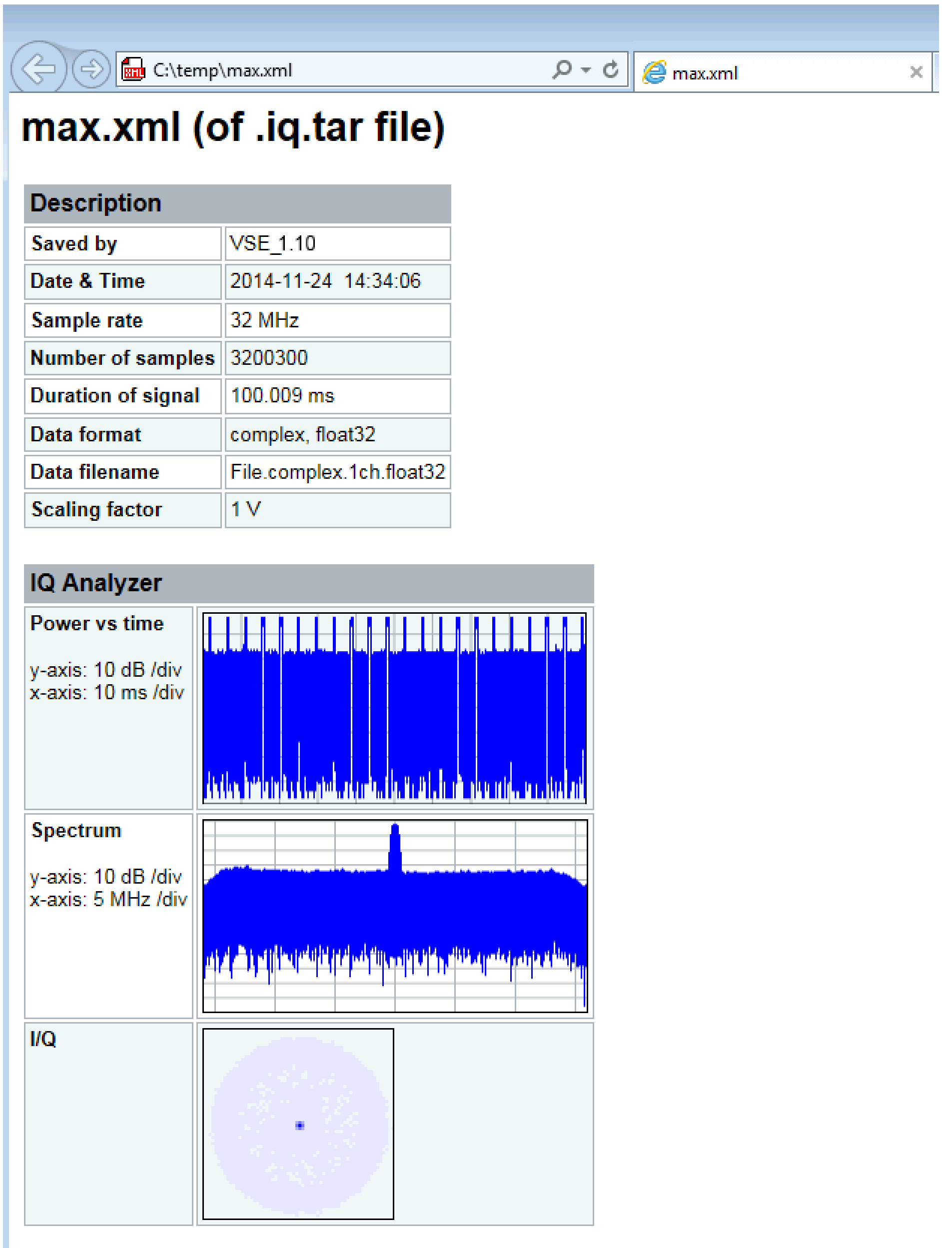
Element	Possible Values	Description
`<ScalingFactor>`	double	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the `<ScalingFactor>`. For polar data only the magnitude value has to be multiplied. For multi-channel signals the `<ScalingFactor>` must be applied to all channels. The attribute `unit` must be set to "`V`". The `<ScalingFactor>` must be > 0. If the `<ScalingFactor>` element is not defined, a value of 1 V is assumed.
`<NumberOfChannels>`	integer	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter A.2, "I/Q data binary file", on page 238). If the `<NumberOfChannels>` element is not defined, one channel is assumed.
`<DataFilename>`		Contains the filename of the I/Q data binary file that is part of the `iq-tar` file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> • <xyz> = a valid Windows file name • <Format> = complex, polar or real (see `Format` element) • <Channels> = Number of channels (see `NumberOfChannels` element) • <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: • xyz.complex.1ch.float32 • xyz.polar.1ch.float64 • xyz.real.1ch.int16 • xyz.complex.16ch.int8
`<UserData>`	xml	Optional: contains user, application or device-specific XML data which is not part of the `iq-tar` specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
`<PreviewData>`	xml	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an `iq-tar` file (e.g. R&S FSPN). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

C.1.1.2 Example

The following example demonstrates the XML description inside the `iq-tar` file. Note that this preview is not supported by all web browsers.



Open the xml file in a web browser. If the stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is in the same directory, the web browser displays the xml file in a readable format.



```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1" xsi:noNamespaceSchemaLocation=
"http://www.rohde-schwarz.com/file/RsIqTar.xsd" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance">
  <Name>VSE_1.10a 29 Beta</Name>
  <Comment></Comment>
  <DateTime>2015-02-19T15:24:58</DateTime>
  <Samples>1301</Samples>
  <Clock unit="Hz">32000000</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
  <DataFilename>File.complex.1ch.float32</DataFilename>

<UserData>
    <RohdeSchwarz>
      <DataImportExport_MandatoryData>
        <ChannelNames>
          <ChannelName>IQ Analyzer</ChannelName>
        </ChannelNames>
        <CenterFrequency unit="Hz">0</CenterFrequency>
      </DataImportExport_MandatoryData>
      <DataImportExport_OptionalData>
        <Key name="Ch1_NumberOfPostSamples">150</Key>
        <Key name="Ch1_NumberOfPreSamples">150</Key>
      </DataImportExport_OptionalData>
    </RohdeSchwarz>
  </UserData>

</RS_IQ_TAR_FileFormat>
```

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$- 2^{15}$ = - 32768	-1 V
Maximum (positive) int16 value	2^{15}-1= 32767	0.999969482421875 V

C.1.2 I/Q data binary file

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `<Format>` element and `<DataType>` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `<NumberOfChannels>` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                         // Real sample 0
I[1],                         // Real sample 1
I[2],                         // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                   // Real and imaginary part of complex sample 0
I[1], Q[1],                   // Real and imaginary part of complex sample 1
I[2], Q[2],                   // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],               // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],               // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],               // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],            // Channel 0, Complex sample 0
I[1][0], Q[1][0],            // Channel 1, Complex sample 0
I[2][0], Q[2][0],            // Channel 2, Complex sample 0

I[0][1], Q[0][1],            // Channel 0, Complex sample 1
I[1][1], Q[1][1],            // Channel 1, Complex sample 1
I[2][1], Q[2][1],            // Channel 2, Complex sample 1

I[0][2], Q[0][2],            // Channel 0, Complex sample 2
I[1][2], Q[1][2],            // Channel 1, Complex sample 2
I[2][2], Q[2][2],            // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
```

```
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

Example: PreviewData in XML

```
  <PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
              <float>-111</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-67</float>
              <float>-69</float>
              ...
              <float>-70</float>
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </Spectrum>
        <IQ>
          <Histogram width="64" height="64">0123456789...0</Histogram>
        </IQ>
```

```
      </Channel>
    </ArrayOfChannel>
  </PreviewData>
```

C.2 CSV file format

CSV files contain I/Q data as comma-separated values. Additional metadata can be saved.

C.2.1 Mandatory data elements

Parameter Name	Possible Values
Name	String
Comment	String
DateTime	Year-Month-DayTHour:Min:Sec
Format	complex
DataType	float32
NumberOfChannels	Integer
Ch<n>_ChannelName	String
Ch<n>_Samples	Integer
Ch<n>_Clock[Hz]	double
Ch<n>_CenterFrequency[Hz]	Double
IQ Data Header	<Channel Name>_I; <Channel Name>_Q (IQ data value)
-----	Double ; Double (IQ data I/Q pairs)

C.2.2 Optional data elements

Parameter name	Possible Values
Ch<n>_AttenuElecState	ON | OFF
Ch<n>_AttenuElecValue[dB]	Integer
Ch<n>_AttenuMech[dB]	Integer

Parameter name	Possible Values
Ch<n>_CalibrationState	ON | OFF
Ch<n>_DeviceHwInfo	String
Ch<n>_DeviceId	String
Ch<n>_DeviceOptions	String
Ch<n>_DeviceVersions	String
Ch<n>_FilterSettings	FLAT | GAUSS | OFF
Ch<n>_HighPassFilterState	ON | OFF
Ch<n>_Impedance[Ohm]	50 | 75
Ch<n>_InputCoupling	AC | DC
Ch<n>_InputPath	RF
Ch<n>_MeasBandwidth[Hz]	double
Ch<n>_NumberOfPostSamples	Integer
Ch<n>_NumberOfPreSamples	Integer
Ch<n>_PreampGain[dB]	Integer
Ch<n>_PreampState	ON | OFF
Ch<n>_RefLevelOffset[dB]	Double
Ch<n>_RefLevel[dBm]	Double
Ch<n>_RefOscillatorInput	OFF | ON
Ch<n>_RefOscillatorFreq[Hz]	Double
Ch<n>_TrgSource	Extern <1 ..4> | I/Q Power | IF Power | RF Power | Power Sensor | Time
Ch<n>_TrgLevel[dB]	Double
Ch<n>_TrgHysteresis[dB]	Double
Ch<n>_TrgTpis[s]	Double
Ch<n>_TrgOffset[s]	Double
Ch<n>_TrgSlope	Rising | Falling | Rising/Falling
Ch<n>_TrgHoldoff[s]	Double
Ch<n>_TrgDropOut[s]	Double
Ch<n>_YigPreSelectorState	ON | OFF

C.2.3 Example

```
DataImportExport_MandatoryData;
Name;ExampleFile
Comment;Example Comment
```

```
DateTime;2015-02-19T15:26:33
Format;complex
DataType;float32
NumberOfChannels;1
Ch1_ChannelName;Example_Channel
Ch1_Samples;10
Ch1_Clock[Hz];3,2000000E+007
Ch1_CenterFrequency[Hz];100,0000000E+007
DataImportExport_EndHeaderSection;
Example_Channel_I;Example_Channel_Q
-5,9390777E-006;-3,4644620E-006
9,8984629E-007;-8,4631858E-005
-5,9885701E-005;4,1078620E-005
2,0786772E-005;7,8692778E-005
-4,9492314E-006;-1,5095156E-004
1,6332464E-005;1,8312156E-005
-5,4936470E-005;4,5532928E-005
-4,8997390E-005;9,7004937E-005
-1,1383232E-005;4,5532928E-005
-8,2157239E-005;3,2170003E-005
```

C.2.4 Simple CSV format

The simple `.CSV` format contains I/Q data only, without any header or meta data. That is, the file contains only (I,Q) data pairs, separated by commas. Several streams of data can be provided in one file, one after the other.

Example:

```
7.0663854e-003,1.7059683e-005,
7.0817876e-003,7.5836733e-006,
7.0711789e-003,-1.2189972e-005,
```

C.3 IQW file format

IQW is a binary file format containing one channel of complex IQ data.

Format description details:

- IQDataFormat: Complex
- IQDataType: Float32
- Byte order: Intel
- Data order: IQIQIQ (I/Q paired or interleaved) or IIIQQQ (I/Q blocks, default)

Mandatory Data Elements

Only the binary I/Q data.

Optional Data Elements

None.

C.4 Matlab® v. 4 / v. 7.3 file format

In Matlab® files, channel-related information is stored in Matlab® variables with names starting with 'ChX_'. 'X' represents the number of the channel with a lower bound of 1, e.g. the variable Ch1_ChannelName contains the name of the first channel. The corresponding data is contained in ChX_Data.

Optional user data can be saved to variables named UserDataX, where 'X' starts at 0. The variable UserData_Count contains the number of UserData variables. For compatibility reasons user data needs to be saved as a 2xN char array, where the first row contains the key of the user data and the second row the actual value. Both rows must have the same column count and are therefore right-padded with white spaces.

Variables can be written to the *.mat files in arbitrary order.

The Matlab® v7.3. file format requires the Matlab® Compiler Runtime (MCR) to be installed on the system and registered in the PATH environment variable.

C.4.1 Mandatory data elements

Variable name	Class	Format / possible values
Name	char	
Comment	char	
DateTime	char	Year-Month-DayTHour:Min:Sec
Format	char	complex
DataType	char	float32
NumberOfChannels	Double	
Ch<n>_ChannelName	char	
Ch<n>_Samples	double	
Ch<n>_Clock_Hz	double	
Ch<n>_CFrequency_Hz	Double	

Variable name	Class	Format / possible values
Ch<n>_Data	Double, Double	I,Q
UserData_Count	Double	(Number of optional user data variables)

C.4.2 Optional data elements

Optional user data can be saved to variables named `UserDataX`, where '`X`' starts at 0. The variable `UserData_Count` contains the number of `UserData` variables. For compatibility reasons user data needs to be saved as a 2xN char array, where the first row contains the key of the user data and the second row the actual value. Both rows must have the same column count and are therefore right-padded with white spaces.

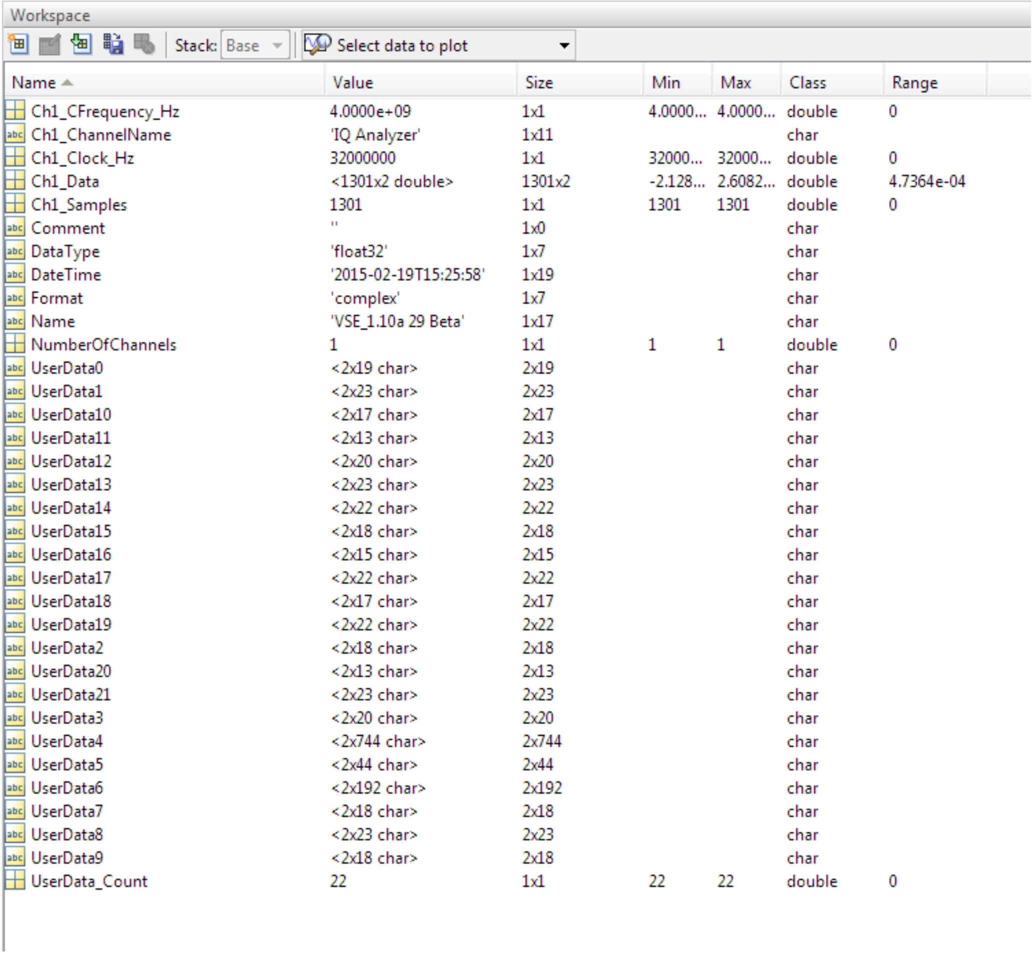
Variable name	Class	Format
UserData<n>	char	Optional Data Parameter name, Value

Table C-2: Optional parameter names to be defined in UserData<n> variables

Parameter name	Possible Values
Ch<n>_AttenuElecState	ON | OFF
Ch<n>_AttenuElecValue_dB	Integer
Ch<n>_AttenuMech_dB	Integer
Ch<n>_CalibrationState	ON | OFF
Ch<n>_DeviceHwInfo	String
Ch<n>_DeviceId	String
Ch<n>_DeviceOptions	String
Ch<n>_DeviceVersions	String
Ch<n>_FilterSettings	FLAT | GAUSS | OFF
Ch<n>_HighPassFilterState	ON | OFF
Ch<n>_Impedance_Ohm	50 | 75
Ch<n>_InputCoupling	AC | DC
Ch<n>_InputPath	RF
Ch<n>_MeasBandwidth_Hz	double
Ch<n>_NumberOfPostSamples	Integer
Ch<n>_NumberOfPreSamples	Integer
Ch<n>_PreampGain_dB	Integer
Ch<n>_PreampState	ON | OFF
Ch<n>_RefLevelOffset_dB	Double
Ch<n>_RefLevel_dBm	Double

Parameter name	Possible Values
Ch<n>_RefOscillatorInput	OFF | ON
Ch<n>_RefOscillatorFreq_Hz	Double
Ch<n>_TrgSource	Extern <1 ..4> | I/Q Power | IF Power | RF Power | Power Sensor | Time
Ch<n>_TrgLevel_dB	Double
Ch<n>_TrgHysteresis_dB	Double
Ch<n>_TrgTpis_s	Double
Ch<n>_TrgOffset_s	Double
Ch<n>_TrgSlope	Rising | Falling | Rising/Falling
Ch<n>_TrgHoldoff_s	Double
Ch<n>_TrgDropOut_s	Double
Ch<n>_YigPreSelectorState	ON | OFF

C.4.3 Example



Name	Value	Size	Min	Max	Class	Range
Ch1_CFrequency_Hz	4.0000e+09	1x1	4.0000...	4.0000...	double	0
Ch1_ChannelName	'IQ Analyzer'	1x11			char	
Ch1_Clock_Hz	32000000	1x1	32000...	32000...	double	0
Ch1_Data	<1301x2 double>	1301x2	-2.128...	2.6082...	double	4.7364e-04
Ch1_Samples	1301	1x1	1301	1301	double	0
Comment	''	1x0			char	
DataType	'float32'	1x7			char	
DateTime	'2015-02-19T15:25:58'	1x19			char	
Format	'complex'	1x7			char	
Name	'VSE_1.10a 29 Beta'	1x17			char	
NumberOfChannels	1	1x1	1	1	double	0
UserData0	<2x19 char>	2x19			char	
UserData1	<2x23 char>	2x23			char	
UserData10	<2x17 char>	2x17			char	
UserData11	<2x13 char>	2x13			char	
UserData12	<2x20 char>	2x20			char	
UserData13	<2x23 char>	2x23			char	
UserData14	<2x22 char>	2x22			char	
UserData15	<2x18 char>	2x18			char	
UserData16	<2x15 char>	2x15			char	
UserData17	<2x22 char>	2x22			char	
UserData18	<2x17 char>	2x17			char	
UserData19	<2x22 char>	2x22			char	
UserData2	<2x18 char>	2x18			char	
UserData20	<2x13 char>	2x13			char	
UserData21	<2x23 char>	2x23			char	
UserData3	<2x20 char>	2x20			char	
UserData4	<2x744 char>	2x744			char	
UserData5	<2x44 char>	2x44			char	
UserData6	<2x192 char>	2x192			char	
UserData7	<2x18 char>	2x18			char	
UserData8	<2x23 char>	2x23			char	
UserData9	<2x18 char>	2x18			char	
UserData_Count	22	1x1	22	22	double	0

C.4.4 Simple matlab® format

As of R&S FSPN software version 1.50, a simple `.mat` format is supported. This format contains I/Q data only, without any meta data. That is, the file contains only variables (double, double) for the corresponding channel data.

When you load a simple Matlab® file, you must define the used sample rate (and optionally analysis bandwidth) manually.

C.5 AID format

AID is a format used to transmit real or complex baseband signals. The IF signal is sent along with information that characterizes the datastream and datastream source.

All datastreams have a frame based structure using the same format, consisting of a global *Frame header* coupled with a data-type specific *Frame body* (i.e. the frame payload).

The header and the body of the frame consist of a number of 32-bit words. The *Frame header* has a predefined structure and size. The size and structure of the *Frame body* depends on the payload type. This is an important factor in the choice of the frame size.

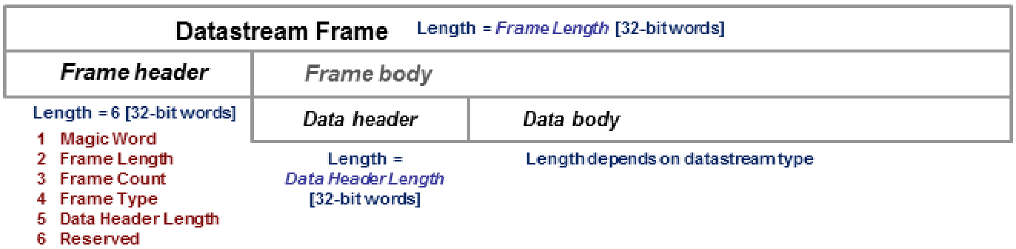


Figure C-1: Generic Datastream Frame structure

Global Frame header

The *Frame header* contains information used for frame synchronization, frame sequencing, payload identification and frame sizing. It consist of six 32-bit words as depicted in the following figure and is defined in **`rs_gx40x_global_frame_header_if_defs.h`**

Table C-3: Global Frame header (structure name: typFRH_FRAMEHEADER)

Word position in frame	Member name Member type	Description
1	**uintMagicWord** ptypUINT	**Magic Word** - 32-bit word, always identical (`0xFB746572`), defines the start of the *Frame header* and is used for frame synchronization. The *Magic Word* and the *Frame Length* are used to identify the beginning of each frame.
2	**uintFrameLength** ptypUINT	**Frame Length** - gives the length of the frame including both *Frame header* and *Frame body*. The length is expressed in 32-bit words. The minimum length is six in case the *Frame body* is empty and the maximum length is limited to the value: • `kFRH_FRAME_LENGTH_MAX = 0x100000` (`1048576 =` 2^{20}) in case of normal frames • `kFRH_FRAME_LENGTH_MAX_EX = 0x400000` (`64* 1048576 =` 2^{26}) in case of extended frames (an extended frame is marked by Bit#0 of the Reserved word of the frame header). Only some datastream types allow the extended frame size, see the definitions in the `rs_gx40x_global_frame_types_if_defs.h`. The next *Magic Word* which denotes the next frame in this data stream will occur `uintFrameLength` [32-bit words] after the *Magic Word* in this frame.
3	**uintFrameCount** ptypUINT	**Frame Count** - sequence counter modulo 2^{32}. Determines the position of this frame in the datastream and is used for sequencing and lost frame detection.

Word position in frame	Member name Member type	Description
4	**uintFrameType** ptypUINT	**Frame Type** - identifies the data type contained in this frame and gives the specific structure of the frame payload. The complete list of frame types (i.e. datastream types) can be found in the following header file: `rs_gx40x_global_frame_types_if_defs.h`
5	**uintDataHeaderLength** ptypUINT	**Data Header Length** - gives the length of the *data header* positioned at the beginning of the *Frame body*. The length is expressed in 32-bit words (`0` means no data header). This information can be used by the software to recognize the version of the datastream format and thus its compatibility to read and correctly interpret the datastream. It enables forward-compatibility with future datastream versions. This value will not vary for a continuous data stream.
6	**uintReserved** ptypUINT	• Bits `#31` to `#1` - Reserved (not yet used, must be `0`) • Bit `#0` - Marks the frame with extended size (up to kFRH_FRAME_LENGTH_MAX_EX 32-bit words).

The *Data Header Length* information is very important for the correct addressing of the data samples. This information gives the exact position in the frame where the *Data body* begins independent of the version of the *data header* (different versions consist of different number of parameters). From the frame beginning (indicated by the *Magic Word*), the first six 32-bit words represent the *Frame header* and the next *Data Header Length* 32-bit words represent the *data header*. After `6+uintDataHeaderLength` 32-bit words starts the *Data body*, i.e. the first data sample.

Frame body

The *Frame body* contains the payload of the frame and its structure depends on the datastream type, as defined by the *Frame Type* element in the *Frame header*.

The *Frame body* is structured into a *data header* followed by the *Data body*. The *data header* contains datastream specific information of the payload.

Bit numbering

Throughout this format description it is assumed that bit #0 is the bit of least numeric significance.

C.5.1 Data body

The IF Data format is valid for the following datastream types:

Table C-4: IF Datastream types

Datastream type ID	Description	Sample data type
ekFRH_DATASTREAM__IFDATA_32RE_32IM_FIX ekFRH_DATASTREAM__IFDATA_32RE_32IM_FIX_RESCALED	Complex IF Data samples, 32-bit real-part and 32-bit imaginary-part, fixed point	typIFD_SAMPLE_32RE_32IM_FIX
ekFRH_DATASTREAM__IFDATA_16RE_16IM_FIX	Complex IF Data samples, 16-bit real-part and 16-bit imaginary-part, fixed point	typIFD_SAMPLE_16RE_16IM_FIX
ekFRH_DATASTREAM__IFDATA_16RE_16RE_FIX	Real IF Data samples, 16-bit real-part, two samples in each 32-bit word, fixed point	typIFD_SAMPLE_16RE_16RE_FIX
ekFRH_DATASTREAM__IFDATA_32RE_32IM_FLOAT_RESCALED	Complex IF Data samples, 32-bit real-part und 32-bit imaginary-part, floating point	typIFD_SAMPLE_32RE_32IM_FLOAT

For the datastream types defined in Table C-4, the same frame body structure is used, the only difference is the carried sample data type.

IF Data Frame Structure

The structure of the IF Datastream is defined in the `rs_gx40x_global_ifdata_header_if_defs.h` header file.

The Data Frame consists of the global *frame header* of type `typFRH_FRAMEHEADER`, as described in "Global Frame header" on page 259, followed by the datastream-specific *Frame body*.

The corresponding "Frame Type" value from the *frame header* for this datastream type can be found in the global frame types header file: `rs_gx40x_global_frame_types_if_defs.h`.

The *frame body* consists of: the *data header* which describes the datastream payload and the *data body* which contains the actual datastream payload.

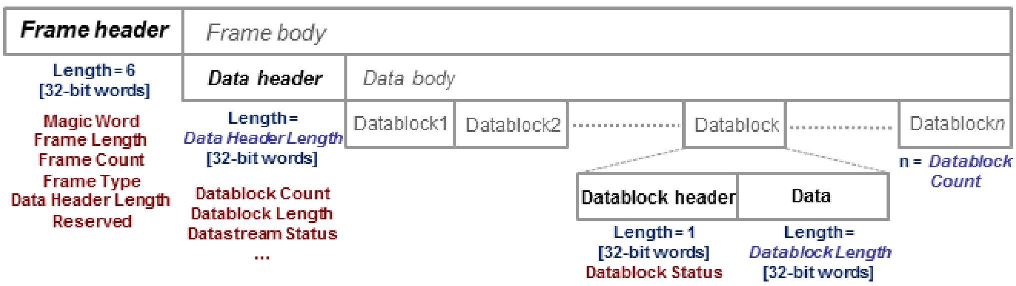


Figure C-2: IF Data frame format

IF data header

The data header describes the datastream payload (such as number of data samples contained in this frame), and contains common properties of the data samples.

The **basic** data header contains several fields that are always sent.

The **extended** data header contains extra information fields sent after the fields of the basic structure.

The length of the data header, as specified by the `uintDataHeaderLength` parameter from the frame header. This parameter provides information about which data header type is used - i.e. the basic header or the extended header.

The IF data header structure, of type `typIFD_IFDATAHEADER`, is described in the following table (data header length = 14 [32-bit words]).

Table C-5: IF DATA header (typIFD_IFDATAHEADER)

Word position in frame	Member name Member type	Description
7	**uintDatablockCount** ptypUINT	**Datablock Count** - represents the number of IF signal data blocks in the IF data frame.
8	**uintDatablockLength** ptypUINT	**Datablock Length** - The number 32-bit words in each IF signal data block excluding the data block header (has to be of the form 2^N with N≥2). This may not be the same as the number of IF signal data samples, as the size of a sample may be 16, 32 or 64 bits.
9 10	**bigtimeTimeStamp** ptypBIGTIME	64-bit **Timestamp** [µs] - Absolute time of the first IF signal data sample, in the first data block of IF signal data in this frame.
11	**uintStatusword** ptypUINT	**Status Word** - extra information that help the receiver react by parameter changes. • Bit `#31` - Reserved • Bit `#30` - **dBFS flag** – `1` indicates that all samples in this frame are considered to be dBFS (dB full scale). – `0` indicates that the values *Antenna Voltage Reference* and *Reciprocal gain correction* (see the *Status Word* description of the datablock header) can be used to calculate the corresponding level for each sample. • Bits `#29` to `#8` - Reserved (not yet used, must be `0`) • Bits `#7` to `#0` - User flags for special signaling between IF Data processing components.
12	**uintSignalSourceID** ptypUINT	**Signal Source Identifier** or antenna identifier (value 0x0 if not used)

Word position in frame	Member name Member type	Description
13	**uintSignalSourceState** ptypUINT	Current **Signal Source State** (value 0x0 if not used) • gives the *Configuration Set Identifier* of the Task Data Set (in GX400) currently being applied by the IF signal source OR • the current *Scan Step Number* in the case of scan operation In the case of memory scanning, the scan step number starts at 0 for the scan channel (memory location) configured with the lowest frequency, and increments (+1) for every channel configured for scanning in the memory scan list. In the case of frequency scanning, the scan step number starts at 0 for the scan step at the lowest frequency, and increments (+1) for every step taken within the configured frequency scan range.
14 15	**uintTunerFrequency_Low** **uintTunerFrequency_High** ptypUINT	64-bit **Tuner Center Frequency** [Hz] - least significant 32 bits (uintTunerFrequency_Low) followed by most significant 32 bits (uintTunerFrequency_High)
16	**uintBandwidth** ptypUINT	IF signal 3dB **Bandwidth** [Hz]
17	**uintSamplerate** ptypUINT	**Sample Rate** of the AD Converter [samples / second] - due to digital filtering within the source, the resulting sample rate of the samples within this frame is: Sample Rate × Interpolation / Decimation
18	**uintInterpolation** ptypUINT	**Interpolation Factor** referred to the ADC signal sample rate. The value 0x1 indicates no interpolation

Word position in frame	Member name Member type	Description
19	**uintDecimation** ptypUINT	**Decimation Factor** referred to the ADC signal sample rate. The value `0x1` indicates no decimation
20	**intAntennaVoltageRef** ptypINT	**Antenna Voltage Reference (AntVoltRef)** is the device specific correction value for the tuner front-end Rx attenuation (expresses anything from antenna input connector to ADC) and is expressed in `[0.1 dBµV]`. This is the level which, while the AGC amplification is at maximum attenuation, is required at the antenna input to produce the full scale value at the ADC. Using this value together with the RecipGain (Reciprocal Gain) value, one can calculate the true signal level at the antenna input connector (see "Data samples" on page 266). The RecipGain value is given in the Status Word of the IF Datablock header Table C-4

The extended IF data header structure, of type `typIFD_IFDATAHEADER_EX`, is described in the following table (total data header length = 19 [32-bit words]).

Table C-6: Extended IF data header (typIFD_IFDATAHEADER_EX) - extra fields only

Word position in frame	Member name Member type	Description
21 22	**bigtimeStartTimeStamp** ptypBIGTIME_NS	64-bit **Timestamp** [ns] - Absolute time of the first sample of the datastream since starting the datastream ("Sample Counter" == 0). This value remains constant until the datastream is stopped and started again or until the tuner performs an internal synchronization.
23 24	**uintSampleCounter_Low** **uintSampleCounter_High** ptypUINT	**Sample Count** - 64-bit counter from the first sample of the first datablock in this frame. Note that this value can be reset when the datastream is stopped and started again or when the tuner performs an internal synchronization. The Sample Count of the next IF frame can be deduced from Datablock Count, Datablock Length and the number of 32-bit words per sample. In this way the number of sample Dropouts can be estimated (that can be replaced with Null values). The exact time is given by *t = Start Time + Sample Count * Decimation / (Sample rate * Interpolation)*.
25	**intKFactor** ptypINT	**kFactor** - Correction factor of the current antenna, given in `0.1dB/m`. Used to determine the field strength (in [dBµV/m]) at the antenna from the voltage level at the antenna input of the receiver. Contains antenna gain, cable attenuation, antenna switch matrix attenuation and anything else from air to antenna input. (the value `0x80000000` is used if no kFactor is defined).

The values contained in the data header fields represent the status at the beginning of the frame. A modification happening during the transmission of a frame will only be noted in the data header of the next frame.

IF Data Body

The IF data body contains zero or more IF Data samples arranged as an array of typIFD_DATABLOCK data blocks (the actual IF signal datastream payload). The number of datablocks is specified by the Datablock Count parameter from the data header.

Each datablock (typIFD_DATABLOCK) has its own datablock header: datablockheaderDatablockHeader (of type typIFD_DATABLOCKHEADER) and a datablock body that contains the actual data sample.

Table C-7: IF Datablock header (typIFD_DATABLOCKHEADER)

Member name **Member type**	**Description**
uintStatusword ptypUINT	Status of the Datablock • Bits #31 to #16 - **RecipGain** - Automatic Gain Control (AGC) **Reciprocal Gain Correction** value that was applied when generating the following IF Data samples. The RecipGain is represented as 16-bit unsigned decimal value (the 16-bit unsigned decimal has to be divided by 2^{16} = 65535 to obtain the unsigned fractional between 0 and 1). For example a correction value of -17.5dB gives a value for RecipGain of 0.1333 which will be represented as 0x2220. Using this value together with the value for the antenna voltage reference, one can calculate the true signal level at the antenna input connector (see "Data samples" on page 266). • Bits #15 to #8 - Reserved (must be 0). • Bits #7 to #2 - User flags for special signaling between IF Data processing components. Set to 0 if not used. • Bit #1 - **Blanking flag** - this flag is set (1) to indicate that the data in this block may have been falsified by some external event. • Bit #0 - **Invalidity flag** - this flag is set (1) to indicate that the data within this block may be corrupt (e.g. the input signal exceeded the range of the AD converter, or the analog signal input from which the data was converted was overloaded), OR any one of the fields in the IF datastream header does not represent the data in this block correctly.

The datablock body is defined as an array of size uintDatablockLength with uintData elements interpreted using the corresponding sample type format ("typIFD_SAMPLE...." as described in the following table). The actual IF data samples have to be extracted from the array. Their structure and size is given by the IF datastream format (Table C-4). The possible IF data sample formats are described in the table below:

Table C-8: IF data sample format

Sample type	**Sample format**	**Most significant bits**	**Least significant bits**	**Data type**
typIFD_SAMPLE _32RE_32IM_FIX typIFD_SAMPLE _32RE_32IM_FLOAT	64-bit I/Q format	First 32-bit Real component		ptypINT or ptypFLOAT_SP
		Second 32-bit Imaginary component		ptypINT or ptypFLOAT_SP

Sample type	Sample format	Most significant bits	Least significant bits	Data type
typIFD_SAMPLE _16RE_16IM_FIX	32-bit I/Q format	16-bit Imaginary component	16-bit Real component	ptypINT
typIFD_SAMPLE _16RE_16RE_FIX	16-bit Real format	16-bit sample number `I+1`	16-bit sample number `I`	ptypINT

The term 'fix' ('fixed' point) indicates signed (2s-complement) fixed point fractional numbers.

Data samples

The absolute signal level in [dBµV] may be calculated as follows:

Level [dBµV] = 10*log($I_{rel}^2+Q_{rel}^2$) [dB] + 20*log (RecipGain / 2^{16}) [dB] + 0.1*AntVoltRef [dBµV]

where I and Q are the real and imaginary parts of each signal sample.

The absolute signal level in [µV] may be calculated as follows:

I [µV] = I_{rel} * (RecipGain / 2^{16}) * AntVoltLin

Q [µV] = Q_{rel} * (RecipGain / 2^{16}) * AntVoltLin

where AntVoltLin [µV] = $10^{(0.1 * AntVoltRef) / 20}$

Depending on the sample format, as presented in Table C-8, I and Q values can be represented as signed integers on 32-bits (I_{int32}) or 16-bits (I_{int16}) or as 32-bit float values (I_{float}). The relative values of I and Q can be calculated with the following formulas (same applies for Q_{rel}):

- $I_{rel} = I_{int32}/(2^{31}-1)$ where I_{int32} is a signed integer, the most significant bit gives the sign (0 is positive, 1 is negative)
- $I_{rel} = I_{int16}/(2^{15}-1)$ where I_{int16} is a signed integer, the most significant bit gives the sign (0 is positive, 1 is negative)
- $I_{rel} = I_{float}$

In the first two cases I_{rel} and Q_{rel} represent relative signal level values between -1 and 1. The absolute signal levels are retrieved through the parameter AntVoltRef as presented above. In the third case, I_{rel} and Q_{rel} can represent directly the absolute signal levels - in this case the RecipGain and AntVoltRef are not used (and are set to RecipGain=1, AntVoltRef=0).

Example

Word position in frame	Frame component name	Hex value	Description
1	**uintMagicWord**	FB746572	Frame synchronisation
2	**uintFrameLength**	0000001E	Entire frame length = 30 (in 32-bit units)

Word position in frame	Frame component name	Hex value	Description
3	**uintFrameCount**	000000FE	Running frame number = 254
4	**uintFrameType**	00000004	The type of data contained in this frame
5	**uintDataHeaderLength**	0000000E	data header length = 14 (in 32-bit units)
6	**uintReserved**	00000000	Reserved field
7	**uintDatablockCount**	00000002	Number of data blocks in this frame = 2
8	**uintDatablockLength**	00000004	The data block length (in 32-bit units) excluding the data block header = 4. Every data block in this frame will have the same length.
9 10	**bigtimeTimeStamp**	00035CED 1D63F4D0	Absolute time [µs] of the first IF signal data sample in this frame
11	**uintStatusword**	00000000	No status change indications.
12	**uintSignalSourceID**	00000003	Antenna ID = 3
13	**uintSignalSourceState**	00000A73	Tuner scan status = position 2675
14	**uintTunerFrequency_Low**	42Ef9EC0	Tuner center frequency = 1,123 GHz
15	**uintTunerFrequency_High**	00000000	
16	**uintBandwidth**	01312d00	The IF Data bandwidth = 20 MHz
17	**uintSamplerate**	0493E000	ADC sample rate = 76,8 Msample/s
18	**uintInterpolation**	00000001	Interpolation factor = none
19	**uintDecimation**	00000003	Decimation factor referred to the ADC sample rate = 3
20	**intAntennaVoltageRef**	0000001E	Antenna reference voltage = 3dBµV
21	**uintStatusword**	22200000	Beginning of the first Datablock. Statusword contains AGC correction factor = 0.1333 and no flags indications.
22	**uintData**	23873454	Real part of first sample
23	**uintData**	34234523	Imaginary part of first sample
24	**uintData**	56567543	Real part of second sample
25	**uintData**	34563456	Imaginary part of second sample
26	**uintStatusword**	41000004	Beginning of the second Datablock. Statusword contains AGC correction factor = 0.2539 and one user flag indication.
27	**uintData**	45345222	Real part of third sample
28	**uintData**	546672ab	Imaginary part of third sample
29	**uintData**	5BB25346	Real part of fourth sample
30	**uintData**	BBF7673e	Imaginary part of fourth sample

C.6 WV format

WV is a format used by Rohde & Schwarz signal generators to store waveforms. A waveform file contains a header and raw I/Q samples.

C.6.1 Mandatory elements

Each waveform file must begin with the TYPE tag. The sequence of the remaining tags is arbitrary.

Element	Description
TYPE	Designates the file type and source of creation (instrument type). Also includes an ASCII-coded checksum of the data part of the WAVEFORM tag, used to detect transmission errors.
CLOCK	The clock frequency (sample rate), in Hz
EMPTYTAG-Length	Length is an ASCII integer value that specifies the number of bytes in the EMPTYTAG, i.e. defines the number of bytes from the colon : to the end bracket }
WAVEFORM-Length	The actual waveform data (I/Q stream) Length specifies the number of bytes in a WAVEFORM tag and is calculated as follows: Length = Number of I/Q pairs * 4 (2 bytes per I and 2 bytes per Q value) + 1 byte (the length of the #) The binary data is represented by 16-bit signed integer in 2's complement notation. It contains the I and Q component alternately, starting with the I component. Each component consists of 2 bytes in Little endian format representation, i.e least significant byte (LSB) first. The values of the 2 bytes in an I component and a Q component are in the range 0x0 to 0xFFFF (-32767 to +32767).

C.6.2 Optional elements

The following elements are optional in a `.wv` file.

Element	Description
DATE	Date and time at which the file was created Syntax: yyyy-mm-dd;hh:mm:ss
LEVEL OFFS	Offset of RMS and peak level relative to the 16-bit full scale modulation (-32767 to + 32767) = 0 dB.
SAMPLES	Number of I/Q samples in the waveform in ASCII format

D Formats for returned values: ASCII format and binary format

When trace data is retrieved using the TRAC:DATA or TRAC:IQ:DATA command, the data is returned in the format defined using the FORMat[:DATA] on page 114. The possible formats are described here.

- ASCII Format (FORMat ASCII):
  The data is stored as a list of comma-separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,16/32/64):
  The data is stored as binary data (definite length block data according to IEEE 488.2), each measurement value being formatted in 16-bit/32-bit/64-bit IEEE 754 floating-point-format.
  The schema of the result string is as follows:
  `#<Length of length><Length of data><value1><value2>…<value n>`
  with:

<Length of length>	Number of digits of the following number of data bytes
<Length of data>	Number of following data bytes
<Value>	2-byte/4-byte/8-byte floating point value

Example: #41024<Data>... contains 1024 data bytes

Data blocks larger than 999,999,999 bytes

According to SCPI, the header of the block data format allows for a maximum of 9 characters to describe the data length. Thus, the maximum REAL 32 data that can be represented is 999,999,999 bytes. However, the R&S FSPN is able to send larger data blocks. In this case, the length of the data block is placed in brackets, e.g. #(1234567890)<value1><value2>…

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

List of Remote Commands (Spectrum Monitor)

Index

R

S

U

V

W

X

Y

Z