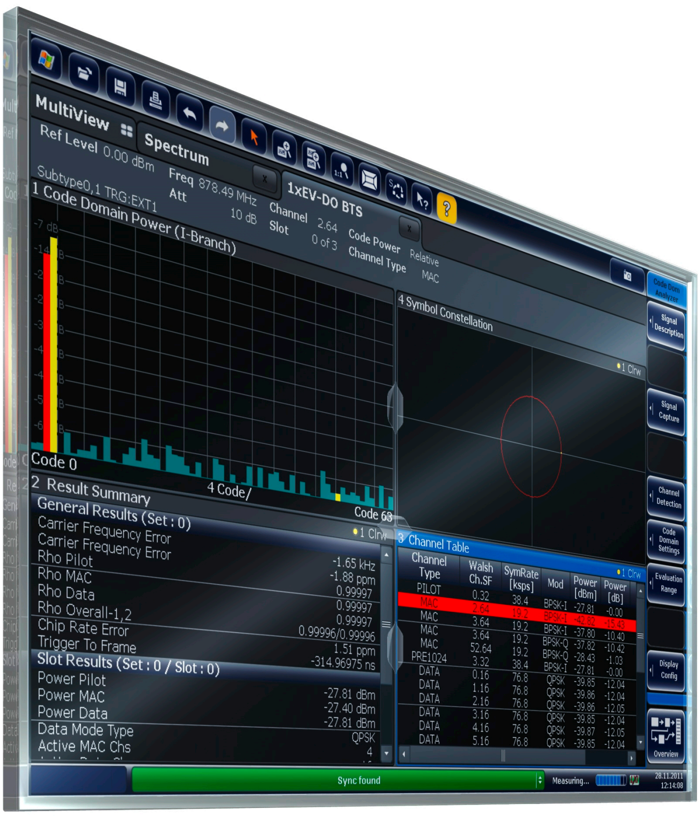
R&S®FSW-84/-K85
1xEV-DO Measurements
User Manual



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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 2.40 and higher:

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

The following firmware options are described:

- R&S FSW-K84 (1313.1480.02)
- R&S FSW-K85 (1313.1497.02)

The software contained in this product makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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

Contents

1 Preface

1.1 About this Manual

This User Manual provides all the information **specific to the 1xEV-DO applications**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSW User Manual.

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

- **Welcome to the 1xEV-DO Measurements Application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **I/Q Data Import and Export**
  Description of general functions to import and export raw I/Q (measurement) data
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup
- **How to Perform Measurements in 1xEV-DO Applications**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Measurement Examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Remote Commands for 1xEV-DO Measurements**
  Remote commands required to configure and perform 1xEV-DO measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FSW User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
  Reference material
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation Overview

The user documentation for the R&S FSW consists of the following parts:

- "Getting Started" printed manual
- Online Help system on the instrument
- User manuals and online manual for base unit and options provided on the product page
- Service manual provided on the internet for registered users
- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website

You find the user documentation on the R&S FSW product page mainly at:

http://www.rohde-schwarz.com/product/FSW > "Downloads" > "Manuals"

Additional download paths are stated directly in the following abstracts of the documentation types.

Getting Started

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

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options. The Online Help is embedded in the instrument's firmware; it is available using the ? icon on the toolbar of the R&S FSW.

User Manuals and Online Manual

Separate manuals are provided for the base unit and the software options:

- **Base unit** manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the **Getting Started** manual.
- **Software option** manuals
  Describe the specific functions of the option. Basic information on operating the R&S FSW is not included.

The **online manual** provides the contents of the user manuals for the base unit and all software options for immediate display on the internet.

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).

Instrument Security Procedures

Deals with security issues when working with the R&S FSW in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the R&S FSW. Brochures provide an overview of the instrument and deal with the specific characteristics, see:

http://www.rohde-schwarz.com/product/FSW > "Downloads" > "Brochures and Data Sheets"

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at:

http://www.rohde-schwarz.com/product/FSW > "Firmware"

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see:

http://www.rohde-schwarz.com/ > "Downloads" > "Applications".

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 names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.

Convention	Description
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 describing how to operate 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 much as possible of the provided functions and possible interdependencies between parameters.

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 1xEV-DO Applications

The 1xEV-DO options are firmware applications that add functionality to the R&S FSW to perform measurements on downlink or uplink signals according to the 1xEV-DO standard.

R&S FSW-K84 performs **B**ase **T**ransceiver **S**tation (**BTS**) measurements on forward link signals on the basis of the 3GPP2 Standard (Third Generation Partnership Project 2).

R&S FSW-K85 performs **M**obile **S**tation (MS) measurements on reverse link signals on the basis of the 3GPP2 Standard (Third Generation Partnership Project 2).

The 1xEV-DO BTS application firmware is based on the "cdma2000 High Rate Packet Data Air Interface Specification" of version C.S0024 v.3.0 dated December 2001 and the "Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Network" of version C.S0032-0 v.1.0 dated December 2001.

These standard documents are published as TIA 856 (IS-856) and TIA 864 (IS-864), respectively.The application firmware supports code domain measurements on 1xEV-DO signals. This code domain power analyzer provides the following analyses, among others: Code Domain Power, Channel Occupancy Table, EVM, Frequency Error and RHO Factor.

In the BTS application, all four channel types (PILOT, MAC, PREAMBLE and DATA) are supported and the modulation types in the DATA channel type are detected automatically. The signals to be measured may contain different modulation types or preamble lengths in each slot, thus making it possible to perform measurements on base stations while operation is in progress.

In the MS application, all 5 channel types (PICH, RRI, DATA, ACK and DRC) as well as TRAFFIC and ACCESS operating mode are supported. Owing to their time structure, the signals are analyzed on half-slot basis.

In addition to the code domain measurements described in the 1xEV-DO standard, the 1xEV-DO applications feature measurements in the spectral range such as channel power, adjacent channel power, occupied bandwidth and spectrum emission mask with predefined settings.

Functions that are not discussed in this manual are the same as in the Spectrum application and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage

http://www2.rohde-schwarz.com/product/FSW.html.

Installation

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

2.1 Starting the 1xEV-DO Applications

The 1xEV-DO measurements require special applications on the R&S FSW.

To activate the 1xEV-DO applications

1. Select the MODE key.

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

2. Select the "1xEV-DO BTS" or "1xEV-DO MS" item.

   The R&S FSW opens a new measurement channel for the 1xEV-DO application.

The measurement is started immediately with the default settings. It can be configured in the 1xEV-DO "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see Chapter 6.2.1, "Configuration Overview", on page 62).

Multiple Measurement Channels and Sequencer Function

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

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

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

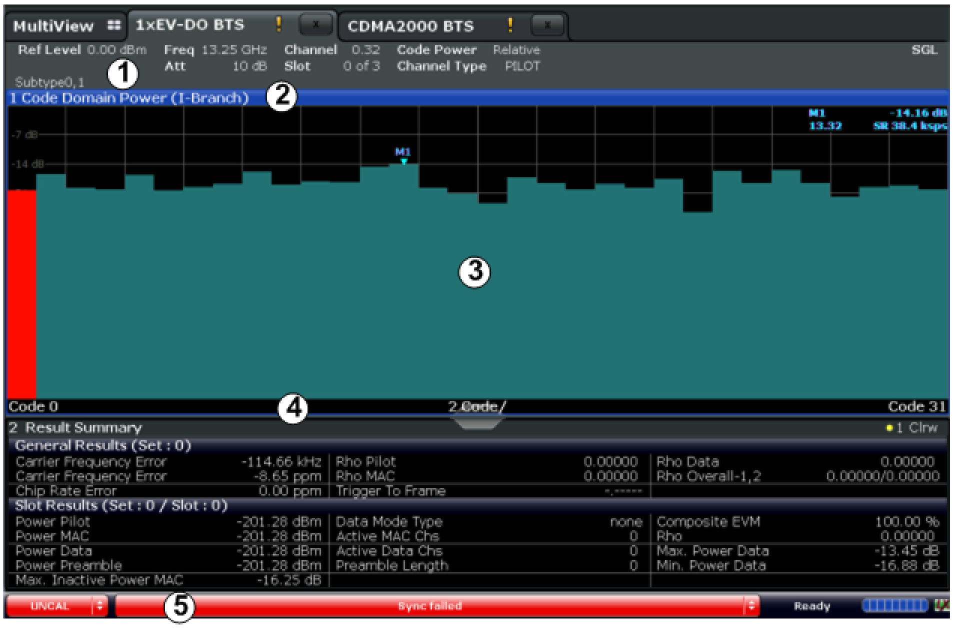
If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a ⚙ symbol in the tab label. The result displays of the individual channels are updated in the tabs (as well as the "MultiView")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

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

2.2 Understanding the Display Information

The following figure shows a measurement diagram during a 1xEV-DO BTS measurement. All different information areas are labeled. They are explained in more detail in the following sections.

(The basic screen elements are identical for 1xEV-DO MS measurements:)



1 = Channel bar for firmware and measurement settings
2+3 = Window title bar with diagram-specific (trace) information
4 = Diagram area with marker information
5 = Diagram footer with diagram-specific information, depending on measurement
6 = Instrument status bar with error messages, progress bar and date/time display

MSRA operating mode

In MSRA operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA operating mode. RF measurements are not available in MSRA operating mode.

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

Channel bar information

In 1xEV-DO applications, the R&S FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in 1xEV-DO applications

Ref Level	Reference level
Freq	Center frequency for the RF signal
Att	Mechanical and electronic RF attenuation
Channel	Channel number (code number and spreading factor)
(Half-)Slot	(Half-) Slot number (see Chapter 4.1, "Slots and Sets", on page 43)
Power Ref	Reference used for power results
Subtype	Subtype of the used transmission standard

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

Window title bar information

For each diagram, the header provides the following information:

Figure 2-1: Window title bar information in 1xEV-DO applications

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

Diagram footer information

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

Status bar information

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

3 Measurements and Result Displays

Access: "Overview" > "Select Measurement"

The 1xEV-DO applications provide several different measurements for signals according to the 1xEV-DO standard. The main and default measurement is Code Domain Analysis. In addition to the code domain power measurements specified by the 1xEV-DO standard, the 1xEV-DO applications offer measurements with predefined settings in the frequency domain, e.g. RF power measurements.

For details on selecting measurements see "Selecting the measurement type" on page 60.

Evaluation methods

The captured and processed data for each measurement can be evaluated with various different methods. All evaluation methods available for the selected 1xEV-DO measurement are displayed in the evaluation bar in SmartGrid mode.

The evaluation methods for CDA are described in Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20.

3.1 Code Domain Analysis

Access: "Overview" > "Select Measurement" > "Code Domain Analyzer"

The 1xEV-DO firmware applications feature a Code Domain Analyzer. It can be used used to perform the measurements required in the 1xEV–DO specification concerning the power of the different codes. In addition, the modulation quality (EVM and RHO factors), frequency error and trigger–to–frame time, and also peak code domain error are determined. Constellation analyses and bit stream analyses are similarly available. The calculation of the timing and phase offsets of the channels for the first active channel can be enabled. The observation period can be adjusted in multiples of the slot.

Basically, the firmware differentiates between the following result classes for the evaluations:

- Results which take the overall signal into account over the whole observation period (all slots)
- Results that take a channel type (such as MAC) into account over the whole period of observation
- Results that take a channel type (such as MAC) into account over a slot
- Results that take a code in a channel type (such as MAC) into account over the whole period of observation
- Results that take a code in a channel type (such as MAC) into account over a slot

Remote command:

`CONF:CDP:MEAS CDP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158

3.1.1 Code Domain Parameters

In Code Domain Analysis, three different types of parameters describe the measured signals:

- Global parameters for the current set
- Parameters for a specific set and slot
- Parameters for a specific channel

All parameters are described in detail in the tables below, including the parameters used for settings or results in SCPI commands (see Chapter 11, "Remote Commands for 1xEV-DO Measurements", on page 148).

Global Parameters

The following parameters refer to the total signal (that is, all channels) for the entire period of observation (that is, all slots):

Table 3-1: Global code domain power parameters

Parameter	SCPI Parameter	Description
Active Channels	ACTive	Specifies the number of active channels found in the signal. Detected data channels as well as special channels are regarded as active.
Carrier Frequency Error	FERRor FERPpm	The frequency error referred to the center frequency of the R&S FSW. The absolute frequency error is the sum of the frequency error of the R&S FSW and that of the device under test. Frequency differences between the transmitter and receiver of more than 1.0 kHz impair synchronization of the Code Domain Power measurement. If at all possible, the transmitter and the receiver should be synchronized. The frequency error is available in the units Hz or ppm referred to the carrier frequency.
Chip Rate Error	CERRor	The chip rate error (1.2288 Mcps) in ppm. A large chip rate error results in symbol errors and, therefore, in possible synchronization errors for Code Domain Power measurements. This parameter is also valid if the R&S FSW could not synchronize to the 1xEV-DO signal.
Composite Data Power	CODPower	**MS application (subtype 2/3) only:** Power of composite data channel
Delta RRI/PICH	DRPich	**MS application (subtype 0/1) only:** Delta RRI/PICH in dB

Parameter	SCPI Parameter	Description
Rho Data	RHOData	**BTS application only:** RHO over all half-slots for the DATA area
Rho MAC	RHOMac	**BTS application only:** RHO over all slots for the MAC area
Rho Overall	RHOVerall	**MS application only:** RHO over all half-slots
Rho Overall-1,2	RHO1 RHO2	**BTS application only:** $RHO_{overall-1}$ over all slots over all chips with averaging starting at the half–slot limit $RHO_{overall-2}$ over all slots over all chips with averaging starting at the quarter–slot limit
Rho Pilot	RHOPilot	**BTS application only:** RHO over all slots for the PILOT area
Trigger to Frame	TFRame	Reflects the time offset from the beginning of the captured signal section to the start of the first slot. In case of triggered data acquisition, this corresponds to the timing offset: *timing offset = frame trigger (+ trigger offset) – start of first slot* If it was not possible to synchronize the R&S FSW to the 1xEV-DO signal, this measurement result is meaningless. For the "Free Run" trigger mode, dashes are displayed ('9' in remote commands).

Slot or Half-Slot Parameters

The following parameters refer to the total signal (that is, all channels) for the selected slot or half-slot.

Table 3-2: Code domain power parameters for a specific (half-)slot

Parameter	SCPI Parameter	Description
Active Data Chs	DACTive	Number of active Data channels
Active MAC Chs	MACTive	Number of active MAC channels
Composite EVM	MACCuracy	The difference between the measured signal and the ideal reference signal in percent. For further details refer to "Composite EVM" on page 25.
Data Mode Type	DMTYpe	**BTS application only:** Modulation type in the DATA channel type: 2 = QPSK 3 = 8-PSK 4 = 16-QAM 10 = 64 QAM
IQ Imbalance	IQIMbalance	IQ imbalance of the signal in %.
IQ Offset	IQOFfset	IQ offset of the signal in %.

Parameter	SCPI Parameter	Description
Max. Inactive Power MAC	IPMMax	Maximum power level in inactive MAC channels, relative to the absolute power of the MAC channel, in dB. This is the highest value from the I- and Q-branch of the inactive MAC channels.
Max. Power Data	PDMax	Maximum power level in Data channel This is the highest value of the I and Q-branch of the Data channel.
Min. Power Data	PDMin	Minimum power level in Data channel This is the lowest value of the I and Q-branch of the Data channel.
Peak CDE	PCDerror	Peak code domain error in dB
Power Data	PDATa	Power in the Data channel in dBm
Power MAC	PMAC	Power in the MAC channel in dBm
Power Pilot	PPILot PPICh	Power of the pilot channel in dBm **BTS application**: power of the PICH channel
Power Preamble	PPReamble	Power in the PREAMBLE channel in dBm
Preamable Length	PLENgth	Length of preamble in chips
RHO	RHO	Quality parameter RHO. According to the 1xEV-DO standard, RHO is the normalized, correlated power between the measured and the ideal reference signal. When RHO is measured, the 1xEV-DO standard requires that only the pilot channel be supplied.
RRI Power	PRRI	Power of the RRI channel in dBm
Slot	SLOT	Slot number
Total Power	PTOTal	Total power of the signal in dBm.

Channel Parameters

The following parameters refer to a specific channel.

Table 3-3: Channel-specific parameters

Parameter	SCPI Parameter	Description
Channel Pwr Rel	CDPRelative	Relative (dB) power of the channel (refers either to the pilot channel or the total power of the signal)
Channel Pwr Abs	CDPabsolute	Absolute (dBm) power of the channel
(Walsh)Channel.SF	CHANnel SFACtor	Channel number including the spreading factor

Parameter	SCPI Parameter	Description
Channel Type		Channel type BTS application: ● 0 = PICH ● 1 = RRI ● 2 = DATA ● 3 = ACK ● 4 = DRC ● 5 = INACTIVE
Code Class		Code class of the channel (See Table 11-3 and Table 11-4)
Code Number		Code number within the channel (0 to <SF>-1)
Composite Data EVM	CDERms CDEPeak	**MS application only:** RMS or peak value of EVM (error vector magnitude) of composite data channel
Composite Data Modu...	CODMulation	**MS application only:** Modulation type and selected branch of the composite data channel
Mapping		**MS application only:** Modulation type including mapping: 0 = I branch 1 = Q branch 2 = I and Q branch
Modulation Type	MTYPe	**BTS application only:** Modulation type including mapping: 0 = BPSK-I 1 = BPSK-Q 2 = QPSK 3 = 8-PSK 4 = 16-QAM 5 = 2BPSK (Modulation types QPSK/8-PSK/16-QAM have complex values.)
Phase Offset	POFFset	Phase offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 117), the maximum value of the phase offset is displayed together with the associated channel in the last two lines. Since the phase offset values of each active channel can be either negative or positive, the absolute values are compared and the maximum is displayed with the original sign. '9' for: ● CDP:TPM OFF ● > 50 active channels found ● inactive channel
Symbol EVM	EVMRms EVMPeak	RMS or Peak value of the symbol EVM measurement result For further details refer to "Symbol EVM" on page 32.

Parameter	SCPI Parameter	Description
Symbol Rate	SRATe	Symbol rate in ksps with which symbols are transmitted
Timing Offset	TOFFset	Timing offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 117), the maximum value of the timing offset is displayed together with the associated channel in the last two lines. Since the timing offset values of each active channel can be either negative or positive, the absolute values are compared and the maximum is displayed with the original sign. '9' for: • CDP:TPM OFF • > 50 active channels found • inactive channel

3.1.2 Evaluation Methods for Code Domain Analysis

Access: "Overview" > "Display Config"

The captured I/Q data can be evaluated using various different methods without having to start a new measurement. All evaluation methods available for the selected 1xEV-DO measurement are displayed in the evaluation bar in SmartGrid mode.

The selected evaluation not only affects the result display, but also the results of the trace data query (see Chapter 11.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 238).

The Code Domain Analyzer provides the following evaluation methods for measurements in the code domain:

Bitstream

The "Bitstream" evaluation displays the demodulated bits of a selected channel over a selected slot.

All bits that are part of inactive channels are marked as being invalid using dashes.

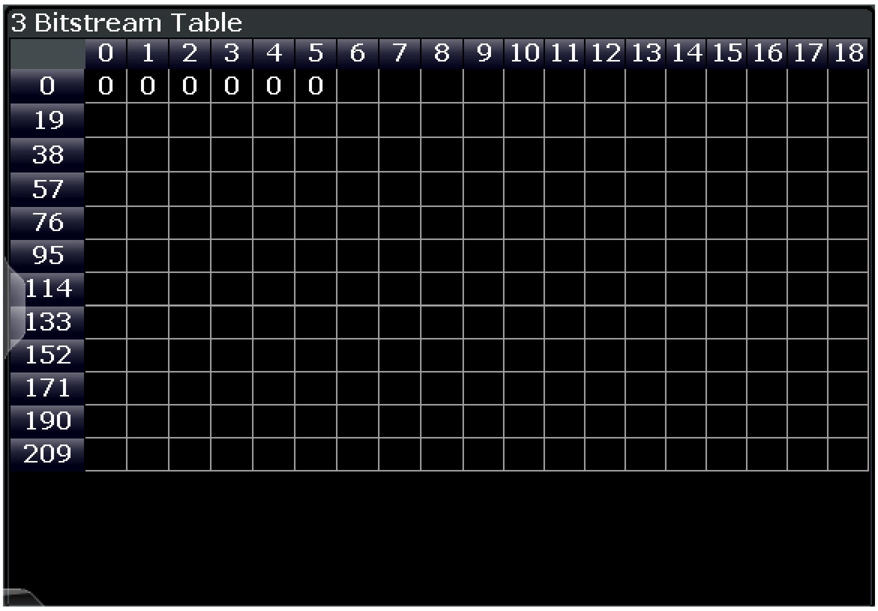


Figure 3-1: Bitstream result display in the BTS application

To select a specific symbol press the MKR key. If you enter a number, the marker jumps to the selected symbol. If there are more symbols than the screen is capable of displaying, use the marker to scroll inside the list.

The number of symbols per slot depends on the spreading factor (symbol rate) and the antenna diversity. The number of bits per symbol depends on the modulation type.

For details see Chapter A.2, "Channel Type Characteristics", on page 275.

Remote command:
`LAY:ADD? '1',RIGH, 'BITS'`, see `LAYout:ADD[:WINDow]?` on page 221

BTS Channel Results

In the BTS application the result summary is divided into two different evaluations:

- Channel and code-specific results
- General results for the set and slot (see "General Results (BTS application only)" on page 26)

The Channel Results show the data of various measurements in numerical form for a specific channel.

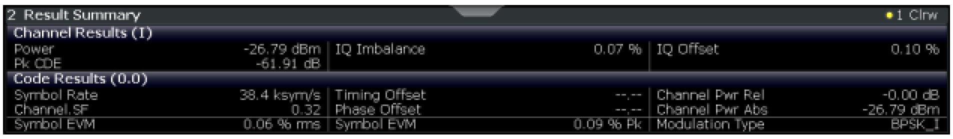


Figure 3-2: Channel results summary

For details on the individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Remote command:
`LAY:ADD? '1',RIGH, CRES`, see `LAYout:ADD[:WINDow]?` on page 221
`CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Channel Table

The "Channel Table" evaluation displays the detected channels and the results of the code domain power measurement over the selected slot. The analysis results for all channels are displayed.


2 Channel Table • 1 Clrw

Channel Type	Walsh Ch.SF	SymRate [ksps]	Mod	Power [dBm]	Power [dB]	T Offs [ns]	P Offs [mrad]
PILOT	0.32	38.4	BPSK-I	-26.79	-0.00	-.--	-.--
MAC	2.64	19.2	BPSK-I	-41.80	-15.41	-.--	-.--
MAC	3.64	19.2	BPSK-I	-36.80	-10.42	-.--	-.--
MAC	3.64	19.2	BPSK-Q	-36.80	-10.42	-.--	-.--
MAC	52.64	19.2	BPSK-Q	-27.41	-1.03	-.--	-.--

Figure 3-3: Channel Table display in the BTS application

For details on the individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

The channels that must be available in the signal to be analyzed and any other control channels are displayed first.

The data channels that are contained in the signal are displayed last.

If the type of a channel can be fully recognized, based on pilot sequences or modulation type, the type is indicated in the table.

The channels are in descending order according to symbol rates and, within a symbol rate, in ascending order according to the channel numbers. Therefore, the inactive codes are always displayed at the end of the table (if "Show inactive channels" is enabled, see Chapter 7.5, "Channel Table Configuration", on page 124.

Which parameters are displayed in the Channel Table is configurable, see Chapter 7.5, "Channel Table Configuration", on page 124.

Remote command:
`LAY:ADD? '1',RIGH, CTABle`, see `LAYout:ADD[:WINDow]?` on page 221

Code Domain Power / Code Domain Error Power

The "Code Domain Power" evaluation shows the power of all possible code channels in the total signal over the selected slot for the selected branch.

"Code Domain Error Power" is the difference in power between the measured and the ideal signal.

The x-axis represents the channel (code) number, which corresponds to the base spreading factor. The y-axis is a logarithmic level axis that shows the (error) power of each channel. With the error power, both active and inactive channels can be evaluated at a glance.

Both evaluations support either Hadamard or BitReverse code sorting order (see Chapter 4.8, "Code Display and Sort Order", on page 52).

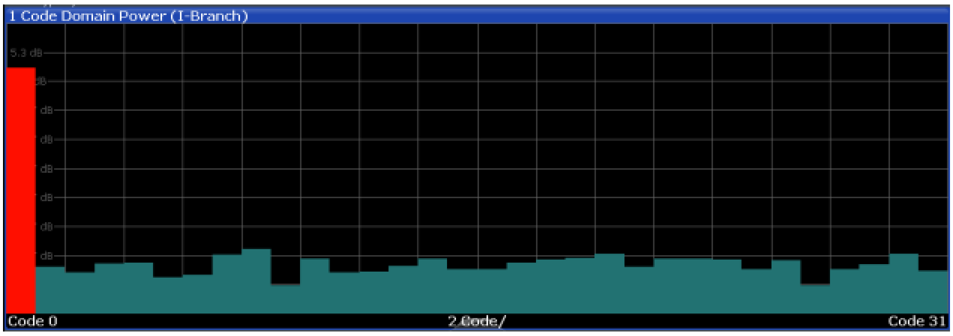


Figure 3-4: Code Domain Power Display in the BTS application

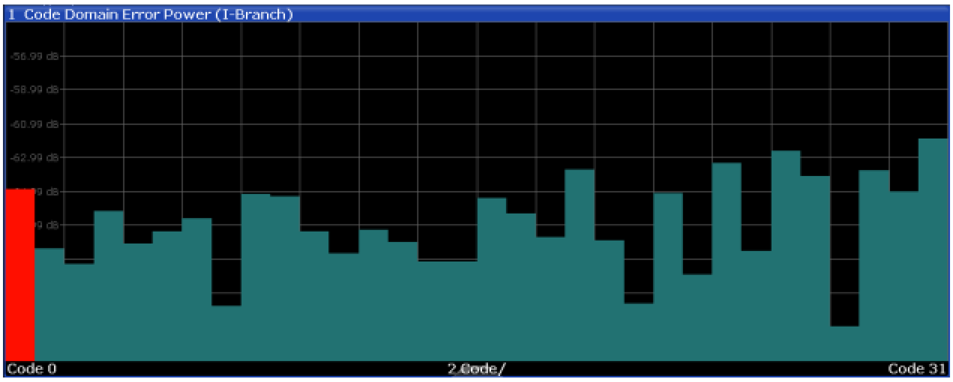


Figure 3-5: Code Domain Error Power result display

Active and inactive data channels are defined via the Inactive Channel Threshold. The power values of the active and inactive channels are shown in different colors.

Table 3-4: Assignment of colors in CDEP result display

Color	Usage
Red	Selected channel (code number)
Yellow	Active channel
Green	Inactive channel
Light blue	Alias power of higher spreading factor
Magenta	Alias power as a result of transmit diversity

Remote command:
CDP:
`LAY:ADD? '1',RIGH, CDPower`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES? CDP` or `CALC:MARK:FUNC:CDP:RES? CDPR`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233
CDEP:
`LAY:ADD? '1',RIGH, CDEPower`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233.

Composite Constellation

In "Composite Constellation" evaluation the constellation points of the 1536 chips are displayed for the specified slot. This data is determined inside the DSP even before the channel search. Thus, it is not possible to assign constellation points to channels. The constellation points are displayed normalized with respect to the total power.

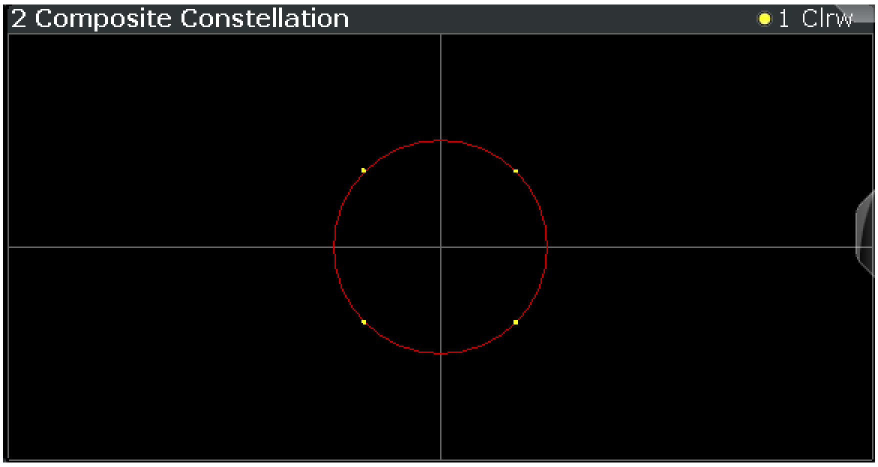


Figure 3-6: Composite Constellation display in the BTS application

Remote command:

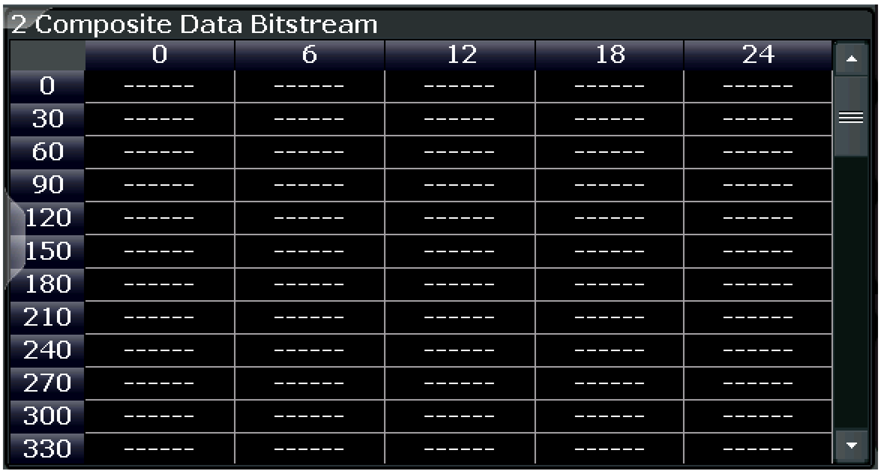
`LAY:ADD? '1',RIGH, CCON`, see `LAYout:ADD[:WINDow]?` on page 221

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Composite Data Bitstream (MS application only)

This result display is only available in the MS application for subtypes 2 or 3.

The Composite Data Bitstream provides information on the demodulated bits for the special composite data channel and selected half-slot, regardless of which channel is selected.



	0	6	12	18	24
0	------	------	------	------	------
30	------	------	------	------	------
60	------	------	------	------	------
90	------	------	------	------	------
120	------	------	------	------	------
150	------	------	------	------	------
180	------	------	------	------	------
210	------	------	------	------	------
240	------	------	------	------	------
270	------	------	------	------	------
300	------	------	------	------	------
330	------	------	------	------	------

Figure 3-7: Composite Data Bitstream result display

The number of displayed symbols depends on the spreading factor, see Chapter A.2, "Channel Type Characteristics", on page 275.

Remote command:
`LAY:ADD? '1',RIGH, CDB`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Composite Data Constellation (MS application only)

This result display is only available in the MS application for subtypes 2 or 3.

The Composite Data Constellation shows the channel constellation of the modulated composite data signal at symbol level. The results are displayed for the special composite data channel, regardless of which channel is selected.

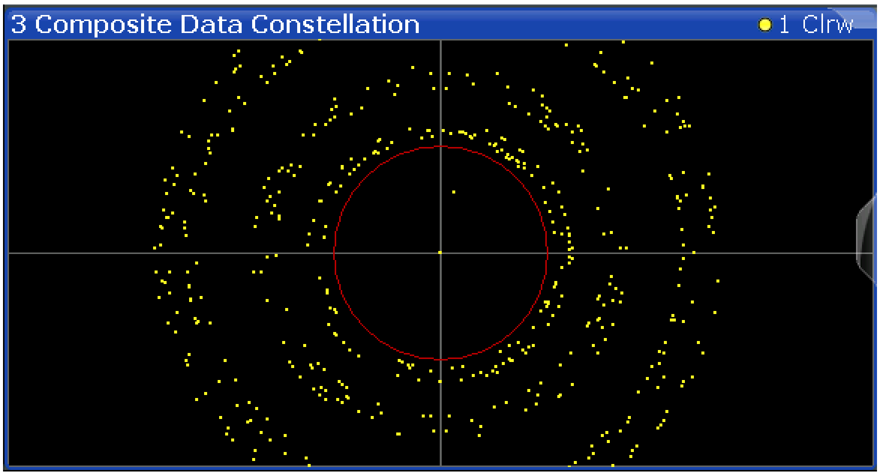


Figure 3-8: Composite Data Constellation result display

Remote command:
`LAY:ADD? '1',RIGH, CDC`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Composite EVM

This result display measures the modulation accuracy. It determines the error vector magnitude (EVM) over the total signal. The EVM is the root of the ratio of the mean error power (root mean square) to the power of an ideally generated reference signal. Thus, the EVM is shown in %. The diagram consists of a composite EVM for each slot.

The measurement evaluates the total signal over the entire period of observation. The selected slot is highlighted red. You can set the number of slots in the "Signal Capture" settings (see "Number of Slots" on page 96).

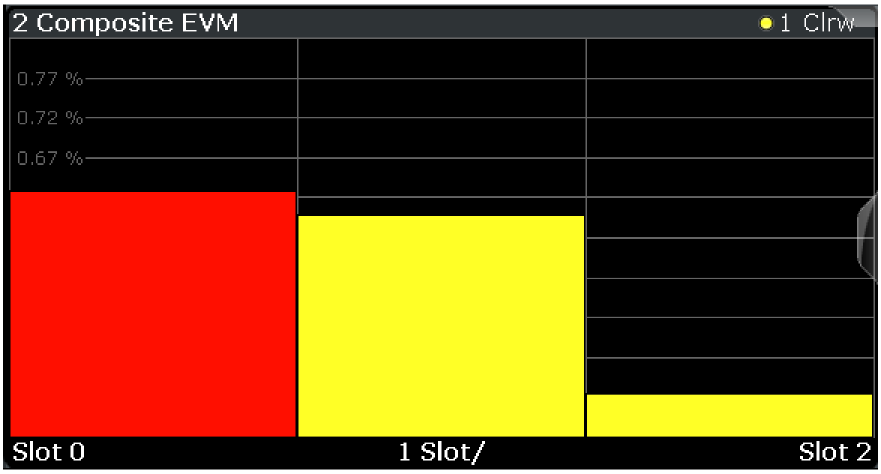


Figure 3-9: Composite EVM result display

Only the channels detected as being active are used to generate the ideal reference signal. If a channel is not detected as being active, e.g. on account of low power, the difference between the test signal and the reference signal and therefore the composite EVM is very large. Distortions also occur if unassigned codes are wrongly given the status of "active channel". To obtain reliable measurement results, select an adequate channel threshold via the "Inactive Channel Threshold" on page 99 setting.

Remote command:

`LAY:ADD? '1',RIGH, CEVM`, see `LAYout:ADD[:WINDow]?` on page 221

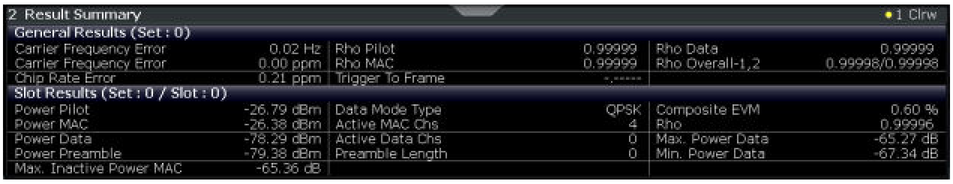
`CALC:MARK:FUNC:CDP:RES? MACCuracy`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

General Results (BTS application only)

In the BTS application the result summary is divided into two different evaluations:

- Channel and code-specific results (see "BTS Channel Results" on page 21)
- General results for the set and slot

The General Results show the data of various measurements in numerical form for all channels in all slots in a specific set.



2 Result Summary — 1 Clrw

General Results (Set : 0)					
Carrier Frequency Error	0.02 Hz	Rho Pilot	0.99999	Rho Data	0.99999
Carrier Frequency Error	0.00 ppm	Rho MAC	0.99999	Rho Overall-1,2	0.99998/0.99998
Chip Rate Error	0.21 ppm	Trigger To Frame	-.-----		
Slot Results (Set : 0 / Slot : 0)					
Power Pilot	-26.79 dBm	Data Mode Type	QPSK	Composite EVM	0.60 %
Power MAC	-26.38 dBm	Active MAC Chs	4	Rho	0.99996
Power Data	-78.29 dBm	Active Data Chs	0	Max. Power Data	-65.27 dB
Power Preamble	-79.38 dBm	Preamble Length	0	Min. Power Data	-67.34 dB
Max. Inactive Power MAC	-65.36 dB				

Figure 3-10: General results summary

For details on the individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Remote command:

`LAY:ADD? '1',RIGH, GRES`, see `LAYout:ADD[:WINDow]?` on page 221

`CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Mag Error vs Chip

The Magnitude Error versus chip display shows the magnitude error for all chips of the selected slot.

The magnitude error is calculated as the difference of the magnitude of the received signal to the magnitude of the reference signal. The reference signal is estimated from the channel configuration of all active channels. The magnitude error is related to the square root of the mean power of reference signal and given in percent.

$$MAG_k = \frac{|s_k| - |x_k|}{\sqrt{\frac{1}{N}\sum_{n=0}^{N-1}|x_n|^2}} \bullet 100\% \quad | N = 2560 \quad | k \in [0 \ldots (N-1)]$$

Where:

MAG_k	Magnitude error of chip number k
s_k	Complex chip value of received signal
x_k	Complex chip value of reference signal
k	Index number of the evaluated chip
N	Number of chips at each CPICH slot
n	Index number for mean power calculation of reference signal

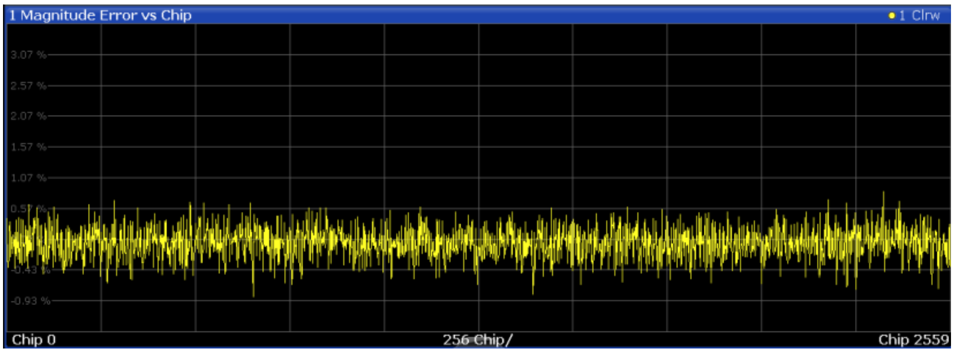


Figure 3-11: Magnitude Error vs Chip display for 1xEV-DO BTS measurements

Remote command:

`LAY:ADD? '1',RIGH, MECHip`, see `LAYout:ADD[:WINDow]?` on page 221

TRACe<n>[:DATA]? TRACE<1...4>

Peak Code Domain Error

The Peak Code Domain Error is defined as the maximum value for the Code Domain Power / Code Domain Error Power for all codes. Thus, the error between the measurement signal and the ideal reference signal is projected onto the code domain at a specific base spreading factor. In the diagram, each bar of the x-axis represents one slot. The y-axis represents the error power.

The measurement evaluates the total signal over the entire period of observation. The currently selected slot is highlighted red.

You can select the Number of Sets and the number of evaluated slots in the Signal Capture settings (see Chapter 6.2.6, "Signal Capture (Data Acquisition)", on page 96).

MS application: the error is calculated only for the selected branch (I or Q).

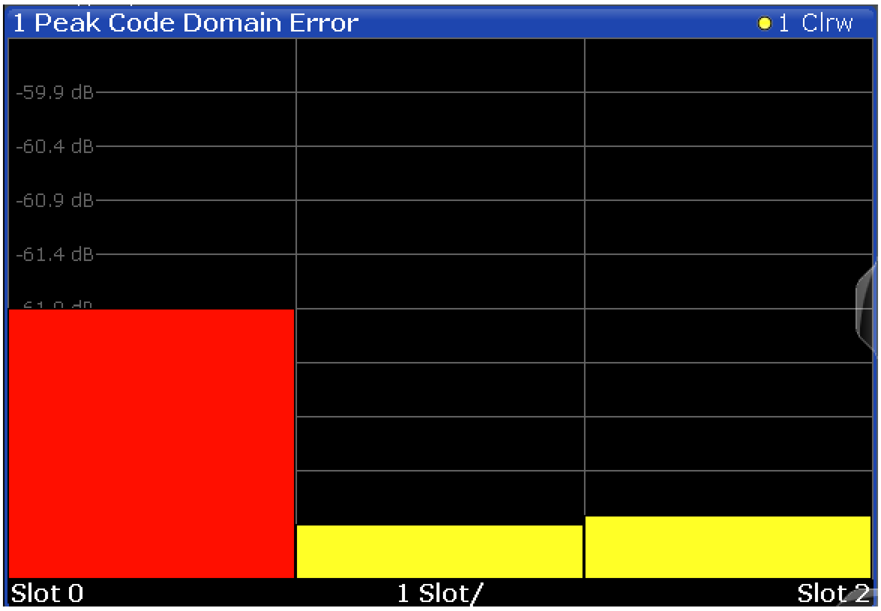


Figure 3-12: Peak Code Domain Error display in the BTS application

Note: Only the channels detected as being active are used to generate the ideal reference signal. If a channel is not detected as being active, e.g. on account of low power, the difference between the test signal and the reference signal is very large. The result display therefore shows a peak code domain error that is too high. Distortions also occur if unassigned codes are wrongly given the status of "active channel". To obtain reliable measurement results, select an adequate channel threshold via the Inactive Channel Threshold setting.

Remote command:
`LAY:ADD? '1',RIGH, PCDerror`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES? PCDerror`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Phase Error vs Chip

Phase Error vs Chip activates the phase error versus chip display. The phase error is displayed for all chips of the selected slot.

The phase error is calculated by the difference of the phase of received signal and phase of reference signal. The reference signal is estimated from the channel configuration of all active channels. The phase error is given in degrees in a range of +180° to -180°.

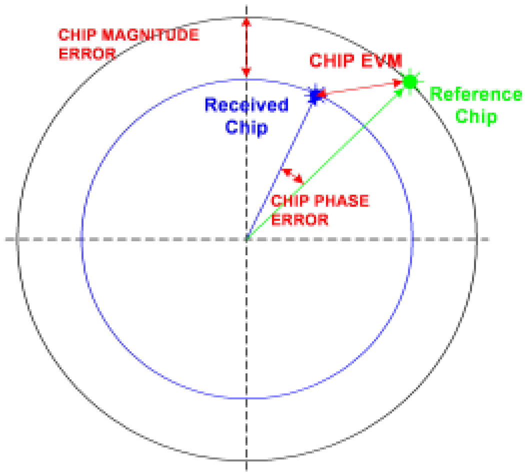
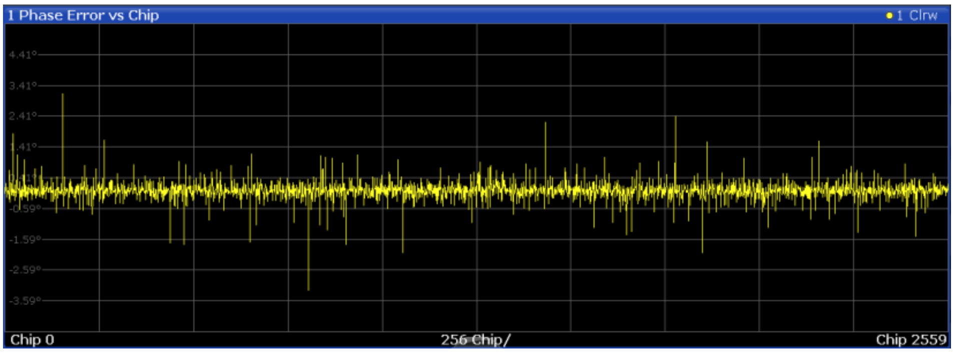


Figure 3-13: Calculating the magnitude, phase and vector error per chip

- $PHI_k = \varphi(s_k) - \varphi(x_k) \quad | \quad N = 2560 \quad | \quad k \in [0 \ldots (N-1)]$

Where:

PHI_k	Phase error of chip number k
s_k	Complex chip value of received signal
x_k	Complex chip value of reference signal
k	Index number of the evaluated chip
N	Number of chips at each CPICH slot
φ(x)	Phase calculation of a complex value



Remote command:
`LAY:ADD? '1',RIGH, PECHip`, see `LAYout:ADD[:WINDow]?` on page 221
TRACe<n>[:DATA]? TRACE<1...4>

Power vs Chip (BTS application only)
This result display shows the power for all chips in a specific slot. Therefore, a trace consists of 2048 power values.

The measurement evaluates the total signal over a single slot in the selected branch. The selected slot is highlighted red.

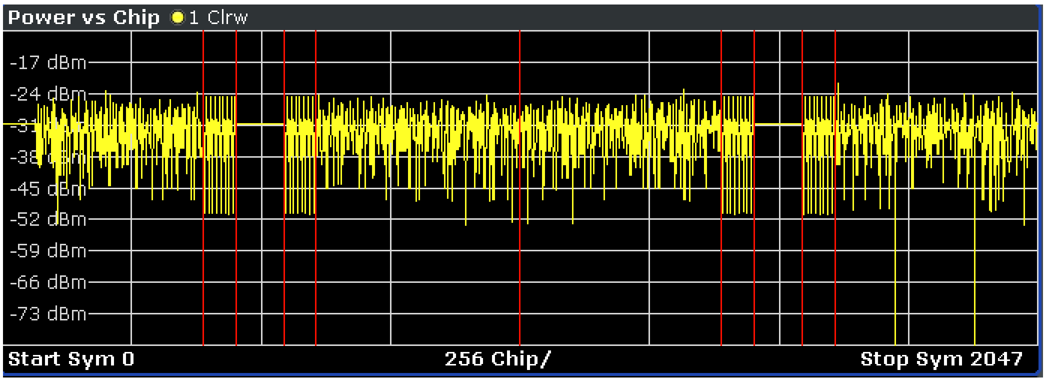
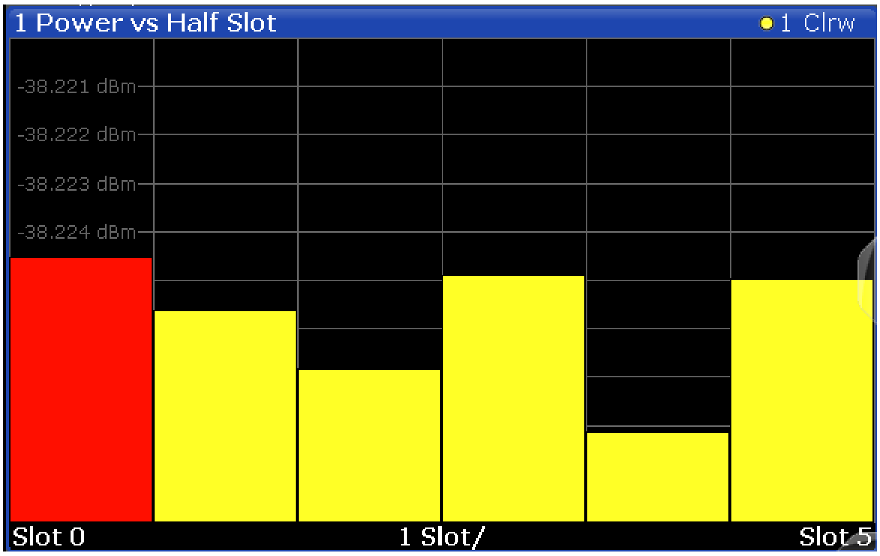


Figure 3-14: Power vs Chip result display

Due to the symmetric structure of the 1xEV-DO forward link signal, it is easy to identify which channel types in the slot have power.

Remote command:
`LAY:ADD? '1',RIGH, PVChip`, see `LAYout:ADD[:WINDow]?` on page 221

Power vs Halfslot (MS application only)
This result display shows the power of the selected channel over all half-slots.



Remote command:
`LAY:ADD? '1',RIGH, PHSLot`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Power vs Symbol
The "Power vs. Symbol" evaluation calculates the absolute power in dBm for each symbol in the selected channel and the selected (half-)slot.

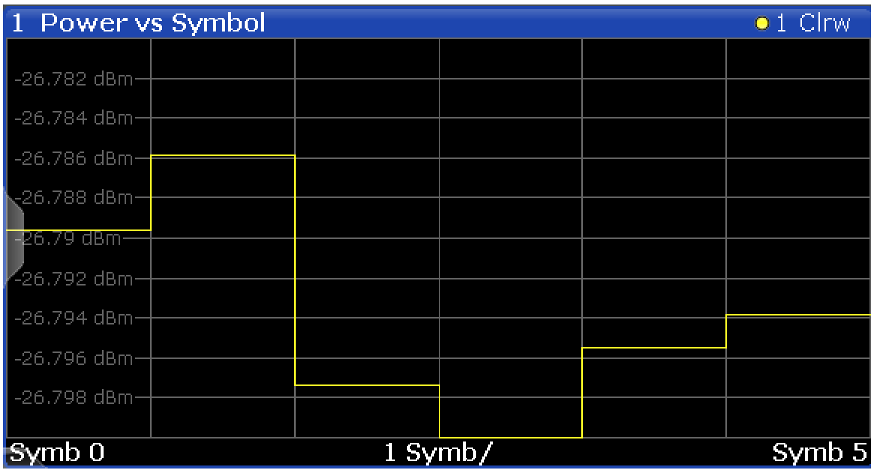


Figure 3-15: Power vs Symbol result display

Remote command:

`LAY:ADD? '1',RIGH, PSYMbol`, see `LAYout:ADD[:WINDow]?` on page 221

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Result Summary (MS application only)

The "Result Summary" evaluation displays a list of measurement results on the screen. For details on the displayed values see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Note: BTS application. In the BTS application the result summary is divided into two different evaluations:

- Channel and code-specific results (see "BTS Channel Results" on page 21)
- General results for the set and slot (see "General Results (BTS application only)" on page 26)

The Result Summary shows the data of various measurements in numerical form for all channels.

2 Result Summary • 1 Clrw

General Results (Set : 0)(I)					
Carrier Frequency Error	-0.61 Hz	DELTA RRI/PICH	0.00 dB	Trigger To Frame	-.-----
Carrier Frequency Error	-0.00 ppm	Rho Overall	0.52985	Active Channels	4 Chips
Chip Rate Error	0.06 ppm				
Slot Results (Half Slot : 0)					
Total Power	-31.23 dBm	Composite EVM	81.58 %	IQ Imbalance	0.09 %
Pilot Power	-38.22 dBm	Pk CDE (SF 16/I)	-4.78 dB	IQ Offset	1.87 %
RRI Power	-38.23 dBm	Rho	0.60039 dBm		
Channel Results					
Channel Pwr Rel	-6.99 dB	Timing Offset	--.--	Channel.SF	0.16
Channel Pwr Abs	-38.22 dBm	Phase Offset	--.--	Symbol Rate	76.80 ksym/s
Symbol EVM	0.97 % rms	Symbol EVM	3.06 % Pk		

Figure 3-16: Result Summary display in the MS application

The Result Summary is divided into three parts:

- General results for the selected set
- Slot results for the selected half-slot
- Channel results for the selected channel

Remote command:
LAY:ADD? '1',RIGH, RSUMmary, see LAYout:ADD[:WINDow]? on page 221
CALC:MARK:FUNC:CDP:RES?; see CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult? on page 233

Symbol Constellation

The "Symbol Constellation" evaluation shows all modulated symbols of the selected channel and the selected slot.

The BTS application supports BPSK, QPSK, 8PSK, 16QAM and 64QAM modulation types. The modulation type itself depends on the channel type. Refer to Chapter A.2, "Channel Type Characteristics", on page 275 for further information.

Note: QPSK constellation points are located on the diagonals (not x and y-axis) of the constellation diagram. BPSK constellation points are always on the x-axis.

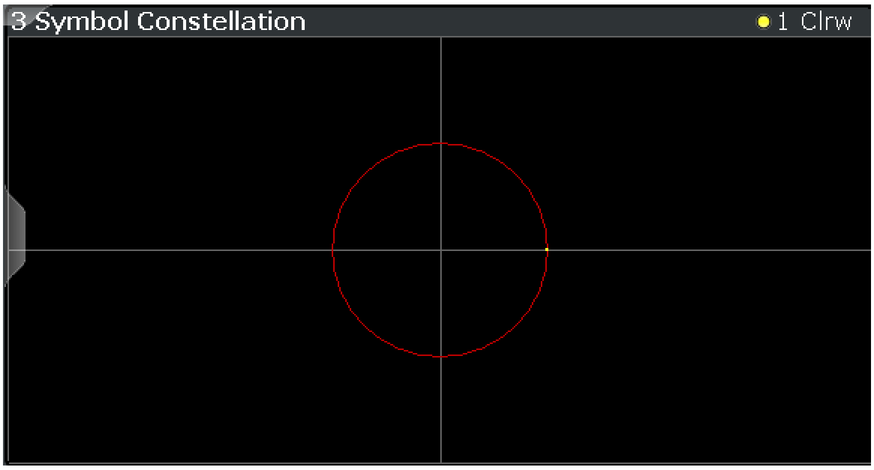


Figure 3-17: Symbol Constellation display in the BTS application

The number of symbols is in the range from 1 to 100, depending on the symbol rate of the channel (see Chapter A.2, "Channel Type Characteristics", on page 275).

Remote command:
LAY:ADD? '1',RIGH, SCONst, see LAYout:ADD[:WINDow]? on page 221
CALC:MARK:FUNC:CDP:RES? ; see CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult? on page 233

Symbol EVM

The "Symbol EVM" evaluation shows the error between the measured signal and the ideal reference signal in percent for the selected channel and the selected slot. A trace over all symbols of a slot is drawn.

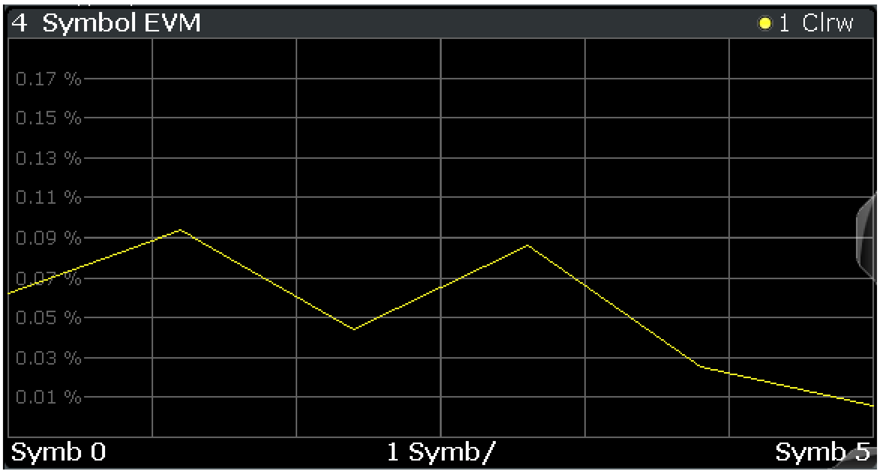


Figure 3-18: Symbol EVM display in the BTS application

The number of symbols is in the range from 1 to 100, depending on the symbol rate of the channel (see Chapter A.2, "Channel Type Characteristics", on page 275).

Inactive channels can be measured, but the result is meaningless since these channels do not contain data.

Remote command:
`LAY:ADD? '1',RIGH, SEVM`, see `LAYout:ADD[:WINDow]?` on page 221
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 233

Symbol Magnitude Error

The Symbol Magnitude Error is calculated analogous to symbol EVM. The result is one symbol magnitude error value for each symbol of the slot of a special channel. Positive values of symbol magnitude error indicate a symbol magnitude that is larger than the expected ideal value. Negative symbol magnitude errors indicate a symbol magnitude that is less than the expected ideal value. The symbol magnitude error is the difference between the magnitude of the received symbol and that of the reference symbol, related to the magnitude of the reference symbol.

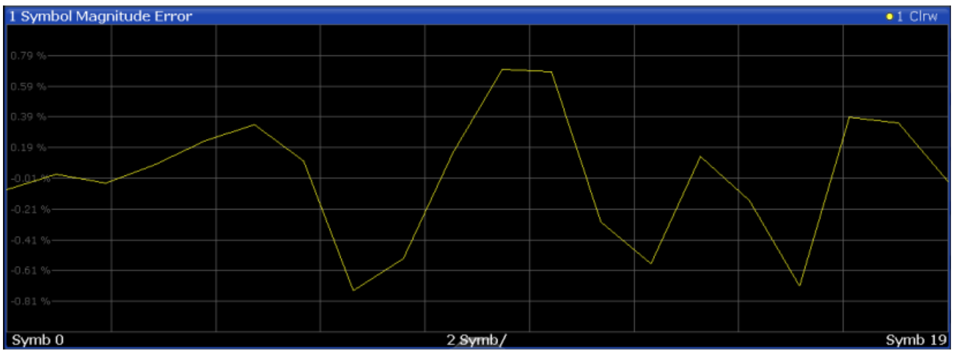


Figure 3-19: Symbol Magnitude Error display for 1xEV-DO BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SMERror`, see `LAYout:ADD[:WINDow]?` on page 221
TRACe<n>[:DATA]? TRACE<1...4>

Symbol Phase Error

The Symbol Phase Error is calculated analogous to symbol EVM. The result is one symbol phase error value for each symbol of the slot of a special channel. Positive values of symbol phase error indicate a symbol phase that is larger than the expected ideal value. Negative symbol phase errors indicate a symbol phase that is less than the expected ideal value.

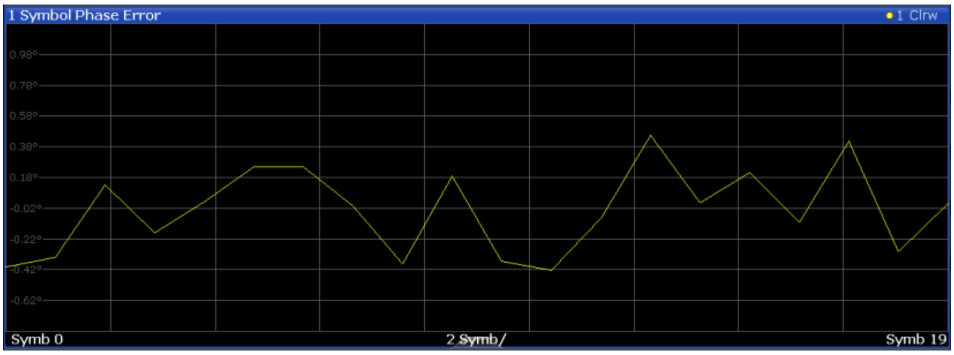


Figure 3-20: Symbol Phase Error display for 1xEV-DO BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SPERror`, see `LAYout:ADD[:WINDow]?` on page 221
TRACe<n>[:DATA]? TRACE<1...4>

3.2 RF Measurements

Access: "Overview" > "Select Measurement"

In addition to the Code Domain Analysis measurements, the 1xEV-DO firmware applications also provide some RF measurements as defined in the 1xEV-DO standard. RF measurements are identical to the corresponding measurements in the base unit, but configured according to the requirements of the 1xEV-DO standard.

For details on these measurements see the R&S FSW User Manual.

3.2.1 RF Measurement Types and Results

The 1xEV-DO applications provide the following RF measurements:

Power vs Time (BTS application only)

Access: "Overview" > "Select Measurement" > "Power vs Time"

The Power vs Time measurement examines a specified number of half slots. Up to 36 half slots can be captured and processed simultaneously. That means that for a standard measurement of 100 half slots only three data captures are necessary. After the data has been captured, the R&S FSW averages the measured values and compares the results to the emission envelope mask.

This measurement is required by the standard for the "Emission Envelope Mask". It is only available in the BTS application.

The Power vs Time diagram displays the averaged power values versus time and the results of the limit checks.

Limit check indicates the overall result of all limit checks.

PVTFU / PVTIU indicates the upper limit check.

PVTFL / PVTIL indicates the lower limit check.

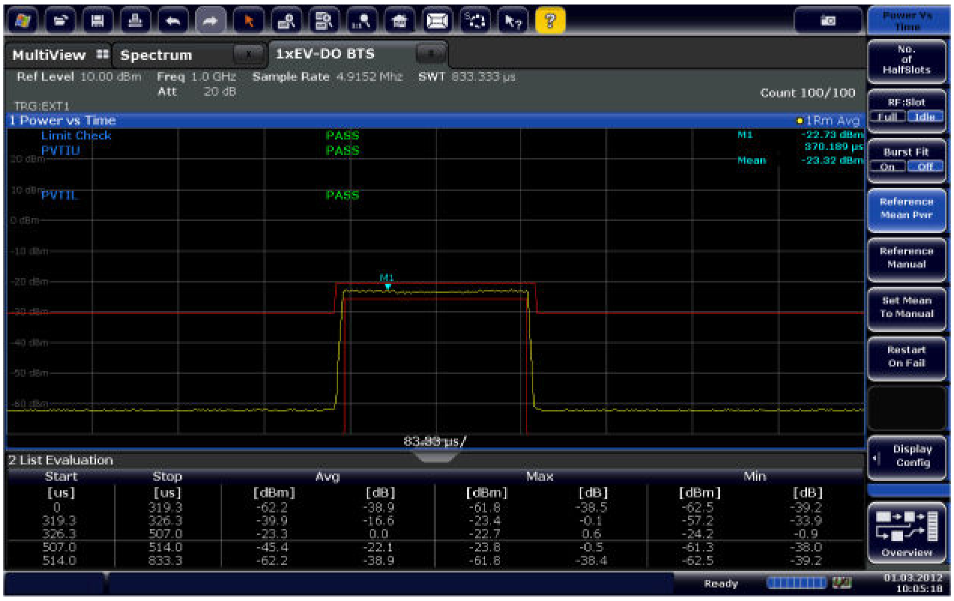


Figure 3-21: Power vs Time measurement results in the 1xEV-DO BTS application

Remote command:
`CONF:CDP:MEAS PVT`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158
Querying results:
`CONFigure:CDPower[:BTS]:PVTime:LIST:RESult?` on page 251

Power
Access: "Overview" > "Select Measurement" > "Power"

The Power measurement determines the 1xEV-DO signal channel power.

To do so, the 1xEV-DO application performs a Channel Power measurement as in the Spectrum application with settings according to the 1xEV-DO standard. The bandwidth and the associated channel power are displayed in the Result Summary.

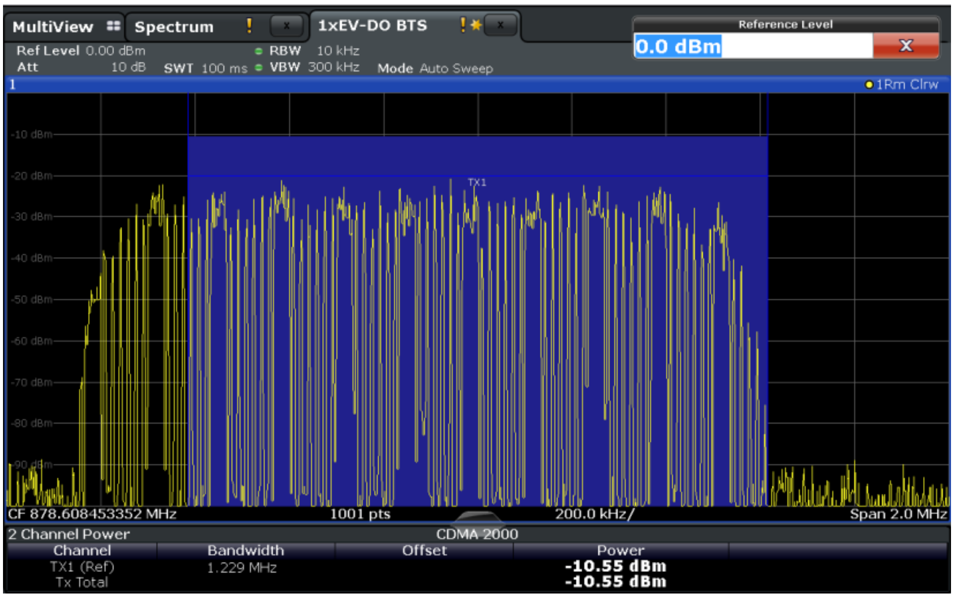


Figure 3-22: Power measurement results in the 1xEV-DO BTS application

Remote command:
CONF:CDP:MEAS POW, see CONFigure:CDPower[:BTS]:MEASurement on page 158
Querying results: CALC:MARK:FUNC:POW:RES? CPOW, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 249
CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 249

Channel Power ACLR
Access: "Overview" > "Select Measurement" > "Channel Power ACLR"

Channel Power ACLR performs an adjacent channel power measurement in the default setting according to 1xEV-DO specifications (adjacent channel leakage ratio).

The R&S FSW measures the channel power and the relative power of the adjacent channels and of the alternate channels. The results are displayed in the Result Summary.

Figure 3-23: ACLR measurement results in the 1xEV-DO BTS application

Remote command:
`CONF:CDP:MEAS ACLR`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158
Querying results:
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249

Spectrum Emission Mask
Access: "Overview" > "Select Measurement" > "Spectrum Emission Mask"

The Spectrum Emission Mask measurement determines the power of the 1xEV-DO signal in defined offsets from the carrier and compares the power values with a spectral mask specified by the 1xEV-DO specifications. The limits depend on the selected bandclass.Thus, the performance of the DUT can be tested and the emissions and their distance to the limit be identified.

Note: The 1xEV-DO standard does not distinguish between spurious and spectral emissions.

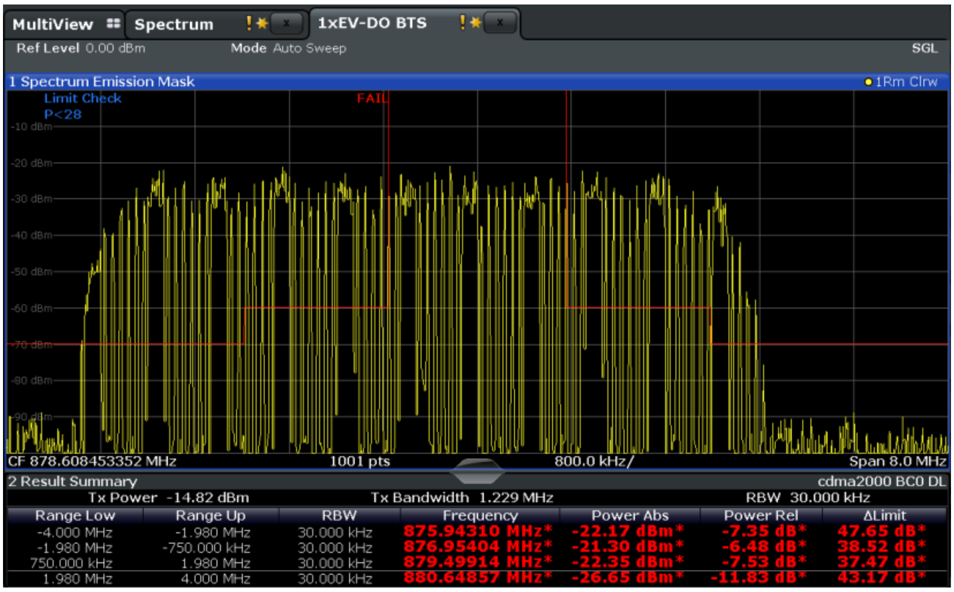


Figure 3-24: SEM measurement results in the 1xEV-DO BTS application

Remote command:
`CONF:CDP:MEAS ESP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158
Querying results:
`CALC:MARK:FUNC:POW:RES? CPOW`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALCulate<n>:LIMit<k>:FAIL?` on page 248

Occupied Bandwidth

Access: "Overview" > "Select Measurement" > "OBW"

The Occupied Bandwidth measurement determines the bandwidth in which – in default settings - 99 % of the total signal power is to be found. The percentage of the signal power to be included in the bandwidth measurement can be changed.

The occupied bandwidth (Occ BW) and the frequency markers are displayed in the marker table.

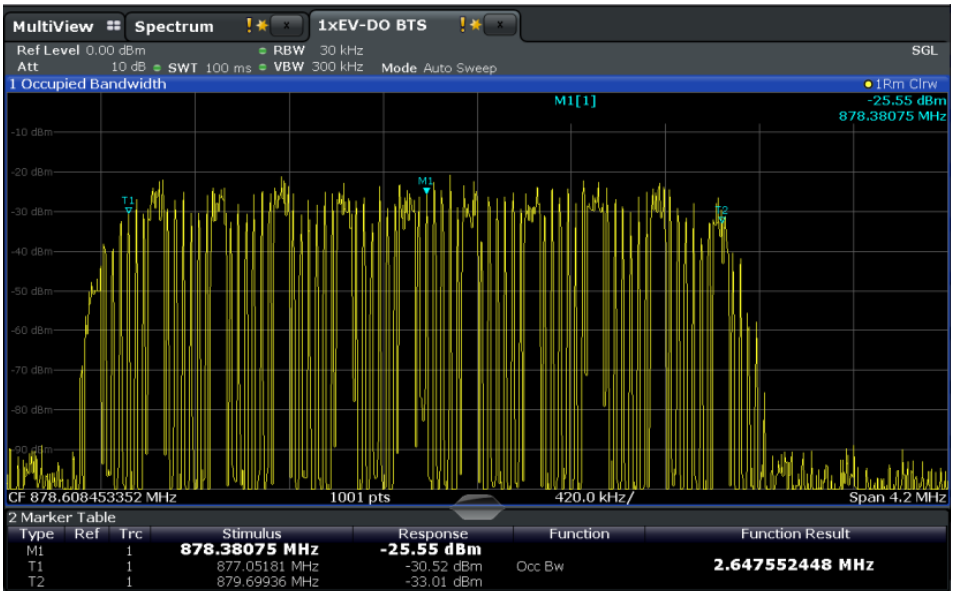


Figure 3-25: OBW measurement results in the 1xEV-DO BTS application

Remote command:
`CONF:CDP:MEAS OBAN`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158
Querying results:
`CALC:MARK:FUNC:POW:RES? OBW`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249

CCDF

Access: "Overview" > "Select Measurement" > "CCDF"

The CCDF measurement determines the distribution of the signal amplitudes (complementary cumulative distribution function). The CCDF and the Crest factor are displayed. For the purposes of this measurement, a signal section of user-definable length is recorded continuously in the zero span, and the distribution of the signal amplitudes is evaluated.

Figure 3-26: CCDF measurement results in the 1xEV-DO BTS application

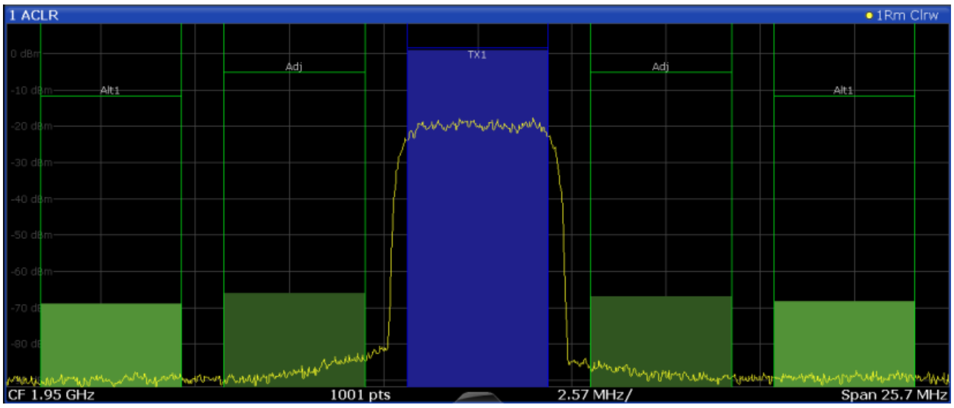
Remote command:
`CONF:CDP:MEAS CCDF`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 158
Querying results:
`CALCulate<n>:MARKer<m>:Y?` on page 236
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult?` on page 249
`CALCulate<n>:STATistics:RESult<t>?` on page 251

3.2.2 Evaluation Methods for RF Measurements

Access: "Overview" > "Display Config"

The evaluation methods for RF measurements are identical to those in the Spectrum application.

Diagram
Displays a basic level vs. frequency or level vs. time diagram of the measured data to evaluate the results graphically. This is the default evaluation method. Which data is displayed in the diagram depends on the "Trace" settings. Scaling for the y-axis can be configured.

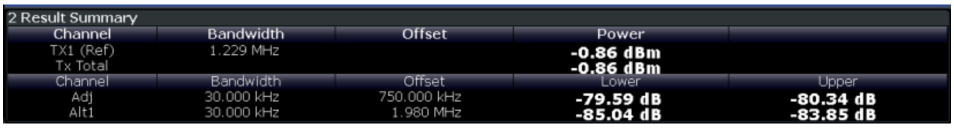


Remote command:

`LAY:ADD? '1',RIGH, DIAG`, see `LAYout:ADD[:WINDow]?` on page 221

Result Summary

Result summaries provide the results of specific measurement functions in a table for numerical evaluation. The contents of the result summary vary depending on the selected measurement function. See the description of the individual measurement functions for details.



2 Result Summary

Channel	Bandwidth	Offset	Power	
TX1 (Ref)	1.229 MHz		-0.86 dBm	
Tx Total			-0.86 dBm	
Channel	Bandwidth	Offset	Lower	Upper
Adj	30.000 kHz	750.000 kHz	-79.59 dB	-80.34 dB
Alt1	30.000 kHz	1.980 MHz	-85.04 dB	-83.85 dB

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

Remote command:

`LAY:ADD? '1',RIGH, RSUM`, see `LAYout:ADD[:WINDow]?` on page 221

Marker Table

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

This table may be displayed automatically if configured accordingly (see "Marker Table Display" on page 128).

4 Marker Table

Wnd	Type	Ref	Trc	X-value	Y-value
1	M1		1	13.25 GHz	-200.0 dBm
1	D2	M1	1	-600.0 kHz	0.0 dB
1	D3	M1	1	600.0 kHz	0.0 dB
1	D4	M1	1	-2.0 MHz	0.0 dB

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

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 221

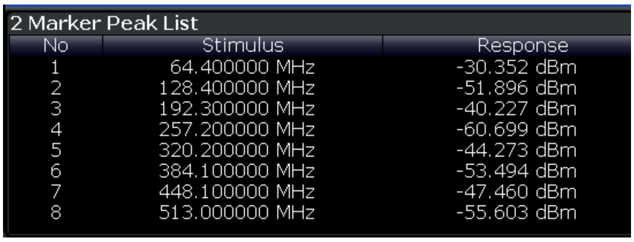
Results:

`CALCulate<n>:MARKer<m>:X` on page 255

`CALCulate<n>:MARKer<m>:Y?` on page 236

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.



2 Marker Peak List

No	Stimulus	Response
1	64.400000 MHz	-30.352 dBm
2	128.400000 MHz	-51.896 dBm
3	192.300000 MHz	-40.227 dBm
4	257.200000 MHz	-60.699 dBm
5	320.200000 MHz	-44.273 dBm
6	384.100000 MHz	-53.494 dBm
7	448.100000 MHz	-47.460 dBm
8	513.000000 MHz	-55.603 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 221

Results:

`CALCulate<n>:MARKer<m>:X` on page 255

`CALCulate<n>:MARKer<m>:Y?` on page 236

Evaluation List

Displays the averaged, maximum and minimim values and the measurement range for the current measurement.

Remote command:

`LAY:ADD? '1',RIGH,LEV`, see `LAYout:ADD[:WINDow]?` on page 221

4 Measurement Basics

The R&S FSW 1xEV-DO applications perform measurements according to the "cdma2000 High Rate Packet Data" standard, which is generally referred to as 1xEV-DO (First EVolution Data Only).

1xEV-DO® was specified by 3GPP2 (3rd Generation Partnership Project 2). The following link provides access to 3GPP2 specifications:

http://www.3gpp2.org/Public_html/specs/index.cfm

The 1xEV-DO standard was developed from the cdma2000 standard, which in turn was an extension of cdmaOne (IS 95). All these standards are based on the same RF parameters, thus the RF measurements of cdma2000 and 1xEV-DO are identical. In the code domain, however, cdma2000 and 1xEV-DO are not compatible: The chips for 1xEV-DO are assigned chronologically one after the other to the different channel types. Furthermore, in the DATA channel type, 8-PSK and 16-QAM modulation methods are used in addition to QPSK. With cdma2000, only BPSK and QPSK modulation methods are used. Finally, a slot is always assigned to precisely one mobile station with 1xEV-DO, whereas with cdma2000, several mobile stations communicate with the base station simultaneously.

Some background knowledge on basic terms and principles used in 1xEV-DO tests and measurements is provided here for a better understanding of the required configuration settings.

4.1 Slots and Sets

The "cdma2000 High Rate Packet Data" standard was defined for packet-oriented data transmission. The user data is transmitted in individual data packages, each of which can have different transmission settings such as the power level. The data in one such package is called a **slot**. In the 1xEV-DO standard, a slot is a basic time unit of 1.666 ms duration and corresponds to the expression "power control group" (PCG) in cdma2000. Each slot consists of two half-slots with identical structures. Each half-slot contains 1024 chips, which are distributed as shown below according to the different channel types.

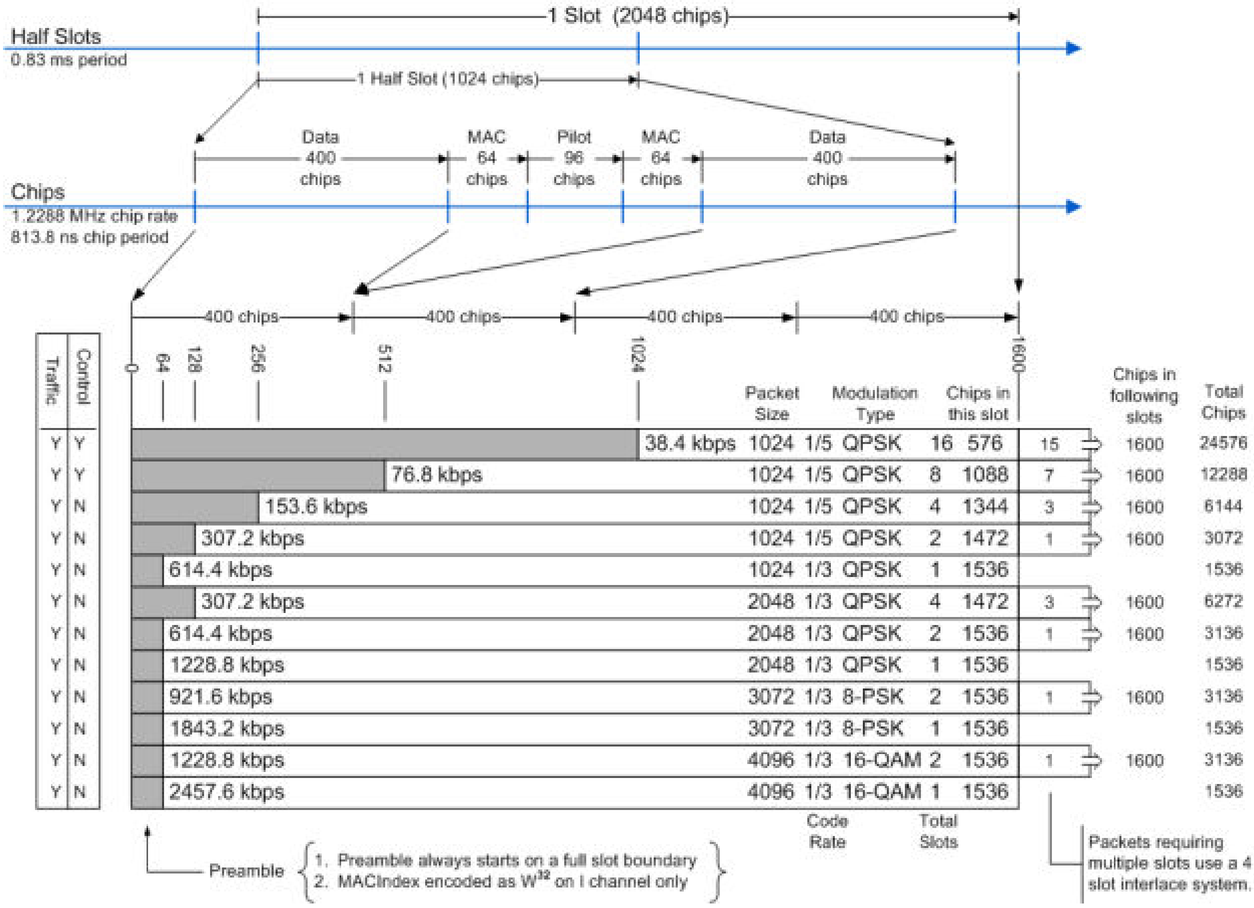


Figure 4-1: Slot structure, chip distribution and preamble lengths in 1xEV-DO BTS application

The 1xEV-DO applications can capture up to 48000 slots (about 80 seconds) in a single sweep. To improve performance during measurement and analysis, the R&S FSW 1xEV-DO Measurements application does not process the captured slots all at once, but rather in **sets**, one at a time. One set usually consists of 32 slots in the BTS application, and 64 slots in the MS application. You can select how many sets are captured, and which set is currently analyzed and displayed. The possible capture range is from 1 to a maximum of 1500 (BTS application) or 810 (MS application) sets.

4.2 Scrambling via PN Offsets and Long Codes

Short code scrambling

Base stations use a pseudo noise (PN) sequence (also referred to as short code sequence) to scramble the data during transmission. The used PN sequence is circulated in fixed time intervals. A specified **PN offset** value determines the start phase for the short code sequence.

The PN parameter is unique for each base station. Thus, the 1xEV-DO BTS application can distinguish the signals from different base stations quickly, if both of the following conditions apply:

- Tthe "PN Offset" is defined in the signal description
- An external trigger is used to provide a reference for the start phase

If no offset is specified or no external trigger is available, calculation is much slower as the correct PN must be determined from all possible positions.

During short code scrambling, the channel data is split up into I and Q components.

Long code scrambling

Mobile stations also use a PN short code, but with a fixed or no offset. Additionally, a complex **long code** is used for scrambling, making the data less susceptible to interference. The long code used by a mobile station is defined by a mask on either branch. The 1xEV-DO MS application requires these masks to distinguish the senders. The masks are defined in the signal description.

During long code scrambling, the channel data is mapped either to the I or to the Q branch of the complex input signal.

4.3 Synchronization (MS application only)

The 1xEV-DO MS application has two synchronization stages: the frame synchronization (detection of the first chip of the frame) and the rough frequency/phase synchronization. For the frame synchronization, different methods are implemented. Two methods use the known sequence of a pilot channel (Pilot or Auxiliary Pilot); a third does not require a pilot channel. The frequency/phase synchronization always requires a pilot channel (Pilot or Auxiliary Pilot). Synchronization is usually only successful if both frame and frequency/phase synchronization were performed correctly.

Auto synchronization

Using auto synchronization mode, the following modes are tried sequentially until synchronization was successful. If none of the methods were successful, a failed synchronization is reported. If the result of the correlation methods (sync on Pilot and Auxiliary Pilot) becomes increasingly worse (due to bad power conditions), the non-data-aided synchronization works optimally. In this case, synchronization should be successful.

Pilot synchronization

For frame synchronization, this method uses the correlation characteristic of the known pilot channel (i.e. pilot channel sequence = spreading code including scrambling sequence). The correlation must be calculated for all hypotheses of the scrambling code (32768; for external triggers only 2048) to get the correct peak at the frame start. This correlation method can fail if the power of the underlying pilot channel is too low compared to the total power. In this case, the expected correlation peak is hidden by the upcoming auto-correlation noise of the bad hypothesis.

The frequency/phase synchronization also takes advantage of the known linear phase of the pilot channel.

Auxiliary pilot synchronization

Similar to synchronization on pilot, but with the different known sequence (= spreading code) of the auxiliary pilot channel. The benefits and problems of this approach are therefore identical to the synchronization on pilot. This mode is useful if the signal does not contain a pilot channel.

Channel power synchronization

This frame synchronization method does not require a pilot channel because it analyzes the power of any specified channel (currently code 3 with spreading factor 4, which is the data channel 2). Again the channel power must be calculated for all hypotheses of the scrambling code (32768; for external triggers only 2048). Only for the correct position the result is low (inactive channel) or high (active channel) in contrast to the wrong hypothesis. Obviously, a small band exists for which no power drop or peak is detected, if the power of the tested channel is nearly equal to the noise of the other hypotheses (from total signal).

The frequency/phase synchronization works in the same way as for the methods above with the difference that here, both pilot channels are tried consecutively.

4.4 Channel Detection and Channel Types

The 1xEV-DO applications provide two basic methods of detecting active channels:

- **Automatic search using pilot sequences**
  The application performs an automatic search for active channels throughout the entire code domain. At the specific codes at which channels can be expected, the application detects an active channel if the corresponding symbol rate and a sufficiently high power level is measured (see "Inactive Channel Threshold" on page 99).
  Any channel that does not have a predefined channel number and symbol rate is considered to be a data channel.
  In the MS application, a channel is considered to be active if a minimum signal/noise ratio is maintained within the channel.
- **Comparison with predefined channel tables**
  The input signal is compared to a predefined channel table. All channels that are included in the predefined channel table are considered to be active.
  For a list of predefined channel tables provided by the 1xEV-DO applications, see Chapter A.1, "Predefined Channel Tables", on page 272.

Quasi-inactive channels in the MS application

In the MS application, only one branch in the code domain is analyzed at a time (see also Chapter 4.7, "Code Mapping and Branches", on page 51). However, even if the code on the analyzed branch is inactive, the code with the same number on the other branch can belong to an active channel. In this case, the channel is indicated as **quasi-inactive** in the current branch evaluation.

4.4.1 BTS Channel Types

The 1xEV-DO standard defines the BTS channel types. 1xEV-DO forward link signals contain 4 channel types which are sent exclusively at specific times (see also Figure 4-1):

- **PILOT**: The PILOT channel type comprises 96 chips and is located in the center of each half-slot. It must be available in the signal for the base station signal to be detected. In the PILOT channel type, only the 0.32 channel on the I branch is active. With spreading factor 32, the BPSK-I and, hypothetically, BPSK-Q modulation are used. Hypothetically because no signal should exist on the Q branch.
- **MAC**: The Medium Access Control channel type is 64 chips in front of and behind the PILOT. The MAC channel type contains the reverse activity (RA) channel and the MAC reverse power control (RPC) channels with which the power of the active terminals is controlled. The MAC indices described in the standard MAC can be transformed into Walsh codes very easily. The analysis for the MAC channel type is performed with spreading factor 64. BPSK-I and BPSK-Q modulation are used.
- **DATA**: The DATA channel type is located with a length of up to 400 chips at the beginning and end of each half slot. The useful data is transmitted in it. As shown in Figure 4-1, there are packets that transmit their data distributed over 1, 2, 4, 8 or 16 slots, depending on the transmission rate. Initially, a PREAMBLE range is transmitted, being between 64 and 1024 chips long - followed by the data. If more than one slot is required for transmission, the other data of this data packet follows at intervals of four slots, then without another preamble. In the DATA channel type, QPSK, 8-PSK and 16-QAM modulation types are used. Analysis is performed with a spreading factor of 16.
- **PREAMBLE**: The first 64 to 1024 chips of the DATA channel type are replaced by the PREAMBLE channel type at the beginning of a data packet. Depending on the transmission speeds being used and whether the start of data of the packet is missed, preambles of different length can be in the signal. The application firmware detects the preambles automatically. If the PREAMBLE channel type is examined and no preamble is found in the signal, this is indicated by the message "PREAMBLE MISSING" (see Chapter 8.1, "Error Messages", on page 131. Spreading factor 32 is used for analysis of the PREAMBLE channel type as for the PILOT channel type. Again, only a BPSK-I modulated channel should occur, but with variable code number.

4.4.2 MS Channel Types

The following channel types can be detected in 1xEV-DO MS signals by the 1xEV-DO MS application.

Table 4-1: Channel types in 1xEV-DO MS signals

Channel type	Ch.no / SF	Mapping	Description
PICH	0.16	I	Reverse Pilot Channel
RRI	0.16	I	Reverse Rate Indicator
DATA	2.4	Q	Reverse Data Channel
ACK	4.8	I	Reverse Acknowledgment Channel
DRC	8.16	Q	Reverse Data Rate Control Channel

If the RRI and the PICH channel types are active, it is assumed that for the first 256 chips (1/4 of the half slot, 1/8 of the entire slot) only the RRI and then the PICH is active in this half slot. If only the PICH is active (RRI activity 0), the PICH is active for the entire 1024 chips of the half slot.

Operating Modes - Access and Traffic

In the MS application, there are two operating modes for transmission: Access mode and Traffic mode.

The following diagrams show the possible channels together with their position on the I and Q branch, the possible orientation in time and the gain.

The **ACCESS** mode initiates and controls the data transmission between the mobile station and the base station. In Access mode, only the Reverse Pilot Channel (PICH) and the Reverse Data Channel (DATA) are used.

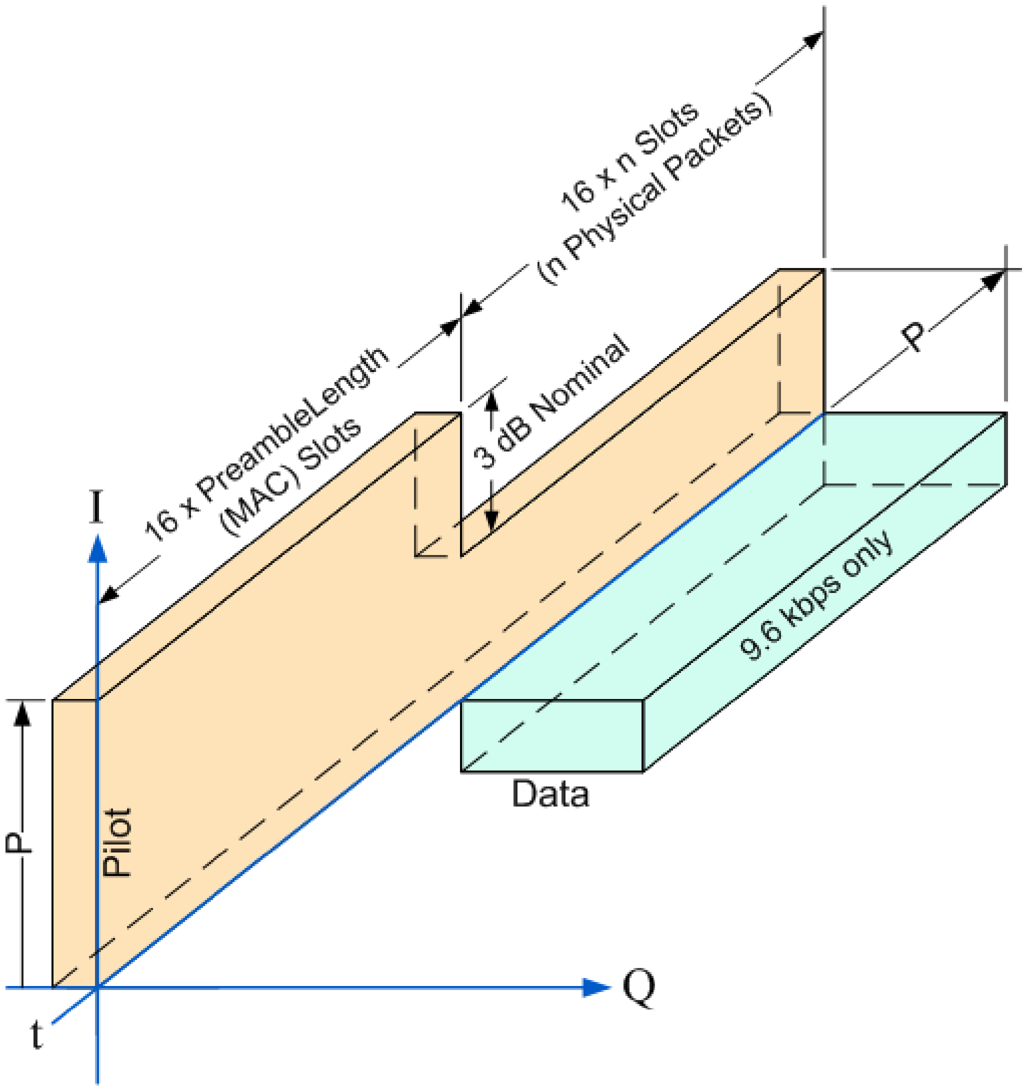


Figure 4-2: 1xEV-DO MS channels in ACCESS mode

Once the transmission has been established, the **TRAFFIC** mode takes over. The Traffic mode contains all five channels listed in Table 4-1.

The RRI takes up the first 256 chips of the first half slot and shares its code with the PICH. The ACK is always just one half slot in length. The DRC is a multiple of slots in length and offset by one half slot.

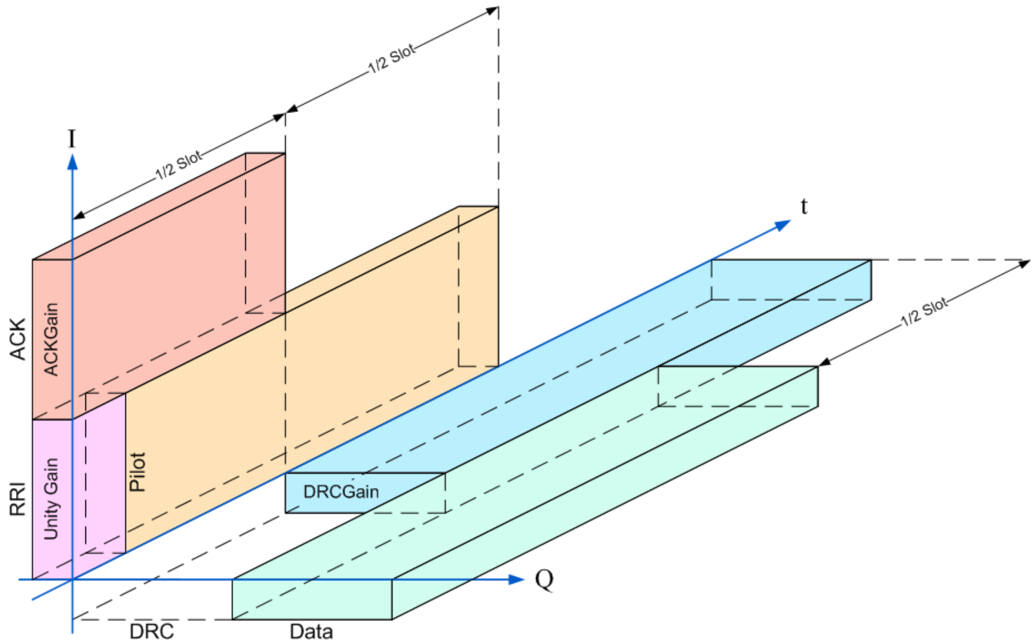


Figure 4-3: 1xEV-DO MS channels in TRAFFIC mode

4.5 Subtypes

The 1xEV-DO standard includes various subtypes of the protocol for the physical layer. In **subtype 2**, the number of active users increases. This affects the used traffic channel MAC, and the spreading factor (number of orthogonal codes) doubles for channel types MAC and PREAMBLE.

In subtype 2 the following modulation types are added within some of the MAC channels in the BTS application:

- ON/OFF keying ACK on the I branch (OOKA-I)
- ON/OFF keying ACK on the Q branch (OOKA-Q)
- ON/OFF keying NACK on the I branch (OOKN-I)
- ON/OFF keying NACK on the Q branch (OOKN-Q)

If the 2 bits within an ON/OFF keying modulation are identical, the modulation cannot be recognized as an ON/OFF keying modulation. If both bits contain '1' (ON), the modulation is identical to a BPSK and is recognized as BPSK. If both bits contain '0' (OFF) there is no power within that code and slot and therefore no modulation is detected. If the evaluation is set to "MAPPING COMPLEX", the separate I and Q branch detection within the result summary is no longer selected. The modulation type is a 2BPSK with the coding number 5 via remote.

In the MS application, as of subtype 2, the new modulation types B4, Q4, Q2, Q4Q2 and E4E2 are supported.

In both R&S FSW 1xEV-DO Measurements applications, a special multicarrier mode is available (see below) and channels using the new modulation types can be detected.

As of subtype 3, the additional modulation type 64QAM can be used. For BTS signals, the MAC RA channel occupies a variable code number and the preamble occupies the I- and the Q-branch.

4.6 Multicarrier Mode

The 1xEV-DO applications can filter out and analyze one carrier out of a multicarrier signal, if a special multicarrier mode is activated in the signal description.

Two filter types used to select the required carrier from the signal are available for selection: a low-pass filter and an RRC filter.

By default, the low-pass filter is active. The low-pass filter affects the quality of the measured signal compared to a measurement without a filter. The frequency response of the low-pass filter is shown below.

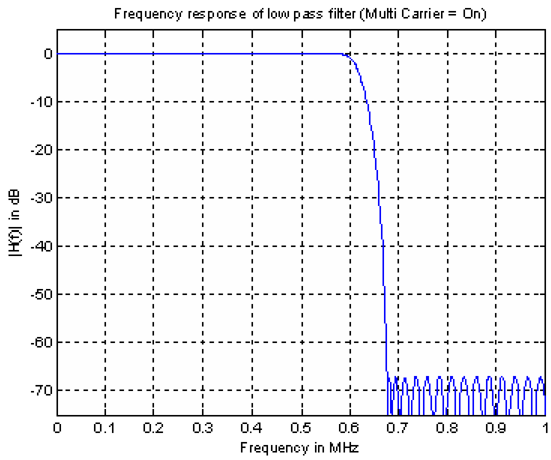


Figure 4-4: Frequency response of the low-pass multicarrier filter

The RRC filter comes with an integrated Hamming window. The roll-off factor of the RRC filter defines the slope of the filter curve and therefore the excess bandwidth of the filter. The cut-off frequency of the RRC filter is the frequency at which the passband of the filter begins. Both parameters can be configured.

4.7 Code Mapping and Branches

Since 1xEV-DO signals use long code scrambling, the channel data is mapped either to the I or to the Q branch of the complex input signal. During channel detection, the branch to which the data was mapped is determined and indicated in the channel table. During analysis, each branch of the symbol constellation area (imaginary part, I, or real part, Q) can be evaluated independently. Thus, when analyzing signals, you must define which branch results you want to analyze. Especially for code power measurements the results can vary considerably. While a channel can be active on one branch, the other branch can belong to an inactive channel.

For BTS signals, the complex data (i.e. both branches simultaneously) can be analyzed as well.

4.8 Code Display and Sort Order

In the result displays that refer to codes, the currently selected code is highlighted in the diagram. You select a code by entering a code number in the "Evaluation Range" settings.

By default, codes are displayed in ascending order of the code number (**Hadamard** order). The currently selected code number is highlighted.

In 1xEV-DO signals, the codes that belong to the same channel need not lie next to each other in the code domain, they can be distributed. All codes that belong to the same channel are highlighted in light green.

In the 1xEV-DO BTS signals, each of the four channel types occurs at a specific time within each slot. Thus, instead of selecting a code, you can also select which channel type to evaluate and display directly. By default, the Pilot channel as the first in the slot is evaluated.

In 1xEV-DO MS signals, the sort order of the codes can be changed so that codes that belong to the same channel are displayed next to each other (**Bit-Reverse** sorting).

Example: Example for Hadamard order

With Hadamard sorting, the following code order is displayed (the Pilot channel is selected):

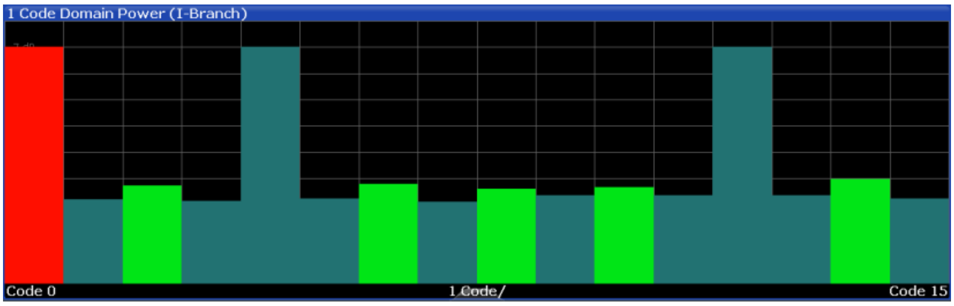


Figure 4-5: Code Domain Error Power result display in Hadamard code sorting order

The same results in Bit-Reverse order:

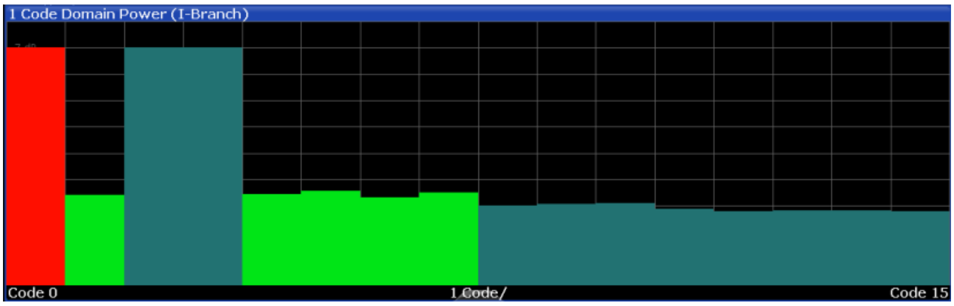


Figure 4-6: Code Domain Error Power result display in BitReverse code sorting order

For the display in the 1xEV-DO BTS application, the scale for code-based diagrams displays 32 codes.

For the display in the 1xEV-DO MS application, the scale for code-based diagrams displays 16 codes.

4.9 Test Setup for 1xEV-DO Base Station or Mobile Station Tests

Before a 1xEV-DO measurement can be performed, the R&S FSW must be set up in a test environment. This section describes the required settings of the R&S FSW if it is used as a 1xEV-DO base or mobile station tester. Before starting the measurements, you must supply the R&S FSW with power and configure it correctly, as described in the R&S FSW Getting Started manual, "Preparing For Use". Furthermore, the application firmware 1xEV-DO BTS or 1xEV-DO MS must be enabled. Installation and enabling of the application firmware are described in the R&S FSW Getting Started manual or in the Release Notes.

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can damage the instrument and connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

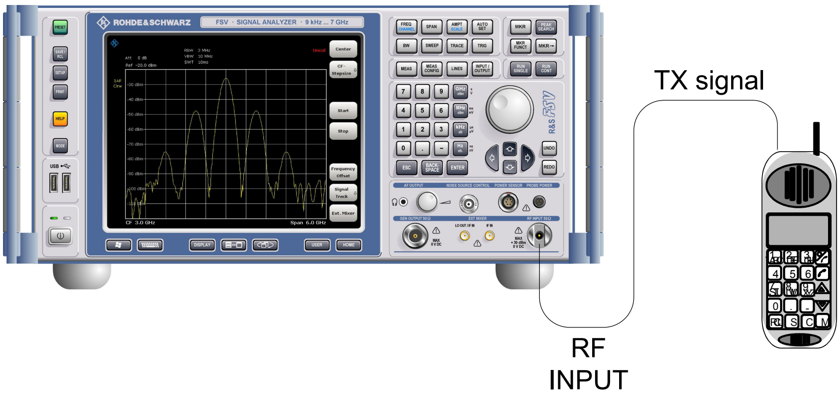
Required units and accessories

The measurements are performed with the following units and accessories:

- An R&S FSW equipped with the 1xEV-DO BTS or MS option.
- R&S SMU signal generator equipped with option SMU-B9/B10/B11 baseband generator and SMUK46 1xEV-DO incl. 1xEVDV.
- 1 coaxial cable, 50 Ω, approximately 1 m, N connector
- 2 coaxial cables, 50 Ω, approximately 1 m, BNC connector

General Test Setup

Connect the antenna output (or TX output) of the base station/mobile station to the RF input of the R&S FSW. Use a power attenuator exhibiting suitable attenuation.



The following values for external attenuation are recommended to ensure that the RF input of the R&S FSW is protected and the sensitivity of the unit is not reduced too much:

Maximum Power	Recommended external attenuation
≥ 55 to 60 dBm	35 to 40 dB
≥ 50 to 55 dBm	30 to 35 dB
≥ 45 to 50 dBm	25 to 30 dB
≥ 40 to 45 dBm	20 to 25 dB
≥ 35 to 40 dBm	15 to 20 dB
≥ 30 to 35 dBm	10 to 15 dB
≥ 25 to 30 dBm	0 to 10 dB
≥ 20 to 25 dBm	0 to 5 dB
≤ 20 dBm	0 dB

- For signal measurements at the output of two-port networks, connect the reference frequency of the signal source to the rear reference input (REF INPUT) of the R&S FSW.
- The R&S FSW must be operated with an external frequency reference to ensure that the error limits of the 1xEV-DO specification for frequency measurements on base stations/mobile stations are met. A rubidium frequency standard can be used as a reference source, for example.
- If the base station/mobile station has a trigger output, connect the trigger output of the base station/mobile station to one of the trigger inputs (TRIGGER INPUT) of the R&S FSW (see "Trigger 2/3" on page 78).

Presettings

(For details see Chapter 6.2, "Code Domain Analysis", on page 61)

1. Enter the external attenuation.
2. Enter the reference level.
3. Enter the center frequency.
4. Set the trigger.
5. If used, enable the external reference.
6. Select the 1xEV-DO standard and the desired measurement.
7. Set the PN offset.

4.10 CDA Measurements in MSRA Operating Mode

The 1xEV-DO BTS application can also be used to analyze data in MSRA operating mode.

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications receive an extract of the captured data for analysis, referred to as the **application data**. For the 1xEV-DO BTS application in MSRA operating mode, the application data range is defined by the same settings used to define the signal capture in Signal and Spectrum Analyzer mode. In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the 1xEV-DO BTS measurement.

Data coverage for each active application

Generally, if a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA Master display indicates the data covered by each application, restricted to the channel bandwidth used by the corresponding standard (for 1xEV-DO: 1.2288 MHz), by vertical blue lines labeled with the application name.

Analysis interval

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

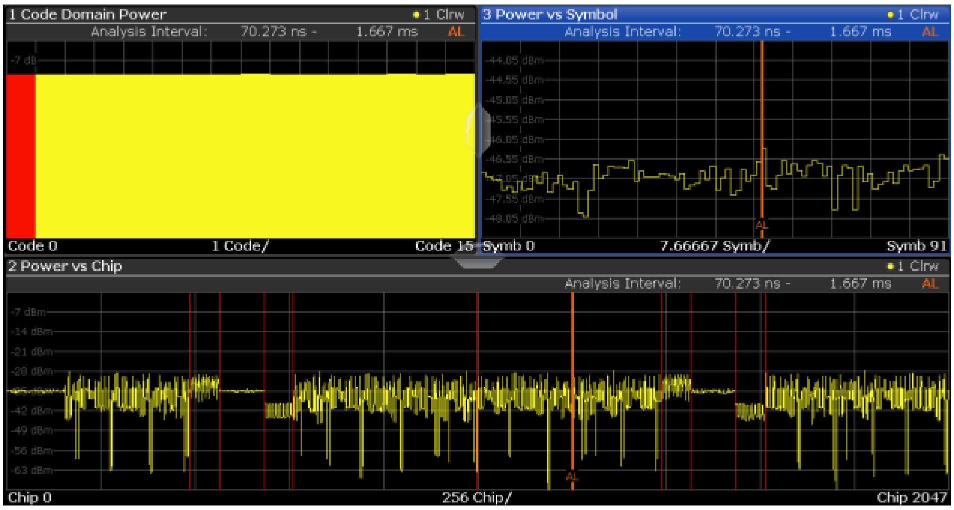
In the 1xEV-DO BTS application, the analysis interval is automatically determined according to the selected channel, slot or set to analyze which is defined for the evaluation range, depending on the result display. The analysis interval cannot be edited directly in the 1xEV-DO BTS application, but is changed automatically when you change the evaluation range.

Analysis line

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

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

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



For details on the MSRA operating mode, see the R&S FSW MSRA User Manual.

5 I/Q Data Import and Export

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

Importing and exporting I/Q signals is useful for various applications:

- Generating and saving I/Q signals in an RF or baseband signal generator or in external software tools to analyze them with the R&S FSW later
- Capturing and saving I/Q signals with an RF or baseband signal analyzer to analyze them with the R&S FSW or an external software tool later

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`.

For a detailed description see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Export only in MSRA mode

In MSRA mode, I/Q data can only be exported to other applications; I/Q data cannot be imported to the MSRA Master or any MSRA applications.

5.1 Import/Export Functions

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

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.

For a description of the other functions in the "Save/Recall" menu, see the R&S FSW User Manual.

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.

Note that the I/Q data must have a specific format as described in the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:
`MMEMory:LOAD:IQ:STATe` on page 263

Export
Access: "Save/Recall" > Export

Opens a submenu to configure data export.

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.

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

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Remote command:
`MMEMory:STORe<n>:IQ:STATe` on page 264
`MMEMory:STORe<n>:IQ:COMMent` on page 263

6 Configuration

The 1xEV-DO applications provide several different measurements for signals according to the 1xEV-DO standard. The main and default measurement is Code Domain Analysis. In addition to the code domain power measurements specified by the 1xEV-DO standard, the 1xEV-DO applications offer measurements with predefined settings in the frequency domain, e.g. RF power measurements.

Only one measurement type can be configured per channel; however, several channels for 1xEV-DO applications can be configured in parallel on the R&S FSW. Thus, you can configure one channel for a Code Domain Analysis, for example, and another for a Power measurement for the same input signal. Then you can use the Sequencer to perform all measurements consecutively and either switch through the results easily or monitor all results at the same time in the "MultiView" tab.

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

Selecting the measurement type

When you activate a measurement channel in a 1xEV-DO application, Code Domain Analysis of the input signal is started automatically. However, the 1xEV-DO applications also provide other measurement types.

► To select a different measurement type, do one of the following:
   - Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the required measurement.
   - Press the MEAS key. In the "Select Measurement" dialog box, select the required measurement.

6.1 Result Display

The captured signal can be displayed using various evaluation methods. All evaluation methods available for 1xEV-DO applications are displayed in the evaluation bar in SmartGrid mode when you do one of the following:

- Select the "SmartGrid" icon from the toolbar.
- Select the "Display" button in the "Overview".
- Press the MEAS key.
- Select the "Display Config" softkey in any 1xEV-DO menu.

Up to 16 evaluation methods can be displayed simultaneously in separate windows. The 1xEV-DO evaluation methods are described in Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20.

To close the SmartGrid mode and restore the previous softkey menu select the "Close" icon in the righthand corner of the toolbar, or press any key.

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

6.2 Code Domain Analysis

Access: MODE > "1xEV-DO BTS"/"1xEV-DO UE"

1xEV-DO measurements require a special application on the R&S FSW

When you activate a 1xEV-DO application the first time, a set of parameters is passed on from the currently active application:

- Center frequency and frequency offset
- Reference level and reference level offset
- Attenuation

After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate a 1xEV-DO application, Code Domain Analysis of the input signal is started automatically with the default configuration. The "Code Domain Analyzer" menu is displayed and provides access to the most important configuration functions. This menu is also displayed when you press the MEAS CONFIG key.

The "Span", "Bandwidth", "Lines", and "Marker Functions" menus are not available in the 1xEV-DO application.

Code Domain Analysis can be configured easily in the "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu.

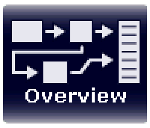
Importing and Exporting I/Q Data

Access: , "Save/Recall" menu > "Import I/Q"/ "Export I/Q"

The 1xEV-DO applications can not only measure the 1xEV-DO I/Q data to be evaluated. They can also import I/Q data, provided it has the correct format. Furthermore, the evaluated I/Q data from the 1xEV-DO applications can be exported for further analysis in external applications.

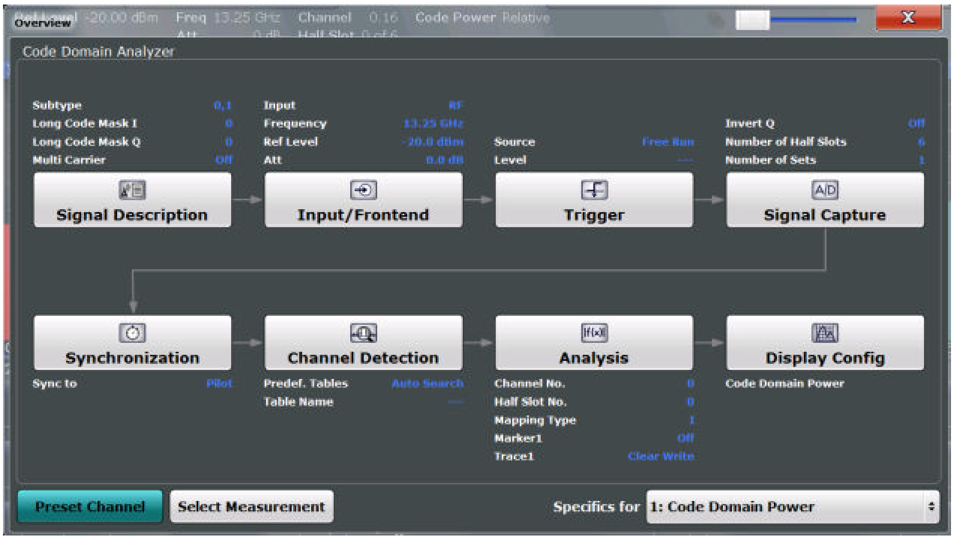
For details on importing and exporting I/Q data, see the R&S FSW User Manual.

6.2.1 Configuration Overview



Access: all menus

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



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire measurement channel from input over processing to output and evaluation by stepping through the dialog boxes as indicated in the "Overview".

The available settings and functions in the "Overview" vary depending on the currently selected measurement. For RF measurements, see Chapter 6.3, "RF Measurements", on page 109.

For Code Domain Analysis, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. "Select Measurement"
   See "Selecting the measurement type" on page 60
2. "Signal Description"
   See Chapter 6.2.2, "Signal Description", on page 64

3. "Input/ Frontend"
   SeeChapter 6.2.3, "Data Input and Output Settings", on page 68 and Chapter 6.2.4, "Frontend Settings", on page 81
4. (Optionally:) "Trigger"
   See Chapter 6.2.5, "Trigger Settings", on page 90
5. "Signal Capture"
   See Chapter 6.2.6, "Signal Capture (Data Acquisition)", on page 96
6. "Synchronization" (MS application only)
   See Chapter 6.2.8, "Synchronization (MS Application Only)", on page 97
7. "Channel Detection"
   See Chapter 6.2.9, "Channel Detection", on page 98
8. "Analysis"
   See Chapter 7, "Analysis", on page 116
9. "Display Configuration"
   See Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20

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 the "Preset Channel" button in the lower lefthand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Note that the PRESET key restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FSW (except for the default Spectrum application channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 157

Select Measurement
Selects a different measurement to be performed.

See "Selecting the measurement type" on page 60.

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

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

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

6.2.2 Signal Description

Access: "Overview" > "Signal Description"

The signal description provides information on the expected input signal.

6.2.2.1 BTS Signal Description

Access: "Overview" > "Signal Description"

These settings describe the input signal in BTS measurements.

Subtype

Specifies the characteristics of the used transmission standard.

For details, see Chapter 4.5, "Subtypes", on page 50.

"0,1"	Single carrier
"2"	Increased number of active users

"3" Modulation type 64QAM can be detected.

Remote command:
`CONFigure:CDPower[:BTS]:SUBType` on page 161

PN Offset

Specifies the Pseudo Noise (PN) offset from an external trigger. If no offset is specified or no external trigger is available, calculation is much slower as the correct PN must be determined from all possible positions.

For details, see Chapter 4.2, "Scrambling via PN Offsets and Long Codes", on page 44.

Remote command:
`[SENSe:]CDPower:PNOFfset` on page 162

Multicarrier

Activates or deactivates the multicarrier mode. This mode improves the processing of multicarrier signals. It allows you to measure one carrier out of a multicarrier signal.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier[:STATe]` on page 161

Enhanced Algorithm ← Multicarrier

Activates or deactivates the enhanced algorithm that is used for signal detection on multicarrier signals. This algorithm slightly increases the calculation time.

This setting is only available if "Multicarrier" on page 65 is activated.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:MALGo` on page 161

Multicarrier Filter ← Multicarrier

Activates or deactivates the usage of a filter for signal detection on multicarrier signals.

This setting is only available if "Multicarrier" on page 65 is activated.

For details, see Chapter 4.6, "Multicarrier Mode", on page 51.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe]` on page 160

Filter Type ← Multicarrier

Selects the filter type if Multicarrier Filter is activated.

Two filter types are available for selection: a low-pass filter and an RRC filter.

By default, the low-pass filter is active. The low-pass filter affects the quality of the measured signal compared to a measurement without a filter.

The RRC filter comes with an integrated Hamming window. If selected, two more settings become available for configuration: the Roll-Off Factor and the Cut Off Frequency.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160

Roll-Off Factor ← Filter Type ← Multicarrier
Defines the roll-off factor of the RRC filter which defines the slope of the filter curve and therefore the excess bandwidth of the filter. Possible values are between 0.01 and 0.99 in 0.01 steps. The default value is 0.02.

This parameter is available for the RRC filter.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 159

Cut Off Frequency ← Filter Type ← Multicarrier
Defines the frequency at which the passband of the RRC filter begins. Possible values are between 0.1 MHz and 2.4 MHz in 1 Hz steps. The default value is 1.25 MHz

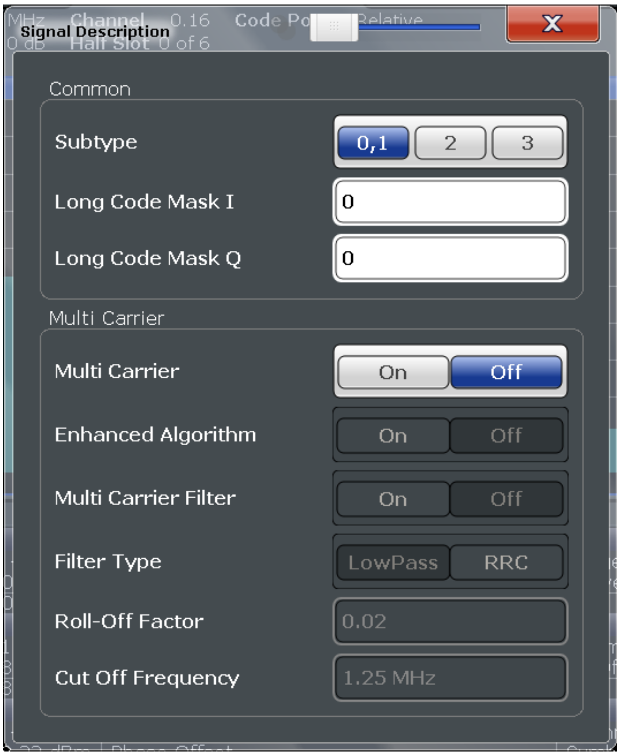
This parameter is available for the RRC filter.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency` on page 159

6.2.2.2 MS Signal Description

Access: "Overview" > "Signal Description"

These settings describe the input signal in MS measurements.



Subtype

Specifies the characteristics of the used transmission standard.

For details, see Chapter 4.5, "Subtypes", on page 50.

"0,1"	Single carrier
"2"	Increased number of active users
"3"	Modulation type 64QAM can be detected.

Remote command:
`CONFigure:CDPower[:BTS]:SUBType` on page 161

Long Code Mask I / Long Code Mask Q

Defines the long code mask for each branch of the mobile in hexadecimal form. The value range is from `0` to `4FFFFFFFFFF`.

For more information on long codes, see "Long code scrambling" on page 45.

Remote command:
`[SENSe:]CDPower:LCODe:I` on page 162
`[SENSe:]CDPower:LCODe:Q` on page 162

Multicarrier

Activates or deactivates the multicarrier mode. This mode improves the processing of multicarrier signals. It allows you to measure one carrier out of a multicarrier signal.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier[:STATe]` on page 161

Enhanced Algorithm ← Multicarrier

Activates or deactivates the enhanced algorithm that is used for signal detection on multicarrier signals. This algorithm slightly increases the calculation time.

This setting is only available if "Multicarrier" on page 65 is activated.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:MALGo` on page 161

Multicarrier Filter ← Multicarrier

Activates or deactivates the usage of a filter for signal detection on multicarrier signals.

This setting is only available if "Multicarrier" on page 65 is activated.

For details, see Chapter 4.6, "Multicarrier Mode", on page 51.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe]` on page 160

Filter Type ← Multicarrier

Selects the filter type if Multicarrier Filter is activated.

Two filter types are available for selection: a low-pass filter and an RRC filter.

By default, the low-pass filter is active. The low-pass filter affects the quality of the measured signal compared to a measurement without a filter.

The RRC filter comes with an integrated Hamming window. If selected, two more settings become available for configuration: the Roll-Off Factor and the Cut Off Frequency.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160

Roll-Off Factor ← Filter Type ← Multicarrier
Defines the roll-off factor of the RRC filter which defines the slope of the filter curve and therefore the excess bandwidth of the filter. Possible values are between 0.01 and 0.99 in 0.01 steps. The default value is 0.02.

This parameter is available for the RRC filter.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 159

Cut Off Frequency ← Filter Type ← Multicarrier
Defines the frequency at which the passband of the RRC filter begins. Possible values are between 0.1 MHz and 2.4 MHz in 1 Hz steps. The default value is 1.25 MHz

This parameter is available for the RRC filter.

Remote command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency` on page 159

6.2.3 Data Input and Output Settings

Access: INPUT / OUTPUT

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

6.2.3.1 Input Source Settings

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

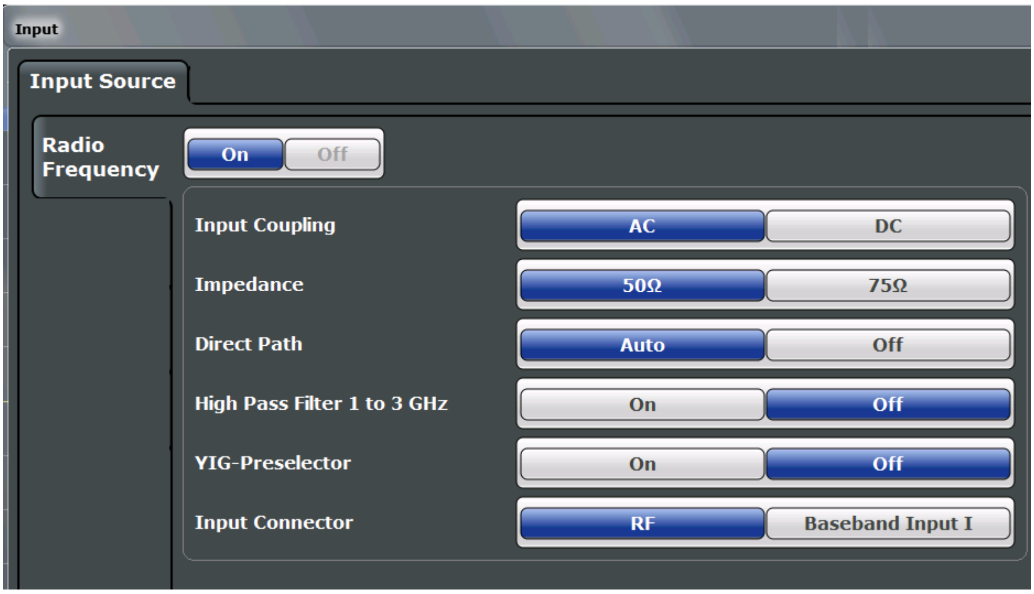
The input source determines which data the R&S FSW will analyze.

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

Since the Digital I/Q input and the Analog Baseband input use the same digital signal path, both cannot be used simultaneously. When one is activated, established connections for the other are disconnected. When the second input is deactivated, connections to the first are re-established. This may cause a short delay in data transfer after switching the input source.

Radio Frequency 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 166

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

This function is not available for input from the optional Digital Baseband Interface or from the optional Analog Baseband Interface.

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

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

Remote command:
`INPut:COUPling` on page 164

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

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

This value also affects the unit conversion (see "Reference Level" on page 84).

This function is not available for input from the optional Digital Baseband Interface or from the optional Analog Baseband Interface . For analog baseband input, an impedance of 50 Ω is always used.

Remote command:
`INPut:IMPedance` on page 165

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:
`INPut:DPATh` on page 164

High-Pass Filter 1...3 GHz
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 analyzer to measure the harmonics for a DUT, for example.

This function requires an additional hardware option.

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

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 165

YIG-Preselector
Activates or deactivates the YIG-preselector, if available on the R&S FSW.

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

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

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 165

Input Connector
Determines whether the RF input data is taken from the RF INPUT connector (default) or the optional BASEBAND INPUT I connector. This setting is only available if the optional Analog Baseband Interface is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

For more information on the Analog Baseband Interface (R&S FSW-B71), see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

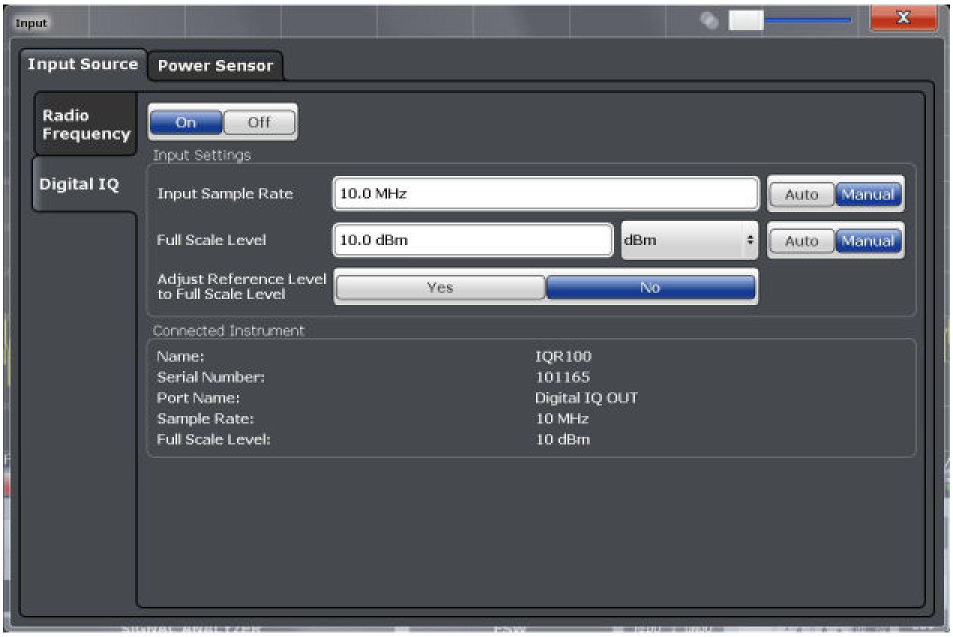
Remote command:
`INPut:CONNector` on page 163

Digital I/Q Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Digital I/Q" tab

The following settings and functions are available to provide input via the optional Digital Baseband Interface in the applications that support it.

These settings are only available if the Digital Baseband Interface option is installed on the R&S FSW.



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

Digital I/Q Input State

Enables or disable the use of the "Digital IQ" input source for measurements.

"Digital IQ" is only available if the optional Digital Baseband Interface is installed.

Remote command:
`INPut:SELect` on page 166

Input Sample Rate

Defines the sample rate of the digital I/Q signal source. This sample rate must correspond with the sample rate provided by the connected device, e.g. a generator.

If "Auto" is selected, the sample rate is adjusted automatically by the connected device.

The allowed range is from 100 Hz to 10 GHz.

Remote command:
`INPut:DIQ:SRATe` on page 169
`INPut:DIQ:SRATe:AUTO` on page 170

Full Scale Level

The "Full Scale Level" defines the level and unit that should correspond to an I/Q sample with the magnitude "1".

If "Auto" is selected, the level is automatically set to the value provided by the connected device.

Remote command:
`INPut:DIQ:RANGe[:UPPer]` on page 169
`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 169
`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 168

Adjust Reference Level to Full Scale Level
If enabled, the reference level is adjusted to the full scale level automatically if any change occurs.

Remote command:
`INPut:DIQ:RANGe:COUPling` on page 169

Connected Instrument
Displays the status of the Digital Baseband Interface connection.

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

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port
- Sample rate of the data currently being transferred via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full Scale Level), if provided by connected instrument

Remote command:
`INPut:DIQ:CDEVice` on page 167

DigIConf
Starts the optional R&S DigIConf application. This function is available in the In-/Output menu, but only if the optional software is installed.

Note that R&S DigIConf requires a USB connection (not LAN!) from the R&S FSW to the R&S EX-IQ-BOX in addition to the Digital Baseband Interface connection. R&S DigIConf version 2.20.360.86 Build 170 or higher is required.

To return to the R&S FSW application, press any key. The R&S FSW application is displayed with the "Input/Output" menu, regardless of which key was pressed.

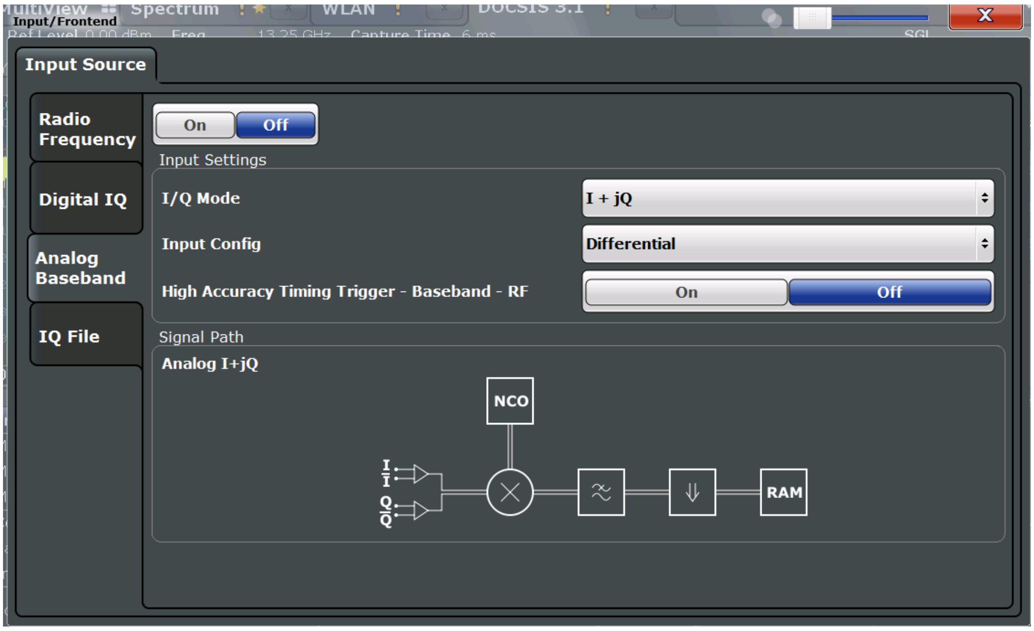
For details on the R&S DigIConf application, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.
If you select the "File > Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available until you restart the application using the "DigIConf" softkey in the R&S FSW once again.

Analog Baseband Input Settings

Access: INPUT/OUTPUT > "Input Source Config" > "Analog Baseband" tab

The following settings and functions are available to provide input via the optional Analog Baseband Interface in the applications that support it.



For more information on the optional Analog Baseband Interface, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

If Analog Baseband input is used, measurements in the frequency and time domain are not available.

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the optional Analog Baseband Interface is installed.

Remote command:

`INPut:SELect` on page 166

I/Q Mode

Defines the format of the input signal.

For more information on I/Q data processing modes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

"I + jQ" The input signal is filtered and resampled to the sample rate of the application.
Two inputs are required for a complex signal, one for the in-phase component, and one for the quadrature component.

"I Only / Low IF I"
The input signal at the BASEBAND INPUT I connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband I**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF I**).

"Q Only / Low IF Q"
The input signal at the BASEBAND INPUT Q connector is filtered and resampled to the sample rate of the application.
If the center frequency is set to 0 Hz, the real baseband signal is displayed without down-conversion (**Real Baseband Q**).
If a center frequency greater than 0 Hz is set, the input signal is down-converted with the center frequency (**Low IF Q**).

Remote command:
`INPut:IQ:TYPE` on page 176

Input Configuration
Defines whether the input is provided as a differential signal via all four Analog Baseband connectors or as a plain I/Q signal via two simple-ended lines.

Note: Both single-ended and differential probes are supported as input; however, since only one connector is occupied by a probe, the "Single-ended" setting must be used for all probes.

"Single Ended" I, Q data only

"Differential" I, Q and inverse I,Q data
(Not available for R&S FSW85)

Remote command:
`INPut:IQ:BALanced[:STATe]` on page 175

High Accuracy Timing Trigger - Baseband - RF
Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

Note: Prerequisites for previous models of R&S FSW.
For R&S FSW models with a serial number lower than 103000, special prerequisites and restrictions apply for high accuracy timing:

- To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
- As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
- Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.

- When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

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

Remote command:
`CALibration:AIQ:HATiming[:STATe]` on page 176

Center Frequency
Defines the center frequency for analog baseband input.

For real-type baseband input (I or Q only), the center frequency is always 0 Hz.

Note: If the analysis bandwidth to either side of the defined center frequency exceeds the minimum frequency (0 Hz) or the maximum frequency (40 MHz/80 MHz), an error is displayed. In this case, adjust the center frequency or the analysis bandwidth.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 180

Probe Settings

Probes are configured in a separate tab on the "Input" dialog box which is displayed when you select the INPUT/OUTPUT key and then "Input Source Config".

For each possible probe connector (Baseband Input I, Baseband Input Q), the detected type of probe, if any, is displayed. The following information is provided for each connected probe:

- Probe name
- Serial number
- R&S part number
- Type of probe ("Differential", "Single Ended")

For more information on using probes with an R&S FSW, see the R&S FSW User Manual.

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

Common Mode Offset

Sets the common mode offset. The setting is only available if a differential probe is connected to the R&S FSW.

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

Remote command:
[SENSe:]PROBe<p>:SETup:CMOFfset on page 177

Microbutton Action

Active R&S probes (except for 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<p>:SETup:MODE on page 178

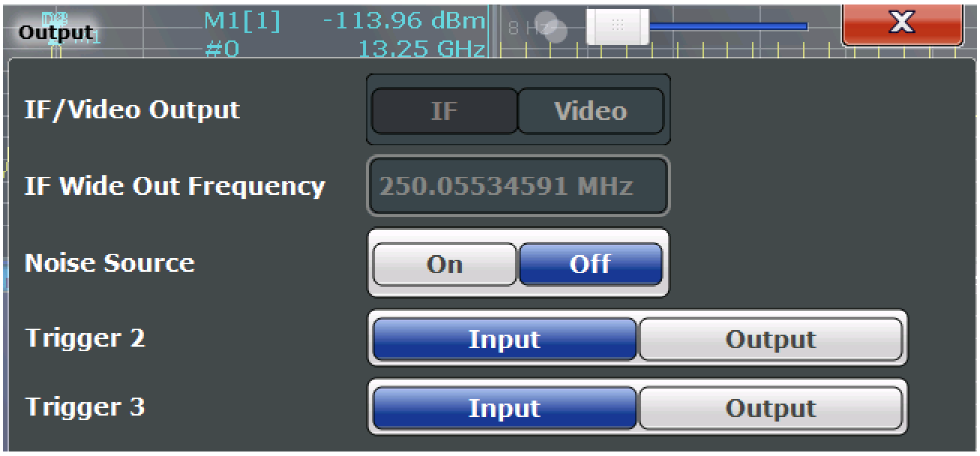
6.2.3.2 Output Settings

Access: INPUT/OUTPUT > "Output"

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

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

How to provide trigger signals as output is described in detail in the R&S FSW User Manual.



Noise Source

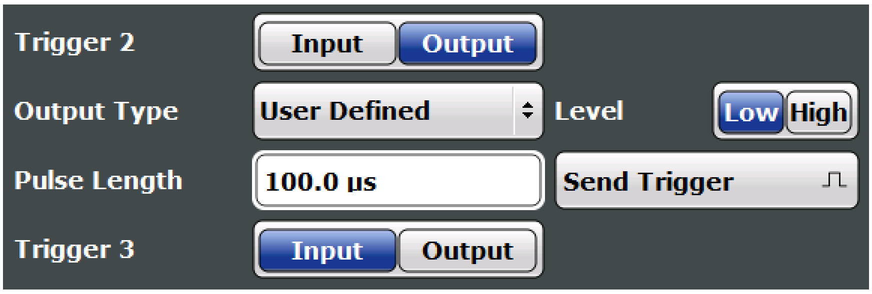
This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FSW on and off.

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

Remote command:

`DIAGnostic:SERVice:NSOurce` on page 180

Trigger 2/3



Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

Note: Providing trigger signals as output is described in detail in the R&S FSW User Manual.

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

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

Remote command:
`OUTPut:TRIGger<port>:DIRection` on page 195

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

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

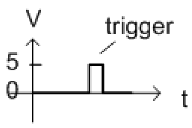
"Trigger Armed" Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low-level signal at the AUX port (pin 9).

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

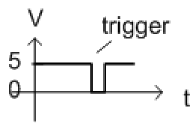
Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 196

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

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



low-level constant, high-level trigger



high-level constant, low-level trigger

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 195

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 197

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

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

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 196

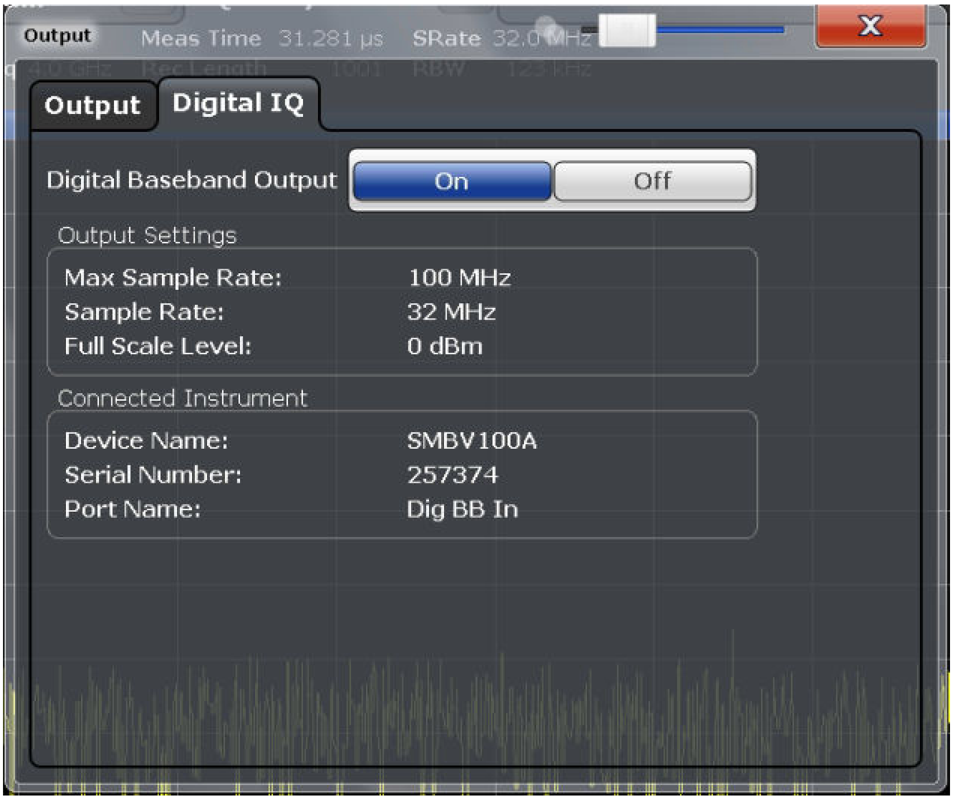
6.2.3.3 Digital I/Q Output Settings

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

The optional Digital Baseband Interface allows you to output I/Q data from any R&S FSW application that processes I/Q data to an external device.

These settings are only available if the Digital Baseband Interface option is installed on the R&S FSW.

Digital I/Q output is available with bandwidth extension option R&S FSW-B500/ -B512, but not with R&S FSW-B512R (Real-Time).



For details on digital I/Q output, see the R&S FSW I/Q Analyzer User Manual.

Digital Baseband Output

Enables or disables a digital output stream to the optional Digital Baseband Interface, if available.

Note: If digital baseband output is active, the sample rate is restricted to 200 MHz (max. 160 MHz bandwidth).
The only data source that can be used for digital baseband output is RF input.

For details on digital I/Q output, see the R&S FSW I/Q Analyzer User Manual.

Remote command:
`OUTPut:DIQ` on page 170

Output Settings Information

Displays information on the settings for output via the optional Digital Baseband Interface.

The following information is displayed:

- Maximum sample rate that can be used to transfer data via the Digital Baseband Interface (i.e. the maximum input sample rate that can be processed by the connected instrument)
- Sample rate currently used to transfer data via the Digital Baseband Interface
- Level and unit that corresponds to an I/Q sample with the magnitude "1" (Full Scale Level)

Remote command:
`OUTPut:DIQ:CDEVice?` on page 170

Connected Instrument

Displays information on the instrument connected to the optional Digital Baseband Interface, if available.

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

- Name and serial number of the instrument connected to the Digital Baseband Interface
- Used port

Remote command:
`OUTPut:DIQ:CDEVice?` on page 170

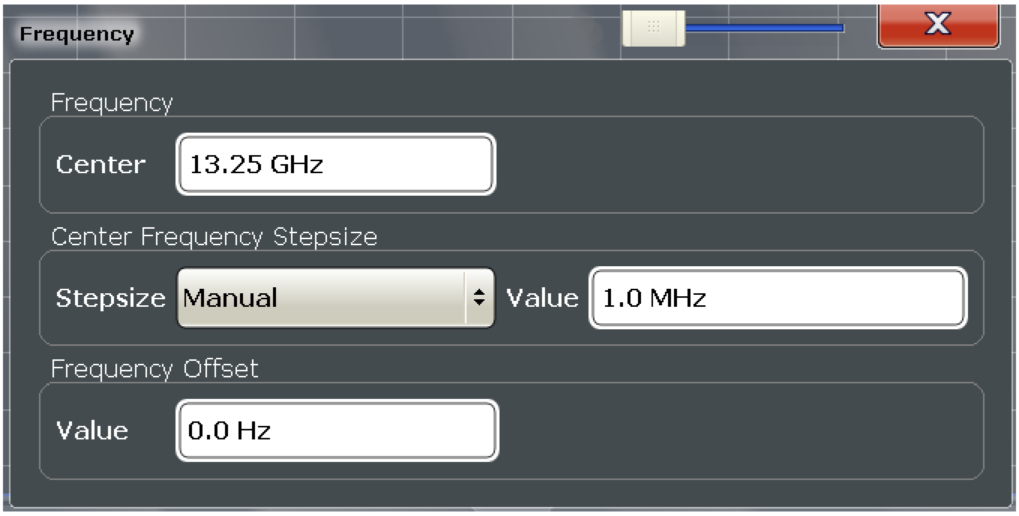
6.2.4 Frontend Settings

Access: "Overview" > "Input / Frontend"

The frequency, amplitude and y-axis scaling settings represent the "frontend" of the measurement setup.

6.2.4.1 Frequency Settings

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



Center frequency

Defines the center frequency of the signal in Hertz.

The allowed range of values for the center frequency depends on the frequency span.

span > 0: $span_{min}/2 \le f_{center} \le f_{max} - span_{min}/2$

f_{max} and $span_{min}$ depend on the instrument and are specified in the data sheet.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 180

Center Frequency Stepsize

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

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

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

This setting is available for frequency and time domain measurements.

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

Remote command:
[SENSe:]FREQuency:CENTer:STEP on page 181

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, or 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, but not if it shows frequencies relative to the signal's center frequency.

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 -100 GHz to 100 GHz. The default setting is 0 Hz.

Note: In MSRA mode, this function is only available for the MSRA Master.

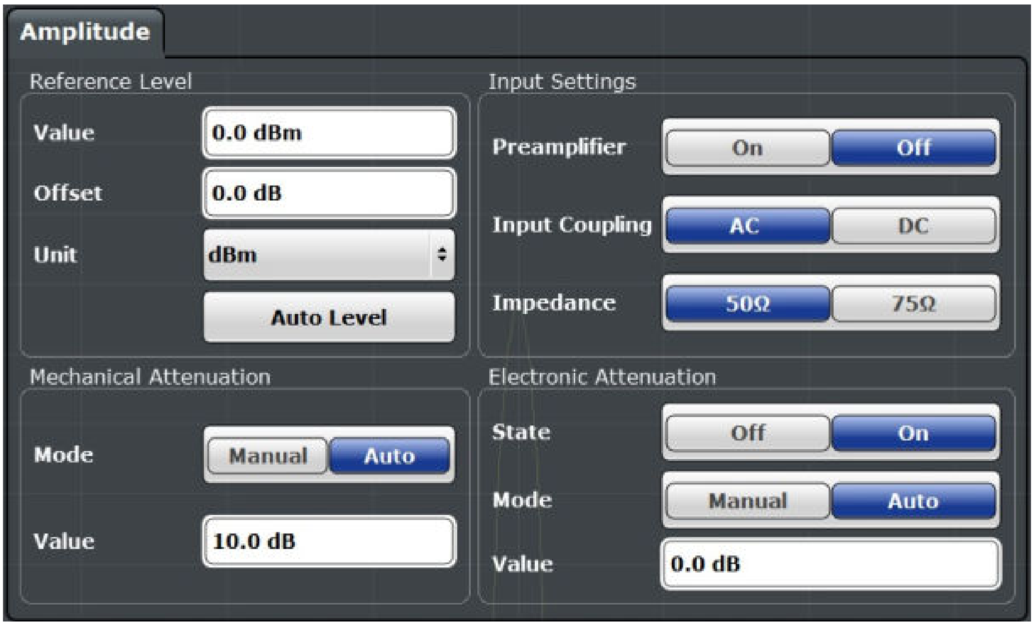
Remote command:
[SENSe:]FREQuency:OFFSet on page 182

6.2.4.2 Amplitude Settings

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

Amplitude settings determine how the R&S FSW must process or display the expected input power levels.

Amplitude settings for input from the optional Analog Baseband interface are described in Chapter 6.2.4.3, "Amplitude Settings for Analog Baseband Input", on page 87.



Reference Level

Defines the expected maximum input signal level. Signal levels above this value may not be measured correctly, which is indicated by the "IF OVLD" status display ("OVLD" for analog baseband or digital baseband input).

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 184

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 FSW so the application shows correct power results. All displayed power level results are shifted by this value.

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 185

Unit ← Reference Level
For CDA measurements, do not change the unit, as this would lead to useless results.

Setting the Reference Level Automatically (Auto Level) ← Reference Level
Automatically determines a reference level which ensures that no overload occurs at the R&S FSW for the current input data. At the same time, the internal attenuators and the preamplifier (for analog baseband input: the full scale level) are adjusted so the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 108).

Remote command:
`[SENSe:]ADJust:LEVel` on page 210

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

This function is not available for input from the optional Digital Baseband Interface.

Attenuation Mode / Value ← RF Attenuation
The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). This ensures that no overload occurs at the RF INPUT connector for the current reference level. It is the default setting.

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

This function is not available for input from the optional **Digital Baseband Interface**.

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

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

Remote command:
INPut:ATTenuation on page 186
INPut:ATTenuation:AUTO on page 187

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

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

This function is not available for input from the optional Digital Baseband Interface.

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) > 13.6 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may 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.

Both the electronic and the mechanical attenuation can be varied in 1 dB steps. Other entries are rounded to the next lower integer value.

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

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

Remote command:
INPut:EATT:STATe on page 188
INPut:EATT:AUTO on page 187
INPut:EATT on page 187

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

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

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

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

This function is not available for input from the (optional) Digital Baseband Interface.

For R&S FSW26 or higher models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW8 or 13 models, the following settings are available:

"Off" Deactivates the preamplifier.

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

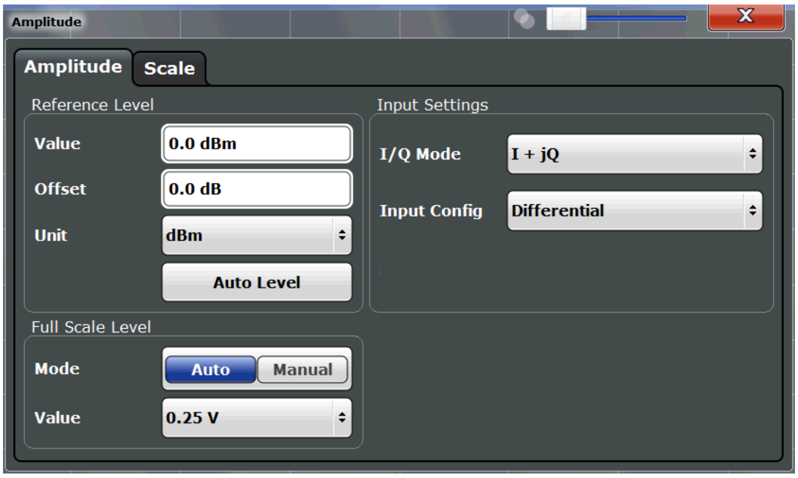
"30 dB" The RF input signal is amplified by about 30 dB.

Remote command:
`INPut:GAIN:STATe` on page 185
`INPut:GAIN[:VALue]` on page 185

6.2.4.3 Amplitude Settings for Analog Baseband Input

Access: "Overview" > "Amplitude"

The following settings and functions are available to define amplitude settings for input via the optional Analog Baseband Interface in the applications that support it.



The input settings provided here are identical to those in the "Input Source" > "Analog Baseband" tab, see "Analog Baseband Input Settings" on page 73.

For more information on the optional Analog Baseband Interface, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Reference Level

Defines the expected maximum input signal level. Signal levels above this value may not be measured correctly, which is indicated by the "IF OVLD" status display ("OVLD" for analog baseband or digital baseband input).

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 184

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 FSW so the application shows correct power results. All displayed power level results are shifted by this value.

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 185

Unit ← Reference Level

For CDA measurements, do not change the unit, as this would lead to useless results.

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

Automatically determines a reference level which ensures that no overload occurs at the R&S FSW for the current input data. At the same time, the internal attenuators and the preamplifier (for analog baseband input: the full scale level) are adjusted so the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 108).

Remote command:
`[SENSe:]ADJust:LEVel` on page 210

Full Scale Level Mode / Value

The full scale level defines the maximum power you can input at the Baseband Input connector without clipping the signal.

The full scale level can be defined automatically according to the reference level, or manually.

For manual input, the following values can be selected:

- 0.25 V
- 0.5 V
- 1 V
- 2 V

If probes are connected, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

For details on probes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

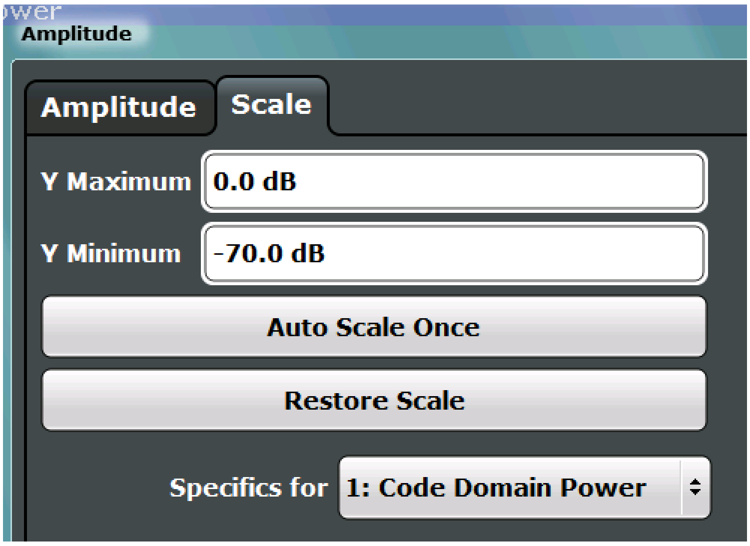
Remote command:
`INPut:IQ:FULLscale:AUTO` on page 175
`INPut:IQ:FULLscale[:LEVel]` on page 175

6.2.4.4 Y-Axis Scaling

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

Or: AMPT > "Scale Config"

The vertical axis scaling is configurable. In Code Domain Analysis, the y-axis usually displays the measured power levels.



Y-Maximum, Y-Minimum
Defines the amplitude range to be displayed on the y-axis of the evaluation diagrams.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 183
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 184

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.

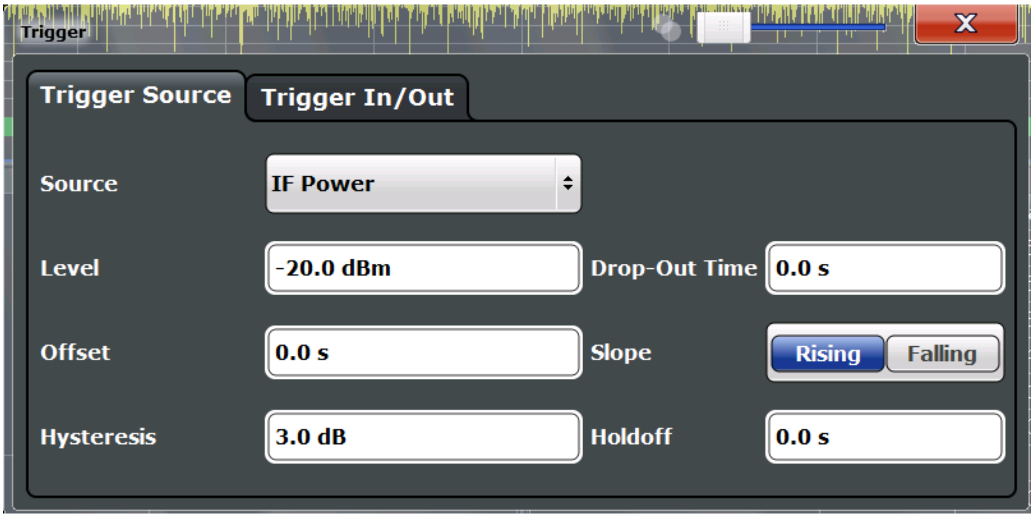
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 183

Restore Scale (Window)
Restores the default scale settings in the currently selected window.

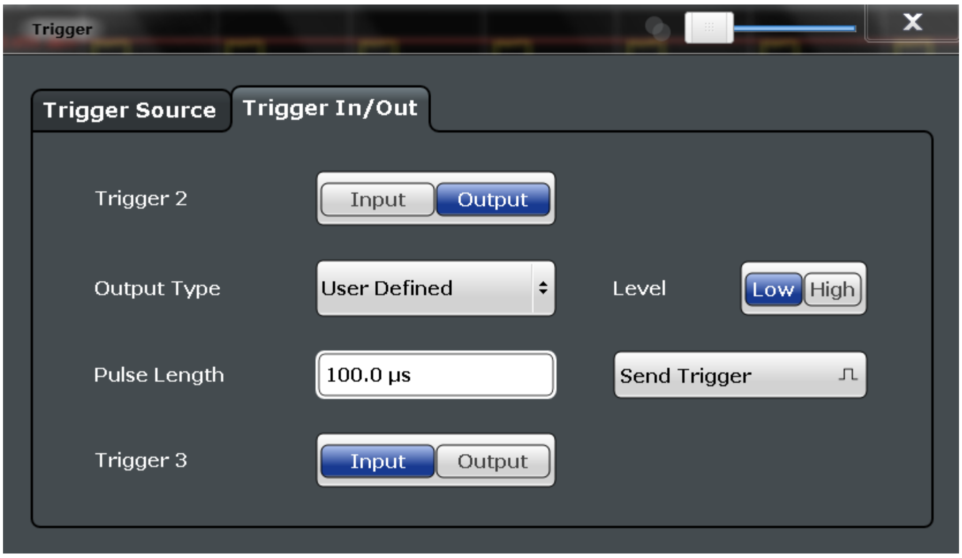
6.2.5 Trigger Settings

Access: "Overview" > "Trigger"

Trigger settings determine when the input signal is measured.



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



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

Trigger Source

The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Source

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

Remote command:

`TRIGger[:SEQuence]:SOURce` on page 193

Free Run ← Trigger Source ← Trigger Source

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

Remote command:

`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 193

External Trigger 1/2/3 ← Trigger Source ← Trigger Source

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

(See "Trigger Level" on page 93).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRIGGER 1 INPUT connector on the front panel.

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

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

"External Trigger 2"
Trigger signal from the TRIGGER 2 INPUT / OUTPUT connector.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 78).

"External Trigger 3"
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector on the rear panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 78).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`
`TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 193

Digital I/Q ← Trigger Source ← Trigger Source
For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the optional Digital Baseband Interface is available:

Defines triggering of the measurement directly via the LVDS connector. In the selection list you must specify which general purpose bit (GP0 to GP5) will provide the trigger data.

Note:
If the Digital I/Q enhanced mode is used, i.e. the connected device supports transfer rates up to 200 Msps, only the general purpose bits GP0 and GP1 are available as a Digital I/Q trigger source.

The following table describes the assignment of the general purpose bits to the LVDS connector pins.

(For details on the LVDS connector, see the R&S FSW I/Q Analyzer User Manual.)

Table 6-1: Assignment of general purpose bits to LVDS connector pins

Bit	LVDS pin
GP0	SDATA4_P - Trigger1
GP1	SDATA4_P - Trigger2
GP2 *)	SDATA0_P - Reserve1
GP3 *)	SDATA4_P - Reserve2
GP4 *)	SDATA0_P - Marker1
GP5 *)	SDATA4_P - Marker2
*): not available for Digital I/Q enhanced mode	

Remote command:
`TRIG:SOUR GP0`, see `TRIGger[:SEQuence]:SOURce` on page 193

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

For frequency sweeps, the third IF represents the start frequency. The trigger bandwidth at the third IF depends on the RBW and sweep type.

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.

This trigger source is available for frequency and time domain measurements only.

It is not available for input from the optional Digital Baseband Interface or the optional Analog Baseband Interface.

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

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

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 193

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 191
For analog baseband or digital baseband input only:
`TRIGger[:SEQuence]:LEVel:BBPower` on page 190

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

Note: For input from the optional Analog Baseband Interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns. This avoids unintentional trigger events (as no hysteresis can be configured in this case).

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 189

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

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

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 190

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

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

This setting is available for frequency and time domain measurements only.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 190

Trigger Holdoff ← Trigger Source

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

Remote command:

`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 190

Slope ← Trigger Source

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

Remote command:

`TRIGger[:SEQuence]:SLOPe` on page 192

Capture Offset ← Trigger Source

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

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

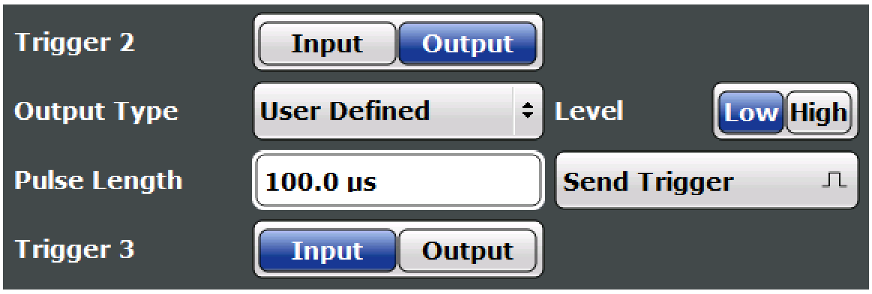
For details on the MSRA operating mode, see the R&S FSW MSRA User Manual.

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

Remote command:

`[SENSe:]MSRA:CAPTure:OFFSet` on page 266

Trigger 2/3



Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

Note: Providing trigger signals as output is described in detail in the R&S FSW User Manual.

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

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

Remote command:
OUTPut:TRIGger<port>:DIRection on page 195

Output Type ← Trigger 2/3

Type of signal to be sent to the output

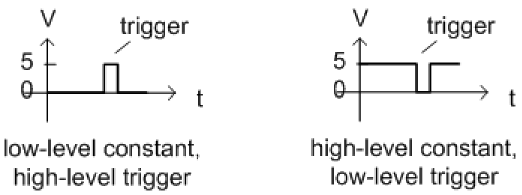
"Device Triggered"	(Default) Sends a trigger when the R&S FSW triggers.
"Trigger Armed"	Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state. This state is indicated by a status bit in the STATus:OPERation register (bit 5), as well as by a low-level signal at the AUX port (pin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

Remote command:
OUTPut:TRIGger<port>:OTYPe on page 196

Level ← Output Type ← Trigger 2/3

Defines whether a high (1) or low (0) constant signal is sent to the trigger output connector.

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<port>:LEVel on page 195

Pulse Length ← Output Type ← Trigger 2/3

Defines the duration of the pulse (pulse width) sent as a trigger to the output connector.

Remote command:
OUTPut:TRIGger<port>:PULSe:LENGth on page 197

Send Trigger ← Output Type ← Trigger 2/3

Sends a user-defined trigger to the output connector immediately.

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

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

Remote command:
OUTPut:TRIGger<port>:PULSe:IMMediate on page 196

6.2.6 Signal Capture (Data Acquisition)

Access: "Overview" > "Signal Capture"

How much and how data is captured from the input signal is user-definable.

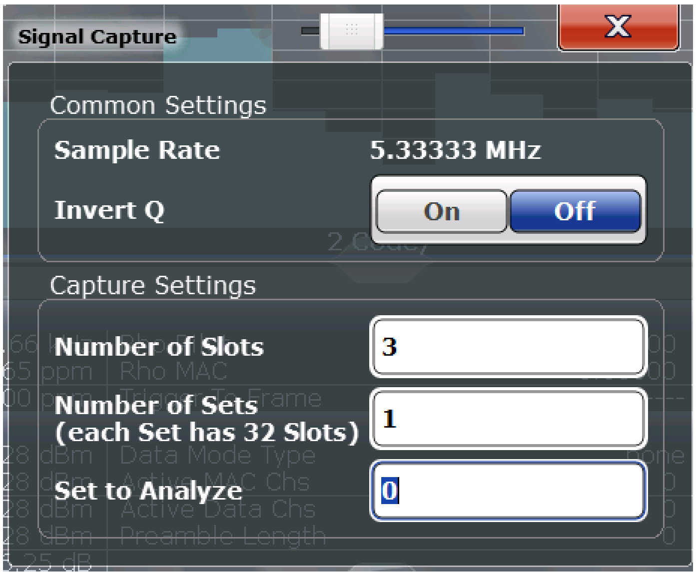


Figure 6-1: Signal capture settings in BTS application

MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition settings for the 1xEV-DO application in MSRA mode define the **application data** (see Chapter 6.2.7, "Application Data (MSRA) ", on page 97).

For details on the MSRA operating mode, see the R&S FSW MSRA User Manual.

Sample Rate

The sample rate is always 5.33333 MHz (indicated for reference only).

Invert Q

Inverts the sign of the signal's Q-branch. The default setting is OFF.

Remote command:
`[SENSe:]CDPower:QINVert` on page 198

Number of Slots

Sets the number of slots you want to analyze.

The maximum number of slots is 36 for the BTS application, and 70 in the MS application. The default value is 3. To capture more slots, increase the "Number of Sets" on page 97 to capture. In this case, the number of slots is <number of sets> x 32 (BTS application) or <number of sets> x 64 (MS application).

For more information on slots and sets, see Chapter 4.1, "Slots and Sets", on page 43.

Remote command:
`[SENSe:]CDPower:IQLength` on page 197

Number of Sets
Defines the number of consecutive sets to be captured and stored in the instrument's IQ memory. The possible value range is from 1 to a maximum of 1500 (BTS application) or 810 (MS application) sets.

The default setting is 1.

If you capture more than one set, the number of slots/PCGs is always 64 (1xEV-DO BTS application: 32) and is not available for modification.

Remote command:
`[SENSe:]CDPower:SET:COUNt` on page 198

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 97 – 1.

Remote command:
`[SENSe:]CDPower:SET` on page 215

6.2.7 Application Data (MSRA)

For the 1xEV-DO BTS application in MSRA operating mode, the application data range is defined by the same settings used to define the signal capturing in Signal and Spectrum Analyzer mode (see "Number of Sets" on page 97).

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the 1xEV-DO BTS measurement (see "Capture Offset" on page 94).

The **analysis interval** cannot be edited manually. It is determined automatically according to the selected channel, slot or set to analyze, which is defined for the evaluation range, depending on the result display. Note that the channel/slot/set is analyzed *within the application data*.

6.2.8 Synchronization (MS Application Only)

Access: "Overview" > "Synchronization"

The "Synchronization" settings are only available for MS measurements. They define how channels are synchronized for channel detection.

Sync To
Defines the synchronization mode for frame synchronization (detection of the first chip of the frame). Two methods use the known sequence of a pilot channel (Pilot or Auxiliary Pilot); a third does not require a pilot channel.

For details, see Chapter 4.3, "Synchronization (MS application only)", on page 45.

"Auto"	The following modes are tried sequentially until synchronization was successful. If none of the methods was successful, a failed synchronization is reported.
"Pilot"	Uses the correlation characteristic of the known pilot channel.
"Auxiliary Pilot"	Similar to synchronization on pilot, but with the different known sequence (= spreading code) of the auxiliary pilot channel. This mode is useful if the signal does not contain a pilot channel.
"Channel Power"	Analyzes the power of any specified channel.

Remote command:
`[SENSe:]CDP:SMODe` on page 198

6.2.9 Channel Detection

Access: "Overview" > "Channel Detection"

The channel detection settings determine which channels are found in the input signal.

6.2.9.1 General Channel Detection Settings

Access: "Overview" > "Channel Detection"

Inactive Channel Threshold

Defines the minimum power that a single channel must have compared to the total signal to be recognized as an active channel.

The default value is -60 dB. With this value, the Code Domain Analyzer can detect all channels with signals such as the 1xEV-DO test models. Decrease the "Inactive Channel Threshold" value, if not all channels contained in the signal are detected.

Remote command:
`[SENSe:]CDPower:ICTReshold` on page 203

Using Predefined Channel Tables

Defines the channel search mode.

"Predefined" Compares the input signal to the predefined channel table selected in the "Predefined Tables" list

"Auto" Detects channels automatically using pilot sequences and fixed code numbers
The automatic search provides an overview of the channels contained in the currently measured signal. If channels are not detected as being active, change the Inactive Channel Threshold or select the "Predefined" channel search mode.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle[:STATe]` on page 202

6.2.9.2 Channel Table Management

Access: "Overview" > "Channel Detection" > "Predefined Channel Tables"

Predefined Tables

The list shows all available channel tables and marks the currently used table with a checkmark. The currently *focussed* table is highlighted blue.

For details on predefined channel tables provided by the 1xEV-DO applications, see Chapter A.1, "Predefined Channel Tables", on page 272.

The following channel tables are available by default:

"DO16QAM, DO8PSK, DO_IDLE, DOQPSK"
Channel tables for BTS application

"5CHANS, PICH, PICHRRI"
Channel tables for MS application

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:CATalog?` on page 200

Selecting a Table

Selects the channel table currently focused in the "Predefined Tables" list and compares it to the measured signal to detect channels.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:SELect` on page 202

Creating a New Table

Creates a new channel table. For a description of channel table settings and functions, see Chapter 6.2.9.3, "Channel Table Settings and Functions", on page 101.

For step-by-step instructions on creating a new channel table, see "To define or edit a channel table" on page 133.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:NAME` on page 206

Editing a Table

You can edit existing channel table definitions. The details of the selected channel are displayed in the "Channel Table" dialog box.

Copying a Table

Copies an existing channel table definition. The details of the selected channel are displayed in the "Channel Table" dialog box.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:COPY` on page 201

Deleting a Table
Deletes the currently selected channel table after a message is confirmed.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DELete` on page 202

Restoring Default Tables
Restores the predefined channel tables delivered with the instrument.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:RESTore` on page 202

6.2.9.3 Channel Table Settings and Functions

Access: "Overview" > "Channel Detection" > "Predefined Channel Tables" > "New"/ "Copy"/ "Edit"

Some general settings and functions are available when configuring a predefined channel table.

For details on channel table entries, see Chapter 6.2.9.4, "BTS Channel Details", on page 102 or Chapter 6.2.9.5, "Channel Details (MS Application)", on page 103.

Name
Name of the channel table that is displayed in the "Predefined Channel Tables" list.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:NAME` on page 206

Comment
Optional description of the channel table.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:COMMent` on page 203

Adding a Channel
Inserts a new row in the channel table to define another channel.

Deleting a Channel
Deletes the currently selected channel from the table.

Creating a New Channel Table from the Measured Signal (Measure Table)
Creates a completely new channel table according to the current measurement data.

Remote command:
`CONFigure:CDPower[:BTS]:MEASurement` on page 158

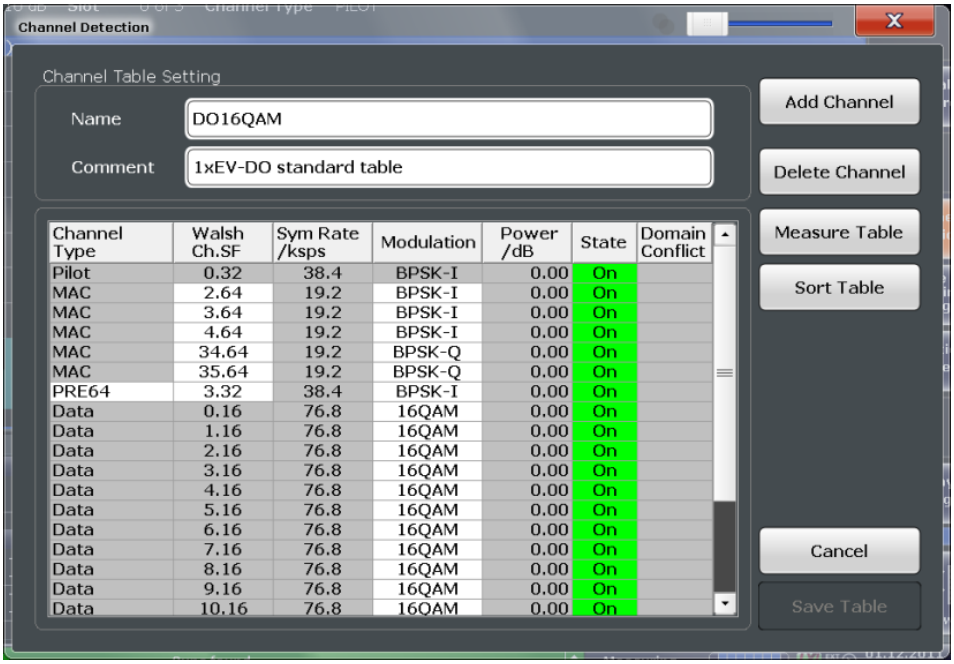
Sorting the Table
Sorts the channel table entries.

Cancelling the Configuration
Closes the "Channel Table" dialog box without saving the changes.

Saving the Table
Saves the changes to the table and closes the "Channel Table" dialog box.

6.2.9.4 BTS Channel Details

Access: "Overview" > "Channel Detection" > "Predefined Channel Tables" > "New"/ "Copy"/ "Edit" > "Add Channel"



For details on the individual parameters, see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Channel Type

Type of channel according to 1xEV-DO standard. For a list of possible channel types, see Chapter 4.4.1, "BTS Channel Types", on page 47.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203

Channel Number (Walsh Ch./SF)

Channel number, consisting of walsh channel code and spreading factor

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203

Symbol Rate

Symbol rate at which the channel is transmitted.

Modulation

Modulation type used for transmission.

For a list of available modulation types, see Table A-8.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203

Power

Contains the measured relative code domain power. The unit is dB. The fields are filled with values after you press the "Meas" button (see "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 102).

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203

Status

Indicates the channel status. Codes that are not assigned are marked as inactive channels.

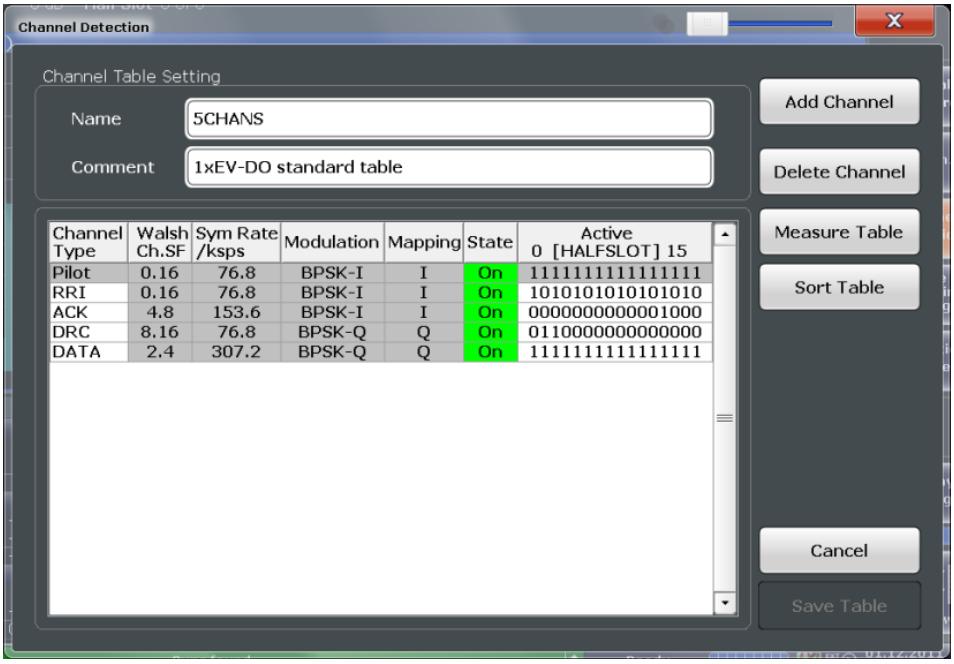
Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203

Domain Conflict

Indicates a code domain conflict between channel definitions (e.g. overlapping channels).

6.2.9.5 Channel Details (MS Application)

Access: "Overview" > "Channel Detection" > "Predefined Channel Tables" > "New"/ "Copy"/ "Edit" > "Add Channel"



For details on the individual parameters, see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Channel Type

Type of channel according to 1xEV-DO standard.

For a list of possible channel types, see Chapter 4.4.2, "MS Channel Types", on page 48.

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 205

Channel Number (Walsh Ch./SF)

Channel number, consisting of walsh channel code and spreading factor

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 205

Symbol Rate

Symbol rate at which the channel is transmitted.

Modulation

Modulation type used for transmission.

For a list of available modulation types, see Table A-10.

Remote command:
CONFigure:CDPower[:BTS]:CTABle:DATA on page 203

Mapping

Branch onto which the channel is mapped (I or Q). The setting is not editable, since the standard specifies the channel assignment for each channel.

For more information, see Chapter 4.7, "Code Mapping and Branches", on page 51.

Remote command:
[SENSe:]CDPower:MAPPing on page 214

Status

Indicates the channel status. Codes that are not assigned are marked as inactive channels.

Remote command:
CONFigure:CDPower[:BTS]:CTABle:DATA on page 205

Activity

The decimal number - interpreted as a binary number in 16 bits - determines the half slot in which the channel is active (value 1) or inactive (value 0).

Remote command:
CONFigure:CDPower[:BTS]:CTABle:DATA on page 205

6.2.10 Sweep Settings

Access: SWEEP

The sweep settings define how the data is measured.

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 207
[SENSe:]AVERage<n>:COUNt on page 206

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

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

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

Remote command:
`INITiate<n>:CONTinuous` on page 229

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

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

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, the Sequencer sweeps a channel in single sweep mode only once.
Furthermore, the RUN SINGLE key controls the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode.

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

Remote command:
`INITiate<n>[:IMMediate]` on page 230

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

Remote command:
`INITiate<n>:CONMeas` on page 229

6.2.11 Automatic Settings

Access: AUTO SET

The R&S FSW 1xEV-DO Measurements application can adjust some settings automatically according to the current measurement settings. To do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

MSRA operating mode

In MSRA operating mode, the following automatic settings are not available, as they require a new data acquisition. However, 1xEV-DO applications cannot acquire data in MSRA operating mode.

Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- Auto Level
- "Auto Scale All" on page 108

Note: MSRA operating modes. In MSRA operating mode, this function is only available for the MSRA Master, not the applications.

Remote command:
`[SENSe:]ADJust:ALL` on page 208

Setting the Reference Level Automatically (Auto Level)

Automatically determines a reference level which ensures that no overload occurs at the R&S FSW for the current input data. At the same time, the internal attenuators and the preamplifier (for analog baseband input: the full scale level) are adjusted so the signal-to-noise ratio is optimized, while signal compression and clipping are minimized.

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 108).

Remote command:
`[SENSe:]ADJust:LEVel` on page 210

Auto Scale Window

Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in the currently selected window. No new measurement is performed.

Auto Scale All

Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in all displayed diagrams. No new measurement is performed.

Restore Scale (Window)

Restores the default scale settings in the currently selected window.

Resetting the Automatic Measurement Time (Meastime Auto)

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

Remote command:
`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 209

Changing the Automatic Measurement Time (Meastime Manual)

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

Remote command:
`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 209
`[SENSe:]ADJust:CONFigure:DURation` on page 208

Upper Level Hysteresis

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

Remote command:
`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 210

Lower Level Hysteresis

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

Remote command:
`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 209

6.3 RF Measurements

1xEV-DO measurements require special applications on the R&S FSW, which you activate using the MODE key.

When you activate a measurement channel in 1xEV-DO applications, Code Domain Analysis of the input signal is started automatically. However, the 1xEV-DO applications also provide various RF measurement types.

Selecting the measurement type

► To select an RF measurement type, do one of the following:
  - Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the required measurement.
  - Press the MEAS key. In the "Select Measurement" dialog box, select the required measurement.

Some parameters are set automatically according to the 1xEV-DO standard the first time a measurement is selected (since the last PRESET operation). A list of these parameters is given with each measurement type. The parameters can be changed, but are not reset automatically the next time you re-enter the measurement.

The main measurement configuration menus for the RF measurements are identical to the Spectrum application.

For details refer to "Measurements" in the R&S FSW User Manual.

The measurement-specific settings for the following measurements are available via the "Overview".

6.3.1 Power Vs Time (BTS only)

The Power vs Time measurement performs a special Spectrum Emission Mask measurement with predefined settings as defined by the 1xEV-DO standard. To do so, it examines a specified number of half slots. Up to 36 half slots can be captured and processed simultaneously. That means that for a standard measurement of 100 half slots only three data captures are necessary. After capturing the data the application averages the measured values and compares the results to the emission envelope mask.

Table 6-2: Default settings used for the Power vs Time measurement

Setting	Default value
Frequency	Span 0 (Zero Span)
Sweep Time	833.38 Ms

Setting	Default value
RBW	3 MHz
VBW	10 MHz
Detector	RMS
Trace Mode	Average

The measurement-specific settings for the Power vs Time measurement are currently not available via the "Overview", only via softkeys in the "Power vs Time" menu, which is displayed when you press the MEAS CONFIG key.

Furthermore, the following buttons are not available in the "Overview":

- Signal Description
- Signal Capture
- Synchronization
- Channel Detection

The following settings can be configured for the Power vs Time measurement:

No of HalfSlots

Defines the number of halfslots used for averaging. The default value is 100.

Remote command:
`[SENSe:]SWEep:COUNt` on page 207

RF:Slot

Defines the expected signal. The limit lines and the borders for calculating the mean power are set accordingly.

"Full" Full slot signal
The lower and upper limit line are called "PVTFL"/"PVTFU"

"Idle" Idle slot signal
The lower and upper limit line are called "PVTIL"/"PVTIU"

Remote command:
`CONFigure:CDPower[:BTS]:RFSLot` on page 218

Burst Fit

Activates an automatic burst alignment to the center of the diagram. If enabled, the following steps are performed:

- 1. The algorithm searches the maximum and minimum gradient.

- 2. The maximum peak between these two values is determined.
- 3. From this point the 7 dB down points are searched.
- 4. If these points are within plausible ranges the burst is centered in the screen, otherwise nothing happens.

By default, this algorithm is OFF.

This function is only available if the RF:Slot is set to "Idle".

Remote command:
CONFigure:CDPower[:BTS]:PVTime:BURSt:CENTer on page 218

Reference Mean Pwr
If enabled, the mean power is calculated and the limit lines are set relative to that mean power.

The standard requires that the FULL slot first be measured with the limit line relative to the mean power of the averaged time response.

This value should also be used as the reference for the IDLE slot measurement.

Remote command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 216

Reference Manual
Defines the reference value for the limits manually.

Remote command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 216
CALCulate<n>:LIMit<k>:PVTime:RVALue on page 217

Set Mean to Manual
When selected, the current mean power value of the averaged time response is used as the fixed reference value for the limit lines. "Reference Manual" is activated. Now the IDLE slot can be selected and the measurement sequence can be finished.

Remote command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 216

Restart on Fail
Evaluates the limit line over all results at the end of a single sweep. The sweep restarts if the result is "FAIL". After a "PASS" or "MARGIN" result, the sweep ends.

This function is only available in single sweep mode.

Remote command:
CONFigure:CDPower[:BTS]:PVTime:FREStart on page 218

6.3.2 Signal Channel Power Measurements

The Power measurement determines the 1xEV-DO signal channel power.

To do so, the RF signal power of a single channel is analyzed with 1.2288 MHz bandwidth over a single trace. The displayed results are based on the root mean square. The bandwidth and the associated channel power are displayed in the Result Summary.

In order to determine the signal channel power, the 1xEV-DO application performs a Channel Power measurement as in the Spectrum application with the following settings:

Table 6-3: Predefined settings for 1xEV-DO Output Channel Power measurements

Setting	Default Value
ACLR Standard	1xEV-DO MC1
Number of adjacent channels	0
Frequency Span	2 MHz

For further details about the Power measurement refer to "Channel Power and Adjacent-Channel Power (ACLR) Measurements" in the R&S FSW User Manual.

6.3.3 Channel Power (ACLR) Measurements

The Adjacent Channel Power measurement analyzes the power of the Tx channel and the power of adjacent and alternate channels on the left and right side of the Tx channel. The number of Tx channels and adjacent channels can be modified as well as the band class. The bandwidth and power of the Tx channel and the bandwidth, spacing and power of the adjacent and alternate channels are displayed in the Result Summary.

Channel Power ACLR measurements are performed as in the Spectrum application with the following predefined settings according to 1xEV-DO specifications (adjacent channel leakage ratio).

Table 6-4: Predefined settings for 1xEV-DO ACLR Channel Power measurements

Setting	Default value
Bandclass	0: 800 MHz Cellular
Number of adjacent channels	2

For further details about the ACLR measurements refer to "Measuring Channel Power and Adjacent-Channel Power" in the R&S FSW User Manual.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset
- RBW, VBW
- Sweep time
- Span
- Number of adjacent channels
- Fast ACLR mode

The main measurement menus for the RF measurements are identical to the Spectrum application. However, for ACLR and SEM measurements in 1xEV-DO applications, an additional softkey is available to select the required bandclass.

Bandclass

The bandclass defines the frequency band used for ACLR and SEM measurements. It also determines the corresponding limits and ACLR channel settings according to the 1xEV-DO standard.

For an overview of supported bandclasses and their usage, see Chapter A.3, "Reference: Supported Bandclasses", on page 277.

Remote command:

`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 219

6.3.4 Spectrum Emission Mask

The Spectrum Emission Mask measurement shows the quality of the measured signal by comparing the power values in the frequency range near the carrier against a spectral mask that is defined by the 1xEV-DO specifications. The limits depend on the selected bandclass. In this way, the performance of the DUT can be tested and the emissions and their distance to the limit be identified.

Note that the 1xEV-DO standard does not distinguish between spurious and spectral emissions.

The Result Summary contains a peak list with the values for the largest spectral emissions including their frequency and power.

The 1xEV-DO applications perform the SEM measurement as in the Spectrum application with the following settings:

Table 6-5: Predefined settings for 1xEV-DO SEM measurements

Bandclass	0: 800 MHz Cellular
Span	-4 MHz to +1.98 MHz
Number of ranges	5
Fast SEM	ON
Sweep time	100 ms
Number of power classes	3
Power reference type	Channel power

For further details about the Spectrum Emission Mask measurements refer to "Spectrum Emission Mask Measurement" in the R&S FSW User Manual.

Changing the RBW and the VBW is restricted due to the definition of the limits by the standard.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset

- Sweep time
- Span

The main measurement menus for the RF measurements are identical to the Spectrum application. However, for ACLR and SEM measurements, an additional softkey is available to select the required bandclass.

Bandclass
The bandclass defines the frequency band used for ACLR and SEM measurements. It also determines the corresponding limits and ACLR channel settings according to the 1xEV-DO standard.

For an overview of supported bandclasses and their usage, see Chapter A.3, "Reference: Supported Bandclasses", on page 277.

Remote command:
`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 219

6.3.5 Occupied Bandwidth

The Occupied Bandwidth measurement is performed as in the Spectrum application with default settings.

Table 6-6: Predefined settings for 1xEV-DO OBW measurements

Setting	Default value
% Power Bandwidth	99 %
Channel bandwidth	1.2288 MHz

The Occupied Bandwidth measurement determines the bandwidth that the signal occupies. The occupied bandwidth is defined as the bandwidth in which – in default settings - 99 % of the total signal power is to be found. The percentage of the signal power to be included in the bandwidth measurement can be changed.

For further details about the Occupied Bandwidth measurements refer to "Measuring the Occupied Bandwidth" in the R&S FSW User Manual.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset
- RBW, VBW
- Sweep time
- Span

6.3.6 CCDF

The CCDF measurement determines the distribution of the signal amplitudes (complementary cumulative distribution function). The CCDF and the Crest factor are displayed. For the purposes of this measurement, a signal section of user-definable length is recorded continuously in zero span, and the distribution of the signal amplitudes is evaluated.

The measurement is useful to determine errors of linear amplifiers. The crest factor is defined as the ratio of the peak power and the mean power. The Result Summary displays the number of included samples, the mean and peak power and the crest factor.

The CCDF measurement is performed as in the Spectrum application with the following settings:

Table 6-7: Predefined settings for 1xEV-DO CCDF measurements

CCDF	Active on trace 1
Analysis bandwidth	10 MHz
Number of samples	62500
VBW	5 MHz

For further details about the CCDF measurements refer to "Statistical Measurements" in the R&S FSW User Manual.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset
- Analysis bandwidth
- Number of samples

7 Analysis

Access: "Overview" > "Analysis"

Analyzing RF Measurements

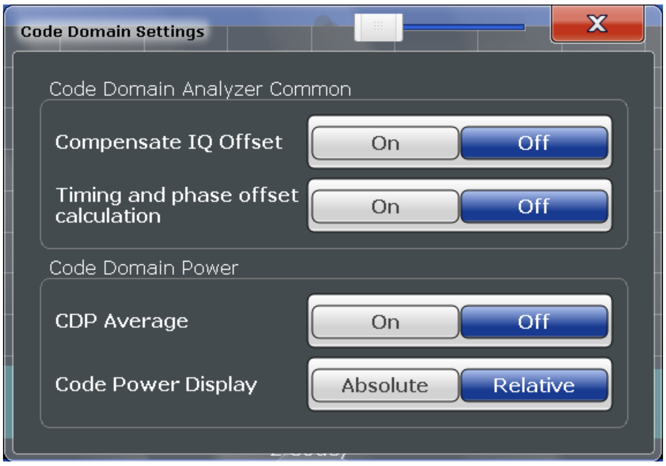
General result analysis settings concerning the trace, markers, lines etc. for RF measurements are identical to the analysis functions in the Spectrum application. Only some special marker functions and spectrograms are not available in the 1xEV-DO applications.

For details, see the "General Measurement Analysis and Display" chapter in the R&S FSW User Manual.

7.1 Code Domain Analysis Settings (BTS Application)

Access: "Overview" > "Analysis" > "Code Domain Settings" tab

Some evaluations provide further settings for the results. The settings for CDA measurements are described here.



Compensate IQ Offset
If enabled, the I/Q offset is eliminated from the measured signal. This is useful to deduct a DC offset to the baseband caused by the DUT, thus improving the EVM. Note, however, that for EVM measurements according to standard, compensation must be disabled.

Remote command:
`[SENSe:]CDPower:NORMalize` on page 211

Timing and phase offset calculation
Activates or deactivates the timing and phase offset calculation of the channels to the pilot channel. If deactivated, or if more than 50 active channels are in the signal, the calculation does not take place and dashes are displayed instead of values as results.

Remote command:
`[SENSe:]CDPower:TPMeas` on page 213

CDP Average
The Code Domain Analysis is averaged over all slots in the set. For channel types Data and Preamble this calculation assumes that preambles of different lengths do not occur in the slots. If active, "ALL" is displayed in the "Slot" field in the channel bar.

This function is required by the 1xEV-DO standard.

Remote command:
`[SENSe:]CDPower:AVERage` on page 211

Code Power Display
For "Code Domain Power" evaluation:

Defines whether the absolute power or the power relative to the chosen reference (in BTS application: relative to total power) is displayed.

Remote command:
`[SENSe:]CDPower:PDISplay` on page 212

7.2 Code Domain Analysis Settings (MS Application)

Access: "Overview" > "Analysis" > "Code Domain Settings" tab

Some evaluations provide further settings for the results. The settings for CDA measurements are described here.

Code Display Order

Defines the sorting of the channels for the Code Domain Power and Code Domain Error result displays.

For further details on the code order, refer to Chapter 4.8, "Code Display and Sort Order", on page 52.

"Hadamard" By default, the codes are sorted in Hadamard order, i.e. in ascending order.
The power of each code is displayed; there is no visible distinction between channels. If a channel covers several codes, the display shows the individual power of each code.

"Bit-Reverse" Bundles the channels with concentrated codes, i.e. all codes of a channel are next to one another. Thus you can see the total power of a concentrated channel.

Remote command:
`[SENSe:]CDPower:ORDer` on page 212

Compensate IQ Offset

If enabled, the I/Q offset is eliminated from the measured signal. This is useful to deduct a DC offset to the baseband caused by the DUT, thus improving the EVM. Note, however, that for EVM measurements according to standard, compensation must be disabled.

Remote command:
[SENSe:]CDPower:NORMalize on page 211

Timing and phase offset calculation

Activates or deactivates the timing and phase offset calculation of the channels to the pilot channel. If deactivated, or if more than 50 active channels are in the signal, the calculation does not take place and dashes are displayed instead of values as results.

Remote command:
[SENSe:]CDPower:TPMeas on page 213

Operation Mode

The operation mode is used for the channel search.

"Access"	The signal can contain only PICH (always available) and DATA channels.
"Traffic"	The signal can contain all channels (PICH/RRI/DATA/ACK and DRC). PICH and RRI are always available.

Remote command:
[SENSe:]CDPower:OPERation on page 211

CDP Average

The Code Domain Analysis is averaged over all slots in the set. For channel types Data and Preamble this calculation assumes that preambles of different lengths do not occur in the slots. If active, "ALL" is displayed in the "Slot" field in the channel bar.

This function is required by the 1xEV-DO standard.

Remote command:
[SENSe:]CDPower:AVERage on page 211

Code Power Display

For "Code Domain Power" evaluation:

Defines whether the absolute power or the power relative to the chosen reference (in BTS application: relative to total power) is displayed.

Remote command:
[SENSe:]CDPower:PDISplay on page 212

Power Reference

For "Code Domain Power" evaluation in the MS application only:

Defines the reference for relative power display.

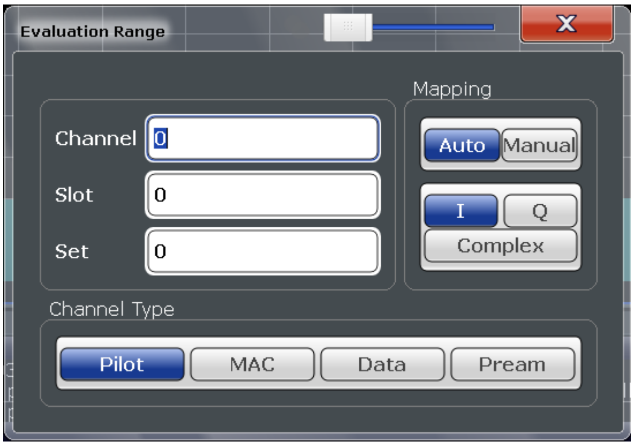
"Total"	Relative to the total signal power
"PICH"	Relative to the power of the PICH

Remote command:
[SENSe:]CDPower:PREFerence on page 212

7.3 Evaluation Range (BTS Application)

Access: "Overview" > "Analysis" > "Evaluation Range" tab

The evaluation range defines which channel (Code Number), slot or set is analyzed in the result display.



Channel

Selects a channel for the following evaluations (see also Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20):

- Bitstream
- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs PCG
- Power vs Symbol
- Result Summary
- Symbol Constellation
- Symbol EVM

The specified code is selected and marked in red.

For details on how specific codes are displayed see Chapter 4.8, "Code Display and Sort Order", on page 52.

The number of available channels depends on the specified channel type. For channel type PILOT and PREAMBLE values between 0 and 31 are valid. For channel type MAC the range is between 0 and 63 and for DATA channels the range is 0 to 15.

Remote command:
`[SENSe:]CDPower:CODE` on page 214

(Half-)Slot
Selects a (half-)slot for the following evaluations:

- Bitstream
- Channel Table
- Code Domain Error Power
- Code Domain Power
- Composite Constellation
- Peak Code Domain Error
- Power vs (Half-)Slot
- Power vs Symbol
- Result Summary
- Symbol Constellation
- Symbol EVM

Remote command:
[SENSe:]CDPower:SLOT on page 215

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 97 – 1.

Remote command:
[SENSe:]CDPower:SET on page 215

Mapping
Switches between the evaluation of the I or the Q branch, or the complex signal in BTS measurements. Mapping can be defined manually for all channels, or automatically depending on the channel type.

Table 7-1: Automatic mapping according to channel type for evaluation

Channel type	Mapping
Pilot	I or Q
MAC	I or Q
Preamble	I or Q
Data	Complex

This setting affects the following evaluations:

- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs slot
- Result Summary

Remote command:
[SENSe:]CDPower:MMODe on page 214

Channel Type
In the 1xEV-DO BTS signals, each of the four channel types occurs at a specific time within each slot. Thus, instead of selecting a code, you can also select which channel type to evaluate and display directly. By default, the Pilot channel as the first in the slot is evaluated.

- Pilot
- MAC
- Preamble
- Data

For further details on the characteristics of the channel types, refer to Chapter A.2, "Channel Type Characteristics", on page 275.

Remote command:
`[SENSe:]CDPower:CTYPe` on page 214

7.4 Evaluation Range (MS Application)

Access: "Overview" > "Analysis" > "Evaluation Range" tab

The evaluation range defines which part of the signal is analyzed in the result display.

Channel
Selects a channel for the following evaluations (see also Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20):

- Bitstream
- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs PCG
- Power vs Symbol
- Result Summary

- Symbol Constellation
- Symbol EVM

The specified code is selected and marked in red.

For details on how specific codes are displayed see Chapter 4.8, "Code Display and Sort Order", on page 52.

The number of available channels depends on the specified channel type. For channel type PILOT and PREAMBLE values between 0 and 31 are valid. For channel type MAC the range is between 0 and 63 and for DATA channels the range is 0 to 15.

Remote command:
`[SENSe:]CDPower:CODE` on page 214

(Half-)Slot
Selects a (half-)slot for the following evaluations:

- Bitstream
- Channel Table
- Code Domain Error Power
- Code Domain Power
- Composite Constellation
- Peak Code Domain Error
- Power vs (Half-)Slot
- Power vs Symbol
- Result Summary
- Symbol Constellation
- Symbol EVM

Remote command:
`[SENSe:]CDPower:SLOT` on page 215

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 97 – 1.

Remote command:
`[SENSe:]CDPower:SET` on page 215

Branch
Switches between the evaluation of the I and the Q branch in MS measurements.

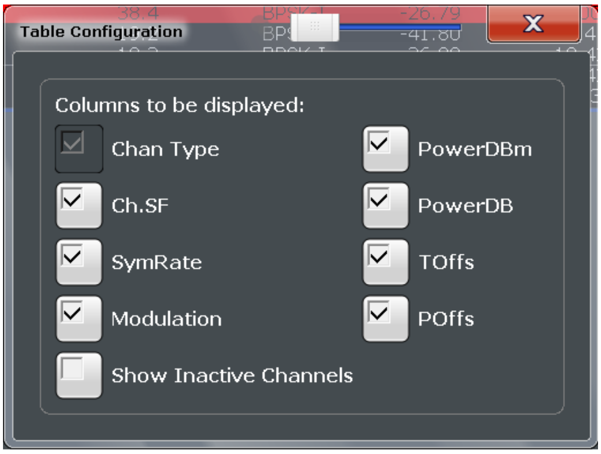
This affects the following evaluations:

- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs slot
- Result Summary

Remote command:
`[SENSe:]CDPower:MAPPing` on page 214

7.5 Channel Table Configuration

You can configure which parameters are displayed in the Channel Table evaluation by double-clicking the table header. A "Table Configuration" dialog box is displayed in which you select the columns to be displayed.



By default, only active channels are displayed. To display all channels, including the inactive ones, enable the "Show Inactive Channels" option.

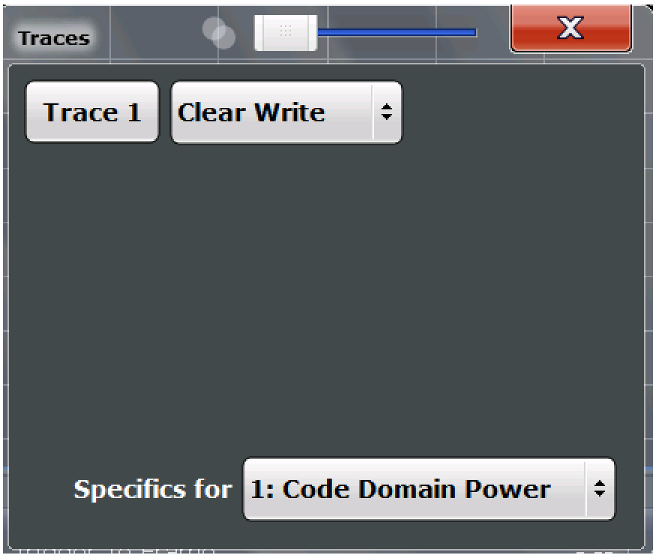
For details on the individual parameters, see Chapter 3.1.1, "Code Domain Parameters", on page 16.

7.6 Traces

Access: "Overview" > "Analysis" > "Trace"

Or: TRACE > "Trace Config"

The trace settings determine how the measured data is analyzed and displayed on the screen.



In CDA evaluations, only one trace can be active in each diagram at any time.

Window-specific configuration

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

Trace Mode

Defines the update mode for subsequent traces.

"Clear Write" Overwrite mode: the trace is overwritten by each measurement. This is the default setting.

"Max Hold" The maximum value is determined over several measurements and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is greater than the previous one.

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is lower than the previous one.

"Average" The average is formed over several measurements.
The Sweep / Average Count determines the number of averaging procedures.

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 253

7.7 Markers

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

Or: MKR

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

Markers in Code Domain Analysis measurements

In Code Domain Analysis measurements, the markers are set to individual symbols, codes, slots or channels, depending on the result display. Thus you can use the markers to identify individual codes, for example.

7.7.1 Individual Marker Settings

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

Or: MKR > "Marker Config"

In CDA evaluations, up to four markers can be activated in each diagram at any time.

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 255
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 256

X-value

Defines the position of the marker on the x-axis (channel, slot, symbol, depending on evaluation).

Remote command:
`CALCulate<n>:DELTamarker<m>:X` on page 256
`CALCulate<n>:MARKer<m>:X` on page 255

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 255
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 256

All Markers Off

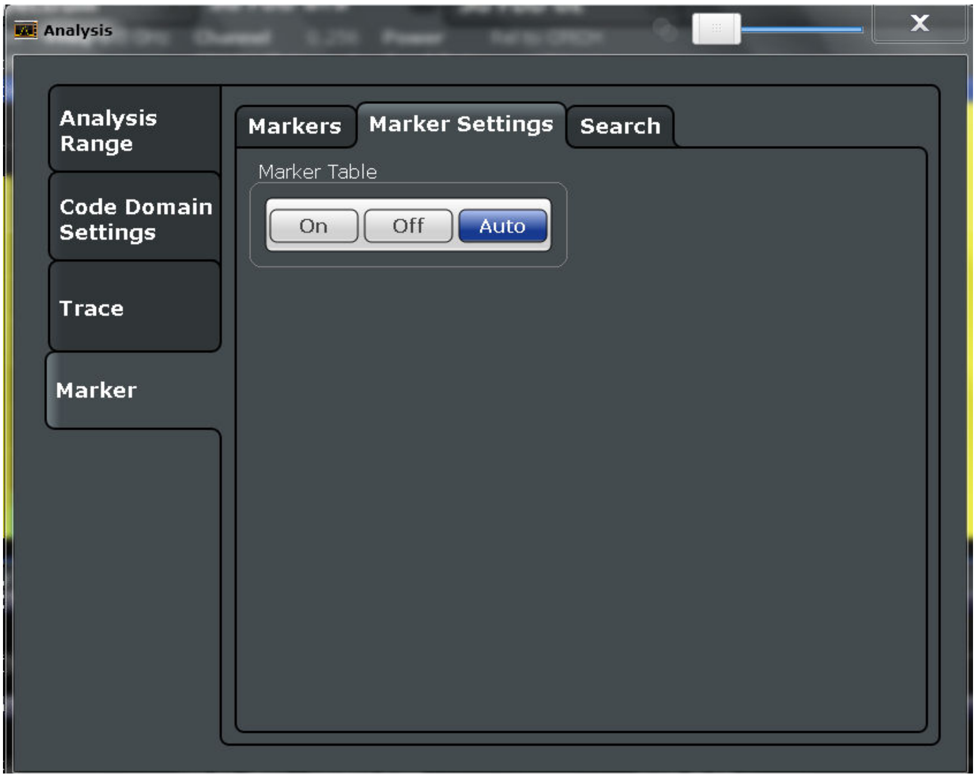
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 255

7.7.2 General Marker Settings

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

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



Marker Table Display

Defines how the marker information is displayed.

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

"Off" Displays the marker information within the diagram area. No separate marker table is displayed.

"Auto" (Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

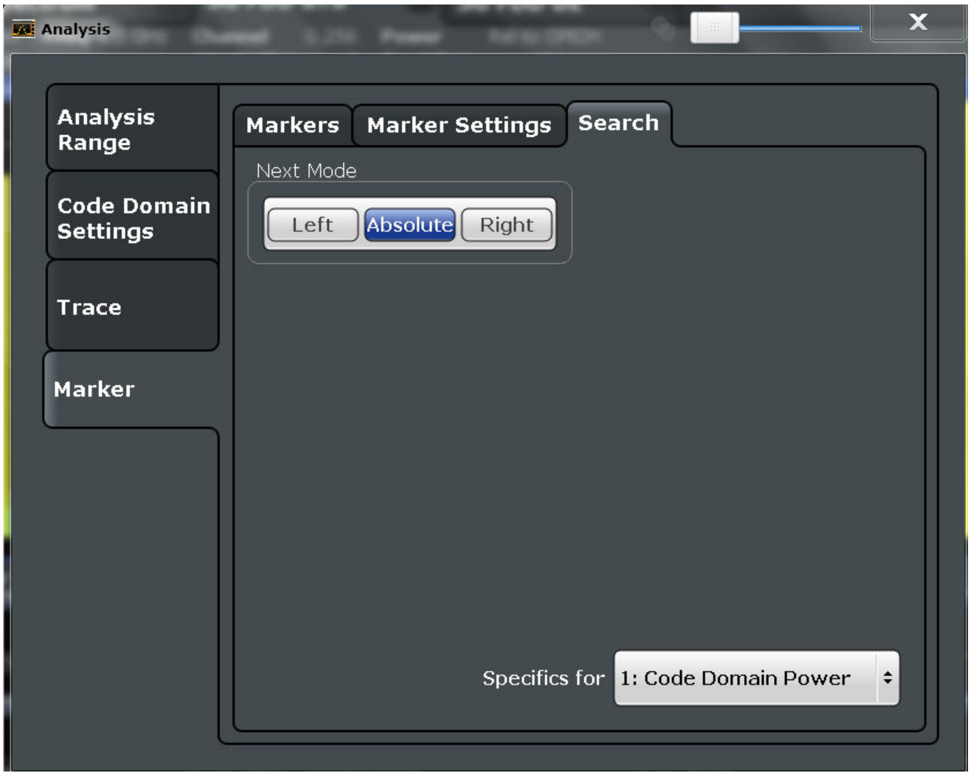
Remote command:
DISPlay:MTABle on page 258

7.7.3 Marker Search Settings

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

Access: MKR -> > "Search Config"

Several functions are available to set the marker to a specific position very quickly and easily. In order to determine the required marker position, searches can be performed. The search results are affected by special settings.



Search Mode for Next Peak

Selects the search mode for the next peak search.

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

Remote command:

Chapter 11.10.2.3, "Positioning the Marker", on page 258

7.7.4 Marker Positioning Functions

Access: MKR ->

The following functions set the currently selected marker to the result of a peak search.

Markers in Code Domain Analysis measurements

In Code Domain Analysis measurements, the markers are set to individual symbols, codes, slots or channels, depending on the result display. Thus you can use the markers to identify individual codes, for example.

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 259
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 259
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 258
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 261
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 262
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 261

Search Next Minimum

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

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 260
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 259
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 260
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 262
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 262
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 263

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 259
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 261

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 260
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 262

8 Optimizing and Troubleshooting the Measurement

If the results do not meet your expectations, try the following methods to optimize the measurement:

Synchronization fails:

- Check the center frequency.
- Perform an automatic reference level adjustment.
- In BTS mode:
  When using an external trigger, check whether an external trigger signal is being sent to the R&S FSW and check the "PN offset ".
- In MS mode, check the "Long Code Mask" and "Long Code Offset".
- Make sure "Invert Q" is off.

8.1 Error Messages

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`.

A short explanation of the application-specific error messages for 1xEV-DO measurements is given below.

Status bar message	Description
Sync not found	This message is displayed if synchronization is not possible. Possible causes are that frequency, level, or signal description values are set incorrectly, or the input signal is invalid.
Sync OK	This message is displayed if synchronization is possible.
Preamble missing	This message is displayed if the PREAMBLE channel type is examined and no preamble is found in the signal.

9 How to Perform Measurements in 1xEV-DO Applications

The following step-by-step instructions describe how to perform measurements with the 1xEV-DO applications.

To perform Code Domain Analysis

1. Press the MODE key and select the "1xEV-DO BTS" application for base station tests, or "1xEV-DO MS" for mobile station tests.

   Code Domain Analysis of the input signal is performed by default.
2. Select the "Overview" softkey to display the "Overview" for Code Domain Analysis.
3. Select the "Signal Description" button and configure the expected input signal.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Signal Capture" button and define the acquisition parameters for the input signal.
7. For MS tests, select the "Synchronization" button and define the reference to be used for synchronization.
8. Select the "Channel Detection" button and define how the individual channels are detected within the input signal. If necessary, define a channel table as described in "To define or edit a channel table" on page 133.
9. Select the "Display Config" button and select the evaluation methods that are of interest to you.
   Arrange them on the display to suit your preferences.
10. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
11. Select the "Analysis" button in the "Overview" to configure how the data is evaluated in the individual result displays.
    - Select the set, slot or code to be evaluated.
    - Configure specific settings for the selected evaluation method(s).
    - Optionally, configure the trace to display the average over a series of sweeps. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.

To define or edit a channel table

Channel tables contain a list of channels to be detected and their specific parameters. You can create user-defined and edit pre-defined channel tables.

1. From the main "Code Domain Analyzer" menu, select the "Channel Detection" soft-key to open the "Channel Detection" dialog box.
2. To define a new channel table, select the "New" button next to the "Predefined Tables" list.
   To edit an existing channel table:
   a) Select the existing channel table in the "Predefined Tables" list.
   b) Select the "Edit" button next to the "Predefined Tables" list.
3. In the "Channel Table" dialog box, define a name and, optionally, a comment that describes the channel table. The comment is displayed when you set the focus on the table in the "Predefined Tables" list.
4. Define the channels to be detected using one of the following methods:
   Select the "Measure Table" button to create a table that consists of the channels detected in the currently measured signal.
   Or:
   a) Select the "Add Channel" button to insert a row for a new channel below the currently selected row in the channel table.
   b) Define the channel specifications required for detection.
5. Select the "Save Table" button to store the channel table.

   The table is stored and the dialog box is closed. The new channel table is included in the "Predefined Tables" list in the "Channel Detection" dialog box.
6. To activate the use of the new channel table:
   a) Select the table in the "Predefined Tables" list.
   b) Select the "Select" button.
      A checkmark is displayed next to the selected table.
   c) Toggle the "Use Predefined Channel Table" setting to "Predefined".
   d) Toggle the "Compare Meas Signal with Predefined Table" setting to "On".
   e) Start a new measurement.

To perform an RF measurement

1. Press the MODE key and select the "1xEV-DO BTS" application for base station tests, or "1xEV-DO MS" for mobile station tests.

   Code Domain Analysis of the input signal is performed by default.
2. Select the RF measurement:
   a) Press the MEAS key.
   b) In the "Select Measurement" dialog box, select the required measurement.

   The selected measurement is activated with the default settings for 1xEV-DO immediately.

3. If necessary, adapt the settings as described for the individual measurements in the R&S FSW User Manual.
4. Select the "Display Config" button and select the evaluation methods that are of interest to you.
   Arrange them on the display to suit your preferences.
5. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
6. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the result displays.
   - Configure a trace to display the average over a series of sweeps; if necessary, increase the "Sweep Count" in the "Sweep" settings.
   - Configure markers and delta markers to determine deviations and offsets within the evaluated signal.
   - Use special marker functions to calculate noise or a peak list.
   - Configure a limit check to detect excessive deviations.
7. Optionally, export the trace data of the graphical evaluation results to a file.
   a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
   b) Select "Export Trace to ASCII File".
   c) Define a file name and storage location and select "OK".

To select the application data for MSRA measurements

In multi-standard radio analysis you can analyze the data captured by the MSRA Master in the 1xEV-DO BTS application. Assuming you have detected a suspect area of the captured data in another application, you would now like to analyze the same data in the 1xEV-DO BTS application.

1. Select the "Overview" softkey to display the "Overview" for Code Domain Analysis.
2. Select the "Signal Capture" button.
3. Define the application data range as and the "Number of Sets". You must determine the number of sets according to the following formula:
   <No of sets> = <measurement time in seconds> / 80 ms (time per set)
   Enter the next larger integer value.
4. Define the starting point of the application data as the "Capture offset". The offset is calculated according to the following formula:
   <capture offset> = <starting point for application> - <starting point in capture buffer>
5. The analysis interval is automatically determined according to the selected channel, slot or frame to analyze (defined for the evaluation range), depending on the result display. Note that the frame/slot/channel is analyzed *within the application data*. If the analysis interval does not yet show the required area of the capture buf-

fer, move through the frames/slots/channels in the evaluation range or correct the application data range.

6. If the Sequencer is off, select the "Refresh" softkey in the "Sweep" menu to update the result displays for the changed application data.

10 Measurement Examples

The following measurement examples demonstrate the basic Code Domain Analysis functions for the 1xEV-DO standard. These examples assume a basic test setup as described in Chapter 4.9, "Test Setup for 1xEV-DO Base Station or Mobile Station Tests", on page 53.

The following measurement examples are basic 1xEV-DO base station tests using a setup with a signal generator, e.g. an R&S SMU. They are meant to demonstrate how operating and measurement errors can be avoided using correct settings. The measurements are performed on a 1xEV-DO signal with an R&S FSW equipped with the 1xEV-DO BTS application.

Measurement examples for mobile station tests

The measurements can be performed for mobile station tests in a similar way with the 1xEV-DO MS application. In this case, use the following settings:

- "DIGITAL STD > LINK DIRECTION > UP/REVERSE"
- "FREQ" = *833.49GHz*

The measurements are performed using the following devices and accessories:

- The R&S FSW with Application Firmware R&S FSW-K84: 1xEV-DO Base Station Test
- The Vector Signal Generator R&S SMU with option R&S SMU-B46: digital standard 1xEV-DO (options R&S SMU-B20 and R&S SMU-B11 required)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

The following measurements are described:

10.1 Meas 1: Measuring the Signal Channel Power

In the Power measurement, the total channel power of the 1xEV-DO signal is displayed. The measurement also displays spurious emissions like harmonics or intermodulation products that occur close to the carrier.

Test setup

► Connect the RF output of the R&S SMU to the RF input of the R&S FSW (coaxial cable with N connectors).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *0 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*
5. "MEAS > POWER"

   The spectrum of the signal and the corresponding power levels within the 1.2288 MHz channel bandwidth are displayed.

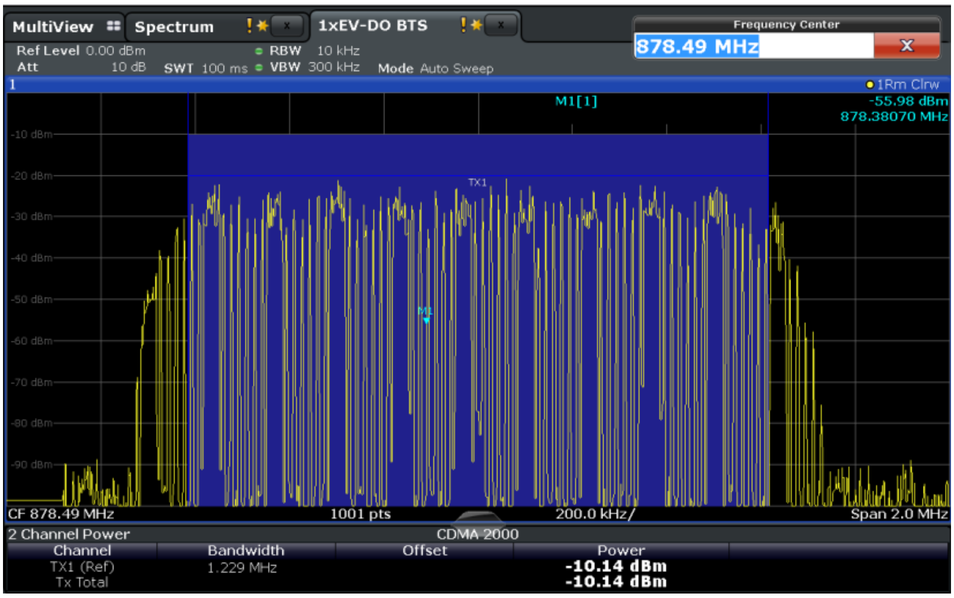


Figure 10-1: Meas 1: Measuring the Signal Channel Power

10.2 Meas 2: Measuring the Spectrum Emission Mask

The 1xEV-DO specification calls for a measurement that monitors compliance with a spectral mask over a range of at least ±4.0 MHz around the 1xEV-DO carrier. To assess the power emissions within the specified range, the signal power is measured with a 30kHz filter. The resulting trace is compared with a limit line as defined in the 1xEV-DO standard. The limit lines are automatically selected as a function of the used band class.

Test setup

► Connect the RF output of the R&S SMU to the RF input of the R&S FSW (coaxial cable with N connectors).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *0 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*
5. "MEAS > Spectrum Emission Mask"

   The spectrum of the signal is displayed, including the limit line defined in the standard. To understand where and about how much the measurement has failed, the (General) Result Summary shows the frequencies where the largest spurious emissions in each range occurred.

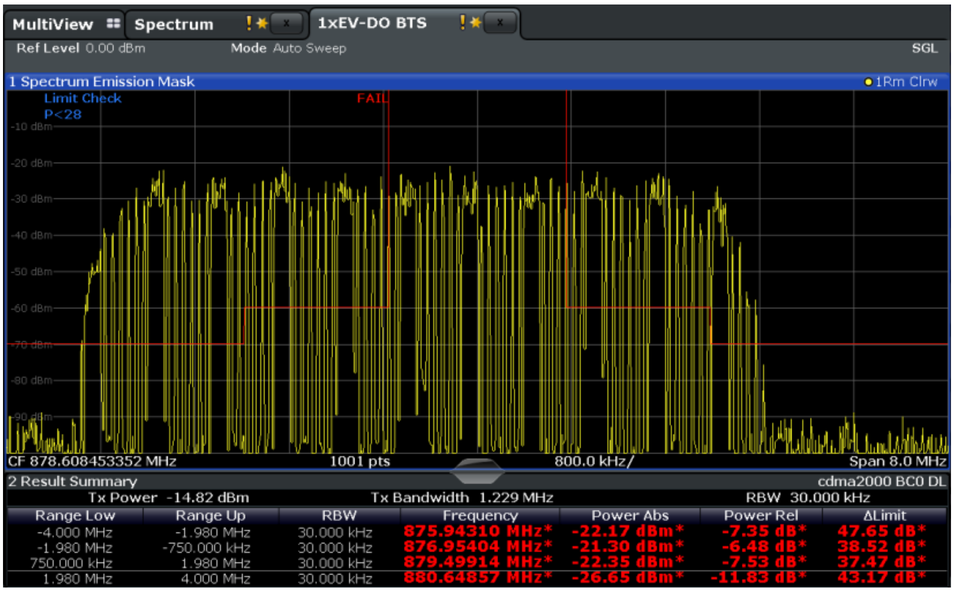


Figure 10-2: Meas 2: Measuring the Spectrum Emission Mask

10.3 Meas 3: Measuring the Relative Code Domain Power and Frequency Error

A Code Domain Power measurement analyzes the signal over a single Power Control Group (PCG). It also determines the power of all codes and channels.

The following examples show a Code Domain Power measurement on a test model with 9 channels. In this measurement, changing some parameters one after the other should demonstrate the resulting effects: values adapted to the measurement signal are changed to non-adapted values.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"

6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *10 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*

   The following results are displayed: the first window shows the power of the code domain of the signal. The x-axis represents the individual codes, while the y-axis shows the power of each code.
   In the second window, the (General) Result Summary is displayed. It shows the numeric results of the code domain power measurement, including the frequency error.

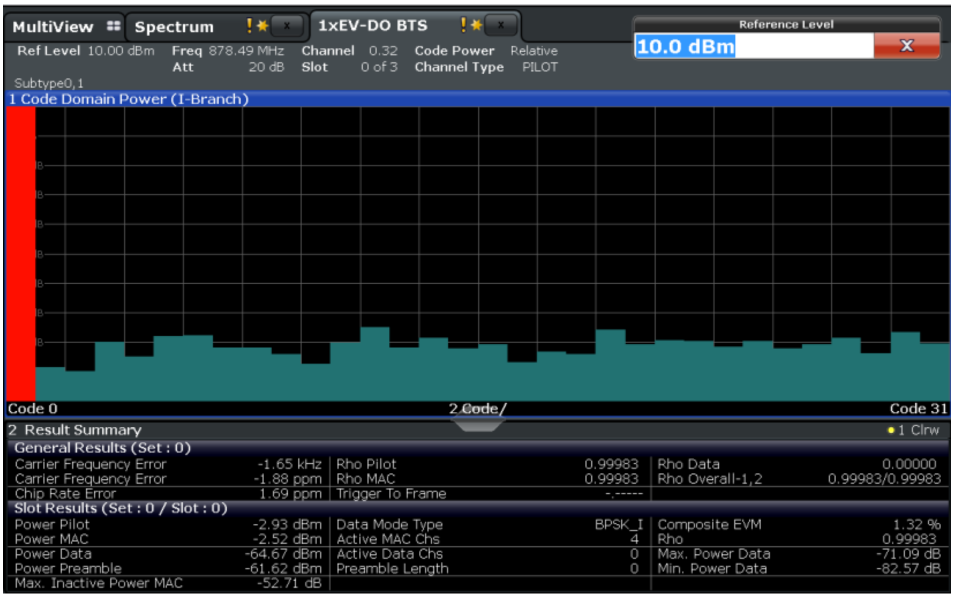


Figure 10-3: Meas 3: Measuring the Relative Code Domain Power and Frequency Error

Synchronization of the reference frequencies

The frequency error can be reduced by synchronizing the transmitter and the receiver to the same reference frequency.

► "SETUP > Reference > External Reference ..."

   Again, the first window shows the Code Domain Power measurement and the second window contains the (General) Result Summary. After the reference frequencies of the devices have been synchronized, the frequency error should be smaller than 10 Hz.

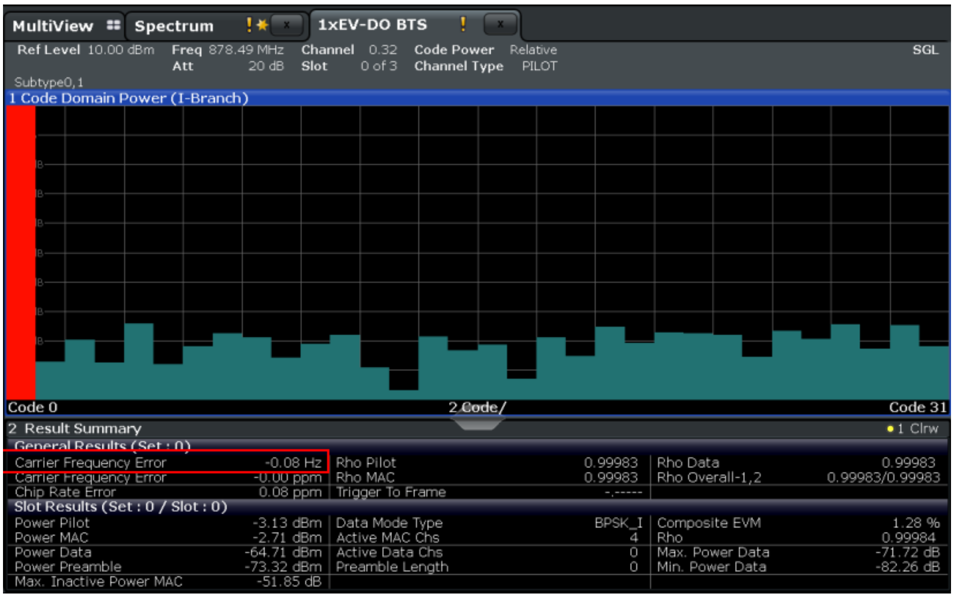


Figure 10-4: Meas 3: Reducing the Frequency Error by synchronizing the devices

Behavior with deviating center frequency setting

A measurement can only be valid if the center frequency of the DUT and the analyzer are balanced.

1. On the signal generator, change the center frequency in steps of 0.1 kHz and observe the analyzer display.
   Up to a frequency error of approximately 1.0 kHz, a Code Domain Power measurement on the R&S FSW is still possible. A frequency error within this range causes no apparent difference in the accuracy of the Code Domain Power measurement.
   In case of a frequency error of more than 1.0 kHz, the probability of incorrect synchronization increases. This is indicated by the "SYNC FAILED" error message.
   If the frequency error exceeds approximately 1.5 kHz, a Code Domain Power measurement cannot be performed. This is also indicated by the "SYNC FAILED" error message.
2. Reset the center frequency of the signal generator to *878.49 MHz*.

The center frequency of the DUT should not deviate by more than 1.0 kHz from that of the R&S FSW.

10.4 Meas 4: Measuring the Triggered Relative Code Domain Power

If the code domain power measurement is performed without external triggering, a section of the test signal is recorded at an arbitrary point of time and the firmware attempts to detect the start of a PCG. To detect this start, all possibilities of the PN sequence location have to be tested in Free Run trigger mode. This requires computing time. This computing time can be reduced by using an external (frame) trigger and entering the correct PN offset. If the search range for the start of the power control group and the PN offset are known then fewer possibilities have to be tested. This increases the measurement speed.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output of the R&S SMU (TRIGOUT1 of PAR DATA).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE"= "ON"
8. TRIG > Marker 1 > PN Sequence Period

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *10 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*
5. "TRIG > External Trigger 1"

   The following results are displayed: the first window shows the power of the code domain of the signal. Compared to the measurement without an external trigger (see Figure 10-4), the repetition rate of the measurement increases.
   In the second window, the (General) Result Summary is displayed. It shows the numeric results of the code domain power measurement, including the frequency error. The "Trigger to Frame" shows the offset between the trigger event and and the start of the PCG.

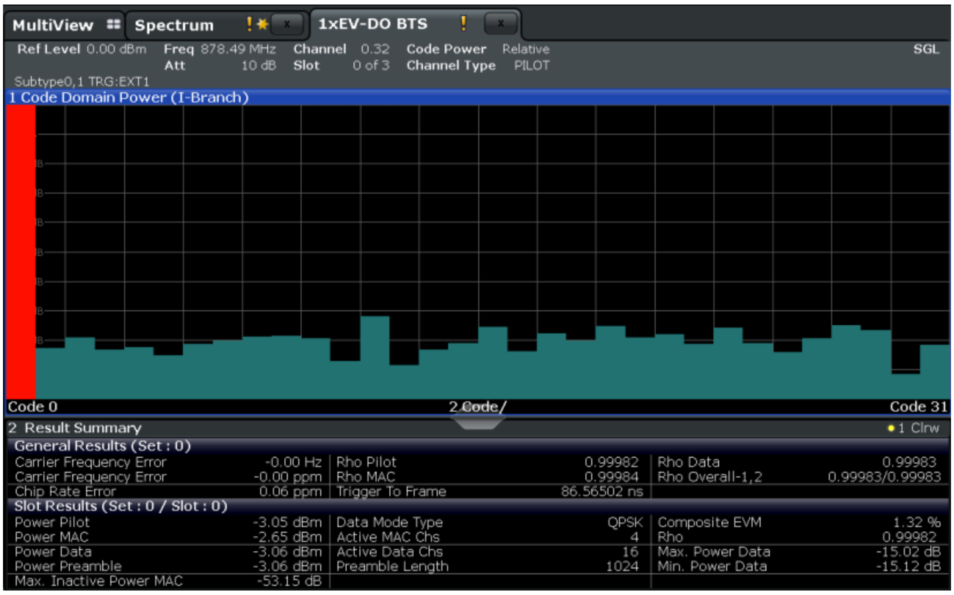


Figure 10-5: Meas 4: Measuring the Triggered Relative Code Domain Power

10.4.1 Adjusting the Trigger Offset

If necessary, the delay between the trigger event and the start of the frame can be compensated for by adjusting the trigger offset. (In the described measurement example no significant delay is measured, thus this step need not be performed.)

1. "TRIG > External Trigger 1"
2. Set the offset to the difference between the frame start and the trigger event: "TRIG > Trigger Offset" = *<XXX> s*

   In the (General) Result Summary, the "Trigger to Frame" offset between the trigger event and and the start of the frame should be eliminated.

10.4.2 Behaviour With the Wrong PN Offset

The last adjustment is setting the PN (Pseudo Noise) offset correctly. The measurement is only valid if the PN offset on the analyzer is the same as that of the transmit signal.

► "Signal Description > PN Offset"= *200*.

In the (General) Result Summary, the "Trigger to Frame" result is not correct. Also, the error message `SYNC FAILED` indicates that the synchronization has failed.

Correct the "PN Offset".

► "Signal Description > PN Offset"= *0*.

Now the PN offset on the R&S FSW is the same as that of the signal. In the (General) Result Summary the "Trigger to Frame" value is now correct.

10.5 Meas 5: Measuring the Composite EVM

The Error Vector Magnitude (EVM) describes the quality of the measured signal compared to an ideal reference signal generated by the R&S FSW. In the I-Q plane, the error vector represents the ratio of the measured signal to the ideal signal on symbol level. The error vector is equal to the square root of the ratio of the measured signal to the reference signal. The result is given in %.

In the Composite EVM measurement the error is averaged over all channels (by means of the root mean square) for a given PCG. The measurement covers the entire signal during the entire observation time. In the graphical display the results are shown in a diagram, in which the x-axis represents the examined PCGs and the y-axis shows the EVM values.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output of the R&S SMU (TRIGOUT1 of PAR DATA).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *10 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*

5. "TRIG > External Trigger 1"
6. "MEAS CONFIG > Display Config > Composite EVM" (Window 2, replacing Result Summary)
7. AUTO SET > Auto Scale All

   The following results are displayed: the first window shows the diagram of the Composite EVM measurement result. In the second window, the (General) Result Summary is displayed. The Slot Results show the numeric results of the Code Domain Power measurement, including the values for the Composite EVM.

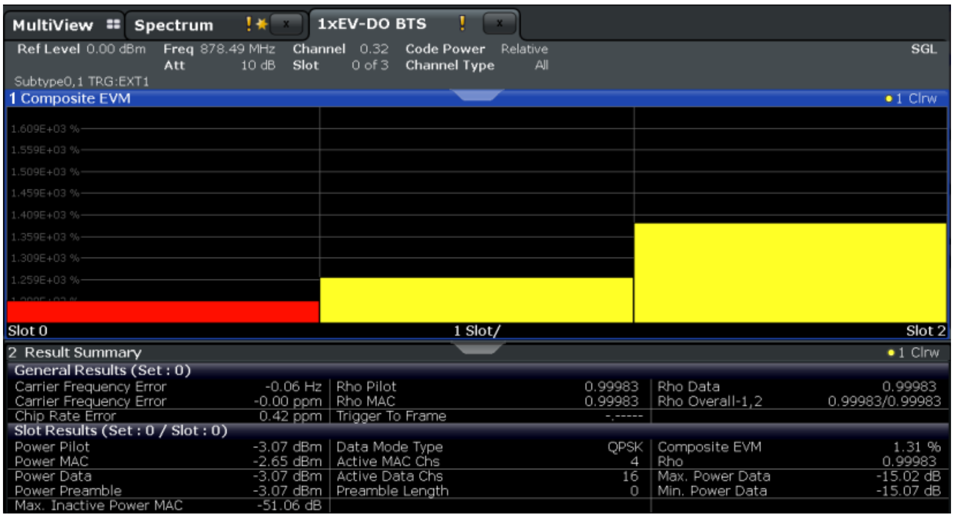


Figure 10-6: Meas 5: Measuring the Composite EVM

10.6 Meas 6: Measuring the Peak Code Domain Error and the RHO Factor

The Code Domain Error Power describes the quality of the measured signal compared to an ideal reference signal generated by the R&S FSW. In the I-Q plane, the error vector represents the difference of the measured signal and the ideal signal. The Code Domain Error is the difference in power on symbol level of the measured and the reference signal projected to the class of of the base spreading factor. The unit of the result is dB.

In the Peak Code Domain Error (PCDE) measurement, the maximum error value over all channels is determined and displayed for a given PCG. The measurement covers the entire signal during the entire observation time. In the graphical display the results are shown in a diagram, in which the x-axis represents the PCGs and the y-axis shows the PCDE values.

A measurement of the RHO factor is shown in the second part of the example. RHO is the normalized, correlated power between the measured and the ideal reference signal. The maximum value of RHO is 1. In that case the measured signal and the reference signal are identical. When measuring RHO, it is required that only the pilot channel is active.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output of the R&S SMU (TRIGOUT1 of PAR DATA).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL" = *0 dBm*
4. "DIGITAL STD" = "1xEV-DO"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > 1xEV-DO > STATE" = "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > 1xEV-DO BTS"
3. "AMPT > Reference level"= *0 dBm*
4. "FREQ > Center frequency" = *878.49 MHz*
5. "TRIG > External Trigger 1"
6. "MEAS CONFIG > Display Config > Peak Code Domain Error" (Window 1)
7. "AMPT > Scale Config > Auto Scale Once"

   The following results are displayed: the first window shows the diagram of the Peak Code Domain Error. In the second window, the (General) Result Summary is displayed.

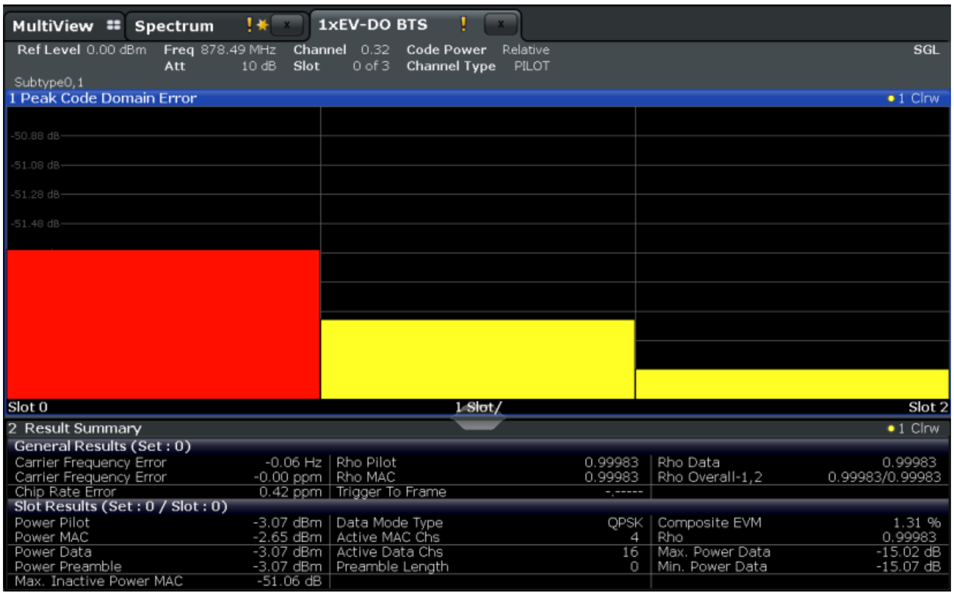


Figure 10-7: Meas 6: Measuring the Peak Code Domain Error and the RHO Factor

Displaying RHO

Make sure that all channels except the pilot channel (code 0.64) are OFF, so that only the pilot channel is available in the measurement.

No specific measurement is required to get the value for RHO. The R&S FSW always calculates this value automatically regardless of the code domain measurement performed. Besides the results of the code domain measurements, the numeric result of the RHO measurement is shown in the (General) Result Summary, by default in the second window.

11 Remote Commands for 1xEV-DO Measurements

The following commands are required to perform measurements in 1xEV-DO applications in a remote environment. It assumes that the R&S FSW has already been set up for remote operation in a network as described in the base unit manual.

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

In particular, this includes:

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

After a short introduction to remote commands, the tasks specific to 1xEV-DO applications are described here:

11.1 Introduction

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

The syntax of a SCPI command consists of a header and, in most cases, 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, these 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 FSW.

Remote command examples

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

11.1.1 Conventions used in Descriptions

Note the following conventions 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 FSW follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

11.1.2 Long and Short Form

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

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

Example:

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

11.1.3 Numeric Suffixes

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

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

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

11.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

11.1.5 Alternative Keywords

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

Example:

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

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

11.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

11.1.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of 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. in case of 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. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of 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`

In some cases, numeric values may be 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 in case of errors.

11.1.6.2 Boolean

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

Querying boolean parameters

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

Example:

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

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

11.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see Chapter 11.1.2, "Long and Short Form", on page 150.

Querying text parameters

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

Example:

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

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

11.1.6.4 Character Strings

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

Example:

`INSTRument:DELete 'Spectrum'`

11.1.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

11.2 Common Suffixes

In the R&S FSW 1xEV-DO Measurements application, the following common suffixes are used in remote commands:

Table 11-1: Common suffixes used in remote commands in the R&S FSW 1xEV-DO Measurements application

Suffix	Value range	Description
<m>	1 to 4 (RF: 1 to 16)	Marker
<n>	1 to 16	Window (**in the currently selected measurement channel**)
<t>	1 (RF: 1 to 6)	Trace
<k>	not applicable (RF: 1 to 8)	Limit line

11.3 Activating the Measurement Channel

1xEV-DO measurements require special applications on the R&S FSW. The measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e creates a new measurement 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" -> "IQAnalyzer2").

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

This command is not available if the MSRA Master channel is selected.

Example: `INST:SEL 'IQAnalyzer'`
`INST:CRE:DUPL`
Duplicates the channel named 'IQAnalyzer' and creates a new measurement channel named 'IQAnalyzer2'.

Usage: Event

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

This command adds an additional measurement channel.

The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 155.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement 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 155).

Example: `INST:CRE IQ, 'IQAnalyzer2'`
Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

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

This command replaces a measurement channel with another one.

Setting parameters:

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

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 155.

<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 155).

Example: `INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'`
Replaces the channel named 'IQAnalyzer2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

Usage: Setting only

INSTrument:DELete <ChannelName>

This command deletes a measurement channel.

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

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'IQAnalyzer4'`
Deletes the channel with the name 'IQAnalyzer4'.

Usage: Event

INSTrument:LIST?

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

Return values:

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

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

Usage: Query only

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

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
Real-Time Spectrum (R&S FSW-B160R/-K160RE)	RTIM	Real-Time Spectrum
Spurious Measurements (R&S FSW-K50)	SPUR	Spurious
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN
*) the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

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; this will cause an error.

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

Usage: Setting only

INSTrument[:SELect] <ChannelType>

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

See also `INSTrument:CREate[:NEW]` on page 154.

For a list of available channel types see Table 11-2.

Parameters:

<ChannelType> **BDO**
1xEV-DO BTS option, R&S FSW–K84

MDO
1xEV-DO MS option, R&S FSW–K85

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 63

11.4 Selecting a Measurement

The following commands are required to define the measurement type in a remote environment. For details on available measurements see Chapter 3, "Measurements and Result Displays", on page 15.

CONFigure:CDPower[:BTS]:MEASurement <Measurement>

This command selects the RF measurement type (with predefined settings according to the 1xEV-DO standard).

Parameters:

<Measurement> ACLR | CCDF | CDPower | ESPectrum | OBWidth | POWer

ACLR
Adjacent-Channel Power measurement

CCDF
measurement of the complementary cumulative distribution function (signal statistics)

CDPower
Code Domain Analyzer measurement.

ESPectrum
check of signal power (Spectrum Emission Mask)

OBWidth
measurement of the occupied bandwidth

POWer
Signal Channel Power measurement
(with predefined settings according to the 1xEV-DO standard)

*RST: CDPower

Example: `CONF:CDP:MEAS POW`
Selects Signal Channel Power measurement.

Manual operation:
See "Power vs Time (BTS application only)" on page 34
See "Power" on page 35
See "Channel Power ACLR" on page 36
See "Spectrum Emission Mask" on page 37
See "Occupied Bandwidth" on page 38
See "CCDF" on page 39
See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 102

11.5 Configuring Code Domain Analysis

11.5.1 Signal Description

The signal description provides information on the expected input signal.

11.5.1.1 BTS Signal Description

The following commands describe the input signal in BTS measurements.

For more information see Chapter 4.6, "Multicarrier Mode", on page 51.

CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency <Frequency>

This command sets the cut-off frequency for the RRC filter.

Parameters:

<Frequency> Range: 0.1 MHz to 2.4 MHz
*RST: 1.25

Example:

`CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multicarrier measurements
`CONF:CDP:MCAR:FILT:TYPE RRC`
Activates the RRC filter
`CONF:CDP:MCAR:FILT:COFR 1.5MHZ`
Sets the cut-off frequency to 1.5 MHz

Manual operation: See "Cut Off Frequency" on page 66

CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF <RollOffFactor>

This command sets the roll-off factor for the RRC filter.

Parameters:

<RollOffFactor> Range: 0.01 to 0.99
*RST: 0.02

Example: `CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multicarrier measurements
`CONF:CDP:MCAR:FILT:TYPE RRC`
Activates the RRC filter
`CONF:CDP:MCAR:FILT:ROFF 0.05`
Sets the roll-off factor to 0.05

Manual operation: See "Roll-Off Factor" on page 66

CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe] <State>

This command activates or deactivates the usage of a filter for multicarrier measurements.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT OFF`
Activates an additional filter for multicarrier measurements

Manual operation: See "Multicarrier Filter" on page 65

CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE <Type>

This command sets the filter type to be used in multicarrier mode.

You can set the parameters for the RRC filter with the `CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency` and `CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` commands.

Parameters:

<Type> LPASs | RCC
*RST: LPAS

Example: `CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multicarrier measurements
`CONF:CDP:MCAR:FILT:TYPE RRC`
Activates the RRC filter

Manual operation: See "Filter Type" on page 65
See "Roll-Off Factor" on page 66
See "Cut Off Frequency" on page 66

CONFigure:CDPower[:BTS]:MCARrier:MALGo <State>

This command activates or deactivates the enhanced algorithm for the filters in multi-carrier mode.

Parameters:

<State> ON | OFF

*RST: ON

Example: `CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multicarrier measurements
`CONF:CDP:MCAR:MALG OFF`
Deactivates the enhanced algorithm

Manual operation: See "Enhanced Algorithm" on page 65

CONFigure:CDPower[:BTS]:MCARrier[:STATe] <State>

This command activates or deactivates the multicarrier mode.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CONF:CDP:MCAR ON`
Activates the multicarrier settings.

Manual operation: See "Multicarrier" on page 65

CONFigure:CDPower[:BTS]:SUBType <Subtype>

Selects the subtype of the standard to be used for the measurements.

For more information see Chapter 4.5, "Subtypes", on page 50.

Parameters:

<Subtype> 0 | 1 | 2 | 3

0 | 1
subtype 0/1

2
subtype 2

3
subtype 3

*RST: 0

Example: `CONF:CDP:SUBT 3`
Subtype 3 signal is analyzed

Manual operation: See "Subtype" on page 64

[SENSe:]CDPower:PNOFfset <Offset>

This command sets the PN offset of the base station in multiples of 64 chips.

Parameters:

<Offset> Range: 0 to 511
*RST: 0

Example: `CDP:PNOF 45`
Sets PN offset.

Manual operation: See "PN Offset" on page 65

11.5.1.2 MS Signal Description

The following commands describe the input signal in MS measurements.

Useful commands for describing MS signals described elsewhere:

- `CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency` on page 159
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 159
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 160
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe]` on page 160
- `CONFigure:CDPower[:BTS]:MCARrier:MALGo` on page 161
- `CONFigure:CDPower[:BTS]:MCARrier[:STATe]` on page 161
- `CONFigure:CDPower[:BTS]:SUBType` on page 161

Remote commands exclusive to describing MS signals:

[SENSe:]CDPower:LCODe:I <Mask>

Defines the long code mask of the I branch of the mobile in hexadecimal form.

Parameters:

<Mask> Range: #H0 to #H4FFFFFFFFFF
*RST: #H0

Example: `CDP:LCOD:I '#HF'`
'Define long code mask

Manual operation: See "Long Code Mask I / Long Code Mask Q" on page 67

[SENSe:]CDPower:LCODe:Q <Mask>

Defines the long code mask of the Q branch of the mobile in hexadecimal form.

Parameters:

<Mask> Range: #H0 to #H4FFFFFFFFFF
*RST: #H0

Example: `CDP:LCOD:Q '#HF'`
'Define long code mask

Manual operation: See "Long Code Mask I / Long Code Mask Q" on page 67

11.5.2 Configuring the Data Input and Output

The following commands are required to configure data input and output. For more information see Chapter 6.2.3, "Data Input and Output Settings", on page 68.

11.5.2.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer 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.

(For details on the status register see the R&S FSW User Manual).

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

Usage: Event

INPut:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

For more information on the Analog Baseband Interface (R&S FSW-B71) see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<ConnType>

RF
RF input connector

AIQI
Analog Baseband I connector

*RST: RF

Example: `INP:CONN:AIQI`
Selects input from the analog baseband I connector.

Usage: SCPI confirmed

Manual operation: See "Input Connector" on page 71

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

The command is not available for measurements with the optional Digital Baseband Interface.

Parameters:

<CouplingType>

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 69

INPut:DPATh <State>

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

Parameters:

<State>

AUTO | 1
(Default) the direct path is used automatically for frequencies close to 0 Hz.

OFF | 0
The analog mixer path is always used.

*RST: 1

Example: `INP:DPAT OFF`

Usage: SCPI confirmed

Manual operation: See "Direct Path" on page 70

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 FSW in order to measure the harmonics for a DUT, for example.

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

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

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 70

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG-preselector described in "YIG-Preselector" on page 71.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)

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

Manual operation: See "YIG-Preselector" on page 71

INPut:IMPedance <Impedance>

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

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

The command is not available for measurements with the optional Digital Baseband Interface.

Parameters:

<Impedance>	50 | 75 *RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 70

INPut:SELect <Source>

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

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

DIQ
Digital IQ data (only available with optional Digital Baseband Interface
For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.

AIQ
Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)
For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual operation: See "Radio Frequency State" on page 69
See "Digital I/Q Input State" on page 72
See "Analog Baseband Input State" on page 74

11.5.2.2 Remote Commands for the Digital Baseband Interface (R&S FSW-B17)

The following commands are required to control the Digital Baseband Interface (R&S FSW-B17) in a remote environment.They are only available if this option is installed.

Information on the `STATus:QUEStionable:DIQ` register can be found in "STATus:QUEStionable:DIQ Register" on page 171.

Configuring Digital I/Q Input and Output

Remote commands for the R&S DigIConf software

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:

`SOURce:EBOX:*RST`

`SOURce:EBOX:*IDN?`

Result:

"Rohde&Schwarz,DigIConf,02.05.436 Build 47"

Example 2:

`SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ`

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEVice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState>	Defines whether a device is connected or not. **0** No device is connected. **1** A device is connected.
<DeviceName>	Device ID of the connected device
<SerialNumber>	Serial number of the connected device

<PortName> Port name used by the connected device

<SampleRate> Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.

Not Started

Has to be Started

Started

Passed

Failed

Done

<PRBSTestState> State of the PRBS test.

Not Started

Has to be Started

Started

Passed

Failed

Done

<SampleRateType> **0**
Maximum sample rate is displayed

1
Current sample rate is displayed

<FullScaleLevel> The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device);
If not available, `1.#QNAN` (not a number) is returned

Example: `INP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,BBMM 1 OUT,`
`100000000,200000000,Passed,Passed,1,1.#QNAN`

Manual operation: See "Connected Instrument" on page 73

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Full Scale Level" on page 72

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "Adjust Reference Level to Full Scale Level" on page 73

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> <numeric value>
Range: 1 µV to 7.071 V
*RST: 1 V

Manual operation: See "Full Scale Level" on page 72

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "Full Scale Level" on page 72). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere
*RST: Volt

Manual operation: See "Full Scale Level" on page 72

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface (see "Input Sample Rate" on page 72).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
*RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See "Input Sample Rate" on page 72

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Input Sample Rate" on page 72

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the optional Digital Baseband Interface on and off.

Using the digital input and digital output simultaneously is not possible.

If digital baseband output is active, the sample rate is restricted to 100 MHz (200 MHz if enhanced mode is possible; max. 160 MHz bandwidth).

Parameters:

<State> ON | OFF

*RST: OFF

Example: `OUTP:DIQ ON`

Manual operation: See "Digital Baseband Output" on page 81

OUTPut:DIQ:CDEVice?

This command queries the current configuration and the status of the digital I/Q data output to the optional Digital Baseband Interface.

Return values:

<ConnState> Defines whether a device is connected or not.

0
No device is connected.

1
A device is connected.

<DeviceName> Device ID of the connected device

<SerialNumber> Serial number of the connected device

<PortName> Port name used by the connected device

<NotUsed> to be ignored

<MaxTransferRate> Maximum data transfer rate of the connected device in Hz

<ConnProtState> State of the connection protocol which is used to identify the connected device.

Not Started

Has to be Started

Started

Passed

Failed

Done

<PRBSTestState> State of the PRBS test.

Not Started

Has to be Started

Started

Passed

Failed

Done

<NotUsed> to be ignored

<Placeholder> for future use; currently "0"

Example: `OUTP:DIQ:CDEV?`
Result:
`1,SMW200A,101190,CODER 1 IN,`
`0,200000000,Passed,Done,0,0`

Usage: Query only

Manual operation: See "Output Settings Information" on page 81
See "Connected Instrument" on page 81

STATus:QUEStionable:DIQ Register

This register contains information about the state of the digital I/Q input and output. This register is used by the optional Digital Baseband Interface.

The status of the `STATus:QUEStionable:DIQ` register is indicated in bit 14 of the `STATus:QUEStionable` register.

You can read out the state of the register with `STATus:QUEStionable:DIQ:CONDition?` on page 173 and `STATus:QUEStionable:DIQ[:EVENt]?` on page 174.

Bit No.	Meaning
0	**Digital I/Q Input Device connected** This bit is set if a device is recognized and connected to the Digital Baseband Interface of the analyzer.
1	**Digital I/Q Input Connection Protocol in progress** This bit is set while the connection between analyzer and digital baseband data signal source (e.g. R&S SMW, R&S Ex-I/Q-Box) is established.

Bit No.	Meaning
2	**Digital I/Q Input Connection Protocol error** This bit is set if an error occurred during establishing of the connect between analyzer and digital I/Q data signal source (e.g. R&S SMW, R&S Ex-I/Q-Box) is established.
3	**Digital I/Q Input PLL unlocked** This bit is set if the PLL of the Digital I/Q input is out of lock due to missing or unstable clock provided by the connected Digital I/Q TX device. To solve the problem the Digital I/Q connection has to be newly initialized after the clock has been restored.
4	**Digital I/Q Input DATA Error** This bit is set if the data from the Digital I/Q input module is erroneous. Possible reasons: ● Bit errors in the data transmission. The bit will only be set if an error occurred at the current measurement. ● Protocol or data header errors. May occur due to data synchronization problems or vast transmission errors. The bit will be set constantly and all data will be erroneous. To solve the problem the Digital I/Q connection has to be newly initialized. NOTE: If this error is indicated repeatedly either the Digital I/Q LVDS connection cable or the receiving or transmitting device might be defect.
5	Not used
6	**Digital I/Q Input FIFO Overload** This bit is set if the sample rate on the connected instrument is higher than the input sample rate setting on the R&S FSW. Possible solution: ● Reduce the sample rate on the connected instrument ● Increase the input sample rate setting on the R&S FSW
7	Not used
8	**Digital I/Q Output Device connected** This bit is set if a device is recognized and connected to the Digital I/Q Output.
9	**Digital I/Q Output Connection Protocol in progress** This bit is set while the connection between analyzer and digital I/Q data signal source (e.g. R&S SMW, R&S Ex-I/Q-Box) is established.
10	**Digital I/Q Output Connection Protocol error** This bit is set if an error occurred while the connection between analyzer and digital I/Q data signal source (e.g. R&S SMW, R&S Ex-I/Q-Box) is established.
11	**Digital I/Q Output FIFO Overload** This bit is set if an overload of the Digital I/Q Output FIFO occurred. This happens if the output data rate is higher than the maximal data rate of the connected instrument. Reduce the sample rate to solve the problem.
12-14	Not used
15	This bit is always set to 0.

STATus:QUEStionable:DIQ:CONDition? <ChannelName>

This command reads out the CONDition section of the `STATus:QUEStionable:DIQ:CONDition` status register.

The command does not delete the contents of the EVENt section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: `STAT:QUES:DIQ:COND?`

Usage: Query only

STATus:QUEStionable:DIQ:ENABle <BitDefinition>, <ChannelName>

This command controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<SumBit> Range: 0 to 65535

Usage: SCPI confirmed

STATus:QUEStionable:DIQ:NTRansition <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<BitDefinition> Range: 0 to 65535

STATus:QUEStionable:DIQ:PTRansition <BitDefinition>,<ChannelName>

This command controls the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<BitDefinition> Range: 0 to 65535

STATus:QUEStionable:DIQ[:EVENt]? <ChannelName>

This command queries the contents of the "EVENt" section of the `STATus:QUEStionable:DIQ` register for IQ measurements.

Readout deletes the contents of the "EVENt" section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: `STAT:QUES:DIQ?`

Usage: Query only

11.5.2.3 Configuring Input via the Optional Analog Baseband Interface

The following commands are required to control the optional Analog Baseband Interface in a remote environment. They are only available if this option is installed.

For more information on the Analog Baseband Interface see the R&S FSW I/Q Analyzer User Manual.

Useful commands for Analog Baseband data described elsewhere:

- `INP:SEL AIQ` (see `INPut:SELect` on page 166)
- `[SENSe:]FREQuency:CENTer` on page 180

Commands for the Analog Baseband calibration signal are described in the R&S FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:

<State>

ON
Differential

OFF
Single ended

*RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input Configuration" on page 75

INPut:IQ:FULLscale:AUTO <State>

This command defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:

<State>

ON
Automatic definition

OFF
Manual definition according to `INPut:IQ:FULLscale[:LEVel]` on page 175

*RST: ON

Example: `INP:IQ:FULL:AUTO OFF`

Manual operation: See "Full Scale Level Mode / Value" on page 88

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see `INPut:IQ:FULLscale:AUTO` on page 175).

Parameters:

<PeakVoltage> 0.25 V | 0.5 V | 1 V | 2 V

Peak voltage level at the connector.
For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

*RST: 1V

Example: `INP:IQ:FULL 0.5V`

Manual operation: See "Full Scale Level Mode / Value" on page 88

INPut:IQ:TYPE <DataType>

This command defines the format of the input signal.

Parameters:

<DataType> IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: `INP:IQ:TYPE Q`

Manual operation: See "I/Q Mode" on page 74

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

For more information see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
The high accuracy timing function is switched on.
The cable for high accuracy timing must be connected to trigger ports 1 and 2.

OFF | 0
The high accuracy timing function is switched off.

*RST: OFF

Example: `CAL:AIQ:HAT:STAT ON`

Manual operation: See "High Accuracy Timing Trigger - Baseband - RF" on page 75

11.5.2.4 Setting up Probes

Probes can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband interface (option R&S FSW-B71) is installed.

[SENSe:]PROBe<p>:SETup:CMOFfset <CMOffset>

Sets the common mode offset. The setting is only available if a differential probe is connected to the R&S FSW.

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

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

<CMOffset> Range: -100E+24 to 100E+24
Increment: 1E-3
*RST: 0
Default unit: V

Manual operation: See "Common Mode Offset" on page 77

[SENSe:]PROBe<p>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<PartNumber> Part number in a string.

Usage: Query only

[SENSe:]PROBe<p>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<SerialNo> Serial number in a string.

Usage: Query only

[SENSe:]PROBe<p>:SETup:MODE <Mode>

Select the action that is started with the micro button on the probe head.

See also: "Microbutton Action" on page 77.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:
<Mode> **RSINgle**
Run single: starts one data acquisition.
NOACtion
Nothing is started on pressing the micro button.
*RST: RSINgle

Manual operation: See "Microbutton Action" on page 77

[SENSe:]PROBe<p>:SETup:NAME?

Queries the name of the probe.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<Name> Name string

Usage: Query only

[SENSe:]PROBe<p>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not detected). To switch the probe on, i.e. activate input from the connector, use `INP:SEL:AIQ` (see `INPut:SELect` on page 166).

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<State> DETected | NDETected
*RST: NDETected

Usage: Query only

[SENSe:]PROBe<p>:SETup:TYPE?

Queries the type of the probe.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<Type> String containing one of the following values:
– None (no probe detected)
– active differential
– active single-ended

Usage: Query only

11.5.2.5 Configuring the Outputs

Configuring trigger input/output is described in Chapter 11.5.4.2, "Configuring the Trigger Output", on page 195.

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FSW on and off.

Suffix:
<n> Window

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

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 78

11.5.3 Frontend Configuration

The following commands configure frequency, amplitude and y-axis scaling settings, which represent the "frontend" of the measurement setup.

For more information see Chapter 6.2.4, "Frontend Settings", on page 81.

11.5.3.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the [SENSe:]FREQuency:CENTer:STEP command.

DOWN
Decreases the center frequency by the step defined using the [SENSe:]FREQuency:CENTer:STEP command.

*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.

Usage: SCPI confirmed

Manual operation: See "Center Frequency" on page 76
See "Center frequency" on page 82

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

This command 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 180.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
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 Stepsize" on page 82

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command 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:CENTer:STEP:LINK <CouplingType>

This command couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:

<CouplingType>

SPAN
Couples the step size to the span. Available for measurements in the frequency domain.

RBW
Couples the step size to the resolution bandwidth. Available for measurements in the time domain.

OFF
Decouples the step size.

*RST: SPAN

Example: `FREQ:CENT:STEP:LINK SPAN`

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <Factor>

This command defines a step size factor if the center frequency step size is coupled to the span or the resolution bandwidth.

Parameters:

<Factor> 1 to 100 PCT

*RST: 10

Example: `FREQ:CENT:STEP:LINK:FACT 20PCT`

[SENSe:]FREQuency:OFFSet <Offset>

This command 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 83.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA slave applications, only the query command is available.

Parameters:

<Offset> Range: -100 GHz to 100 GHz
*RST: 0 Hz

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 83

11.5.3.2 Amplitude and Scaling Settings

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 164
- `INPut:IMPedance` on page 165
- `[SENSe:]ADJust:LEVel` on page 210

Remote commands exclusive to amplitude settings:

DISPlay[:WINDow<n>]: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

Usage: SCPI confirmed

Manual operation: See "Auto Scale Once" on page 89

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for all traces in the selected result display.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Value> <numeric value>

*RST: depends on the result display

The unit and range depend on the result display.

Example: `DISP:TRAC:Y:MIN -60`
`DISP:TRAC:Y:MAX 0`
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Y-Maximum, Y-Minimum" on page 89

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for all traces in the selected result display.

Suffix:
<n> Window

<t> irrelevant

Parameters:
<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example: `DISP:TRAC:Y:MIN -60`
`DISP:TRAC:Y:MAX 0`
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Y-Maximum, Y-Minimum" on page 89

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

Suffix:
<n> Window

<t> irrelevant

Parameters:
<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division
(For example 10 dB in the Code Domain Power result display.)

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command 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>, <t> irrelevant

Parameters:
<ReferenceLevel> The unit is variable.
Range: see datasheet
*RST: 0 dBm

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

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 84

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

This command defines a reference level offset (for all traces in all windows).

Suffix:
<n>, <t> irrelevant

Parameters:
<Offset> Range: -200 dB to 200 dB
*RST: 0dB

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

Manual operation: See "Shifting the Display (Offset)" on page 84

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off. It requires the optional preamplifier hardware.

This function is not available for input from the optional Digital Baseband Interface.

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

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 86

INPut:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 185).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 15 dB | 30 dB

The availability of gain levels depends on the model of the R&S FSW.
R&S FSW8/13: 15dB and 30 dB
R&S FSW26 or higher: 30 dB
All other values are rounded to the nearest of these two.

*RST: OFF

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 86

11.5.3.3 Configuring the Attenuation

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 188).

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.

This function is not available if the optional Digital Baseband Interface is active.

Parameters:

<Attenuation> Range: see data sheet
Increment: 5 dB
*RST: 10 dB (AUTO is set to ON)

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

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 85

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

This function is not available if the optional Digital Baseband Interface is active.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

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

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 85

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 187).

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

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

<Attenuation> attenuation in dB

Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

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

Manual operation: See "Using Electronic Attenuation" on page 86

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

<State> 1 | 0 | ON | OFF

1 | ON

0 | OFF

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 86

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

<State> 1 | 0 | ON | OFF

1 | ON

0 | OFF

*RST: 0

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

Manual operation: See "Using Electronic Attenuation" on page 86

11.5.4 Configuring Triggered Measurements

The following commands are required to configure a triggered measurement in a remote environment.

The tasks for manual operation are described in Chapter 6.2.5, "Trigger Settings", on page 90

The `*OPC` command should be used after commands that retrieve data so that subsequent commands to change the selected trigger source are held off until after the sweep is completed and the data has been returned.

11.5.4.1 Configuring the Triggering Conditions

The following commands are required to configure a triggered measurement.

TRIGger[:SEQuence]:BBPower:HOLDoff <Period>

This command defines the holding time before the baseband power trigger event.

The command requires the optional Digital Baseband Interface or the optional Analog Baseband Interface.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 190 command for new remote control programs.

Parameters:

<Period> Range: 150 ns to 1000 s
*RST: 150 ns

Example: `TRIG:SOUR BBP`
Sets the baseband power trigger source.
`TRIG:BBP:HOLD 200 ns`
Sets the holding time to 200 ns.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

For input from the Analog Baseband Interface (R&S FSW-B71) using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:

<DropoutTime> Dropout time of the trigger.
Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Drop-Out Time" on page 93

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

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

Parameters:

<Offset> *RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 93

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 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 94

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

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 93

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available for the optional Digital Baseband Interface and the optional Analog Baseband Interface.

Parameters:

<Level>	Range:	-50 dBm to +20 dBm
	*RST:	-20 dBm

Example: `TRIG:LEV:BBP -30DBM`

Manual operation: See "Trigger Level" on page 93

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Note that the variable INPUT/OUTPUT connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<port>:DIRection` command.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel>	Range:	0.5 V to 3.5 V
	*RST:	1.4 V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 93

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

For compatibility reasons, this command is also available for the "baseband power" trigger source when using the Analog Baseband Interface (R&S FSW-B71).

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -10 dBm

Example: `TRIG:LEV:IFP -30DBM`

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command 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.

Parameters:

<TriggerLevel>	Range:	-130 dBm to 30 dBm
	*RST:	-20 dBm

Example: `TRIG:LEV:IQP -30DBM`

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:LEVel:VIDeo <Level>

This command defines the level the video signal must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<Level>	Range:	0 PCT to 100 PCT
	*RST:	50 PCT

Example: `TRIG:LEV:VID 50PCT`

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 94

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface or the optional Analog Baseband Interface.

IFPower
Second intermediate frequency
(For frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface. For input from the optional Analog Baseband Interface, this parameter is interpreted as `BBPower` for compatibility reasons.

TIME
Time interval
(For frequency and time domain measurements only.)

PSEN
External power sensor
(For frequency and time domain measurements only.)

GP0 | GP1 | GP2 | GP3 | GP4 | GP5
For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the optional Digital Baseband Interface is available.
Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.
The assignment of the general purpose bits used by the Digital IQ trigger to the LVDS connector pins is provided in "Digital I/Q" on page 92.

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See "Trigger Source" on page 91
See "Free Run" on page 91
See "External Trigger 1/2/3" on page 91
See "Digital I/Q" on page 92
See "IF Power" on page 92

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval> 2.0 ms to 5000

Range: 2 ms to 5000 s
*RST: 1.0 s

Example:
`TRIG:SOUR TIME`
Selects the time trigger input for triggering.
`TRIG:TIME:RINT 50`
The measurement starts every 50 s.

11.5.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors on the R&S FSW.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:

<port> Selects the used trigger port.
2 = trigger port 2 (front panel)
3 = trigger port 3 (rear panel)

Parameters:

<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 78

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:
<port> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Level> **HIGH**
5 V
LOW
0 V
*RST: LOW

Example: `OUTP:TRIG2:LEV HIGH`

Manual operation: See "Level" on page 79

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:
<port> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S FSW has triggered internally.
TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.
UDEFined
Sends a user defined trigger signal. For more information see `OUTPut:TRIGger<port>:LEVel`.
*RST: DEVice

Manual operation: See "Output Type" on page 79

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:
<port> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual operation: See "Send Trigger" on page 79

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port> Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Length> Pulse length in seconds.

Example: `OUTP:TRIG2:PULS:LENG 0.02`

Manual operation: See "Pulse Length" on page 79

11.5.5 Signal Capturing

The following commands configure how much and how data is captured from the input signal.

MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition commands for the 1xEV-DO application in MSRA mode define the **application data** (see Chapter 11.12, "Configuring the Slave Application Data Range (MSRA mode only)", on page 264).

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

Useful commands for configuring signal capture described elsewhere:

- `[SENSe:]CDPower:SET` on page 215

Remote commands exclusive to signal capturing:

[SENSe:]CDPower:IQLength <CaptureLength>

This command sets the capture length in multiples of slots.

In MS mode, the number of half-slots is defined.

Parameters:

<CaptureLength> Range: 2 to 36 (MS mode: 70)
*RST: 3

Manual operation: See "Number of Slots" on page 96

[SENSe:]CDPower:QINVert <State>

This command inverts the Q component of the signal.

Parameters:

ON | OFF	*RST:	OFF

Example: `CDP:QINV ON`
Activates inversion of Q component.

Manual operation: See "Invert Q" on page 96

[SENSe:]CDPower:SET:COUNt <NumberSets>

This command sets the number of sets to be captured and stored in the instrument's memory. Refer to "Number of Sets" on page 97 for more information.

Parameters:

<NumberSets>	Range:	1 to 1500 (BTS mode) or 810 (MS mode)
	*RST:	1

Example: `CDP:SET:COUN 10`
Sets the number of sets to be captured to 10.

Manual operation: See "Number of Sets" on page 97

11.5.6 Synchronization (MS application only)

Synchronization settings define how channels are synchronized for channel detection. They are only available for MS measurements.

[SENSe:]CDP:SMODe <Mode>

The method used for the two synchronization stages: the frame synchronization (detection of the first chip of the frame) and the rough frequency/phase synchronization.

For details see Chapter 4.3, "Synchronization (MS application only)", on page 45.

Parameters:

<Mode>

AUTO
The following modes are tried sequentially until synchronization was successful. If none of the methods was successful a failed synchronization is reported.

PILot
For frame synchronization, this method uses the correlation characteristic of the known pilot channel (i.e. pilot channel sequence = spreading code including scrambling sequence).

AUXiliary Pilot
Similar to synchronization on pilot, but with the different known sequence (= spreading code) of the auxiliary pilot channel.

POWer
This frame synchronization method does not require a pilot channel because it analyzes the power of any specified channel (currently code 3 with spreading factor 4, which is the data channel 2).

*RST: PILot

Manual operation: See "Sync To" on page 98

11.5.7 Channel Detection

The channel detection settings determine which channels are found in the input signal. The commands for working with channel tables are described here.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, the following abbreviations and assignments to a numeric value are used:

Table 11-3: BTS channel types and their assignment to a numeric parameter value

Parameter	Channel type
0	PILOT
1	MAC
2	PREAMBLE (64 chips)
3	PREAMBLE (128 chips)
4	PREAMBLE (256 chips)
5	PREAMBLE (512 chips)
6	PREAMBLE (1024 chips)
7	DATA

Table 11-4: MS channel types and their assignment to a numeric parameter value

Parameter	Channel type
0	PICH
1	RRI
2	DATA
3	ACK
4	DRC
5	INACTIVE
6	DSC
7	Auxiliary pilot

11.5.7.1 General Channel Detection and Channel Table Management

The following commands configure how channels are detected and channel tables are managed.

CONFigure:CDPower[:BTS]:CTABle:CATalog?

This command reads out the names of all channel tables stored on the instrument. The first two result values are global values for all channel tables, the subsequent values are listed for each individual table.

Return values:

<TotalSize>	Sum of file sizes of all channel table files (in bytes)
<FreeMem>	Available memory left on hard disk (in bytes)
<FileName>	File name of individual channel table file
<FileSize>	File size of individual channel table file (in bytes)

Example: `CONF:CDP:CTAB:CAT?`
Sample result (description see table below):
`52853,2634403840,3GB_1_16.XML,`
`3469,3GB_1_32.XML,5853,3GB_1_64.XML,`
`10712,3GB_2.XML,1428,3GB_3_16.XML,`
`3430,3GB_3_32.XML,5868,3GB_4.XML,`
`678,3GB_5_2.XML,2554,3GB_5_4.XML,`
`4101,3GB_5_8.XML,7202,3GB_6.XML,`
`7209,MYTABLE.XML,349`

Usage: Query only

Manual operation: See "Predefined Tables" on page 100

Table 11-5: Description of query results in example:

Value	Description
52853	Total size of all channel table files: 52583 bytes
2634403840	Free memory on hard disk: 2.6 Gbytes
3GB_1_16.XML	Channel table 1: `3GB_1_16.XML`
3469	File size for channel table 1: 3469 bytes
3GB_1_32.XML	Channel table 2: `3GB_1_32.XML`
5853	File size for channel table 2: 5853 bytes
3GB_1_64.XML	Channel table 3: `3GB_1_64.XML`
10712	File size for channel table 3: 10712 bytes
...	Channel table x: ...

CONFigure:CDPower[:BTS]:CTABle:COPY <FileName>

This command copies one channel table into another one. The channel table to be copied is selected with command `CONFigure:CDPower[:BTS]:CTABle:NAME` on page 206.

Parameters:
<FileName> string with a maximum of 8 characters
name of the new channel table

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be copied.
`CONF:CDP:CTAB:COPY 'CTAB_2'`
Copies channel table 'NEW_TAB' to 'CTAB_2'.

Usage: Event

Manual operation: See "Copying a Table" on page 100

CONFigure:CDPower[:BTS]:CTABle:DELete

This command deletes the selected channel table. The channel table to be deleted is selected with the command `CONFigure:CDPower[:BTS]:CTABle:NAME` on page 206.

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be deleted.
`CONF:CDP:CTAB:DEL`
Deletes the table.

Manual operation: See "Deleting a Table" on page 101

CONFigure:CDPower[:BTS]:CTABle:RESTore

This command restores the predefined channel tables to their factory-set values. In this way, you can undo unintentional overwriting.

Example: `CONF:CDP:CTAB:REST`
Restores the channel table.

Usage: Event

Manual operation: See "Restoring Default Tables" on page 101

CONFigure:CDPower[:BTS]:CTABle:SELect <FileName>

This command selects a predefined channel table file for comparison during channel detection.

Before using this command, the channel table must be switched on first with the command `CONFigure:CDPower[:BTS]:CTABle[:STATe]` on page 202.

Parameters:
<FileName> *RST: RECENT

Example: `CONF:CDP:CTAB ON`
Switches the channel table on.
`CONF:CDP:CTAB:SEL 'CTAB_1'`
Selects the predefined channel table 'CTAB_1'.

Manual operation: See "Selecting a Table" on page 100

CONFigure:CDPower[:BTS]:CTABle[:STATe] <State>

This command switches the channel table on or off.

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

Example: `CONF:CDP:CTAB ON`

Manual operation: See "Using Predefined Channel Tables" on page 99

[SENSe:]CDPower:ICTReshold <ThresholdLevel>

This command defines the minimum power which a single channel must have compared to the total signal in order to be regarded as an active channel. Channels below the specified threshold are regarded as "inactive".

Parameters:

<ThresholdLevel> Range: -100 to 10
*RST: -40 dB
Default unit: dB

Example: `CDP:ICTR -10`
Sets the minimum power threshold to -10 dB.

Manual operation: See "Inactive Channel Threshold" on page 99

11.5.7.2 Configuring Channel Tables

Some general settings and functions are available when configuring a predefined channel table.

CONFigure:CDPower[:BTS]:CTABle:COMMent <Comment>

This command defines a comment for the selected channel table:

Prior to this command, the name of the channel table has to be defined with command `CONFigure:CDPower[:BTS]:CTABle:NAME` on page 206.

Parameters:

<Comment>

Example:
`CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name.
`CONF:CDP:CTAB:COMM 'Comment for table 1'`
Defines a comment for the table.
`CONF:CDP:CTAB:DATA 8,0,0,0,0,0,1,0.00,8,1,0,0,0,0,1,0.00,7,1,0, 256,8,0,1,0.00`
Defines the table values.

Manual operation: See "Comment" on page 101

CONFigure:CDPower[:BTS]:CTABle:DATA <ChannelType>, <CodeClass>, <CodeNumber>, <Modulation>, <Reserved1>, <Reserved2>, <Status>, <CDPRelative>

This command defines a channel table.

The following description applies to the EVDO BTS application only. For the MS application, see `CONFigure:CDPower[:BTS]:CTABle:DATA` on page 205.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 202 command.

For a detailed description of the parameters refer to Chapter 3.1.1, "Code Domain Parameters", on page 16.

Parameters:

<ChannelType> The channel type is numerically coded as follows:
0 = PILOT
1 = MAC
2 = PREAMBLE with 64 chip length
3 = PREAMBLE with 128 chip length
4 = PREAMBLE with 256 chip length
5 = PREAMBLE with 512 chip length
6 = PREAMBLE with 1024 chip length
7 = DATA

<CodeClass> Depending on channel type, the following values are allowed:
PILOT: 5
MAC: 6
PREAMBLE: 5
DATA: 4 (spreading factor = $2^{\text{code class}}$)

<CodeNumber> 0…spreading factor-1

<Modulation> Modulation type including mapping:
0 = BPSK-I
1 = BPSK-Q
2 = QPSK
3 = 8-PSK
4 = 16-QAM
Modulation types QPSK/8-PSK/16-QAM have complex values.

<Reserved1> Always 0 (reserved)

<Reserved2> Always 0 (reserved)

<Status> 0: inactive, 1: active
Can be used in a setting command to disable a channel temporarily

<CDPRelative> Power value in dB.

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Selects channel table for editing. If a channel table with this name does not exist, a new channel table is created.
`CONF:CDP:CTAB:DATA 0,6,0,0,0,0,1,0.0,10,5,3,4,0,0,1,0.0`
Defines a table with the following channels: PICH 0.64 and data channel with RC4/Walsh code 3.32.

Manual operation: See "Channel Type" on page 103
See "Channel Number (Walsh Ch./SF)" on page 103
See "Modulation" on page 103
See "Power" on page 103
See "Status" on page 103
See "Modulation" on page 104

CONFigure:CDPower[:BTS]:CTABle:DATA <ChannelType>, <CodeClass>, <CodeNumber>, <Mapping>, <Activity>, <Reserved1>, <Status>, <Reserved2>

This command defines a channel table. The following description applies to EVDO MS mode (K85) only. For BTS mode, see `CONFigure:CDPower[:BTS]:CTABle:DATA` on page 203.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 202 command.

For a detailed description of the parameters refer to Chapter 3.1.1, "Code Domain Parameters", on page 16.

Parameters:

<ChannelType> The channel type is numerically coded as follows:
0 = PICH
1 = RRI
2 = DATA
3 = ACK
4 = DRC
5 = INACTIVE

<CodeClass> 2 to 4

<CodeNumber> 0…15

<Mapping> 0 = I branch
1 = Q branch

<Activity> 0..65535 (decimal)
The decimal number - interpreted as a binary number in 16 bits - determines the half slot in which the channel is active (value 1) or inactive (value 0). See Table 11-6.

<Reserved1> Always 0 (reserved)

<Status> 0: inactive, 1: active
Can be used in a setting command to disable a channel temporarily

<Reserved2> Always 0 (reserved)

Example:
```
"INST:SEL MDO"
```
'Activate 1xEV–DO MS
```
"CONF:CDP:CTAB:NAME 'NEW_TAB'"
```
'Select table to edit
```
"CONF:CDP:CTAB:DATA 0,4,0,0,65535,0,1,0,
1,4,0,0,43690,0,1,0, 2,2,2,1,65535,0,1,0"
```
'Selects PICH 0.16 on I with full activity, RRI 0.16 on I in each even–numbered half slot, and DATA 2.4 on Q with full activity.

Manual operation: See "Channel Type" on page 104
See "Channel Number (Walsh Ch./SF)" on page 104
See "Status" on page 105
See "Activity" on page 105

Table 11-6: Examples for <Activity> parameter settings

Dec.	Binary	Description
65535	1111 1111 1111 1111	Channel is active in each half slot(e.g. DATA)
43690	1010 1010 1010 1010	Channel is active in half slot 0, 2, 4 etc(e.g. RRI)
24576	0110 0000 0000 0000	Channel is active in half slot 1 and 2(e.g. DRC)

CONFigure:CDPower[:BTS]:CTABle:NAME <Name>

This command creates a new channel table file or selects an existing channel table in order to copy or delete it.

Parameters:

<Name> string with a maximum of 8 characters
name of the channel table
*RST: RECENT

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`

Manual operation: See "Creating a New Table" on page 100
See "Name" on page 101

11.5.8 Sweep Settings

[SENSe:]AVERage<n>:COUNt <AverageCount>

This command 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

Usage: SCPI confirmed

Manual operation: See "Sweep / Average Count" on page 105

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of measurements that the application uses to average traces.

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

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

Suffix:
<n> Window

Parameters:
<SweepCount> When you set a sweep count of 0 or 1, the R&S FSW performs one single measurement in single measurement mode.
In continuous measurement mode, if the sweep count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

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.

Usage: SCPI confirmed

Manual operation: See "Sweep / Average Count" on page 105
See "No of HalfSlots" on page 110

11.5.9 Automatic Settings

MSRA operating mode

In MSRA operating mode, the following automatic commands are not available, as they require a new data acquisition. However, 1xEV-DO applications cannot perform data acquisition in MSRA operating mode.

Useful commands for adjusting settings automatically described elsewhere:

- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 183

Remote commands exclusive to adjusting settings automatically:

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

- Reference level
- Scaling

Example: `ADJ:ALL`

Usage: Event

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 107

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 108

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command selects the way the R&S FSW determines the length of the measurement .

Parameters:
<Mode>

AUTO
The R&S FSW determines the measurement length automatically according to the current input data.

MANual
The R&S FSW uses the measurement length defined by `[SENSe:]ADJust:CONFigure:DURation` on page 208.

*RST: AUTO

Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 108
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 108

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 210 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:
<Threshold>
Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:LOW 2`
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 108

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 210 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold> Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:UPP 2`

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 108

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 85

11.5.10 Code Domain Analysis Settings

Some evaluations provide further settings for the results. The commands for Code Domain Analysis are described here.

[SENSe:]CDPower:AVERage <State>

If enabled, the CDP is calculated over all slots and displayed as required by the 1xEV-DO standard.

This command is only available for Code Domain Power evaluations.

Parameters:

<State> ON | OFF

*RST: 0

Example: `CDP:AVER ON`
Activate averaging CDP relative over all slots.

Manual operation: See "CDP Average" on page 117

[SENSe:]CDPower:NORMalize <State>

If enabled, the I/Q offset is eliminated from the measured signal. This is useful to deduct a DC offset to the baseband caused by the DUT, thus improving the EVM. Note, however, that for EVM measurements according to standard, compensation must be disabled.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SENS:CDP:NORM ON`
Activates the elimination of the I/Q offset.

Manual operation: See "Compensate IQ Offset" on page 117

[SENSe:]CDPower:OPERation <Mode>

The operation mode is used for the channel search.

Parameters:

<Mode> ACCess | TRAFfic

ACCess
Only PICH (always available) and DATA channels can exist.

TRAFfic
All channels (PICH/RRI/DATA/ACK and DRC) can exist. PICH and RRI are always in the signal.

*RST: TRAFfic

For further details refer to "Operating Modes - Access and Traffic" on page 48.

Example: `CDP:ORD HAD`
Sets Hadamard order.
`TRAC? TRACE2`
Reads out the results in Hadamard order.
`CDP:ORD BITR`
Sets BitReverse order.
`TRAC? TRACE2`
Reads out the results in BitReverse order.

Manual operation: See "Operation Mode" on page 119

[SENSe:]CDPower:ORDer <SortOrder>

This command sets the channel sorting for the Code Domain Power and Code Domain Error Power result displays.

Parameters:
<SortOrder> HADamard | BITReverse
*RST: HADamard
For further details refer to Chapter 4.8, "Code Display and Sort Order", on page 52.

Example: `CDP:ORD HAD`
Sets Hadamard order.
`TRAC? TRACE2`
Reads out the results in Hadamard order.
`CDP:ORD BITR`
Sets BitReverse order.
`TRAC? TRACE2`
Reads out the results in BitReverse order.

Manual operation: See "Code Display Order" on page 118

[SENSe:]CDPower:PDISplay <Mode>

This command defines how the pilot channel power is displayed in the Result Summary. In relative mode, the reference power is the total power.

Parameters:
<Mode> ABS | REL
*RST: REL

Example: `CDP:PDIS REL`
Pilot channel power is displayed in relation to the total power.

Manual operation: See "Code Power Display" on page 117

[SENSe:]CDPower:PREFerence <Power>

This command specifies the reference power for the relative power result displays (e.g. Code Domain Power, Power vs PCG).

Parameters:

<Power> PICH | TOTal

PICH
The reference power is the power of the pilot channel.

TOTal
The reference power is the total power of the signal.

*RST: PICH

For further information refer to "Power Reference" on page 119.

Example: `CDP:PREF TOT`
Sets total power as reference power.

Manual operation: See "Power Reference" on page 119

[SENSe:]CDPower:TPMeas <State>

This command activates or deactivates the timing and phase offset evaluation of the channels to the pilot.

The results are queried using the `TRAC:DATA? CTAB` command or the `CALC:MARK:FUNC:CDP[:BTS]:RES?` command.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CDP:TPM ON`
Activates timing and phase offset.
`CDP:SLOT 2`
Selects slot 2.
`CDP:CODE 11`
Selects code number 11.
`CALC:MARK:FUNC:CDP:RES? TOFF`
Reads out timing offset of the code with number 11 in slot 2.
`CALC:MARK:FUNC:CDP:RES? POFF`
Reads out the phase offset of the code with number 11 in slot 2.

Manual operation: See "Timing and phase offset calculation " on page 117

11.5.11 Evaluation Range

The evaluation range defines which data is evaluated in the result display.

[SENSe:]CDPower:CODE <CodeNumber>

This command selects the channel code number. The maximum number depends on the spreading factor and thus on the channel type.

For details on the relationship between channel types and spreading factors see Chapter A.2, "Channel Type Characteristics", on page 275.

Parameters:

<CodeNumber> Code number depending on the channel type.

Range: 0 to <Spreading factor>-1
*RST: 0

Example: `CDP:CODE 11`
Selects code number 11.

Manual operation: See "Channel" on page 120

[SENSe:]CDPower:CTYPe <ChannelType>

This command is used to select the channel type. The number of results then changes in most analyses, such as code domain power, symbol EVM, and bit stream, because either a different spreading factor or a different number of symbols is available for the analysis.

Parameters:

<ChannelType> PILot | MAC | PREamble | DATA

*RST: PILOT

Example: `CDP:CTYP MAC`
Select MAC channel type.

Manual operation: See "Channel Type" on page 122

[SENSe:]CDPower:MAPPing <SignalComponent>

This command switches between the I and Q branch of the signal.

Parameters:

<SignalComponent> I | Q

*RST: Q

Example: `CDP:MAPP Q`

Manual operation: See "Mapping" on page 105
See "Branch" on page 123

[SENSe:]CDPower:MMODe <Mode>

This command defines the mapping mode either automatically or user-defined for all channel types.

Parameters:

<Mode> AUTO | IOQ | COMPlex

IOQ
I or Q mapping

COMPlex
Complex mapping

AUTO
Mapping is defined automatically according to the channel type (see "Mapping" on page 121).

*RST: AUTO

Example: `CDP:MMODe COMP`
The pilot channel type (and all other channel types) is analyzed in complex mode

Manual operation: See "Mapping" on page 121

[SENSe:]CDPower:SET <SetNo>

This command selects a specific set for further analysis. The number of sets has to be defined with the `[SENSe:]CDPower:SET:COUNt` command before using this command.

Parameters:

<SetNo> Range: 0 to SET COUNT -1
Increment: 1
*RST: 0

Example: `CDP:SET:COUN 10`
Selects the 11th set for further analysis (counting starts with 0).

Manual operation: See "Set to Analyze" on page 97

[SENSe:]CDPower:SLOT <numeric value>

This command selects the slot (PCG) to be analyzed.

Parameters:

<numeric value> Range: 0 to 63
Increment: 1
*RST: 0

Example: `CDP:SLOT 7`
Selects slot number 7 for analysis.

Manual operation: See "(Half-)Slot" on page 121

11.6 Configuring RF Measurements

RF measurements are performed in the Spectrum application, with some predefined settings as described in Chapter 3.2.1, "RF Measurement Types and Results", on page 34.

For details on configuring these RF measurements in a remote environment, see the Remote Commands chapter of the R&S FSW User Manual.

The 1xEV-DO RF measurements must be activated in 1xEV-DO applications, see Chapter 11.3, "Activating the Measurement Channel", on page 153.

The individual measurements are activated using the `CONFigure:CDPower[:BTS]:MEASurement` on page 158 command (see Chapter 11.4, "Selecting a Measurement", on page 157).

In addition to the common RF measurement configuration commands described for the base unit, some special commands are available in 1xEV-DO applications.

11.6.1 1xEV-DO BTS Power vs Time Measurements

The following commands are only available for Power vs Time measurements in 1xEV-DO BTS application.

Useful commands for configuring RF measurements described elsewhere:

- `[SENSe:]SWEep:COUNt` on page 207

Remote commands exclusive to 1xEV-DO RF measurements:

CALCulate<n>:LIMit<k>:PVTime:REFerence <Mode>

If enabled, the mean power is calculated and the limit lines are set relative to that mean power.

The standard requires that the FULL slot first be measured with the limit line relative to the mean power of the averaged time response.

This value should also be used as the reference for the IDLE slot measurement.

Suffix:

<n>	Window
<k>	Limit line

Parameters:

<Mode> AUTO | ONCE | MANual

AUTO
The mean power is calculated and the limit lines are set relative to that mean power value automatically

ONCE
The current mean power value of the averaged time response is used as the fixed reference value for the limit lines. The reference mode is set to `MANual`. Now the IDLE slot can be selected and the measurement sequence can be finished.

MANual
The reference value for the limits are defined manually.

*RST: AUTO

Example:

`CALC:LIM:PVT:REF AUTO`
Automatic reference value for limit lines. The value should be set to mean power
`CALC:LIM:PVT:REF MAN`
Manual reference value for limit lines
`CALC:LIM:PVT:RVA -33.5`
Set manual reference value to -33.5
`CALC:LIM:PVT:REF ONCE`
Set reference value to mean power
`CALC:LIM:PVT:RVA?`
Query reference value for limit lines. The value should be set to mean power value

Manual operation:
See "Reference Mean Pwr" on page 111
See "Reference Manual" on page 111
See "Set Mean to Manual" on page 111

CALCulate<n>:LIMit<k>:PVTime:RVALue <RefLevel>

This command sets the reference level for calculating the limit lines. Precondition is that the automatic mode of power calculation is switched off via the commands `CALC:LIM:PVT:REF ONCE` or `CALC:LIM:PVT:REF MAN` (see `CALCulate<n>:LIMit<k>:PVTime:REFerence` on page 216).

Suffix:

<n> Window

<k> Limit line

Parameters:

<RefLevel> Reference level in dBm

Range: -200 to 200
*RST: -20dBm
Default unit: dBm

Example: `CALC:LIM:PVT:REF MAN`
Manual reference value for limit lines
`CALC:LIM:PVTime:RVAL -33.5`
Set manual reference value to -33.5

Manual operation: See "Reference Manual" on page 111

CONFigure:CDPower[:BTS]:PVTime:BURSt:CENTer <State>

This command activates an automatic burst alignment to the center of the diagram.

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

Manual operation: See "Burst Fit" on page 110

CONFigure:CDPower[:BTS]:PVTime:FREStart <State>

If switched on, this command evaluates the limit line over all results at the end of a single sweep. The sweep is restarted if this result is FAILED.

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

Example: `CONF:CDP:PVT:FRES ON`
Restarts a single sweep if the result evaluation is failed.

Manual operation: See "Restart on Fail" on page 111

CONFigure:CDPower[:BTS]:RFSLot <Slot>

Defines the expected signal. The limit lines and the borders for calculating the mean power are set accordingly.

Parameters:
<Slot> FULL | IDLE

FULL
Full slot signal
The lower and upper limit line are called "PVTFL"/"PVTFU"

IDLE
Idle slot signal
The lower and upper limit line are called "PVTIL"/"PVTIU"

*RST: FULL

Example: `CONF:CDP:RFSL FULL`
Use limit line for FULL slot and connect FULL slot signal

Manual operation: See "RF:Slot" on page 110

11.6.2 1xEV-DO SEM and ACLR Measurements

CONFigure:CDPower[:BTS]:BCLass|BANDclass <Bandclass>

This command selects the bandclass for the measurement. The bandclass defines the frequency band used for ACLR and SEM measurements. It also determines the corresponding limits and ACLR channel settings according to the 1xEV-DO standard.

Parameters:

<Bandclass> For an overview of available bandclasses and the corresponding parameter values see Chapter A.3, "Reference: Supported Bandclasses", on page 277.

*RST: 0

Example: `CONF:CDP:BCL 1`
Selects band class 1, 1900 MHz

Manual operation: See "Bandclass" on page 113

11.7 Configuring the Result Display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in Chapter 6.1, "Result Display", on page 60.

11.7.1 General Window Commands

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 157).

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 225).

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`

11.7.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 157).

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

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 "Bitstream" on page 21
See "BTS Channel Results" on page 21
See "Channel Table" on page 22
See "Code Domain Power / Code Domain Error Power" on page 22
See "Composite Constellation" on page 24
See "Composite Data Bitstream (MS application only)" on page 24
See "Composite Data Constellation (MS application only)" on page 25
See "Composite EVM" on page 25
See "General Results (BTS application only)" on page 26
See "Mag Error vs Chip" on page 27
See "Peak Code Domain Error" on page 27
See "Phase Error vs Chip" on page 28
See "Power vs Chip (BTS application only)" on page 29
See "Power vs Halfslot (MS application only)" on page 30
See "Power vs Symbol" on page 30
See "Result Summary (MS application only)" on page 31
See "Symbol Constellation" on page 32
See "Symbol EVM" on page 32
See "Symbol Magnitude Error" on page 33
See "Symbol Phase Error" on page 34
See "Diagram" on page 40
See "Result Summary" on page 41
See "Marker Table" on page 41
See "Marker Peak List" on page 42
See "Evaluation List" on page 42

Table 11-7: <WindowType> parameter values for 1xEV-DO application

Parameter value	Window type
BITStream	Bitstream
CCONst	Composite Constellation
CDBits	Composite Bitstream (MS application with subtype 2 or 3 only)
CDConst	Composite Data Constellation (MS application with subtype 2 or 3 only)
CDEPower	Code Domain Error Power
CDPower	Code Domain Power
CEVM	Composite EVM
CRESults	BTS Channel results
CTABle	Channel Table
DIAG	Power vs. Time diagram (BTS application only)
GRESults	General results (BTS application only)

Parameter value	Window type
LEValuation	List evaluation (SEM, Power vs. Time)
MECHip	Magnitude Error vs. Chip
MTABle	Marker table
PCDerror	Peak Code Domain Error
PCHip	Power vs. Chip (BTS application only)
PECHip	Phase Error vs. Chip
PHSLot	Power vs. Halfslot (MS application only)
PSYMbol	Power vs. Symbol
RSUMmary	Result Summary
SCONst	Symbol Constellation
SEVM	Symbol EVM
SMERror	Symbol Magnitude Error
SPERror	Symbol Phase Error

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement 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:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

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: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

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 measurement 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 221 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 220 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

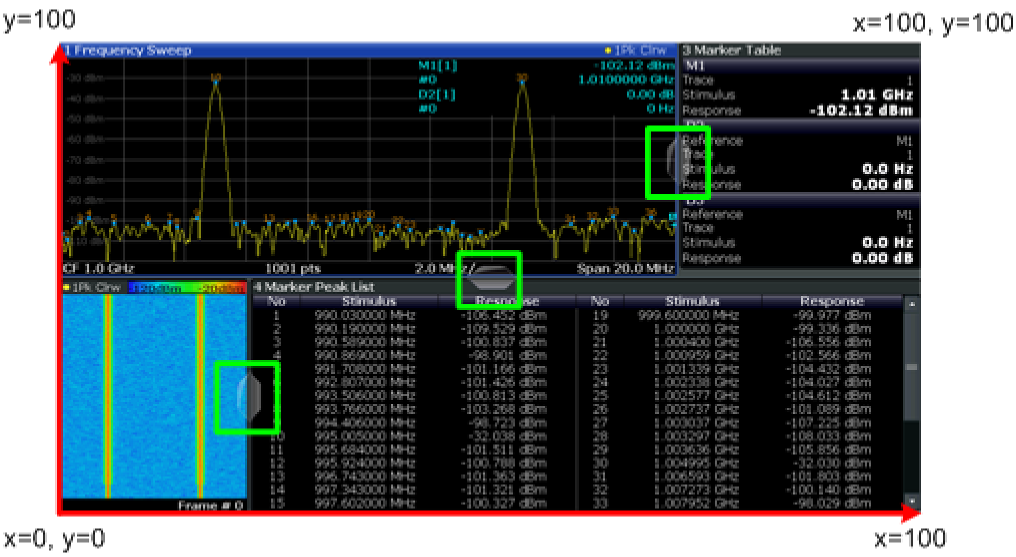


Figure 11-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 11-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 221 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:

<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result 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

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 221 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

11.8 Starting a Measurement

The measurement is started immediately when an 1xEV-DO application is activated, however, you can stop and start a new measurement any time.

ABORt

This command aborts the measurement in the current measurement 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 see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate<n>:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event
SCPI confirmed

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate<n>[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:

<n>	irrelevant

Usage: Event

Manual operation: See "Continue Single Sweep" on page 106

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual measurement 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 the "Remote Basics" chapter in the R&S FSW User Manual.

If the measurement mode is changed for a measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMediate` on page 230) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:

<n>	irrelevant

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1

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 106

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n> irrelevant

Usage: Event

Manual operation: See "Single Sweep/ RUN SINGLE" on page 106

INITiate<n>:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate<n>:SEQuencer:IMMediate` on page 230.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 232.

Suffix:

<n> irrelevant

Usage: Event

INITiate<n>:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 232).

Suffix:

<n> irrelevant

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Usage: Event

INITiate<n>:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 232).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Suffix:

<n>	irrelevant

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate<n>:SEQuencer:REFResh[:ALL]

This function 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 slave applications.

Suffix:

<n>	irrelevant

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.

Usage: Event

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

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

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

11.9 Retrieving Results

The following commands retrieve the results from a 1xEV-DO measurement in a remote environment.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, abbreviations or assignments to a numeric value are used as described in Chapter 11.5.7, "Channel Detection", on page 199.

Specific commands:

11.9.1 Retrieving Calculated CDA Results

The following commands describe how to retrieve the calculated results from the CDA measurements.

CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult? <Parameter>

This command queries individual parameters from the measured and calculated results of the 1xEV-DO code domain power measurement.

For details on individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

Suffix:

<n>	Window
<m>	Marker

Query parameters:

<Parameter> For each result, add the corresponding query parameter.

ACTive
Number of active channels

CDERms
(MS application:) RMS value of EVM (error vector magnitude) of composite data channel

CDEPeak
(MS application:) Peak value of EVM (error vector magnitude) of composite data channel

CDPabsolute
Channel power absolute in dBm

CDPRelative
Channel power relative in dB (relative to total or PICH power, refer to `CDP:PREF` command)

CERRor
Chip rate error in ppm

CHANnel
Channel number

CODMulation
(MS application:) modulation type of the composite data channel

CODPower
(MS application:) power of the composite data channel

DACTive
Number of active Data channels

DMTYpe
Data Mode Type

DRPich
(MS application:) Delta RRI/PICH in dB

EVMPeak
Error vector mag. peak in %

EVMRms
Error vector magnitude RMS in %

FERPpm
Frequency error in ppm

FERRor
Frequency error in Hz

IPMMax
Maximum power level in inactive MAC channel in dB

IQIMbalance
IQ imbalance in %

IQOFfset
IQ offset in %

MACCuracy

Composite EVM in %

MACTive
(BTS application:) number of active MAC channels

MTYPe
Modulation type including mapping

PCDerror
Peak code domain error in dB

PDATa
absolute power in the DATA channel type

PDMax
Maximum power level in Data channel

PDMin
Minimum power level in Data channel

PLENGth
Length of preamble in chips

PMAC
absolute power in the MAC channel type

POFFset
Phase offset in rad

PPILot
absolute power in the PILOT channel type

PPICh
Pilot power in dBm

PPReamble
absolute power in the PREAMBLE channel type

PRRI
(MS application:) RRI power in dBm

PTOTal
Total power in dBm

RHO
RHO

RHO1
(BTS application:) $RHO_{overall-1}$ over all slots over all chips with averaging starting at the half–slot limit

RHO2
(BTS application:) $RHO_{overall-2}$ over all slots over all chips with averaging starting at the quarter–slot limit

RHOData
(BTS application:) RHO over all half-slots for the DATA area

RHOMac
(BTS application:) RHO over all half-slots for the MAC area

RHOPilot
(BTS application:) RHO over all slots for the PILOT area

RHOVerall

(BTS application:) RHO over all half-slots

SFACtor
Spreading factor of channel

SLOT
(BTS application:) Half-slot number

SRATe
Symbol rate in ksps

TFRame I
Trigger to frame

TOFFset
Timing offset in s

Example: `CALC:MARK:FUNC:CDP:RES? PTOT`

Usage: Query only

Manual operation: See "BTS Channel Results" on page 21
See "Code Domain Power / Code Domain Error Power" on page 22
See "Composite Constellation" on page 24
See "Composite Data Bitstream (MS application only)" on page 24
See "Composite Data Constellation (MS application only)" on page 25
See "Composite EVM" on page 25
See "General Results (BTS application only)" on page 26
See "Peak Code Domain Error" on page 27
See "Power vs Halfslot (MS application only)" on page 30
See "Power vs Symbol" on page 30
See "Result Summary (MS application only)" on page 31
See "Symbol Constellation" on page 32
See "Symbol EVM" on page 32

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

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.

See also `INITiate<n>:CONTinuous` on page 229.

Suffix:

<n> Window

<m> Marker

Return values:

<Result> Result at the marker position.

Example:

`INIT:CONT OFF`
Switches to single measurement mode.
`CALC:MARK2 ON`
Switches marker 2.
`INIT;*WAI`
Starts a measurement and waits for the end.
`CALC:MARK2:Y?`
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "CCDF" on page 39
See "Marker Table" on page 41
See "Marker Peak List" on page 42

11.9.2 Retrieving CDA Trace Results

The following commands describe how to retrieve the trace data from the CDA measurements. Note that for these measurements, only 1 trace per window can be configured.

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

TRACe<n>[:DATA]? <ResultType>

This command reads trace data from the R&S FSW.

For details on reading trace data for other than code domain measurements refer to the `TRACe:DATA` command in the base unit description.

Suffix:
<n> Window

Query parameters:
<ResultType> **TRACE1 | TRACE2 | TRACE3 | TRACE4**
Reads out the trace data of the corresponding trace in the specified measurement window. The results of the trace data query depend on the evaluation method in the specified window, which is selected by the `LAY:ADD:WIND` command. The individual results are described in Chapter 11.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 238.

CTABle
For the Channel Table result display, reads out the maximum values of the timing/phase offset between each assigned channel and the pilot channel (see `[SENSe:]CDPower:TPMeas` command).
To query the detailed channel information use the `TRAC:DATA? TRACE1` command for a window with Channel Table evaluation.

LIST
Queries the results of the peak list evaluation for Spectrum Emission Mask measurements.
For each peak the following entries are given:
<peak frequency>, <absolute level of the peak>, <distance to the limit line>
For details refer to the `TRACe:DATA` command in the base unit description.

Usage: Query only

Manual operation:
See "Mag Error vs Chip" on page 27
See "Phase Error vs Chip" on page 28
See "Symbol Magnitude Error" on page 33
See "Symbol Phase Error" on page 34

11.9.3 Measurement Results for TRACe<n>[:DATA]? TRACE<n>

The results of the trace data query (TRACe<n>[:DATA]? TRACE<n>) depend on the evaluation method in the specified window, which is selected by the `LAY:ADD:WIND` command.

For each evaluation method the returned values for the trace data query are described in the following sections.

For details on the graphical results of these evaluation methods, see Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 20.

11.9.3.1 Bitstream

The command returns the bitstream of one slot, i.e. it returns one value for each bit in a symbol.

<bit 1>, <bit 2>,…, <bit n>

The number of symbols per slot depends on the spreading factor, while the number of returned bits per symbol depends on the modulation type (see Chapter A.2, "Channel Type Characteristics", on page 275).

Accordingly, the bitstream per slot is of different lengths.

If a channel is detected as being inactive, the invalid bits in the bit stream are marked by the value "9".

11.9.3.2 Channel Table

Two different commands are available to retrieve the channel table results:

- `TRAC:DATA? TRACEx` commands return detailed trace information for each channel
- `TRAC:DATA? CTABle` provides the maximum values of the timing/phase offset between each assigned channel and the pilot channel

Results for TRACEx Parameters

The command returns 8 values for each channel in the following order:

<channel type>, <code class>, <code number>, <modulation>/<mapping>, <absolute level>, <relative level>, <timing offset>, <phase offset>

For details on the individual parameters see Table 3-3.

In the **BTS application**, the channels are sorted according to these rules:

1. All detected special channels
2. Data channels, in ascending order by code class and within the code class in ascending order by code number
3. Unassigned codes, with the code class of the base spreading factor

In the **MS application**, the channels are sorted according to these rules:

1. All active channels
2. All inactive or quasi-active channels, in ascending code number order, I branch first, followed by Q branch
   Data channels, in ascending order by code class and within the code class in ascending order by code number
3. Unassigned codes, with the code class 4

Results for CTABle Parameter (BTS application)

The command returns 12 values for each channel in the following order:

<max. time offset in s>, <channel type for max. time>, <code number for max. time>, <code class for max. time>, <max. phase offset in rad>, <channel type for max. phase offset>, <code number for max. phase>, <code class for max. phase>, <reserved 1>, …, <reserved 4>

For details on the individual parameters see Table 3-3.

Value	Description
<time offset>	maximum time offset in s
<channel type>	channel type (see Table 11-3)
<code number>	code number of the channel with maximum time offset
<code class>	code class of the channel with maximum time offset
<phase offset>	maximum phase offset in rad
<channel type>	channel type (see Table 11-3)
<code number>	code number of the channel with maximum phase offset
<code class>	code class of the channel with maximum phase offset
<reserved 1...4>	0: reserved for future use

Results for CTABle Parameter (MS application)

The command returns 12 values for each channel in the following order:

<max. time offset in s>, <code number for max. time>, <code class for max. time>, <max. phase offset in rad>, <code number for max. phase>, <code class for max. phase>, <reserved 1>, …, <reserved 6>

Value	Description
<time offset>	maximum time offset in s
<code number>	code number of the channel with maximum time offset
<code class>	code class of the channel with maximum time offset
<phase offset>	maximum phase offset in rad
<code number>	code number of the channel with maximum phase offset
<code class>	code class of the channel with maximum phase offset
<reserved 1...6>	0: reserved for future use

11.9.3.3 Code Domain Error Power (BTS application)

The command returns three values for each code in a channel:

<code number>, <error power>, <power ID>

The number of results corresponds to the spreading factor (see Chapter A.2, "Channel Type Characteristics", on page 275).

In addition, the output depends on the mapping settings. The output is either the I branch, the Q branch or the complex signal.

Value	Description
<code number>	code number within the channel
<error power>	value of the composite EVM
<power ID>	type of power detection: 0 - inactive channel 1 - active channel

The Hadamard or BitReverse order is important for sorting the channels, but not for the number of values.

With Hadamard, the individual codes are output in ascending order.

With BitReverse, codes which belong to a particular channel are adjacent to each other.

Since an error power is output for Code Domain Error Power, consolidation of the power values is not appropriate. The number of codes that are output therefore generally corresponds to the base spreading factor.

11.9.3.4 Code Domain Error Power (MS application)

The command returns four values for each channel:

<code class>, <code number>, <error power>, <power ID>

Value	Description
<code class>	code class of the channel (see Table 11-4)
<code number>	code number of the channel
<signal level>	error power in dB
<power ID>	type of power detection: 0 - inactive channel 1 - active channel 3 - quasi-inactive channel (on the analyzed branch, the channel is not occupied, but an active channel exists on the other branch)

The Hadamard or BitReverse order is important for sorting the channels, but not for the number of values.

With Hadamard, the individual codes are output in ascending order.

With BitReverse, codes which belong to a particular channel are adjacent to each other.

Since an error power is output for Code Domain Error Power, consolidation of the power values is not appropriate. The number of codes that are output therefore generally corresponds to the base spreading factor.

11.9.3.5 Code Domain Power (BTS application)

The command returns three values for each code in a channel:

<code number>, <power level>, <power ID>

The number of results corresponds to the spreading factor (see Chapter A.2, "Channel Type Characteristics", on page 275).

In addition, the output depends on the mapping settings. The output is either the I branch, the Q branch or the complex signal.

Value	Description
<code number>	code number within the channel
<power level>	depending on `[SENSe:]CDPower:PDISplay`: absolute level (in dBm) of the code channel at the selected channel slot or relative level (in dB) of the channel referenced to total power in the channel type
<power ID>	type of power detection: 0 - inactive channel 1 - active channel

In Hadamard order, the different codes are output in ascending order together with their code power. The number of output codes corresponds to the base spreading factor.

In BitReverse order, codes belonging to a channel are next to one another and are therefore output in the class of the channel together with the consolidated channel power. The maximum number of output codes or channels cannot be higher than the base spreading factor, but decreases with every concentrated channel.

For details see Chapter 4.8, "Code Display and Sort Order", on page 52.

11.9.3.6 Code Domain Power (MS application)

The command returns four values for each channel:

<code class>, <code number>, <error power>, <power ID>

Value	Description
<code class>	code class of the channel (see Table 11-4)
<code number>	code number of the channel
<power level>	depending on `[SENSe:]CDPower:PDISplay`: absolute level (in dBm) of the code channel at the selected channel slot or relative level (in dB) of the channel referenced to total power in the channel type
<power ID>	type of power detection: 0 - inactive channel 1 - active channel 3 - quasi-inactive channel (on the analyzed branch, the channel is not occupied, but an active channel exists on the other branch)

In Hadamard order, the different codes are output in ascending order together with their code power. The number of output codes corresponds to the base spreading factor.

In BitReverse order, codes belonging to a channel are next to one another and are therefore output in the class of the channel together with the consolidated channel power. The maximum number of output codes or channels cannot be higher than the base spreading factor, but decreases with every concentrated channel.

For details see Chapter 4.8, "Code Display and Sort Order", on page 52.

11.9.3.7 Composite Constellation

When the trace data for this evaluation is queried, the real and the imaginary branches of each chip are transferred:

<Re $chip_0$>, <Im $chip_0$>, <Re $chip_1$>, <Im $chip_1$>, ..., <Re $chip_n$>, <Im $chip_n$>

The number of value pairs corresponds to the number of chips from the 1024 chips in a half slot.

11.9.3.8 Composite Data Bitstream (MS application)

The command returns the bitstream of one half slot for the composite data channel.

This evaluation is only available for subtypes 2 or 3.

The number of returned bits depends on the modulation type of the composite data channel:

Modulation Type	Number of returned bits
Q4Q2	1536
E4E2	2304

11.9.3.9 Composite Data Constellation (MS application)

The command returns the real and imaginary parts from each despreaded chip of the composite data channel.

This evaluation is only available for subtypes 2 or 3.

11.9.3.10 Composite Data EVM (MS application)

The command returns the error vector magnitude for each despreaded chip of the composite data channel.

This evaluation is only available for subtypes 2 or 3.

The number of returned values is 1024.

11.9.3.11 Composite EVM (RMS)

The command returns two values for each (half-)slot in the following order:

<(Half-)Slot number>, <value in %>

The number of value pairs corresponds to the number of captured (half-) slots.

11.9.3.12 Mag Error vs Chip

When the trace data for this evaluation is queried, a list of magnitude error values of all chips at the selected slot is returned (=2560 values). The values are calculated as the magnitude difference between the received signal and the reference signal for each chip in %, and are normalized to the square root of the average power at the selected slot.

11.9.3.13 Peak Code Domain Error

The command returns 2 values for each (half-)slot in the following order:

<(half-)slot number>, <level value in dB>

The number of value pairs corresponds to the number of captured (half-)slots.

11.9.3.14 Phase Error vs Chip

When the trace data for this evaluation is queried, a list of phase error values of all chips in the selected slot is returned (=2560 values). The values are calculated as the phase difference between the received signal and the reference signal for each chip in degrees, and are normalized to the square root of the average power at the selected slot.

11.9.3.15 Power vs Chip (BTS application)

The command returns one value for each chip:

<level value in dBm>

The number of results that are displayed is always 2048, one power level for each chip.

11.9.3.16 Power vs Half-Slot (MS application)

The command returns one value pair for each half-slot:

<half-slot number>, <level value in dB>

The number of returned value pairs corresponds to the number of captured half-slots.

11.9.3.17 Power vs Symbol

The command returns one value for each symbol:

<value in dBm>

The number of values depends on the number of symbols and therefore the spreading factor (see Chapter A.2, "Channel Type Characteristics", on page 275).

11.9.3.18 Power vs Time (BTS application)

The command returns two values for each sweep point:

<power value in dBm>, <measurement time in µs>

11.9.3.19 Result Summary (Channel Results / General Results, BTS application)

The command returns 30 values for the selected channel in the following order:

<FERRor>, <FERPpm>, <CERRor>, <TFRame>, <RHOPilot>, <RHO1>, <RHO2>, <PPILot>, <PMAC>, <PDATa>, <PPReamble>, <MACCuracy>, <DMTYpe>, <MACTive>, <DACTive>, <PLENGth>, <RHO>, <PCDerror>, <IQIMbalance>, <IQOFfset>, <SRATe>, <CHANnel>, <SFACtor> <TOFFset>, <POFFset>, <CDPRelative>, <CDPabsolute>, <EVMRms>, <EVMPeak>, <MTYPe>

For details on the individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

11.9.3.20 Result Summary (MS application)

The command returns 25 values in the following order:

<SLOT>, <PTOTal>, <PPICh>, <PRRI>, <RHO>, <MACCuracy>, <PCDerror>, <ACTive>, <FERRor>, <FERPpm>, <DRPich>, <RHOVerall>, <TFRame>, <CERRor>, <IQOFfset>, <IQIMbalance>, <SRATe>, <CHANnel>, <SFACtor>, <TOFFset>, <POFFset>, <CDPRelative>, <CDPabsolute>, <EVMRms>, <EVMPeak>

For details on the individual parameters see Chapter 3.1.1, "Code Domain Parameters", on page 16.

11.9.3.21 Symbol Constellation

When the trace data for this evaluation is queried, the real and the imaginary branches of each symbol are returned:

<Re_0>, <Im_0>, <Re_1>, <Im_1>, ..., <Re_n>, <Im_n>

The number of values depends on the number of symbols and therefore the spreading factor (see Chapter A.2, "Channel Type Characteristics", on page 275).

11.9.3.22 Symbol EVM

When the trace data for this evaluation is queried. one EVM value per symbol is returned:

<value in %>

The number of values depends on the number of symbols and therefore the spreading factor (see Chapter A.2, "Channel Type Characteristics", on page 275).

Symbol Magnitude Error

When the trace data for this evaluation is queried, the magnitude error in % of each symbol at the selected slot is transferred. The number of the symbols depends on the spreading factor of the selected channel:

$NOFSymbols=10*2^{(8-CodeClass)}$

Symbol Phase Error

When the trace data for this evaluation is queried, the phase error in degrees of each symbol at the selected slot is transferred. The number of the symbols depends on the spreading factor of the selected channel:

NOFSymbols=10*2$^{(8\text{-CodeClass})}$

11.9.4 Exporting Trace Results

Trace results can be exported to a file.

For more commands concerning data and results storage see the R&S FSW User Manual.

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

Trace export is only available for RF measurements.

For details on the file format see "Reference: ASCII File Export Format" in the R&S FSW User Manual.

Secure User Mode

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Suffix:
<n> Window

Parameters:
<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'C:\TEST.ASC'`
Stores trace 3 from window 1 in the file `TEST.ASC`.

Usage: SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

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.

11.9.5 Retrieving RF Results

The following commands retrieve the results of the 1xEV-DO RF measurements.

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:MARKer<m>:Y?` on page 236

Remote commands exclusive to

CALCulate<n>:LIMit<k>:FAIL?

This command queries the result of a limit check in the specified window.

Note that for SEM measurements, the limit line suffix <k> is irrelevant, as only one specific SEM limit line is checked for the currently relevant power class.

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.

See also `INITiate<n>:CONTinuous` on page 229.

Suffix:

<n> Window

<k> 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
SCPI confirmed

Manual operation: See "Spectrum Emission Mask" on page 37

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? <Measurement>

This command queries the results of power measurements.

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.

See also `INITiate<n>:CONTinuous` on page 229.

Suffix:

<n>, <m> irrelevant

<sb> 1 | 2 | 3 (4 | 5)
Sub block in a Multi-standard radio measurement;
MSR ACLR: 1 to 5
Multi-SEM: 1 to 3
for all other measurements: irrelevant

Query parameters:

<Measurement>

ACPower | MCACpower
ACLR measurements (also known as adjacent channel power or multicarrier adjacent channel measurements).
Returns the power for every active transmission and adjacent channel. The order is:
• power of the transmission channels
• power of adjacent channel (lower,upper)
• power of alternate channels (lower,upper)
MSR ACLR results:
For MSR ACLR measurements, the order of the returned results is slightly different:
• power of the transmission channels
• total power of the transmission channels for each sub block
• power of adjacent channels (lower, upper)
• power of alternate channels (lower, upper)
• power of gap channels (lower1, upper1, lower2, upper2)
The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

GACLr
For MSR ACLR measurements only: returns a list of ACLR values for each gap channel (lower1, upper1, lower2, upper2)

MACM
For MSR ACLR measurements only: returns a list of CACLR values for each gap channel (lower1, upper1, lower2, upper2)

CN
Carrier-to-noise measurements.
Returns the C/N ratio in dB.

CN0
Carrier-to-noise measurements.
Returns the C/N ratio referenced to a 1 Hz bandwidth in dBm/Hz.

CPOWer
Channel power measurements.
Returns the channel power. The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W
For SEM measurements, the return value is the channel power of the reference range (in the specified sub block).

PPOWer
Peak power measurements.
Returns the peak power. The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

For SEM measurements, the return value is the peak power of the reference range (in the specified sub block).

OBANdwidth | OBWidth
Occupied bandwidth.
Returns the occupied bandwidth in Hz.

Usage: Query only

Manual operation: See "Power" on page 35
See "Channel Power ACLR" on page 36
See "Spectrum Emission Mask" on page 37
See "Occupied Bandwidth" on page 38
See "CCDF" on page 39

CALCulate<n>:STATistics:RESult<t>? <ResultType>

This command queries the results of a CCDF or ADP measurement for a specific trace.

Suffix:

<n> irrelevant

<t> Trace

Parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example: `CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 39

CONFigure:CDPower[:BTS]:PVTime:LIST:RESult?

Queries the list evaluation results. The results are a comma-separated list containing the following values for each list range:

Return values:

<RangeNo>	consecutive number of list range
<StartTime>	Start time of the individual list range
<StopTime>	Stop time of the individual list range
<AverageDBM>	Average power level in list range in dBm.
<AverageDB>	Average power level in list range in dB.
<MaxDBM>	Maximum power level in list range in dBm.
<MaxDB>	Maximum power level in list range in dB.
<MinDBM>	Minimum power level in list range in dBm.
<MinDB>	Minimum power level in list range in dB.
<LimitCheck>	Result of limit check for the list range. **0** Passed **1** Failed
<Reserved1>	0; currently not used
<Reserved2>	0; currently not used

Usage: Query only

Manual operation: See "Power vs Time (BTS application only)" on page 34

11.10 General Analysis

The following commands configure general result analysis settings concerning the trace and markers for CDA measurements.

Analysis for RF Measurements

General result analysis settings concerning the trace, markers, lines etc. for RF measurements are identical to the analysis functions in the Spectrum application except for some special marker functions and spectrograms, which are not available in the 1xEV-DO applications.

For details see the "Analysis" chapter in the R&S FSW User Manual.

11.10.1 Traces

The trace settings determine how the measured data is analyzed and displayed on the screen. In 1xEV-DO applications, only one trace per window can be configured for Code Domain Analysis.

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNt`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Suffix:

<n> Window

<t> Trace

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

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 FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:
`INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 125

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Suffix:
<n> Window

<t> Trace

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

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

11.10.2 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. In 1xEV-DO applications, only 4 markers per window can be configured for Code Domain Analysis.

11.10.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Suffix:

<n> Window

<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 127

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Suffix:

<n> Window

<m> Marker

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 127
See "Marker Type" on page 127

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular 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:

<m> Marker (query: 1 to 16)

<n> Window

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).
Range: The range depends on the current x-axis range.

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 41
See "Marker Peak List" on page 42
See "X-value" on page 127

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

Suffix:
<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:
<n> Window

<m> Marker

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

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 127
See "Marker Type" on page 127

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:
<m> Marker

<n> Window

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "X-value" on page 127

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n> Window

<m> Marker

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

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.

See also `INITiate<n>:CONTinuous` on page 229.

The unit depends on the application of the command.

Suffix:

<m> Marker

<n> Window

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

11.10.2.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on 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 128

11.10.2.3 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Peak Search" on page 130

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:
<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Minimum" on page 130

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Peak Search" on page 130

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 130

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Minimum" on page 130

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n> Window

<m> Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 130

11.11 Importing and Exporting I/Q Data and Results

For details on importing and exporting I/Q data see Chapter 5, "I/Q Data Import and Export", on page 58.

MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

Parameters:

<FileName> String containing the path and name of the source file.

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 59

MMEMory:STORe<n>:IQ:COMMent <Comment>

This command 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 59

MMEMory:STORe<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Secure User Mode

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

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

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSW User Manual.

Suffix:
<n> irrelevant

Parameters:
1

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iq.tar'`
Stores the captured I/Q data to the specified file.

Manual operation: See "I/Q Export" on page 59

11.12 Configuring the Slave Application Data Range (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA slave applications define an extract of the captured data for analysis, referred to as the **slave application data**.

For the 1xEV-DO BTS slave application, the slave application data range is defined by the same commands used to define the signal capture in Signal and Spectrum Analyzer mode (see `[SENSe:]CDPower:SET:COUNt` on page 198). Be sure to select the correct measurement channel before executing this command.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the slave application data for the 1xEV-DO BTS measurement.

The **analysis interval** used by the individual result displays cannot be edited, but is determined automatically. However, you can query the currently used analysis interval for a specific window.

The **analysis line** is displayed by default but can be hidden or re-positioned.

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

CALCulate<n>:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA slave applications and the MSRA Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF

*RST: ON

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA slave applications and the MSRA Master.

Suffix:

<n> irrelevant

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.

Default unit: s

CALCulate<n>:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in slave application measurement channels, not the MSRA View or MSRA Master.

Suffix:
<n> Window

Return values:
<IntStart> Start value of the analysis interval in seconds
Default unit: s

<IntStop> Stop value of the analysis interval in seconds

Usage: Query only

INITiate<n>:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` SYST:SEQ:OFF) and only for slave applications in MSRA mode, not the MSRA Master.

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

Suffix:
<n> irrelevant

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.
`INST:SEL 'IQ ANALYZER'`
Selects the IQ Analyzer channel.
`INIT:REFR`
Refreshes the display for the I/Q Analyzer channel.

Usage: Event

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for slave applications in MSRA mode, not for the MSRA Master. 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 slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer.
Range: 0 to <Record length>
*RST: 0

Manual operation: See "Capture Offset" on page 94

11.13 Querying the Status Registers

The following commands query the status registers specific to the 1xEV-DO applications. In addition, the 1xEV-DO applications also use the standard status registers of the R&S FSW.

For details on the common R&S FSW status registers refer to the description of remote commands basics in the R&S FSW User Manual.

*RST does not influence the status registers.

The `STATus:QUEStionable:DIQ` register is described in "STATus:QUEStionable:DIQ Register" on page 171.

The `STATus:QUEStionable:SYNC` register contains information on the error situation in the code domain analysis of the 1xEV-DO applications. The bits can be queried with commands `STATus:QUEStionable:SYNC:CONDition?` on page 268 and `STATus:QUEStionable:SYNC[:EVENt]?` on page 268.

Table 11-8: Status error bits in STATus:QUEStionable:SYNC register for 1xEV-DO applications

Bit No	Meaning
0	This bit is not used.
1	Frame Sync failed. This bit is set when synchronization is not possible within the application. Possible reasons: ● Incorrectly set frequency ● Incorrectly set level ● Incorrectly set PN Offset ● Incorrectly set values for Invert Q ● Invalid signal at input
2 to 3	These bits are not used.
4	**BTS application only:** Preamble Current Slot missing This bit is set when the Preamble channel type is being investigated within the 1xEV-DO BTS application, and there is no preamble in the current slot. The measurement results that can be read out for the Preamble channel type are not valid! In **MS application** this bit is not used.
5	**BTS application only:** Preamble Overall missing This bit is set when the Preamble channel type is being investigated within the 1xEV-DO BTS application, and there is no preamble in at least one of the slots being examined. The measurement results that can be read out for the Preamble channel type are not valid if the analysis takes all slots into account. (CDP with Average, Peak Code Domain Error, Composite EVM) In **MS application** this bit is not used.

Bit No	Meaning
6 to 14	These bits are not used.
15	This bit is always 0.

STATus:QUEStionable:SYNC[:EVENt]? <ChannelName>

This command reads out the EVENt section of the status register.

The command also deletes the contents of the EVENt section.

Suffix:
<n> Window

<m> Marker

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATus:QUEStionable:SYNC:CONDition? <ChannelName>

This command reads out the CONDition section of the status register.

The command does not delete the contents of the EVENt section.

Suffix:
<n> Window

<m> Marker

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATus:QUEStionable:SYNC:ENABle <BitDefinition>, <ChannelName>

This command controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:NTRansition <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:PTRansition <BitDefinition>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

11.14 Deprecated Commands

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 11.7.2, "Working with Windows in the Display", on page 220).

Suffix:
<n> Window

Parameters:
<Evaluation> Type of evaluation you want to display.
See the table below for available parameter values.

Example: `CALC:FEED 'XPOW:CDP'`
Selects the Code Domain Power result display.

Table 11-9: <Evaluation> parameter values

String Parameter	Text Parameter	Evaluation
'XTIM:CDP:BSTRearn'	BITStream	Bitstream
'XTIM:CDP:COMP:CONStellation'	CCONst	Composite Constellation
'XTIM:CDP:CBSTReam'	CDBits	Composite Bitstream (MS mode with subtype 2 or 3 only)
'XTIM:CDP:COMP:CONSt'	CDConst	Composite Data Constellation (MS mode with subtype 2 or 3 only)
'XPOW:CDEPower'	CDEPower	Code Domain Error Power
'XTIM:CDP:COMP:EVM'	CDEVm	Composite EVM
'XPOW:CDP:RATio'	CDPower	Code Domain Power
'XTIM:CDP:MACCuracy'	CEVM	Composite EVM
'XTIM:CDP:ERR:CTABle'	CTABle	Channel Table
'XTIM:CDP:PVCHip'	PCHip PHSLot	Power vs Chip (BTS mode only) Power vs Halfslot (MS mode only)
'XTIM:CDP:ERR:PCDomain'	PCDerror	Peak Code Domain Error

String Parameter	Text Parameter	Evaluation
'XTIM:CDP:PVSYmbol'	PSYMbol	Power vs Symbol
'XTIM:CDP:ERR:SUMMary'	RSUMmary CRESults GRESults	Result Summary Channel Results (BTS mode only) General Results (BTS mode only)
'XPOW:CDP:RATio'	SCONst	Symbol Constellation
'XTIM:CDP:SYMB:EVM'	SEVM	Symbol EVM

CONFigure:CDPower[:BTS]:PVTime:LIST[:STATe] <State>

Opens a new window to display a list evaluation.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see Chapter 11.7.2, "Working with Windows in the Display", on page 220).

Parameters:

<State> ON | OFF

*RST: OFF

[SENSe:]CDPower:LEVel:ADJust

This command adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Note that this command is retained for compatibility reasons only. For new R&S FSW programs use `[SENSe:]ADJust:LEVel` on page 210.

[SENSe:]CDPower:PRESet

This command resets the 1xEV-DO channel to its predefined settings. Any RF measurement is aborted and the measurement type is reset to Code Domain Analysis.

Note that this command is retained for comaptibility reasons only. For new remote control programs use the `SYSTem:PRESet:CHANnel[:EXECute]` command.

Usage: Event

Annex

A Annex

A.1 Predefined Channel Tables

Predefined channel tables offer access to a quick configuration for the channel search. The "1xEV-DO BTS Analysis" option provides the following set of channel tables compliant with the 1xEV-DO specification:

- DOQPSK:
  Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type QPSK in channel type DATA and the following listed active codes in channel types.
- DO8PSK:
  Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 8-PSK in channel type DATA and the following listed active codes in channel types.
- DO16QAM:
  Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 16-QAM in channel type DATA and the following listed active codes in channel types.
- DO_IDLE:
  Channel table with channel types PILOT/MAC – known as IDLE slot, since it does not contain any active channels in the DATA channel type.
- PICH (MS application only)
  Channel table with the pilot channel as it exists in Access mode at least during the first slot 16.
- PICHRRI (MS application only)
  Channel table with pilot channel and RRI with the name PICHRRI. The channels are active on the same code but at different times. If the RRI and the PICH are active, it is assumed that for the first 256 chips (1/4 of the half slot, 1/8 of the entire slot) only the RRI and then the PICH is active in this half slot. If only the PICH is active (RRI activity 0), the PICH is active for the entire 1024 chips of the half slot.
- 5CHANS (MS application only)
  Channel table with 5 channels: PICH/RRI/DRC/ACK/DATA

Table A-1: Base station channel table DOQPSK with QPSK modulation in DATA area

Channel Type	No. of Chan-nels	Code Channel (Walsh Code.SF)	Modulation/Mapping
Pilot	1	0.32	BPSK-I
Mac	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
Preamble (64 chips long)	1	3.32	BPSK-I
Data	16	0.16 1.16 2.16 … 13.16 14.16 15.16	QPSK QPSK QPSK ... QPSK QPSK QPSK

Table A-2: Base station channel table DO8PSK with 8-PSK modulation in DATA area

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Modulation/ Mapping
Pilot	1	0.32	BPSK-I
Mac	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
Preamble (64 chips long)	1	3.32	BPSK-I
Data	16	0.16 1.16 2.16 … 13.16 14.16 15.16	8-PSK 8-PSK 8-PSK ... 8-PSK 8-PSK 8-PSK

Table A-3: Base station channel table DO16QAM with 16QAM modulation in DATA area

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Modulation/ Mapping
Pilot	1	0.32	BPSK-I
Mac	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
Preamble (64 chips long)	1	3.32	BPSK-I
Data	16	0.16 1.16 2.16 ... 13.16 14.16 15.16	16QAM 16QAM 16QAM ... 16QAM 16QAM 16QAM

Table A-4: Base station test model DO_IDLE for idle slot configuration

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Modulation/ Mapping
Pilot	1	0.32	BPSK-I
Mac	5	2.64 (RA)	BPSK-I

Table A-5: Mobile station channel table PICH

Channel type	Code channel (Walsh Code.SF)	Mapping	Activity
PICH	0.16	I	1111 1111 1111 1111

Table A-6: Mobile station channel table PICHRRI

Channel type	Code channel (Walsh Code.SF)	Mapping	Activity
PICH	0.16	I	1111 1111 1111 1111
RRI	0.16	I	1010 1010 1010 1010

Table A-7: Mobile station channel table 5CHANS

Channel type	Code channel (Walsh Code.SF)	Mapping	Activity
PICH	0.16	I	1111 1111 1111 1111
RRI	0.16	I	1010 1010 1010 1010
DATA	2.4	Q	1111 1111 1111 1111

Channel type	Code channel (Walsh Code.SF)	Mapping	Activity
ACK	4.8	I	0000 0000 0000 1000
DRC	8.16	Q	0110 0000 0000 0000

A.2 Channel Type Characteristics

At a chip rate of 1.2288 MHz, the symbol rate results as 1.2288MHz/spreading factor. The bit rate depends on how many bits describe a symbol in the modulation type being used.

BTS signals

Due to the different PREAMBLE lengths, the DATA area is shortened depending on the PREAMBLE. All relationships can be seen in the following table:

Table A-8: Relationship between various parameters in 1xEV-DO BTS application

Channel type	Code class	Sub-type	SF	Symbol rate	Modulation type	Chips per slot	Symbols per slot and code	Bits per slot and code	
								Mapping I or Q	Mapping complex
PILOT	5		32	38.4 ksps	BPSK-I	96*2 = 192	6	6	12
MAC	6	0/1	64	19.2 ksps	BPSK-I, BPSK-Q	64*4 = 256	4	4	8
		2/3	128	9.6 ksps	BPSK-I, BPSK-Q, OOK-ACK-I, OOK-ACK- Q, OOK-NAK-I, OOK-NAK-Q	128*2 = 256	2	2	4
PREAMBLE	5	0/1	32	38.4 ksps	BPSK-I	Preamble length:			
						64: 128: 256: 512: 1024:	2 4 8 16 32	2 4 8 16 32	4 8 16 32 64
		2	64	19.2 ksps	BPSK-I	Preamble length:			
						64: 128: 256: 512: 1024:	1 2 4 8 16	1 2 4 8 16	2 4 8 16 32
		3	128	9.6 ksps	BPSK-I or BPSK-Q	Preamble length:			

<table>
<tr><th rowspan="2">Channel type</th><th rowspan="2">Code class</th><th rowspan="2">Sub-type</th><th rowspan="2">SF</th><th rowspan="2">Symbol rate</th><th rowspan="2">Modulation type</th><th rowspan="2">Chips per slot</th><th rowspan="2">Sym-bols per slot and code</th><th colspan="4">Bits per slot and code</th></tr>
<tr><th colspan="2">Mapping I or Q</th><th colspan="2">Mapping complex</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>64:
128:
256:
512:
1024:</td><td>0.5
1
2
4
8</td><td colspan="2">0.5
1
2
4
8</td><td colspan="2">1
2
4
8
16</td></tr>
<tr><td rowspan="3">DATA</td><td rowspan="3">4</td><td rowspan="2">0/1/2</td><td rowspan="2">16</td><td rowspan="3">76.8 ksps</td><td rowspan="2">QPSK, 8-PSK, 16-QAM</td><td rowspan="2">400*4 -
PreambleChips=
DataNettoChips</td><td rowspan="2"></td><td colspan="4">Mapping always complex
Modulation type:</td></tr>
<tr><td>QPSK</td><td>8-PSK</td><td>16-QAM</td><td>64-QAM</td></tr>
<tr><td>3</td><td>16</td><td>64-QAM</td><td>1600-0 = 1600
1600-64 = 1536
1600-128 = 1472
1600-256 = 1344
1600-512 = 1088
1600-1024 = 576</td><td>100
96
92
84
68
36</td><td>200
192
184
168
136
72</td><td>300
288
276
252
204
104</td><td>400
384
368
336
272
144</td><td>500
480
460
420
340
180</td></tr>
</table>

MS signals

Table A-9: Relationship between various channel parameters in the 1xEV-DO MS application

Data rate [ksps]	Spreading factor	Code class	Symbols per half-slot
76.8	16	4	64
153.6	8	3	128
307.2	4	2	256

Table A-10: Relationship between modulation type and bits per symbol

Modulation type	Bits per symbol
BPSK	1
2BPSK	2
QPSK	2
8-PSK	3
16QAM	4
B4	1
Q2	4
Q4	2

Modulation type	Bits per symbol
Q4Q2	6
E4E2	9

A.3 Reference: Supported Bandclasses

The bandclass defines the frequency band used for ACLR and SEM measurements. It also determines the corresponding limits and ACLR channel settings according to the 1xEV-DO standard. The used bandclass is defined in the SEM or ACLR measurement settings (see "Bandclass" on page 113).

Table A-11: Supported bandclasses for 1xEV-DO RF measurements

Bandclass	SCPI para	Description
0	0	800 MHz Cellular Band
1	1	1.9 GHz PCS Band
2	2	TACS Band
3A	3	JTACS Band: >832 MHz and ≤ 834 MHz >838 MHz and ≤ 846 MHz >860 MHz and ≤ 895 MHz
3B	**21**	JTACS Band: >810 MHz and ≤ 860 MHz except: >832 MHz and ≤ 834 MHz >838 MHz and ≤ 846 MHz
3C	**22**	JTACS Band: ≤810 MHz and >895 MHz
4	4	Korean PCS Band
5	5	450 MHz NMT Band
6	6	2 GHz IMT-2000 Band
7	7	700 MHz Band
8	8	1800 MHz Band
9	9	900 MHz Band
10	10	Secondary 800 MHz
11	11	400 MHz European PAMR Band
12	12	800 MHz PAMR Band
13	13	2.5 GHz IMT-2000 Extension Band
14	14	US PCS 1.9 GHz Band

Bandclass	SCPI para	Description
15	15	AWS Band
16	16	US 2.5 GHz Band
17	17	US 2.5 GHz Forward Link Only Band

A.4 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 preview the I/Q data in a web browser, and allows you to include user-specific data.

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.

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.
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

A.4.1 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 FSW</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>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition. Currently, `fileFormatVersion` "2" is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).

Element	Description
Samples	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	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	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	Specifies the binary format used for samples in the I/Q data binary file (see `DataFilename` element and Chapter A.4.2, "I/Q Data Binary File", on page 282). 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	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	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.4.2, "I/Q Data Binary File", on page 282). 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

Element	Description
UserData	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	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 FSW). 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.

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

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>
```

A.4.2 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)
```

List of Remote Commands (1xEV-DO)

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