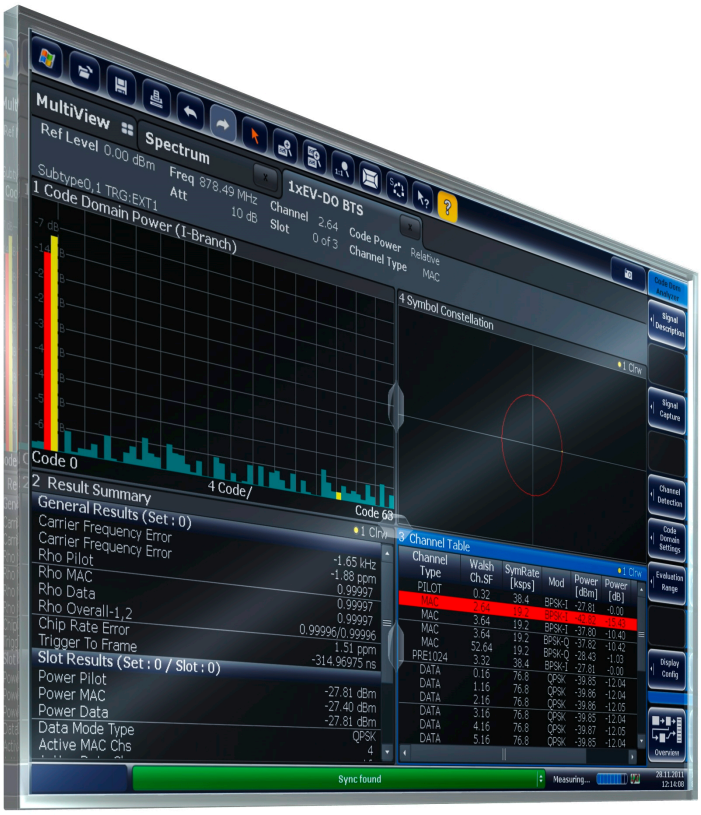
R&S®FSW-84/-K85
1xEV-DO Measurements
User Manual



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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 1.51 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)

The following firmware options are described:

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

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" 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 R&S FSW-K84/-K85 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
- **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**
  Alpahabetical 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
- Documentation CD-ROM with:
  - Getting Started
  - User Manuals for base unit and options
  - Service Manual
  - Release Notes
  - Data sheet and product brochures

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. Online help is available using the icon on the toolbar of the R&S FSW.

Getting Started

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and handling are described. Safety information is also included.

The Getting Started manual in various languages is also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

User Manuals

User manuals are provided for the base unit and each additional (software) option.

The user manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the user manuals, all instrument functions are described in detail. Furthermore, they provide a complete description of the remote control commands with programming examples.

The user manual for the base unit provides basic information on operating the R&S FSW in general, and the Spectrum application in particular. Furthermore, the software functions that enhance the basic functionality for various applications are described here. An introduction to remote control is provided, as well as information on maintenance, instrument interfaces and troubleshooting.

In the individual application manuals, the specific instrument functions of the application are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S FSW is not included in the application manuals.

All user manuals are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S FSW by replacing modules.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes.

The most recent release notes are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html > Downloads > Firmware.

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.
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.

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.

All functions not discussed in this manual are the same as in the base unit 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. Press the MODE key on the front panel of the R&S FSW.

   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 5.2.2, "Configuration Overview", on page 56).

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.

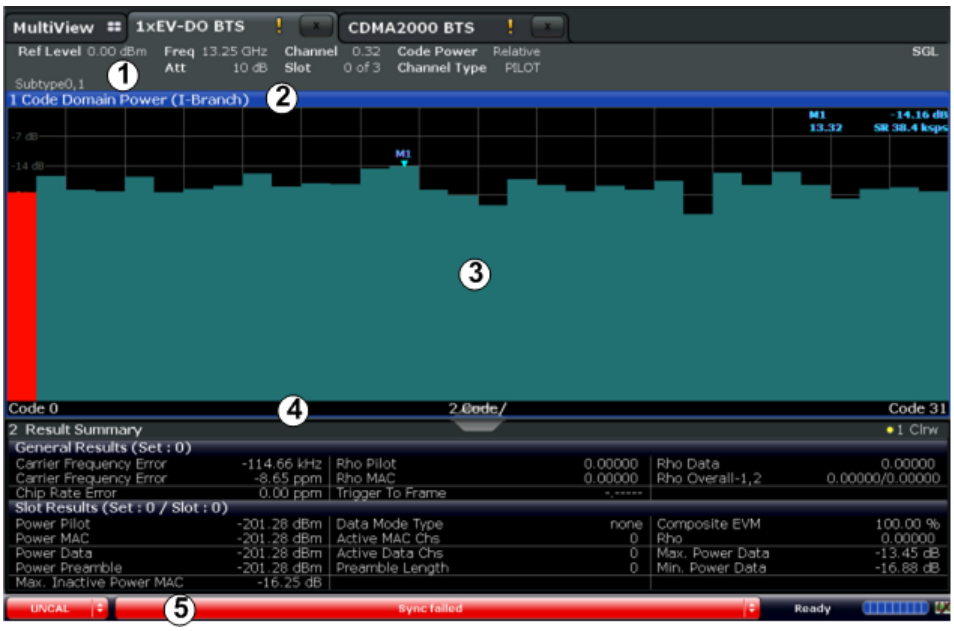
If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a symbol in the tab label. The result displays of the individual channels are updated in the tabs (including the "MultiView") as the measurements are performed. Sequential operation itself is independant 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 40)
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:

Fig. 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

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 54.

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

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

SCPI command:

`CONF:CDP:MEAS CDP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

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 10, "Remote Commands for 1xEV-DO Measurements", on page 137).

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 10-2 and table 10-3)
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 105), 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 30.

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 105), 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

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.

To activate SmartGrid mode, do one of the following:

- 

  Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the configuration "Overview".
- Select the "Display Config" softkey from the MEAS CONFIG menu.

The selected evaluation not only affects the result display, but also the results of the trace data query (see chapter 10.8.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 219).

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.

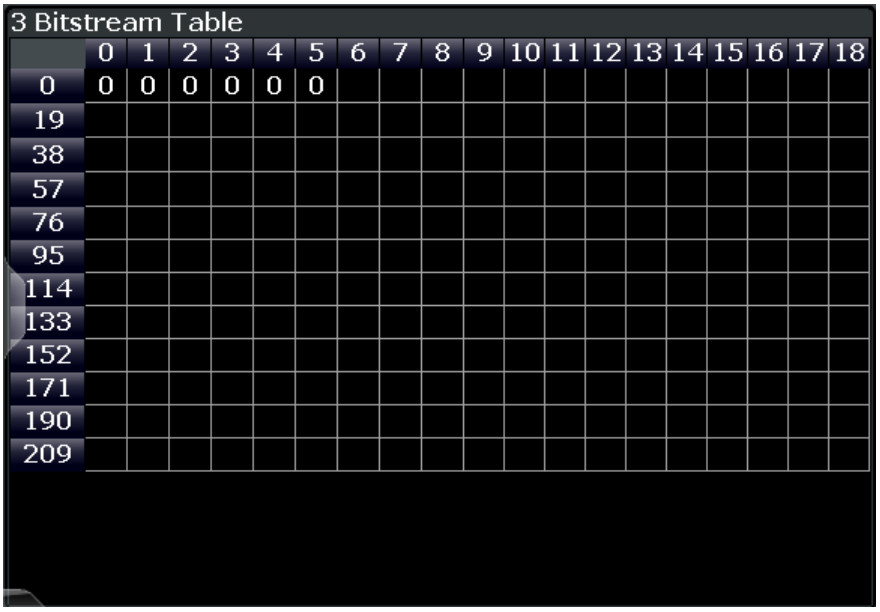


Fig. 3-1: Bitstream result display in the BTS application

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 249.

SCPI command:

`LAY:ADD? '1',RIGH, 'BITS'`, see `LAYout:ADD[:WINDow]?` on page 200

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.

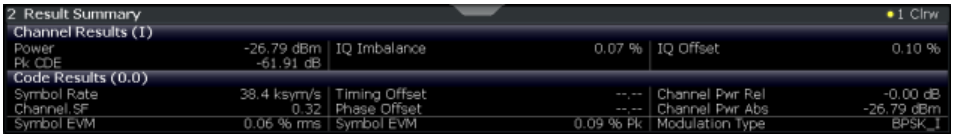


Fig. 3-2: Channel results summary

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

SCPI command:

`LAY:ADD? '1',RIGH, CRES`, see `LAYout:ADD[:WINDow]?` on page 200

`CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

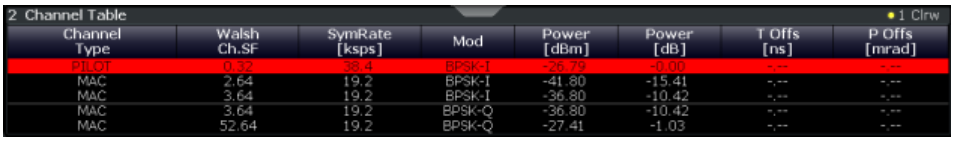


Fig. 3-3: Channel Table display in the BTS application

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 6.5, "Channel Table Configuration", on page 111.

Which parameters are displayed in the Channel Table is configurable, see chapter 6.5, "Channel Table Configuration", on page 111.

SCPI command:

`LAY:ADD? '1',RIGH, CTABle`, see `LAYout:ADD[:WINDow]?` on page 200

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 49).

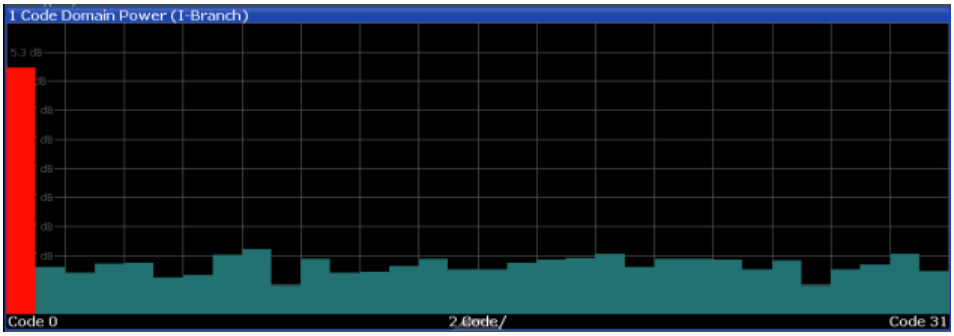


Fig. 3-4: Code Domain Power Display in the BTS application

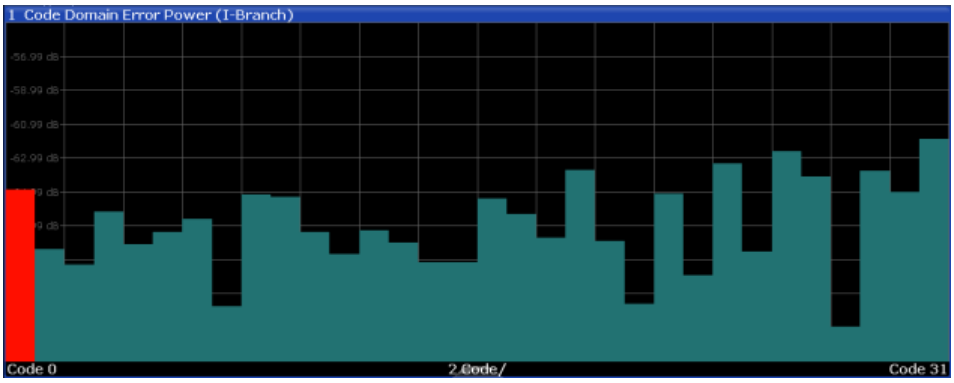


Fig. 3-5: Code Domain Error Power result display

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

SCPI command:

CDP:

`LAY:ADD? '1',RIGH, CDPower`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES? CDP` or `CALC:MARK:FUNC:CDP:RES? CDPR`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

CDEP:

`LAY:ADD? '1',RIGH, CDEPower`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214.

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.

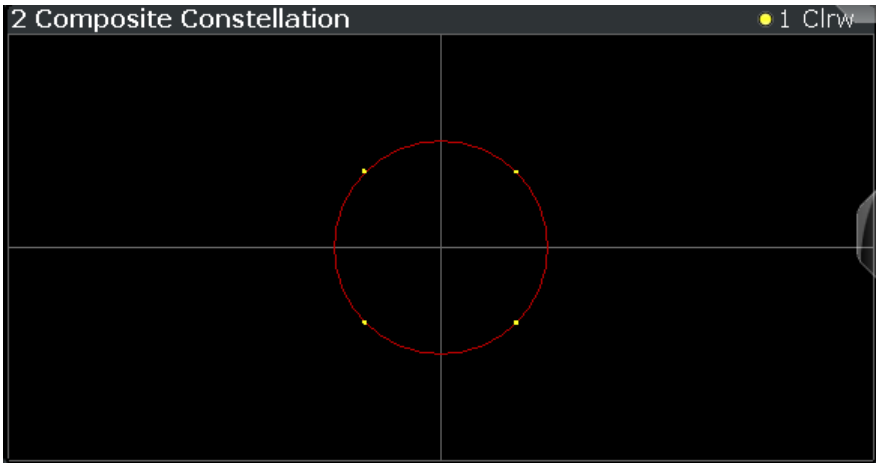


Fig. 3-6: Composite Constellation display in the BTS application

SCPI command:

`LAY:ADD? '1',RIGH, CCON`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

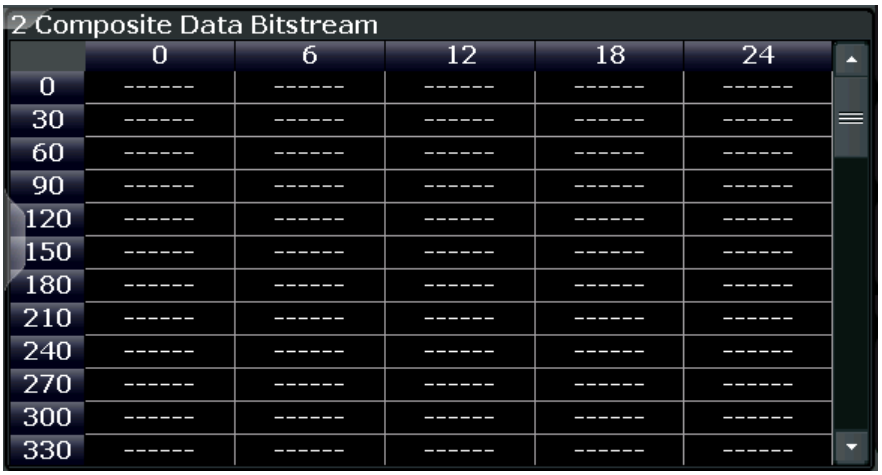


Fig. 3-7: Composite Data Bitstream result display

The number of displayed symbols depends on the spreading factor, see chapter A.2, "Channel Type Characteristics", on page 249.

SCPI command:

`LAY:ADD? '1',RIGH, CDB`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

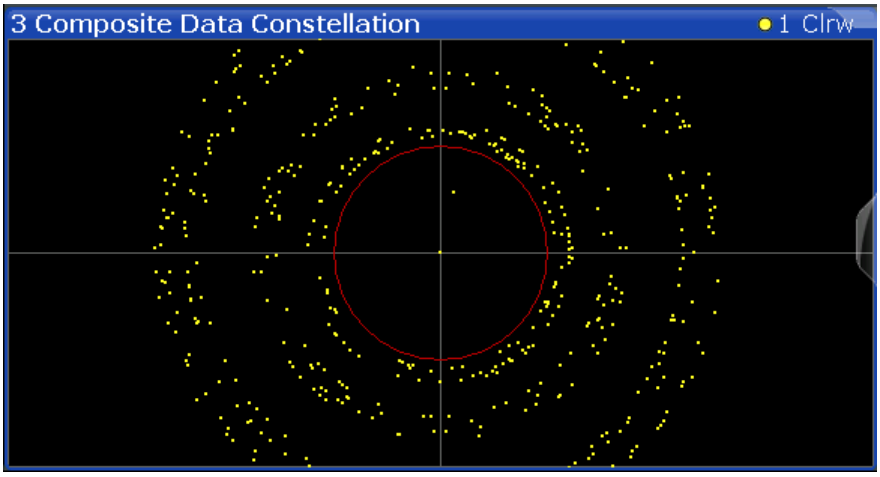


Fig. 3-8: Composite Data Constellation result display

SCPI command:

`LAY:ADD? '1',RIGH, CDC`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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 83).

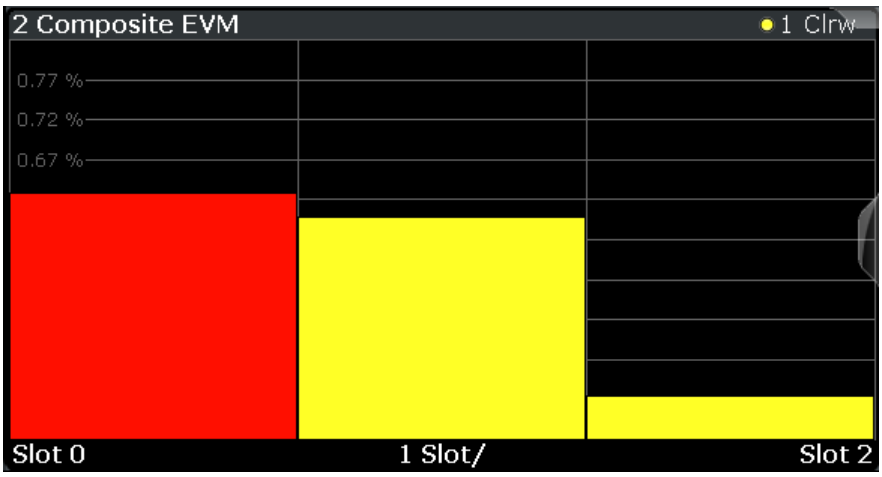


Fig. 3-9: Composite EVM result display

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 86 setting.

SCPI command:

`LAY:ADD? '1',RIGH, CEVM`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES? MACCuracy`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

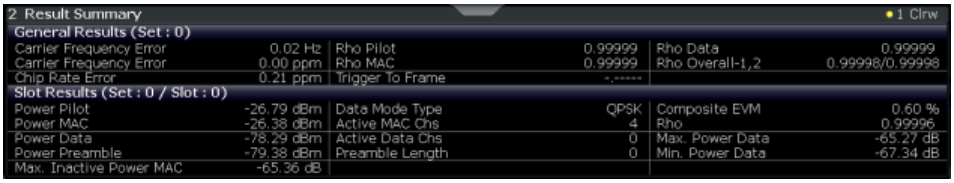


Fig. 3-10: General results summary

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

SCPI command:

`LAY:ADD? '1',RIGH, GRES`, see `LAYout:ADD[:WINDow]?` on page 200

`CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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 5.2.7, "Signal Capture (Data Acquisition)", on page 82).

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

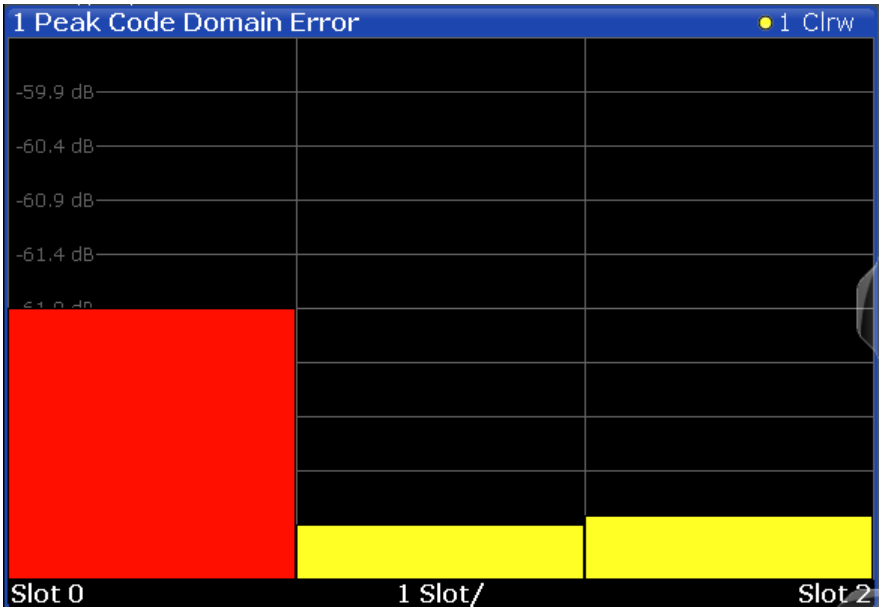


Fig. 3-11: Peak Code Domain Error display in the BTS application

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.

SCPI command:
`LAY:ADD? '1',RIGH, PCDerror`, see `LAYout:ADD[:WINDow]?` on page 200
`CALC:MARK:FUNC:CDP:RES? PCDerror`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

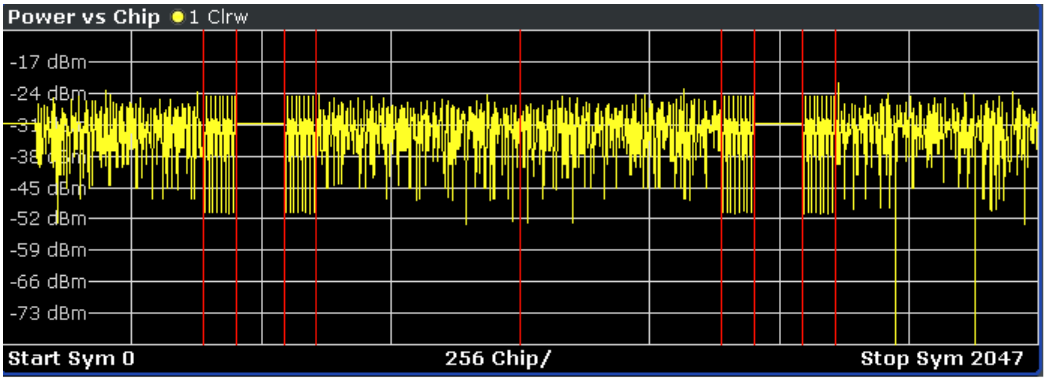


Fig. 3-12: Power vs Chip result display

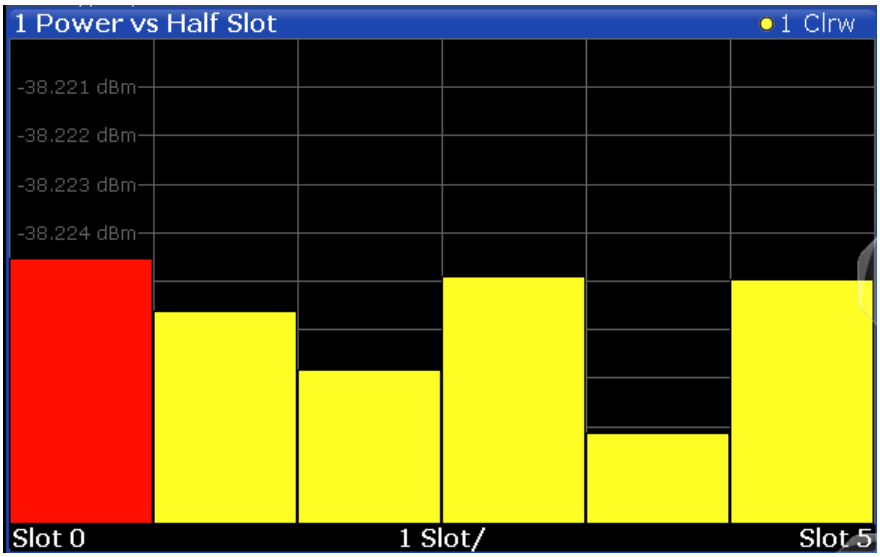
Due to the symmetric structure of the 1xEV-DO forward link signal, it is easy to identify which channel types in the slot have power.

SCPI command:

`LAY:ADD? '1',RIGH, PVChip`, see `LAYout:ADD[:WINDow]?` on page 200

Power vs Halfslot (MS application only)

This result display shows the power of the selected channel over all half-slots.



SCPI command:

`LAY:ADD? '1',RIGH, PHSLot`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

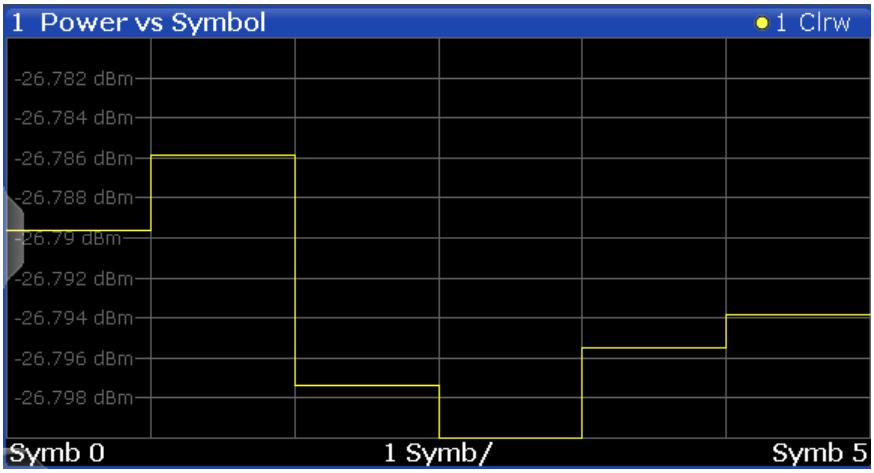


Fig. 3-13: Power vs Symbol result display

SCPI command:
`LAY:ADD? '1',RIGH, PSYMbol`, see `LAYout:ADD[:WINDow]?` on page 200
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

Fig. 3-14: 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

SCPI command:
`LAY:ADD? '1',RIGH, RSUMmary`, see `LAYout:ADD[:WINDow]?` on page 200
`CALC:MARK:FUNC:CDP:RES?`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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 249 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.

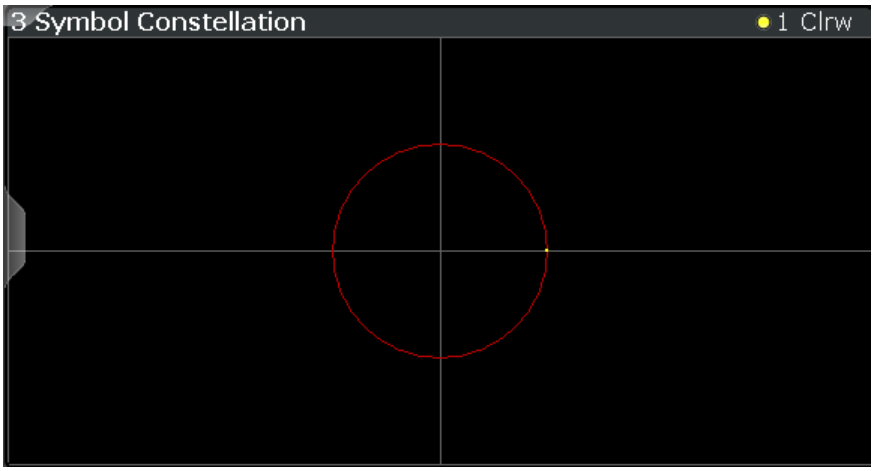


Fig. 3-15: Symbol Constellation display in the BTS application

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 249).

SCPI command:
`LAY:ADD? '1',RIGH, SCONst`, see `LAYout:ADD[:WINDow]?` on page 200
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

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.

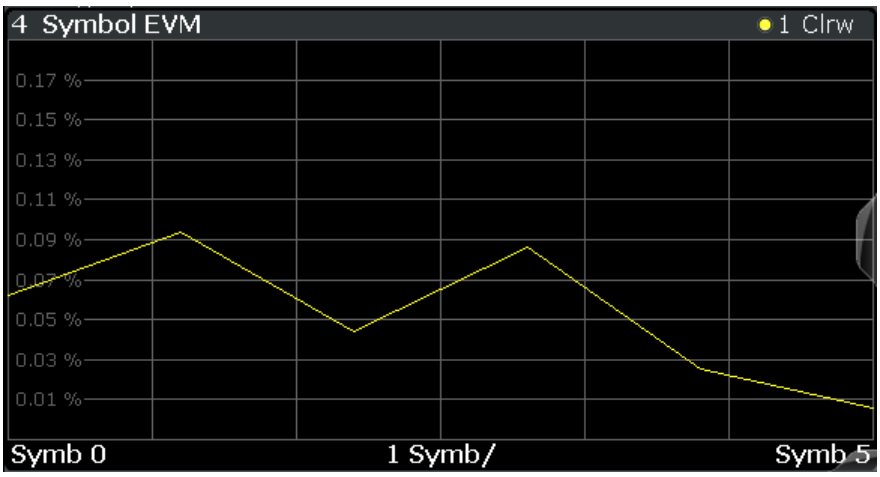


Fig. 3-16: Symbol EVM display in the BTS application

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 249).

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

SCPI command:

`LAY:ADD? '1',RIGH, SEVM`, see `LAYout:ADD[:WINDow]?` on page 200

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 214

3.2 RF Measurements

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)
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.

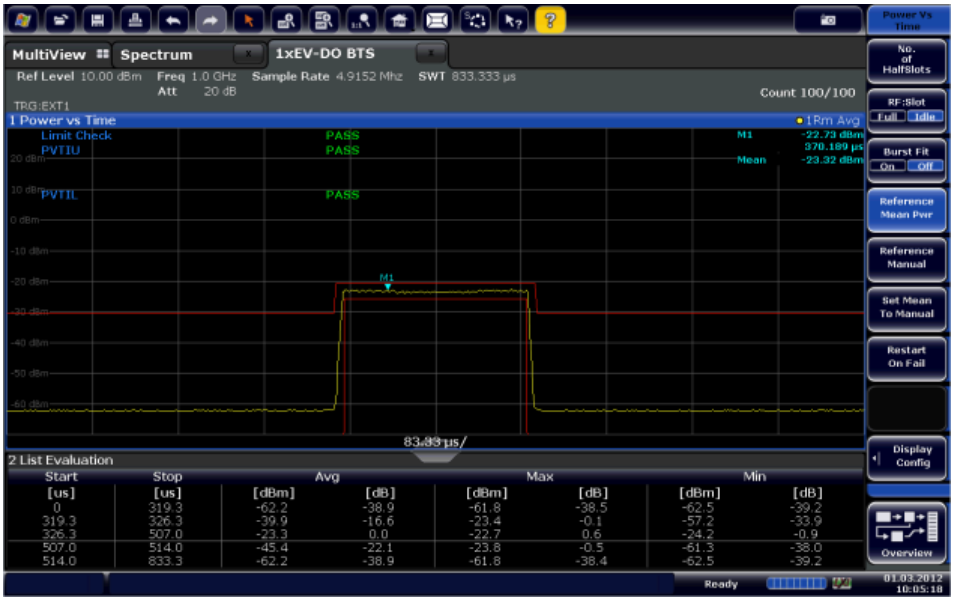


Fig. 3-17: Power vs Time measurement results in the 1xEV-DO BTS application

SCPI command:
`CONF:CDP:MEAS PVT`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

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.

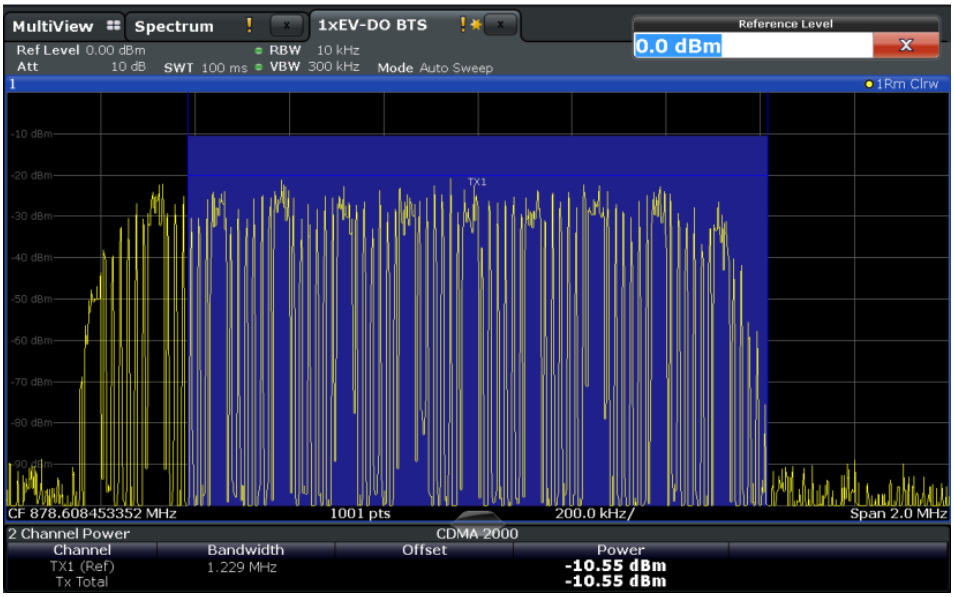


Fig. 3-18: Power measurement results in the 1xEV-DO BTS application

SCPI command:

`CONF:CDP:MEAS POW`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

Querying results: `CALC:MARK:FUNC:POW:RES? CPOW`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

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.

Fig. 3-19: ACLR measurement results in the 1xEV-DO BTS application

SCPI command:

`CONF:CDP:MEAS ACLR`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

Querying results:

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

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.

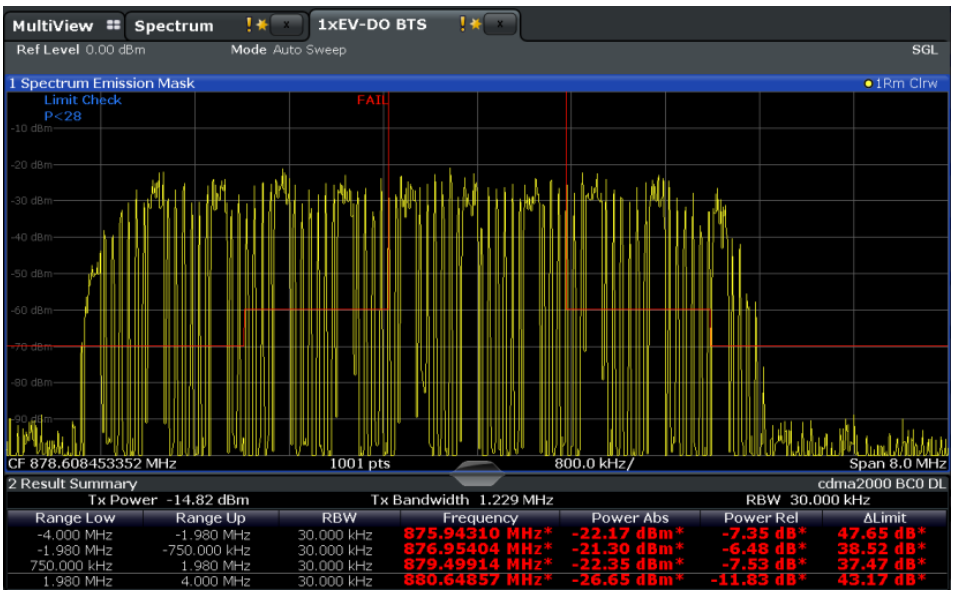


Fig. 3-20: SEM measurement results in the 1xEV-DO BTS application

SCPI command:

`CONF:CDP:MEAS ESP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

Querying results:

`CALC:MARK:FUNC:POW:RES? CPOW`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

`CALCulate<n>:LIMit<k>:FAIL` on page 228

Occupied Bandwidth

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.

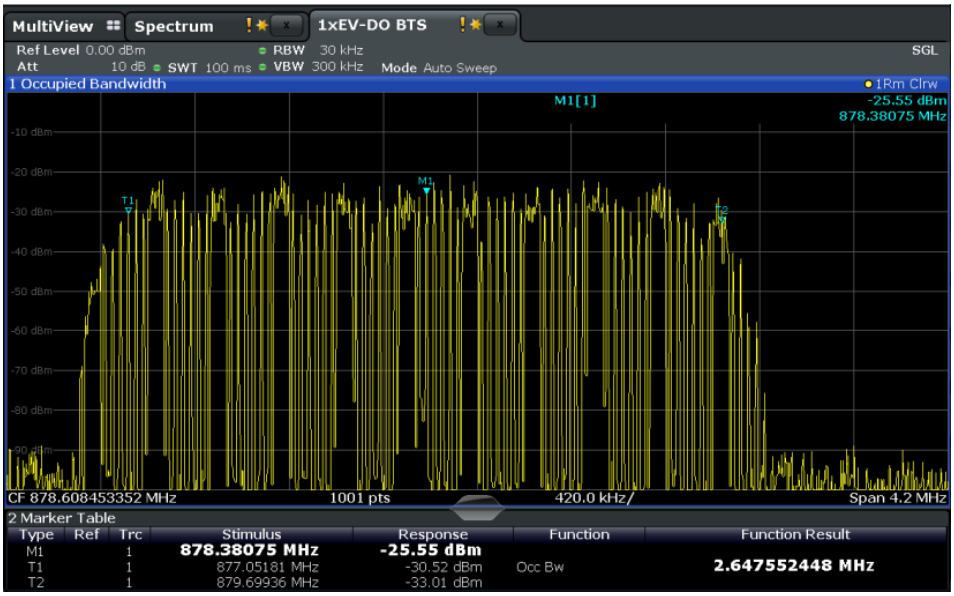


Fig. 3-21: OBW measurement results in the 1xEV-DO BTS application

SCPI command:

`CONF:CDP:MEAS OBAN`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145

Querying results:

`CALC:MARK:FUNC:POW:RES? OBW`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229

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.

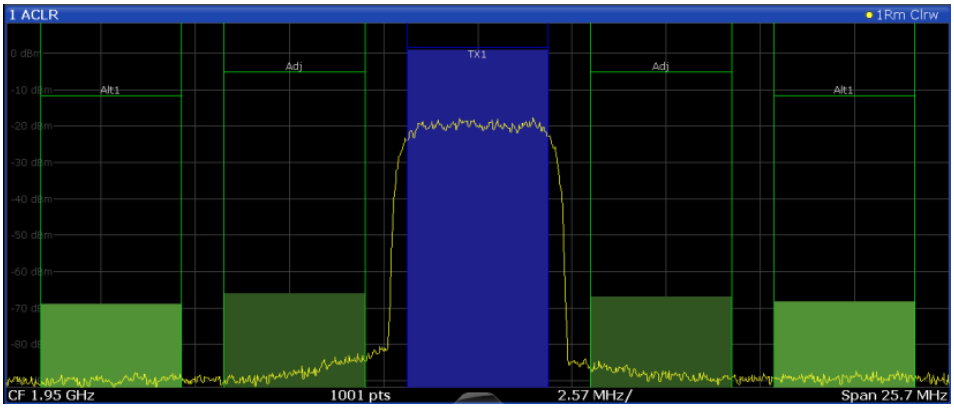
Fig. 3-22: CCDF measurement results in the 1xEV-DO BTS application

SCPI command:
`CONF:CDP:MEAS CCDF`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 145
Querying results:
`CALCulate<n>:MARKer<m>:Y?` on page 217
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult?` on page 229
`CALCulate<n>:STATistics:RESult<t>` on page 230

3.2.2 Evaluation Methods for RF Measurements

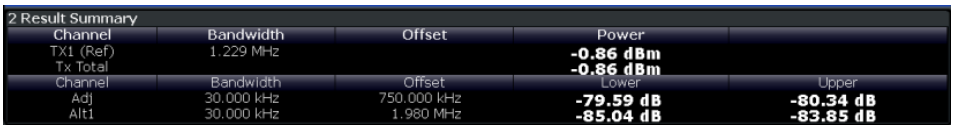
The evaluation methods for RF measurements are identical to those in the Spectrum application.

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.



SCPI command:
`LAY:ADD? '1',RIGH, DIAG`, see `LAYout:ADD[:WINDow]?` on page 200

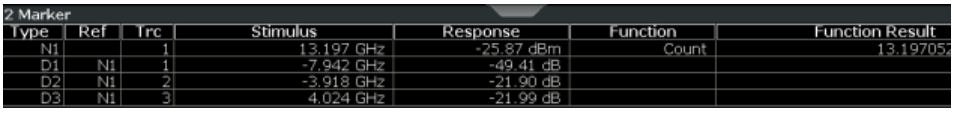
Result Summary
Result summaries provide the results of specific measurement functions in a table for numerical evaluation. The contents of the result summary vary depending on the selected measurement function. See the description of the individual measurement functions for details.



SCPI command:
`LAY:ADD? '1',RIGH, RSUM`, see `LAYout:ADD[:WINDow]?` on page 200

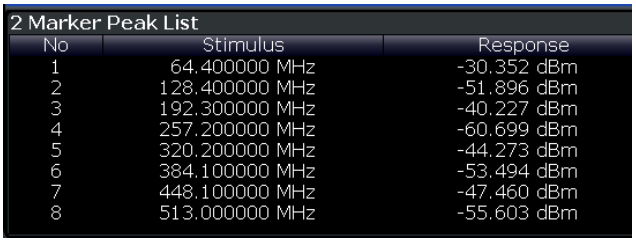
Marker Table
Displays a table with the current marker values for the active markers.

This table may be displayed automatically if configured accordingly (see "Marker Table Display" on page 116).



SCPI command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 200

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

SCPI command:

`LAY:ADD? '1',RIGH, PEAK`, see `LAYout:ADD[:WINDow]?` on page 200

Evaluation List

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

SCPI command:

`LAY:ADD? '1',RIGH,LEV`, see `LAYout:ADD[:WINDow]?` on page 200

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, since the chips for 1xEV-DO are assigned chronologically one after the other to the different channel types, and 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. Furthermore, 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 may 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.

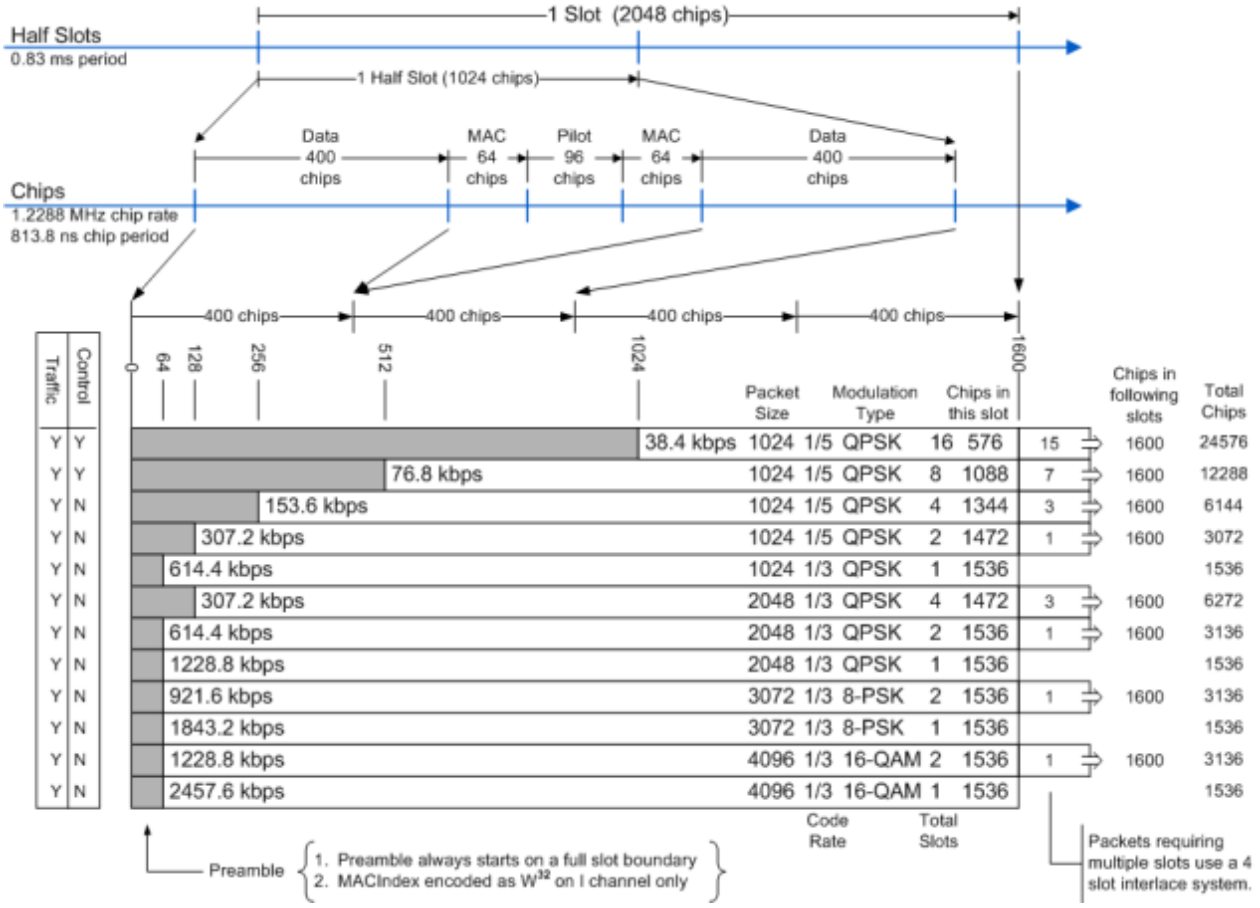


Fig. 4-1: Slot structure, chip distribution and preamble lengths in 1xEV-DO BTS application

The 1xEV-DO applications can capture up to 48000 slots (about 80 seconds) in a single sweep. In order to improve performance during measurement and analysis, the captured slots are not processed by the 1xEV-DO application all at once, but rather in **sets**, one at a time. One set usually consists of 32 slots in BTS application, and 64 slots in the MS application. You can select how many sets are to be 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 signals from different base stations can be distinguished quickly by the 1xEV-DO BTS application if the "PN Off-

set" is defined in the signal description and 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. These masks are required by the 1xEV-DO MS application to distinguish the senders and 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 was 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 and 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) in order to get the correct peak at the position where the frame begins. This correlation method may 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 we will not get a power drop or peak 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 86).
  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 246.

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 48). However, even if the code on the analyzed branch is inactive, the code with the same number on the other branch may 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 7.1, "Error Messages", on page 120. 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

Channel type	Ch.no / SF	Mapping	Description
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.

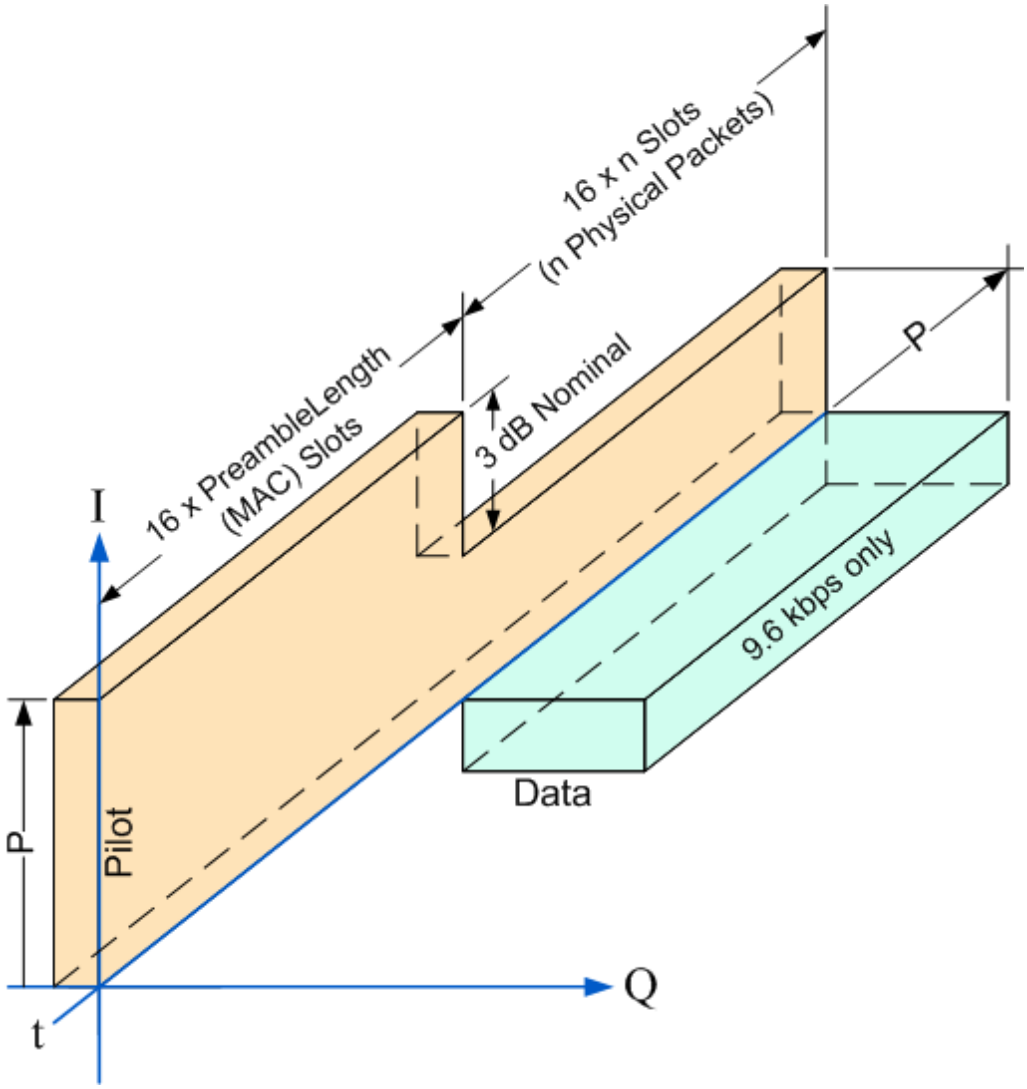


Fig. 4-2: 1xEV-DO MS channels in ACCESS mode

Once the transmission has been established, the **TRAFFIC** mode takes over. The Traffic mode contains all 5 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.

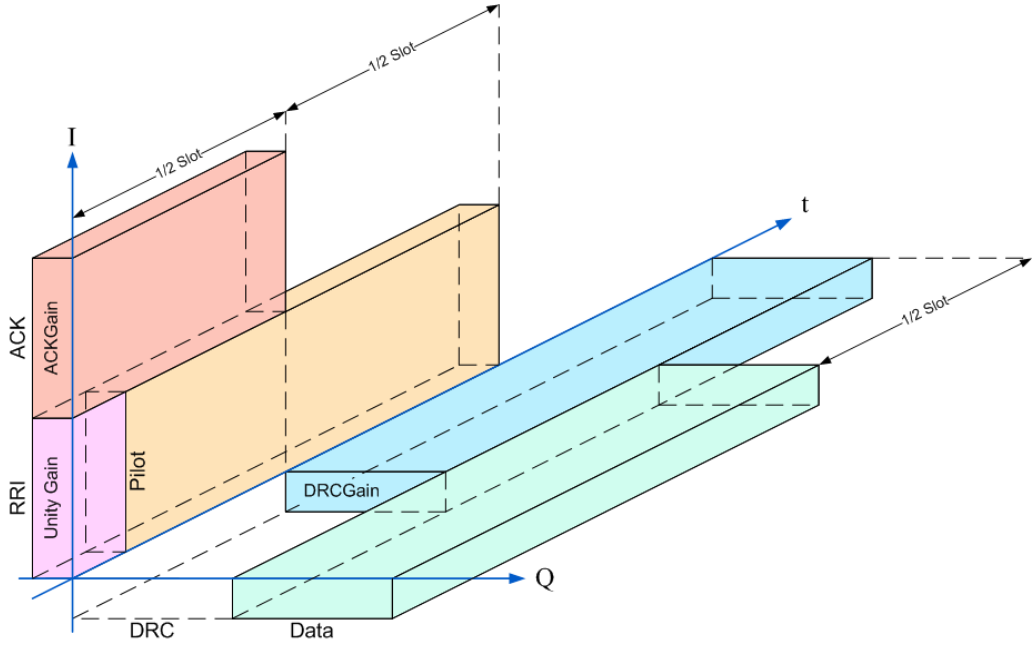


Fig. 4-3: 1xEV-DO MS channels in TRAFFIC mode

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, which has an affect on 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 and 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 applications a special multi-carrier 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 Multi-Carrier Mode

The 1xEV-DO applications can filter out and analyze one carrier out of a multi-carrier signal, if a special multi-carrier 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.

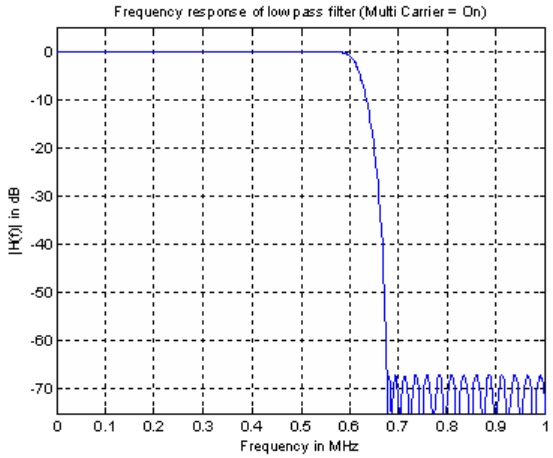


Fig. 4-4: Frequency response of the low-pass multi-carrier filter

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 independantly. Thus, when analyzing signals, you must define which

branch results you want to analyze. Especially for code power measurements the results may vary considerably. While a channel may be active on one branch, the other branch may belong to an inactive channel.

For BTS signals, the complex data (i.e. both branches simultaneously) may 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 may 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 is to be evaluated and displayed 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):

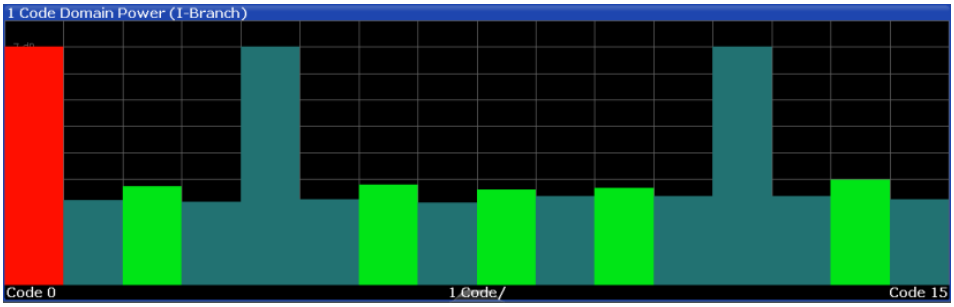


Fig. 4-5: Code Domain Error Power result display in Hadamard code sorting order

The same results in Bit-Reverse order:

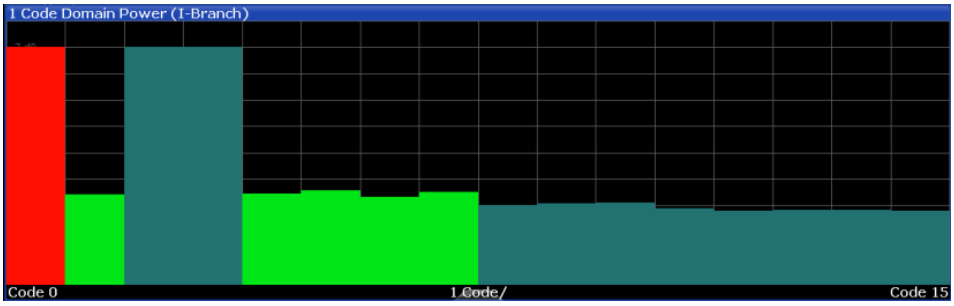


Fig. 4-6: Code Domain Error Power result display in BitReverse code sorting order

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, the R&S FSW has to be configured correctly and supplied with power 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 cause damage to the instrument and to 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.

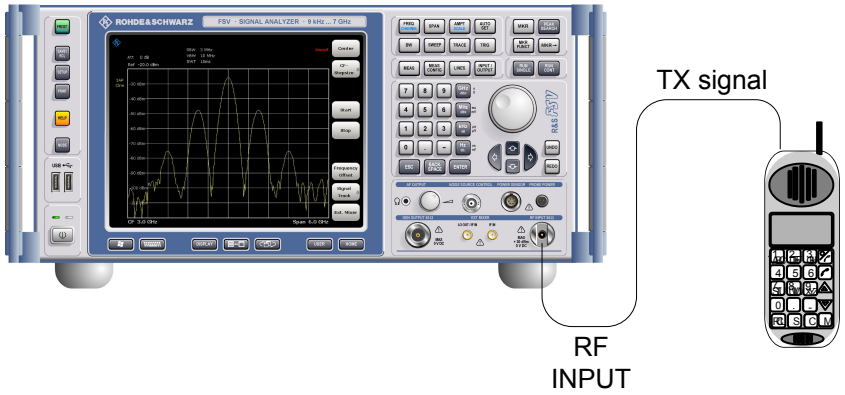
Required units and accessories

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

Maximum Power	Recommended external attenuation
≥ 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 68).

Presettings

(For details see chapter 5.2, "Code Domain Analysis", on page 55)

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 actually 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 can not be edited directly in the 1xEV-DO BTS application, but is changed automatically when you change the evaluation range.

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

5 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 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 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:

- Tap the "Overview" softkey. In the "Overview", tap the "Select Measurement" button. Select the required measurement.
- Press the MEAS key on the front panel. In the "Select Measurement" dialog box, select the required measurement.

5.1 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 on the front panel.

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

5.2 Code Domain Analysis

1xEV-DO measurements require a special application on the R&S FSW, which you activate using the MODE key on the front panel.

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 on the front panel.

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

The I/Q data to be evaluated for 1xEV-DO can not only be measured by the 1xEV-DO applications themselves, it can also be imported to the applications, 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.

The import and export functions are available in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar.

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

5.2.1 Default Settings for Code Domain Analysis

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
- signal source and digital I/Q input settings
- input coupling
- YIG filter state

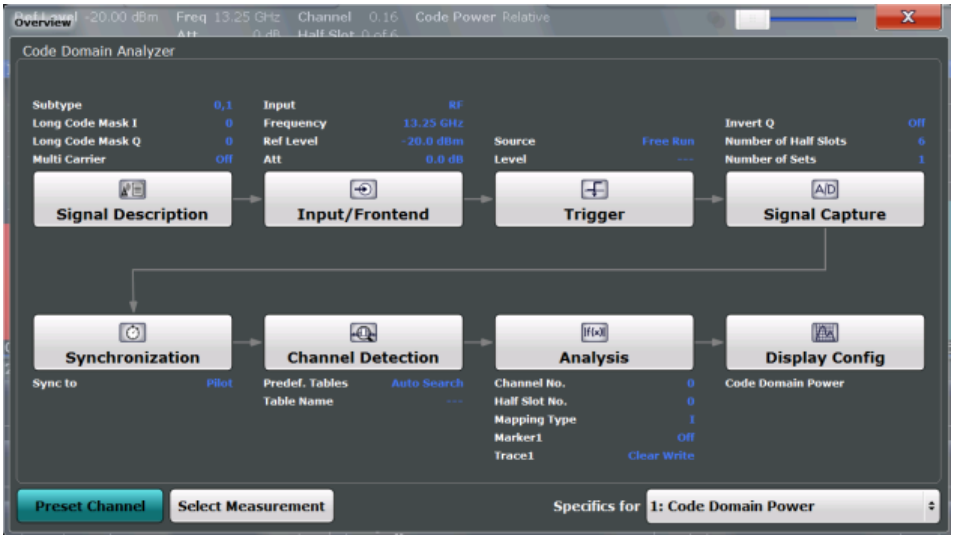
After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

Apart from these settings, the following default settings are activated directly after a 1xEV-DO application is activated, or after a Preset Channel:

The following default settings of the Code Domain Analysis are activated:

5.2.2 Configuration Overview

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



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. 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 5.3, "RF Measurements", on page 97.

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 54
2. "Signal Description"
   See chapter 5.2.3, "Signal Description", on page 58
3. "Input/ Frontend"
   Seechapter 5.2.4, "Data Input and Output Settings", on page 63 and chapter 5.2.5, "Frontend Settings", on page 71
4. (Optionally:) "Trigger"
   See chapter 5.2.6, "Trigger Settings", on page 77
5. "Signal Capture"
   See chapter 5.2.7, "Signal Capture (Data Acquisition)", on page 82
6. "Synchronization" (MS application only)
   See chapter 5.2.9, "Synchronization (MS application only)", on page 84
7. "Channel Detection"
   See chapter 5.2.10, "Channel Detection", on page 85
8. "Analysis"

See chapter 6, "Analysis", on page 104

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 on the front panel restores all measurements **in all measurement channels** on the R&S FSW to their default values!

See chapter 5.2.1, "Default Settings for Code Domain Analysis", on page 56 for details.

SCPI command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 145

Select Measurement
Selects a different measurement to be performed.

See "Selecting the measurement type" on page 54.

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.

5.2.3 Signal Description

The signal description provides information on the expected input signal.

5.2.3.1 BTS 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 47.

"0,1" Single carrier

"2" Increased number of active users

"3" Modulation type 64QAM can be detected.

SCPI command:
`CONFigure:CDPower[:BTS]:SUBType` on page 149

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 41.

SCPI command:
`[SENSe:]CDPower:PNOFfset` on page 150

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

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier[:STATe]` on page 149

Enhanced Algorithm ← Multi Carrier
Activates or deactivates the enhanced algorithm that is used for signal detection on multi-carrier signals. This algorithm slightly increases the calculation time.

This setting is only available if "Enhanced Algorithm" on page 60 is activated.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:MALGo` on page 149

Multi Carrier Filter ← Multi Carrier
Activates or deactivates the usage of a filter for signal detection on multi-carrier signals.

This setting is only available if "Enhanced Algorithm" on page 60 is activated.

For details see chapter 4.6, "Multi-Carrier Mode", on page 48.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe]` on page 148

Filter Type ← Multi Carrier
Selects the filter type if Filter Type 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.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 148

Roll-Off Factor ← Filter Type ← Multi Carrier
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.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 148
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 147

Cut Off Frequency ← Filter Type ← Multi Carrier
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.

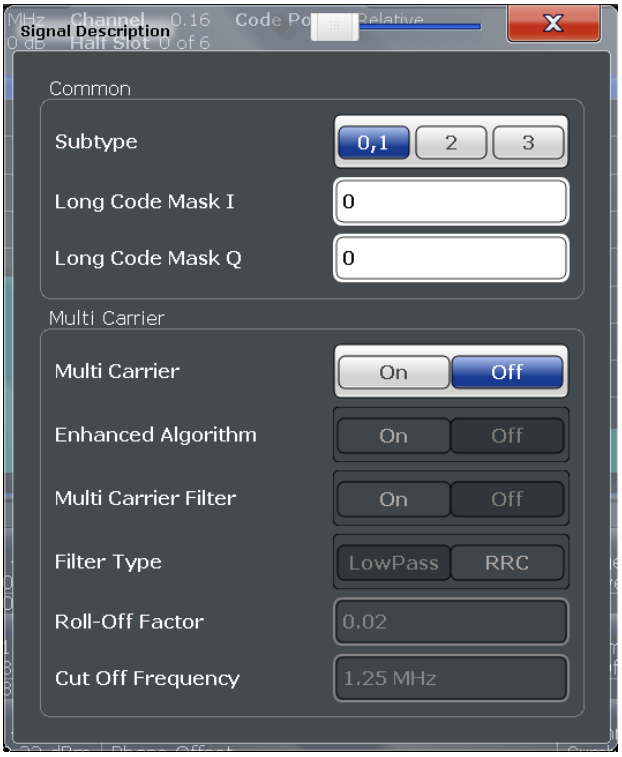
SCPI command:

CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE on page 148

CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency on page 147

5.2.3.2 MS 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 47.

"0,1" Single carrier

"2" Increased number of active users

"3" Modulation type 64QAM can be detected.

SCPI command:
CONFigure:CDPower[:BTS]:SUBType on page 149

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 4FFFFFFFFF.

For more information on long codes see "Long code scrambling" on page 42.

SCPI command:
[SENSe:]CDPower:LCODe:I on page 150
[SENSe:]CDPower:LCODe:Q on page 151

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

SCPI command:
CONFigure:CDPower[:BTS]:MCARrier[:STATe] on page 149

Enhanced Algorithm ← Multi Carrier
Activates or deactivates the enhanced algorithm that is used for signal detection on multi-carrier signals. This algorithm slightly increases the calculation time.

This setting is only available if "Enhanced Algorithm" on page 60 is activated.

SCPI command:
CONFigure:CDPower[:BTS]:MCARrier:MALGo on page 149

Multi Carrier Filter ← Multi Carrier
Activates or deactivates the usage of a filter for signal detection on multi-carrier signals.

This setting is only available if "Enhanced Algorithm" on page 60 is activated.

For details see chapter 4.6, "Multi-Carrier Mode", on page 48.

SCPI command:
CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe] on page 148

Filter Type ← Multi Carrier
Selects the filter type if Filter Type 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.

SCPI command:
CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE on page 148

Roll-Off Factor ← Filter Type ← Multi Carrier
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.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 148
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 147

Cut Off Frequency ← Filter Type ← Multi Carrier
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.

SCPI command:
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 148
`CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency` on page 147

5.2.4 Data Input and Output Settings

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

5.2.4.1 Input Settings

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

Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

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

Radio Frequency Input

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

Radio Frequency State
Activates input from the RF INPUT connector.

SCPI command:
`INPut:SELect` on page 153

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 Digital Baseband Interface (R&S FSW-B17).

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.

SCPI command:
`INPut:COUPling` on page 152

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

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω 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 74).

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

SCPI command:

INPut:IMPedance on page 153

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 R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

(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 filter.)

SCPI command:

INPut:FILTer:HPASs[:STATe] on page 152

YIG-Preselector

Activates or deactivates the YIG-preselector.

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. In order to use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which may lead to image-frequency display.

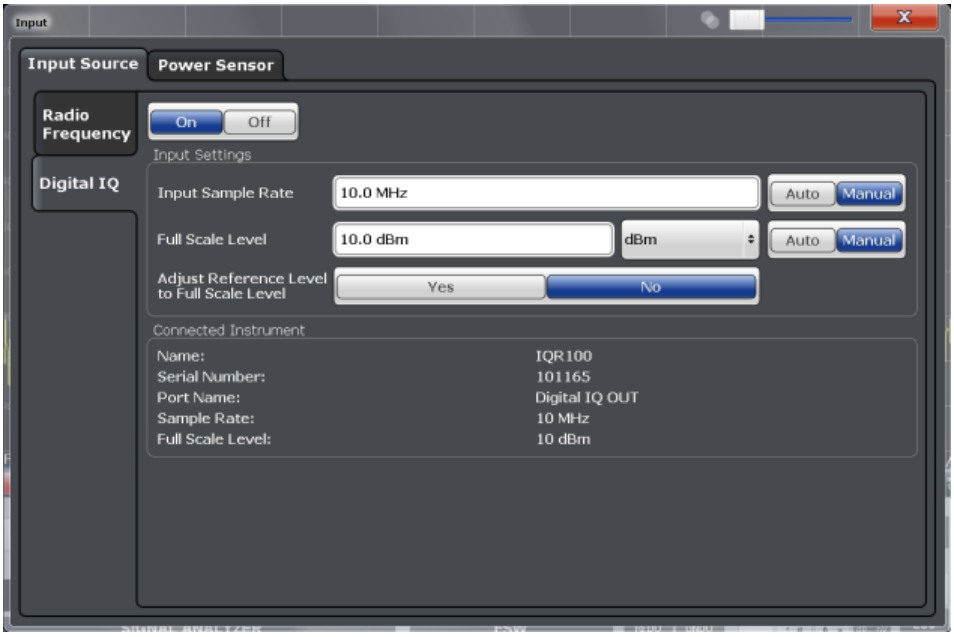
Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

INPut:FILTer:YIG[:STATe] on page 152

Digital I/Q Input Settings

The following settings and functions are available to provide input via the Digital Baseband Interface (R&S FSW-B17) in the applications that support it.

They can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.



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 Digital Baseband Interface (R&S FSW-B17) is installed.

SCPI command:
`INPut:SELect` on page 153

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.

SCPI command:
`INPut:DIQ:SRATe` on page 157
`INPut:DIQ:SRATe:AUTO` on page 157

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.

SCPI command:
INPut:DIQ:RANGe[:UPPer] on page 156
INPut:DIQ:RANGe[:UPPer]:UNIT on page 156
INPut:DIQ:RANGe:AUTO on page 155

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

SCPI command:
INPut:DIQ:RANGe:COUPling on page 156

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

SCPI command:
INPut:DIQ:CDEVice on page 154

DigIConf
Starts the optional R&S DigIConf application. This softkey 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 (R&S FSW-B17) 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 on the front panel. 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.

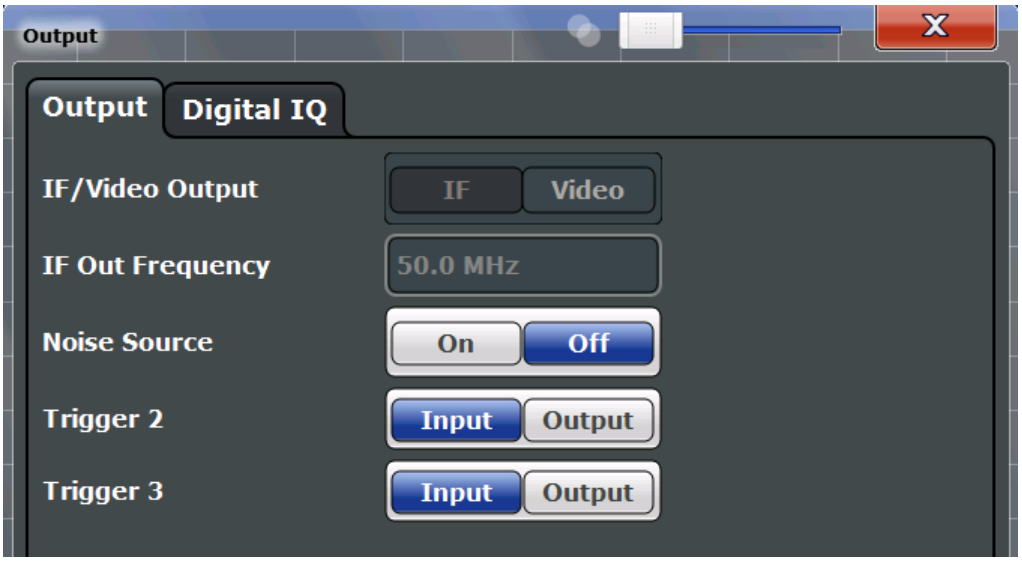
5.2.4.2 Data Output

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.

Output settings can be configured via the INPUT/OUTPUT key or in the "Outputs" dialog box.



Noise Source
Switches the supply voltage for an external noise source on or 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.

SCPI command:
`DIAGnostic<n>:SERVice:NSOurce` on page 161

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. No further trigger parameters are available for the connector.

"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.

SCPI command:

`OUTPut:TRIGger<port>:LEVel` on page 175

`OUTPut:TRIGger<port>:DIRection` on page 175

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 user selects "Send Trigger" button.
In this case, further parameters are available for the output signal.

SCPI command:

`OUTPut:TRIGger<port>:OTYPe` on page 176

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

SCPI command:

`OUTPut:TRIGger<port>:LEVel` on page 175

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

SCPI command:

`OUTPut:TRIGger<port>:PULSe:LENGth` on page 177

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, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

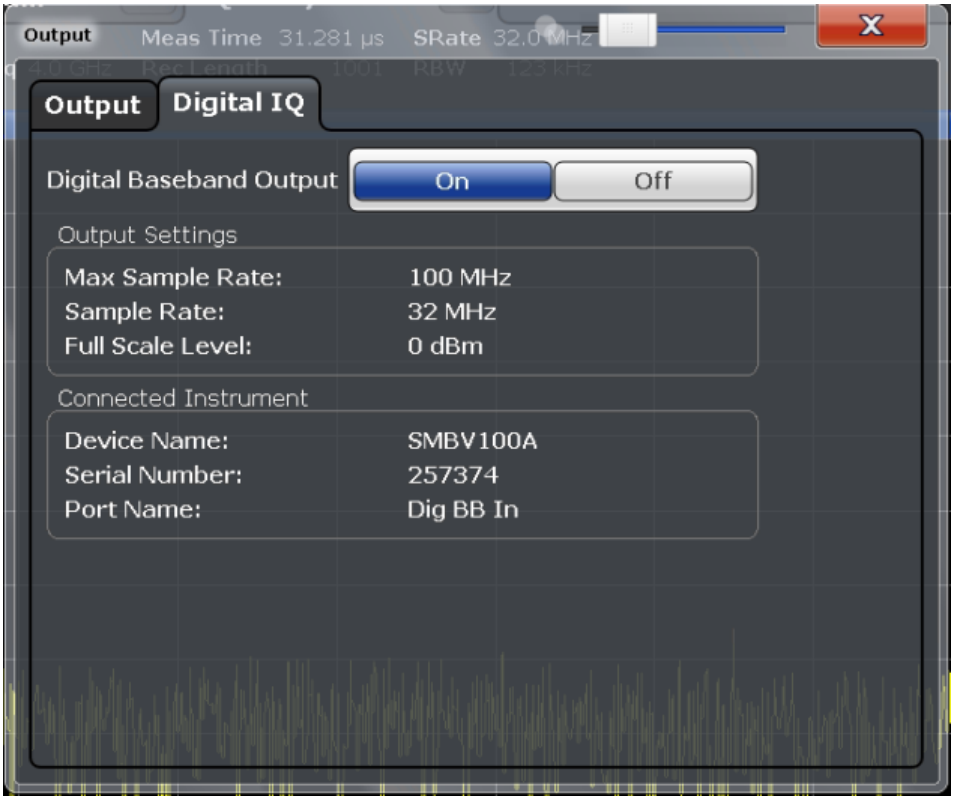
Which pulse level will be sent is indicated by a graphic on the button.

SCPI command:

`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 176

5.2.4.3 Digital I/Q Output Settings

The optional Digital Baseband Interface (R&S FSW-B17) allows you to output I/Q data from any R&S FSW application that processes I/Q data to an external device. The configuration settings for digital I/Q output can be configured via the INPUT/OUTPUT key or in the "Outputs" dialog box.



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 (R&S FSW-B17), if available.

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

SCPI command:
`OUTPut:DIQ` on page 157

Output Settings Information
Displays information on the settings for output via the Digital Baseband Interface (R&S FSW-B17).

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)

SCPI command:
`OUTPut:DIQ:CDEVice` on page 157

Connected Instrument
Displays information on the instrument connected to the Digital Baseband Interface (R&S FSW-B17), 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

SCPI command:
`OUTPut:DIQ:CDEVice` on page 157

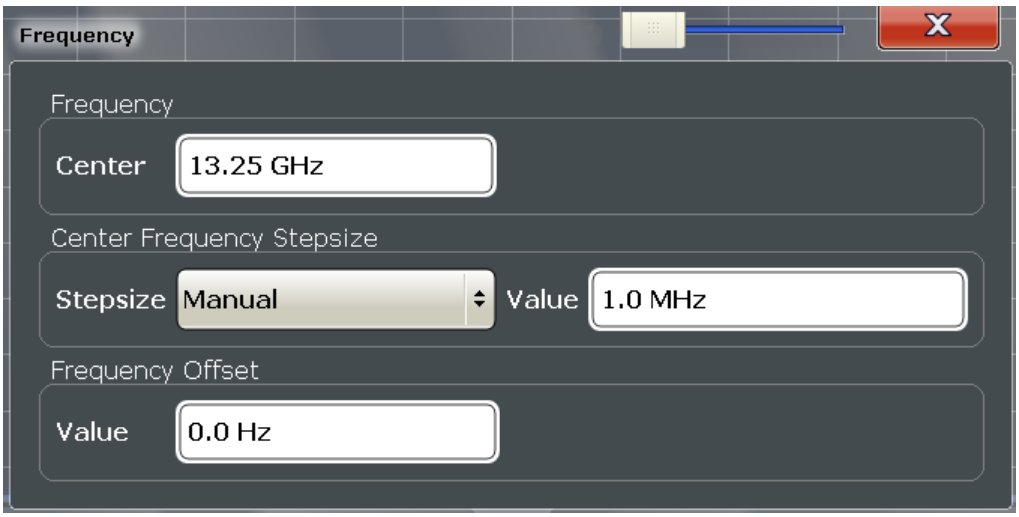
5.2.5 Frontend Settings

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

5.2.5.1 Frequency Settings

Frequency settings for the input signal can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:

- Select the FREQ key and then the "Frequency Config" softkey.
- Select the "Frequency" tab in the "Input Settings" dialog box



Center
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.

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

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

SCPI command:
`[SENSe:]FREQuency:CENTer` on page 162

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased when the arrow keys are pressed. When you use the rotary knob the center frequency changes in steps of only 1/10 of the "Center Frequency Stepsize".

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

This setting is available for RF 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.

SCPI command:
`[SENSe:]FREQuency:CENTer:STEP` on page 162

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

This parameter has no effect on the R&S FSW 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.

SCPI command:

`[SENSe:]FREQuency:OFFSet` on page 164

5.2.5.2 Amplitude Settings

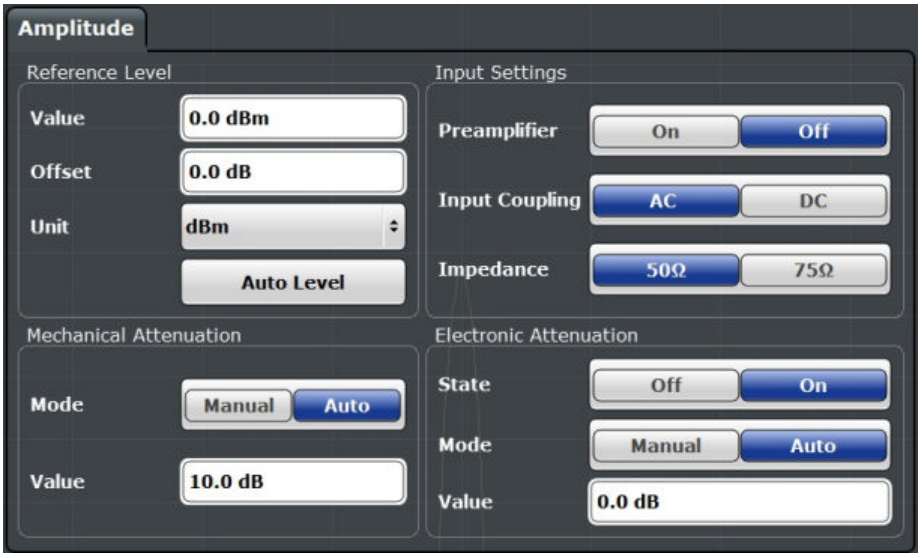
Amplitude settings determine how the R&S FSW must process or display the expected input power levels.

To configure the amplitude settings

Amplitude settings can be configured via the AMPT key or in the "Amplitude" dialog box.

► To display the "Amplitude" dialog box, do one of the following:

- Select "Input/Frontend" from the "Overview" and then switch to the "Amplitude" tab.
- Select the AMPT key and then the "Amplitude Config" softkey.



Reference Level
Defines the expected maximum reference level. Signal levels above this value may not be measured correctly, which is indicated by the "IFOVL" status display.

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

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

Note that the "Reference Level" value ignores the Shifting the Display (Offset). It is important to know the actual power level the R&S FSW must handle.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 165

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. 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 will be shifted by this value.

Note, however, that the Reference Level value ignores the "Reference Level Offset". It is important to know the actual power level the R&S FSW must handle.

To determine the required offset, consider the external attenuation or gain applied to the input signal. A positive value indicates that an attenuation took place (R&S FSW increases the displayed power values) , a negative value indicates an external gain (R&S FSW decreases the displayed power values).

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

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 166

Unit ← Reference Level
For CDA measurements the unit should not be changed, as this would lead to useless results.

Setting the Reference Level Automatically (Auto Level) ← Reference Level
Automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized.

In order to do so, a level measurement is performed to determine the optimal reference level.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 95).

SCPI command:
[SENSe:]ADJust:LEVel on page 190

RF Attenuation
Defines the attenuation applied to the RF input.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

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 the optimum RF attenuation is always used. It is the default setting. By default and when Using Electronic Attenuation (Option B25) is not available, mechanical attenuation is applied.

This function is not available for input from the **Digital Baseband Interface (R&S FSW-B17)**.

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB, also using the rotary knob). 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.

SCPI command:
INPut:ATTenuation on page 167
INPut:ATTenuation:AUTO on page 168

Using Electronic Attenuation (Option B25)
If option R&S FSW-B25 is installed, 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 Digital Baseband Interface (R&S FSW-B17).

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 may 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.

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.

SCPI command:

`INPut:EATT:STATe` on page 169

`INPut:EATT:AUTO` on page 168

`INPut:EATT` on page 168

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, see chapter 5.2.4.1, "Input Settings", on page 63.

Preamplifier (option B24) ← Input Settings

If option R&S FSW-B24 is installed, a preamplifier can be activated for the RF input signal.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 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.

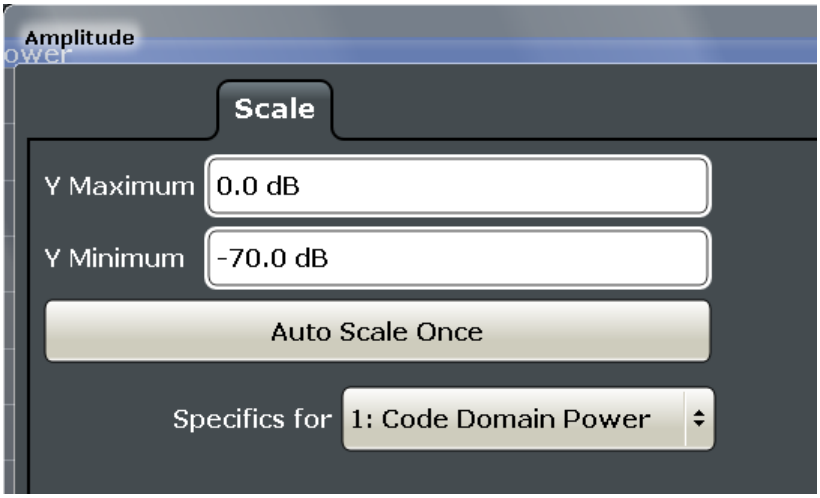
SCPI command:

`INPut:GAIN:STATe` on page 166

`INPut:GAIN[:VALue]` on page 166

5.2.5.3 Y-Axis Scaling

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.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 164
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 165

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

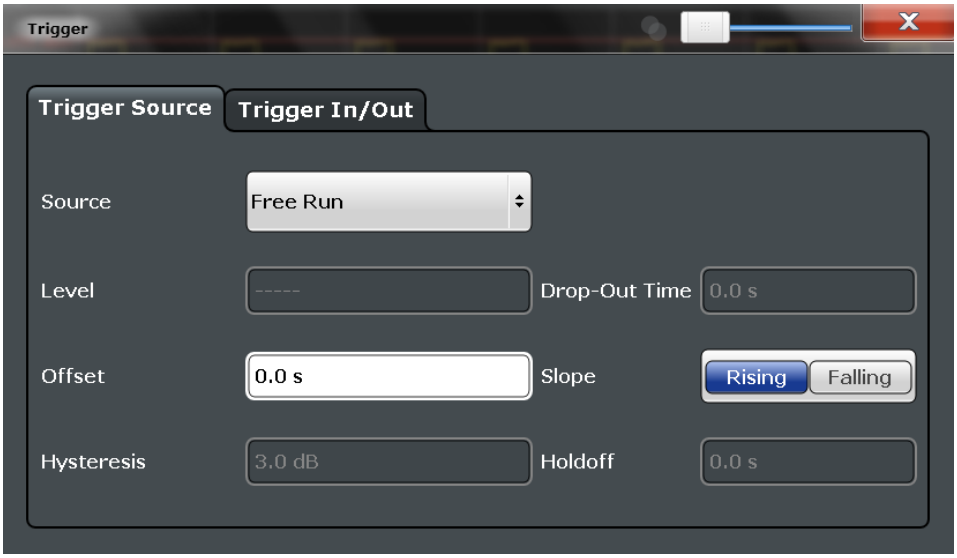
The display is only set once; it is not adapted further if the measurement settings are changed again.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE` on page 164

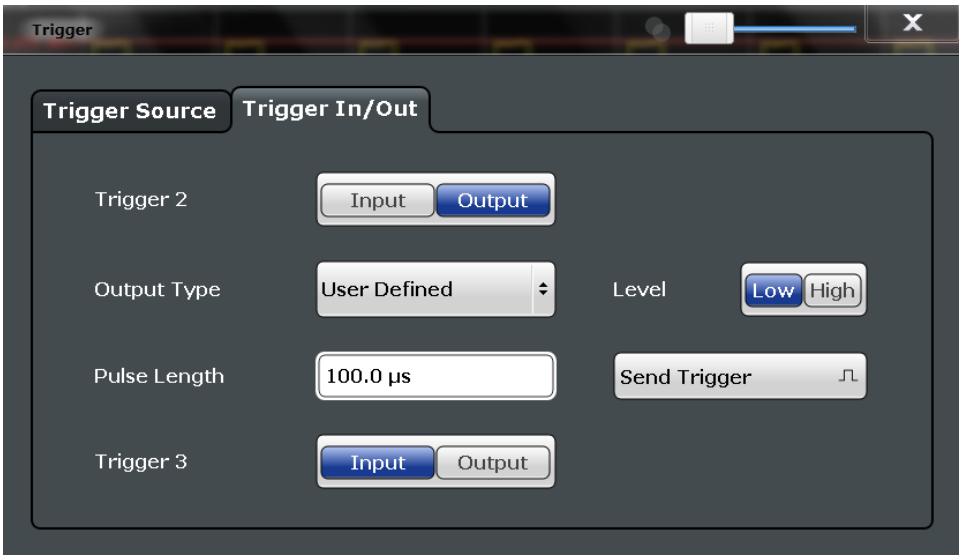
5.2.6 Trigger Settings

Trigger settings determine when the input signal is measured.

Trigger settings can be configured via the TRIG key or in the "Trigger" dialog box, which is displayed when you select the "Trigger" button in the "Overview".



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.

SCPI command:
`TRIGger[:SEQuence]:SOURce` on page 173

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

SCPI command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 173

External Trigger 1/2/3 ← Trigger Source ← Trigger Source
Data acquisition starts when the TTL signal fed into the specified input connector (on the front or rear panel) meets or exceeds the specified trigger level.

(See "Trigger Level" on page 80).

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

"External Trigger 2"
Trigger signal from the TRIGGER INPUT/OUTPUT connector on the front panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 68).

"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 68).

SCPI command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 173

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 Digital Baseband Interface (R&S FSW-B17) 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.

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 5-1: 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

SCPI command:
`TRIG:SOUR GP0`, see `TRIGger[:SEQuence]:SOURce` on page 173

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

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

SCPI command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 171

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

SCPI command:
`TRIGger[:SEQuence]:DTIMe` on page 170

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

offset > 0:	Start of the sweep is delayed
offset < 0:	Sweep starts earlier (pre-trigger)

SCPI command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 170

Hysteresis ← Trigger Source
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Settting 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 RF measurements.

SCPI command:

`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 170

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.

SCPI command:

`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 170

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.

SCPI command:

`TRIGger[:SEQuence]:SLOPe` on page 172

Capture Offset ← Trigger Source
This setting is only available for 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 application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

SCPI command:

`[SENSe:]MSRA:CAPTure:OFFSet` on page 240

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. No further trigger parameters are available for the connector.

"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.

SCPI command:

`OUTPut:TRIGger<port>:LEVel` on page 175

`OUTPut:TRIGger<port>:DIRection` on page 175

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 user selects "Send Trigger" button. In this case, further parameters are available for the output signal.

SCPI command:
`OUTPut:TRIGger<port>:OTYPe` on page 176

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

SCPI command:
`OUTPut:TRIGger<port>:LEVel` on page 175

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 177

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, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

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

SCPI command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 176

5.2.7 Signal Capture (Data Acquisition)

You must define how much and how data is captured from the input signal.

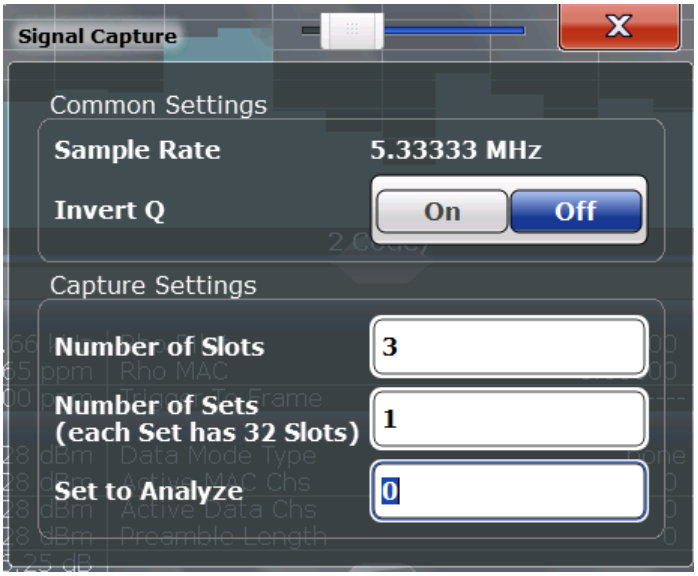


Fig. 5-1: Signal capture settings in BTS application

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 5.2.8, "Application Data (MSRA) ", on page 84).

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.

SCPI command:

`[SENSe:]CDPower:QINVert` on page 178

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 84 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 40.

SCPI command:
[SENSe:]CDPower:IQLength on page 177

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.

SCPI command:
[SENSe:]CDPower:SET:COUNt on page 178

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 84 – 1.

SCPI command:
[SENSe:]CDPower:SET on page 195

5.2.8 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 84).

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 81).

The **analysis interval** cannot be edited manually, but 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*.

5.2.9 Synchronization (MS application only)

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 42.

"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.

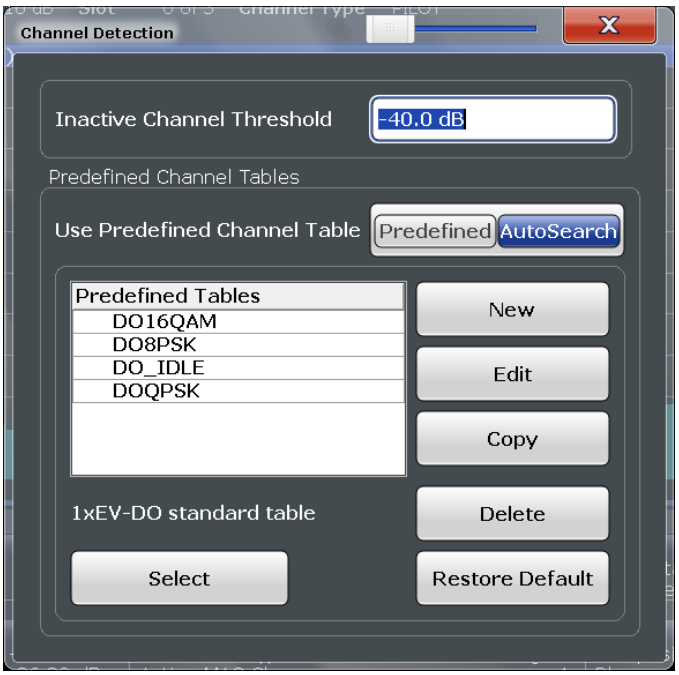
SCPI command:
`[SENSe:]CDP:SMODe` on page 178

5.2.10 Channel Detection

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

5.2.10.1 General Channel Detection Settings

Channel detection settings are configured in the "Channel Detection" dialog box which is displayed when you select the "Channel Detection" button in the configuration "Overview".



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

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

SCPI command:
`[SENSe:]CDPower:ICTReshold` on page 182

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.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle[:STATe]` on page 182

5.2.10.2 Channel Table Management

Channel tables are managed in the "Channel Detection" dialog box which is displayed when you select the "Channel Detection" button in the configuration "Overview".

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 246.

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

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:CATalog?` on page 180

Selecting a Table
Selects the channel table currently focussed in the "Predefined Tables" list and compares it to the measured signal to detect channels.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:SELect` on page 182

Creating a New Table
Creates a new channel table. For a description of channel table settings and functions see chapter 5.2.10.3, "Channel Table Settings and Functions", on page 88.

For step-by-step instructions on creating a new channel table, see "To define or edit a channel table" on page 122.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:NAME` on page 186

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.

SCPI command:
CONFigure:CDPower[:BTS]:CTABle:COPY on page 181

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

SCPI command:
CONFigure:CDPower[:BTS]:CTABle:DELete on page 181

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

SCPI command:
CONFigure:CDPower[:BTS]:CTABle:RESTore on page 182

5.2.10.3 Channel Table Settings and Functions

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

Channel tables are configured in the "Channel Table" dialog box which is displayed when you select the "New", "Copy" or "Edit" buttons for a predefined channel table in the "Channel Detection" dialog box.

For details on channel table entries see chapter 5.2.10.4, "BTS Channel Details", on page 89 or chapter 5.2.10.5, "Channel Details (MS application)", on page 91.

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

SCPI command:
CONFigure:CDPower[:BTS]:CTABle:NAME on page 186

Comment
Optional description of the channel table.

SCPI command:
CONFigure:CDPower[:BTS]:CTABle:COMMent on page 183

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.

SCPI command:
`CONFigure:CDPower[:BTS]:MEASurement` on page 145

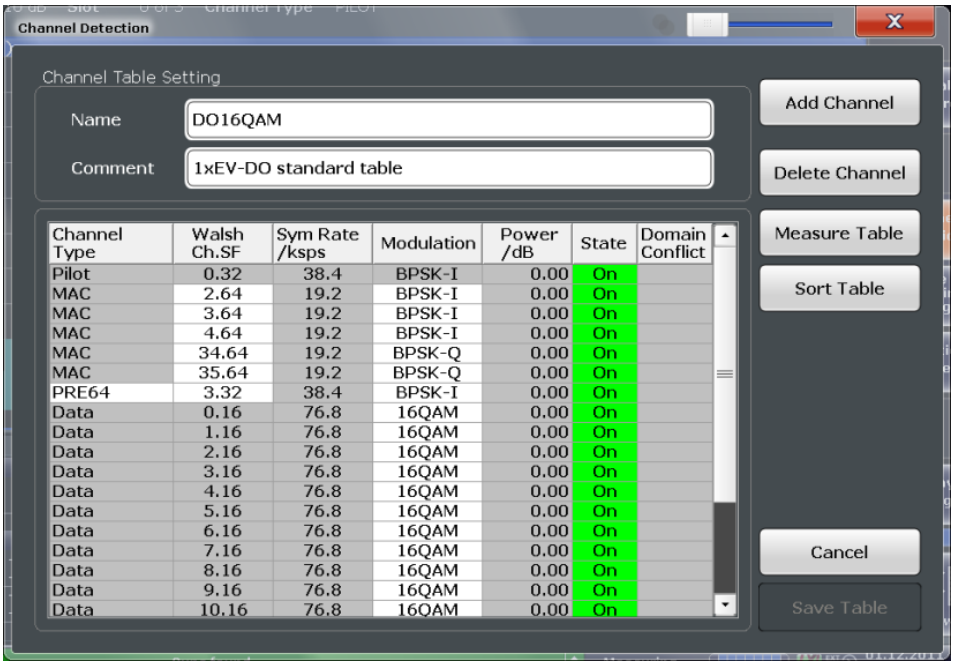
Sorting the Table
Sorts the channel table entries.

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.

5.2.10.4 BTS Channel Details

Channel details are configured in the "Channel Table" dialog box which is displayed when you select the "New", "Copy" or "Edit" buttons for a predefined channel table in the "Channel Detection" dialog box.



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 44.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

Channel Number (Walsh Ch./SF)
Channel number, consisting of walsh channel code and spreading factor

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

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 1-8.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

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 89).

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

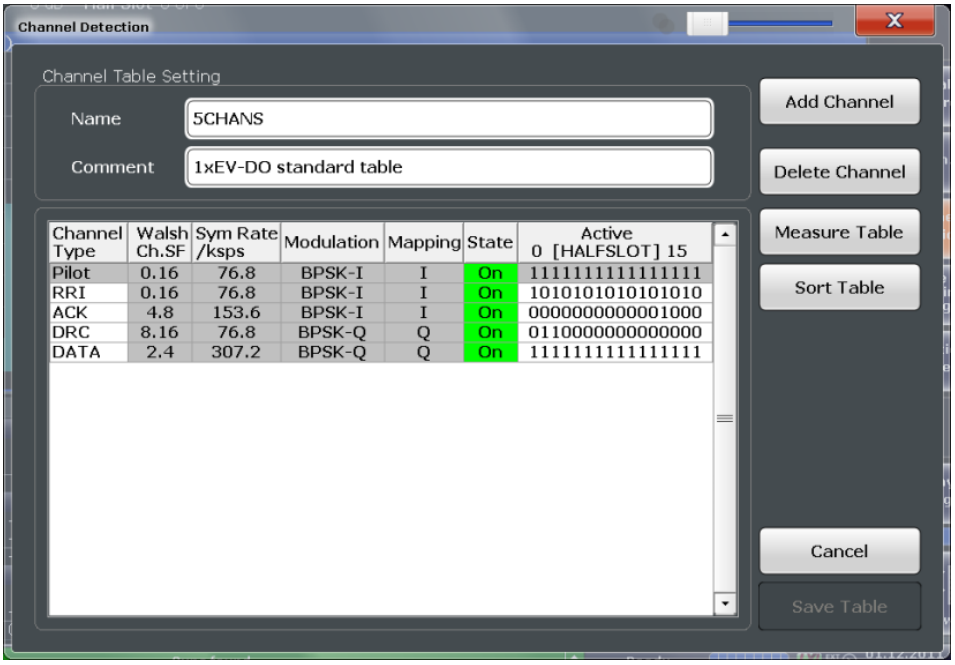
Status
Indicates the channel status. Codes that are not assigned are marked as inactive channels.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

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

5.2.10.5 Channel Details (MS application)

Channel details are configured in the "Channel Table" dialog box which is displayed when you select the "New", "Copy" or "Edit" buttons for a predefined channel table in the "Channel Detection" dialog box.



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 44.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 185

Channel Number (Walsh Ch./SF)
Channel number, consisting of walsh channel code and spreading factor

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 185

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 1-10.

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 183

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 48.

SCPI command:
`[SENSe:]CDPower:MAPPing` on page 194

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

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 185

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).

SCPI command:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 185

5.2.11 Sweep Settings

The sweep settings define how the data is measured.

Sweep/Average Count
Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in all diagrams.

If the trace configurations "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 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

SCPI command:
`[SENSe:]SWEep:COUNt` on page 187
`[SENSe:]AVERage<n>:COUNt` on page 186

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 has an 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 on the front panel 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.

SCPI command:
`INITiate:CONTinuous` on page 210

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 has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer.
Furthermore, the RUN SINGLE key on the front panel 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.

SCPI command:
`INITiate[:IMMediate]` on page 210

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.

SCPI command:
`INITiate:CONMeas` on page 209

5.2.12 Automatic Settings

Some settings can be adjusted by the R&S FSW automatically according to the current measurement settings. In order to do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

To activate the automatic adjustment of a setting, select the corresponding function in the AUTO SET menu or in the configuration dialog box for the setting, where available.

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 perform data acquisition in MSRA operating mode.

Adjusting all Determinable Settings Automatically (Auto All)
Activates all automatic adjustment functions for the current measurement settings.

This includes:

- "Setting the Reference Level Automatically (Auto Level)" on page 74
- "Auto Scale All" on page 95

SCPI command:
`[SENSe:]ADJust:ALL` on page 188

Setting the Reference Level Automatically (Auto Level)
Automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized.

In order to do so, a level measurement is performed to determine the optimal reference level.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 95).

SCPI command:
[SENSe:]ADJust:LEVel on page 190

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.

Resetting the Automatic Measurement Time (Meastime Auto)
Resets the measurement duration for automatic settings to the default value.

SCPI command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 189

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.

SCPI command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 189
[SENSe:]ADJust:CONFigure:DURation on page 188

Upper Level Hysteresis
When the reference level is adjusted automatically using the Setting the Reference Level Automatically (Auto Level) function, 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.

SCPI command:
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer on page 189

Lower Level Hysteresis
When the reference level is adjusted automatically using the Setting the Reference Level Automatically (Auto Level) function, 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.

SCPI command:
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer on page 189

5.2.13 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 207

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 206

Multiple Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 208

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 207

Restore Original Display

Restores the original display and closes all zoom windows.

SCPI command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 207 (single zoom)

`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 208 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates zoom mode; tapping the screen no longer invokes a zoom, but selects an object.

SCPI command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 207 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 208 (for each multiple zoom window)

5.3 RF Measurements

1xEV-DO measurements require special applications on the R&S FSW, which you activate using the MODE key on the front panel.

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:

- Tap the "Overview" softkey. In the "Overview", tap the "Select Measurement" button. Select the required measurement.
- Press the MEAS key on the front panel. 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".

5.3.1 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 pro-

cessed 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 5-2: Default settings used for the Power vs Time measurement

Setting	Default value
Frequency	Span 0 (Zero Span)
Sweep Time	833.38 Ms
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.

SCPI command:
`[SENSe:]SWEep:COUNt` on page 187

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"

SCPI command:
CONFigure:CDPower[:BTS]:RFSLot on page 198

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".

SCPI command:
CONFigure:CDPower[:BTS]:PVTime:BURSt on page 197

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.

SCPI command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 196

Reference Manual
Defines the reference value for the limits manually.

SCPI command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 196
CALCulate<n>:LIMit<k>:PVTime:RVALue on page 197

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.

SCPI command:
CALCulate<n>:LIMit<k>:PVTime:REFerence on page 196

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.

SCPI command:
CONFigure:CDPower[:BTS]:PVTime:FREStart on page 197

5.3.2 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 5-3: 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.

5.3.3 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 5-4: 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 250.

SCPI command:
`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 198

5.3.4 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 5-5: 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 250.

SCPI command:
`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 198

5.3.5 Occupied Bandwidth

The Occupied Bandwidth measurement is performed as in the Spectrum application with default settings.

Table 5-6: 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

5.3.6 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 5-7: 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

6 Analysis

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

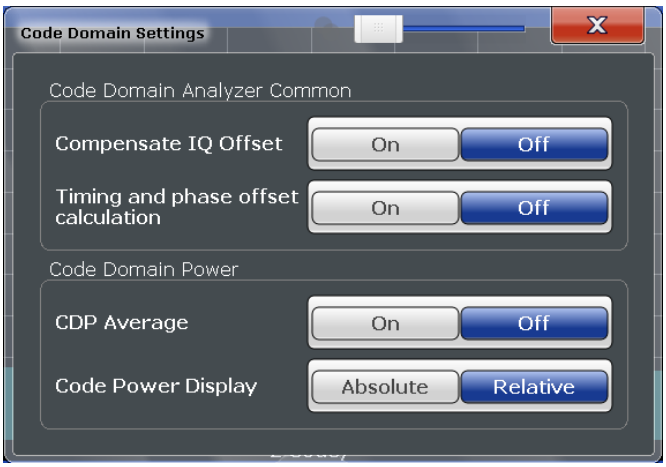
Analyzing RF Measurements

General result analysis settings concerning the trace, markers, lines etc. for RF measurements are identical to the analysis functions in the Spectrum application except for some special marker functions and spectrograms, which are not available in 1xEV-DO applications.

For details see the "General Measurement Analysis and Display" chapter in the R&S FSW User Manual.

6.1 Code Domain Analysis Settings (BTS application)

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.

SCPI command:
[SENSe:]CDPower:NORMalize on page 191

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.

SCPI command:
[SENSe:]CDPower:TPMeas on page 193

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.

SCPI command:
[SENSe:]CDPower:AVERage on page 190

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.

SCPI command:
[SENSe:]CDPower:PDISplay on page 192

6.2 Code Domain Analysis Settings (MS application)

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 49.

"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.

SCPI command:
`[SENSe:]CDPower:ORDer` on page 191

Compensate IQ Offset
If enabled, the I/Q offset is eliminated from the measured signal.

SCPI command:
`[SENSe:]CDPower:NORMalize` on page 191

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.

SCPI command:
[SENSe:]CDPower:TPMeas on page 193

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.

SCPI command:
[SENSe:]CDPower:OPERation on page 191

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.

SCPI command:
[SENSe:]CDPower:AVERage on page 190

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.

SCPI command:
[SENSe:]CDPower:PDISplay on page 192

Power Reference
For "Code Domain Power" evaluation in the MS application only:

Defines the reference for relative power display.

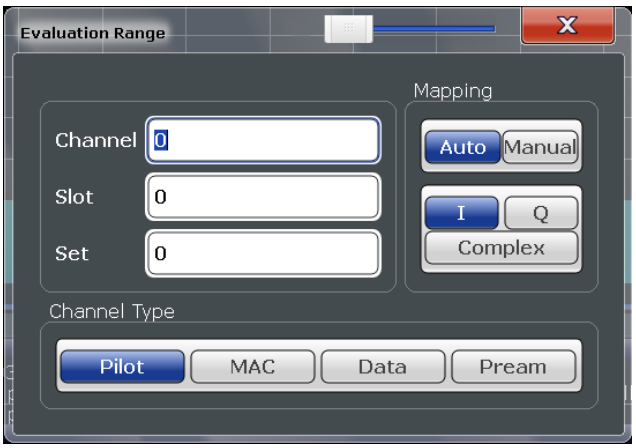
"Total" Relative to the total signal power

"PICH" Relative to the power of the PICH

SCPI command:
[SENSe:]CDPower:PREFerence on page 192

6.3 Evaluation Range (BTS application)

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 49.

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.

SCPI command:
`[SENSe:]CDPower:CODE` on page 193

(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

SCPI command:
[SENSe:]CDPower:SLOT on page 195

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 84 – 1.

SCPI command:
[SENSe:]CDPower:SET on page 195

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 6-1: 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

SCPI command:
[SENSe:]CDPower:MMODe on page 194

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 is to be evaluated and displayed 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 249.

SCPI command:
[SENSe:]CDPower:CTYPe on page 194

6.4 Evaluation Range (MS application)

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 49.

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.

SCPI command:
[SENSe:]CDPower:CODE on page 193

(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

SCPI command:
`[SENSe:]CDPower:SLOT` on page 195

Set to Analyze
Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 84 – 1.

SCPI command:
`[SENSe:]CDPower:SET` on page 195

Branch
Switches between the evaluation of the I and the Q branch in MS measurements.

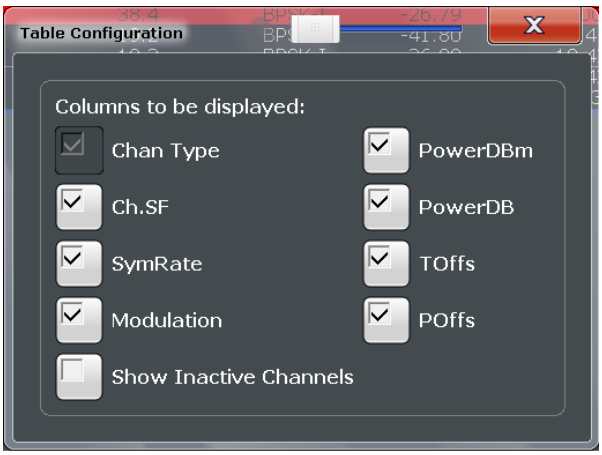
This affects the following evaluations:

- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs slot
- Result Summary

SCPI command:
`[SENSe:]CDPower:MAPPing` on page 194

6.5 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.

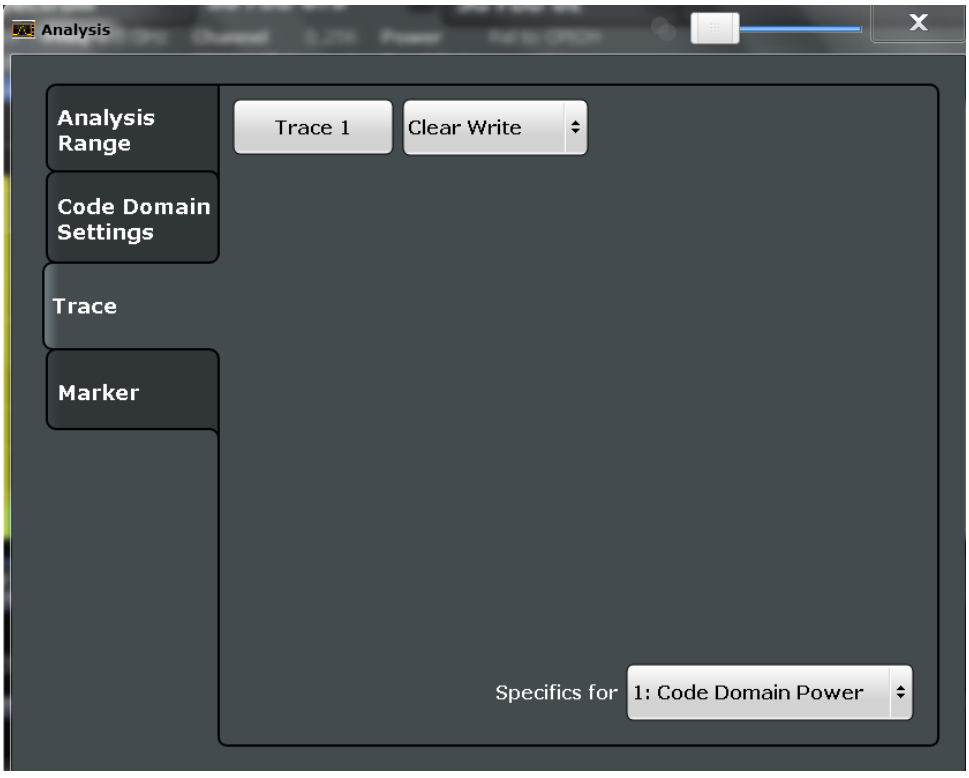


By default, only active channels are displayed. In order to display all channels, including the inactive ones, enable the "Show Inactive Channels" option.

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

6.6 Traces

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 sweep. This is the default setting.
The "Detector" is automatically set to "Auto Peak".

"Max Hold" 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.
The "Detector" is automatically set to "Positive Peak".

"Min Hold" 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.
The "Detector" is automatically set to "Negative Peak".

"Average" The average is formed over several sweeps.
The Sweep/Average Count determines the number of averaging procedures.
The "Detector" is automatically set to "Sample".

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

SCPI command:

`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 231

6.7 Markers

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 are configured in the "Marker" dialog box which is displayed when you do one of the following:

- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab.
- Press the MKR key, then select the "Marker Config" softkey.

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.

6.7.1 Individual Marker Settings

In CDA evaluations, up to 4 markers can be activated in each diagram at any time.

Select Marker
Opens a dialog box to select and activate or deactivate one or more markers quickly.

SCPI command:
Marker selected via suffix <m> in remote commands.

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

SCPI command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

SCPI command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 233
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 234

Stimulus
Defines the position of the marker on the x-axis (channel, slot, symbol, depending on evaluation).

SCPI command:
`CALCulate<n>:DELTamarker<m>:X` on page 234
`CALCulate<n>:MARKer<m>:X` on page 233

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).

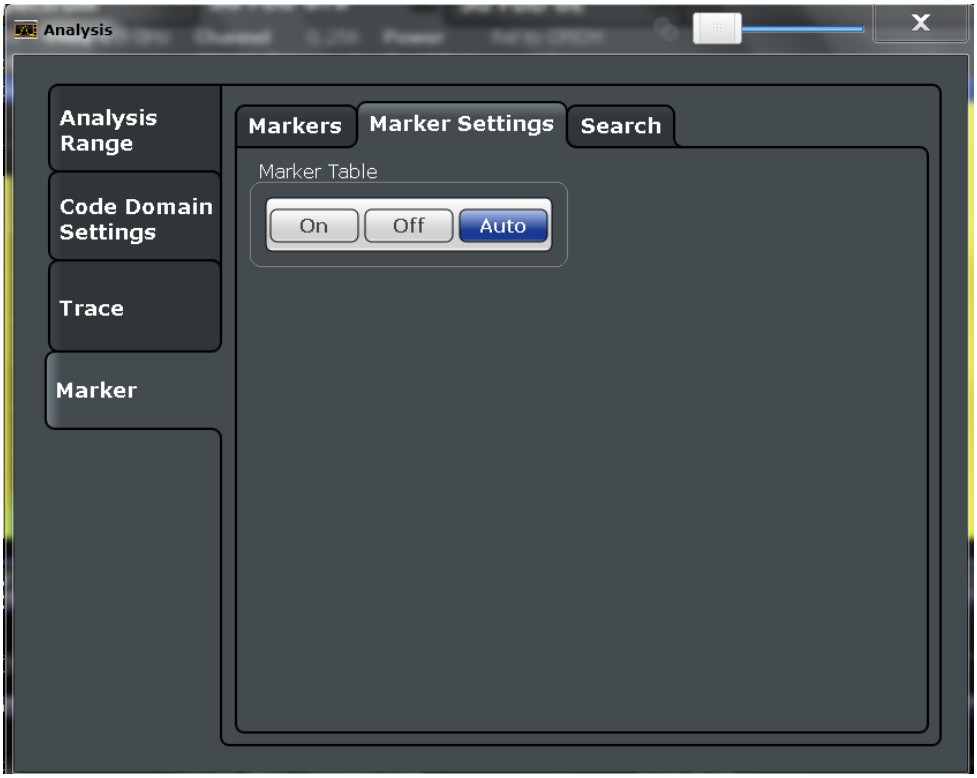
SCPI command:
CALCulate<n>:MARKer<m>[:STATe] on page 233
CALCulate<n>:DELTamarker<m>[:STATe] on page 234

All Markers Off
Deactivates all markers in one step.

SCPI command:
CALCulate<n>:MARKer<m>:AOFF on page 233

6.7.2 General Marker Settings

General marker settings are defined in the "Marker Config" tab of the "Marker" dialog box.



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.

"Auto" (Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

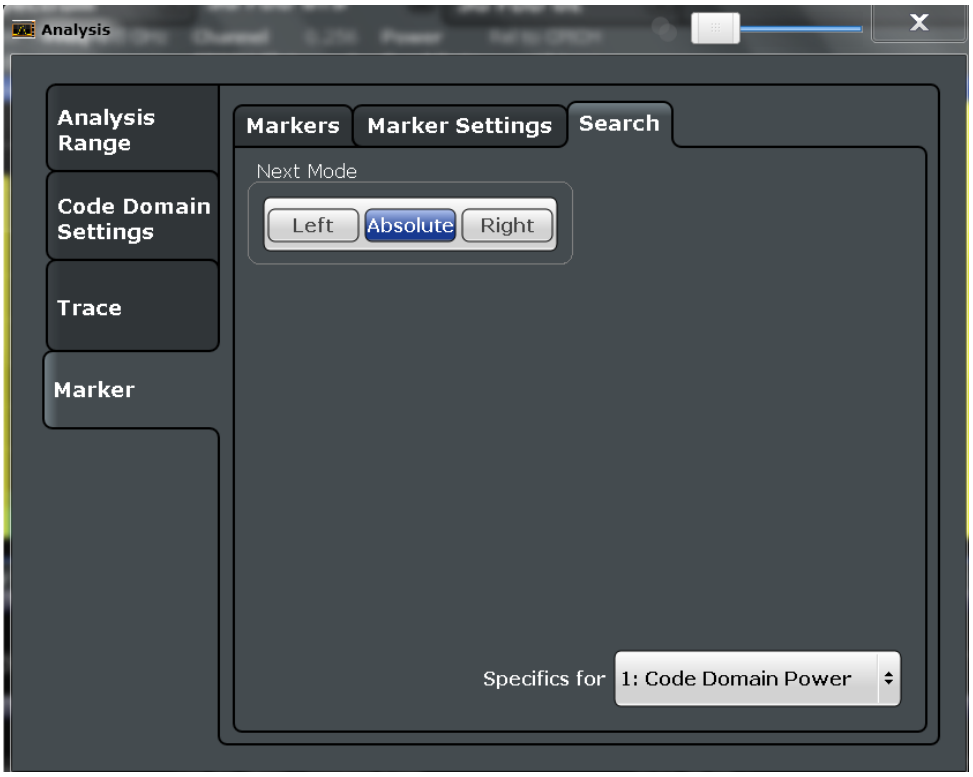
SCPI command:
`DISPlay:MTABle` on page 235

6.7.3 Marker Search Settings

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 may be performed. The search results can be influenced by special settings.

These settings are available as softkeys in the "Marker To" menu, or in the "Search" tab of the "Marker" dialog box. To display this tab, do one of the following:

- Press the MKR key, then select the "Marker Config" softkey. Then select the horizontal "Search" tab.
- In the "Overview", select "Analysis", and switch to the vertical "Marker Config" tab. Then select the horizontal "Search" tab.



Search Mode for Next Peak.....117

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.

SCPI command:

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 238
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 236
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 238
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 236
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 238
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 237
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 238
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 237
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 238
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 237
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 239
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 237

6.7.4 Marker Positioning Functions

The following functions set the currently selected marker to the result of a peak search. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the MKR -> key.

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.

SCPI command:

CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 236
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 238

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.

SCPI command:

CALCulate<n>:MARKer<m>:MINimum:NEXT on page 237
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 238

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

SCPI command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 237
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 238

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

SCPI command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 237
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 239

7 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.

7.1 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.

8 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 on the front panel 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 122.
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" softkey 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) Tap 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) Tap 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 on the front panel 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 on the front panel.
   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 buffer, 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.

9 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 50.

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:

9.1 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.

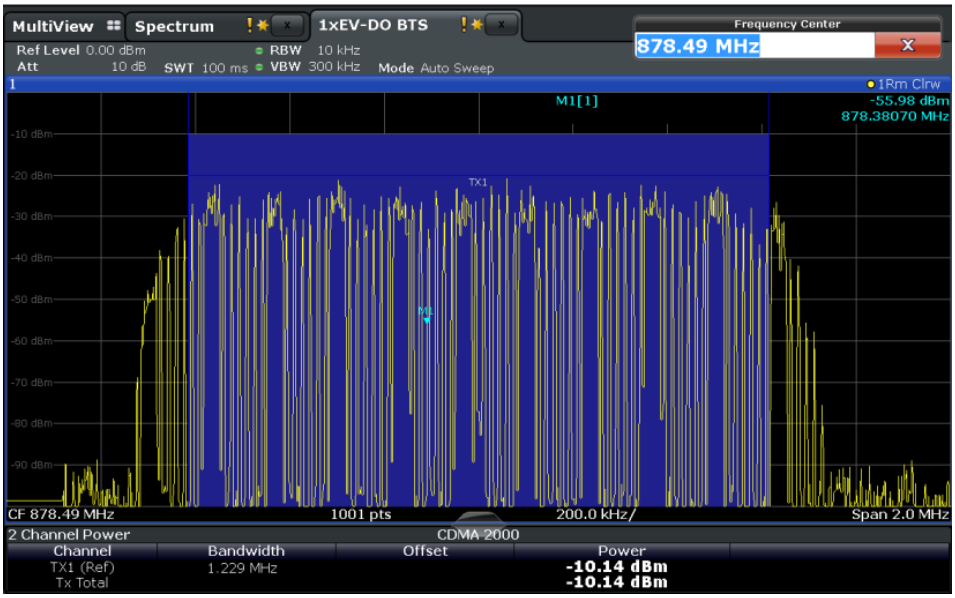


Fig. 9-1: Meas 1: Measuring the Signal Channel Power

9.2 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.

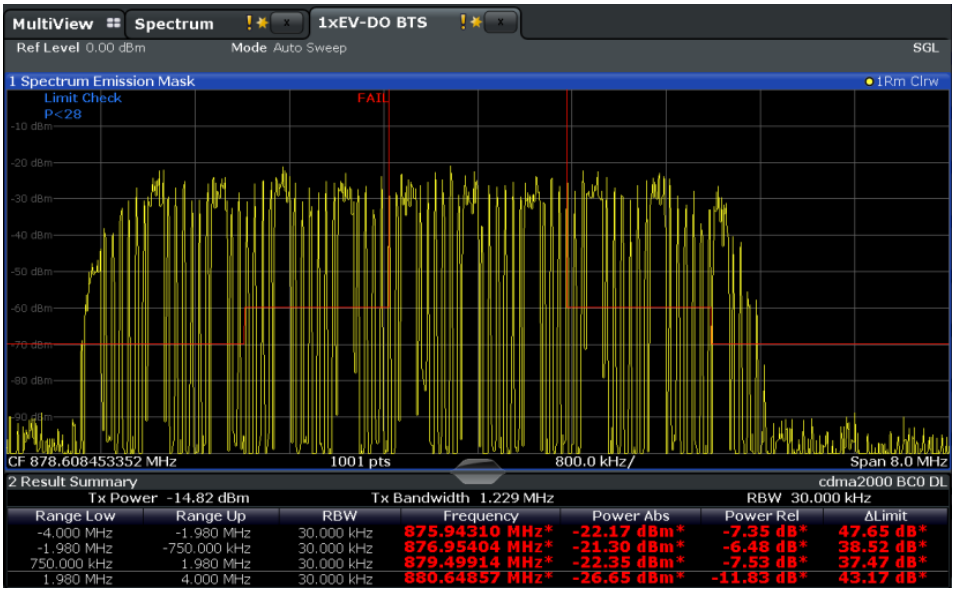


Fig. 9-2: Meas 2: Measuring the Spectrum Emission Mask

9.3 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.

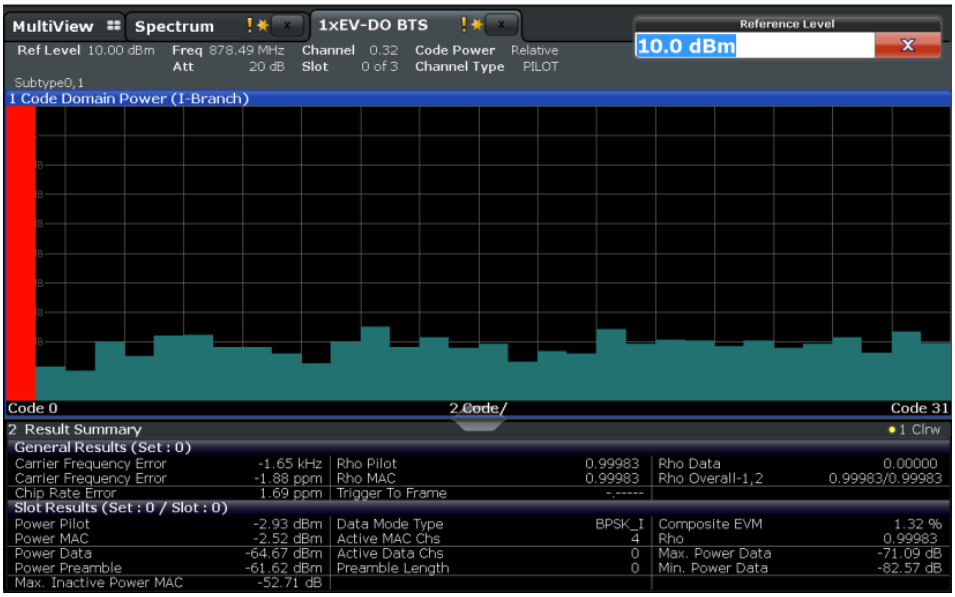


Fig. 9-3: Meas 3: Measuring the Relative Code Domain Power and Frequency Error

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.

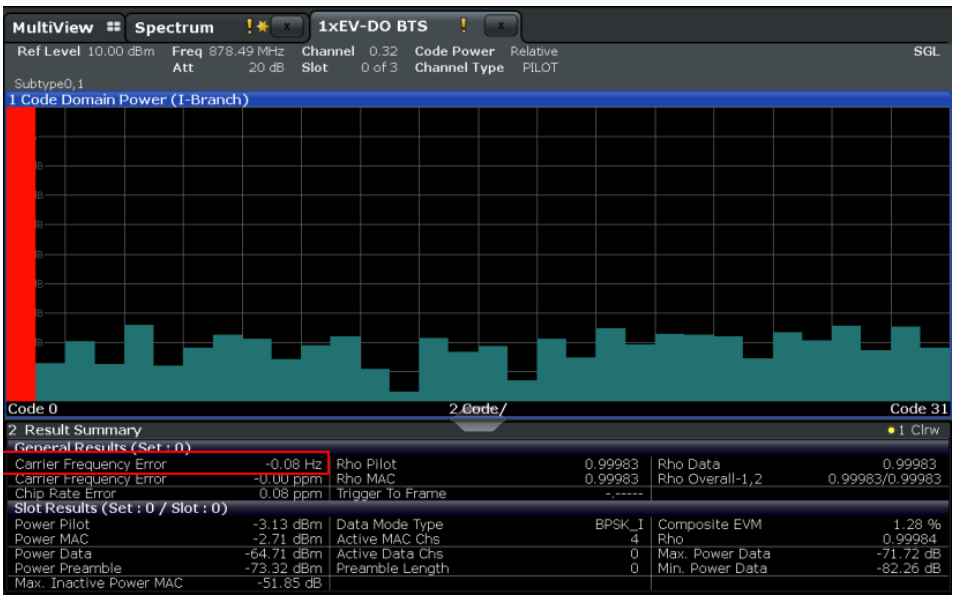


Fig. 9-4: Meas 3: Reducing the Frequency Error by synchronizing the devices

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.

9.4 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 on the front panel of the R&S FSW (TRIGGER INPUT) to the external trigger output on the front panel 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 9-4), 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.

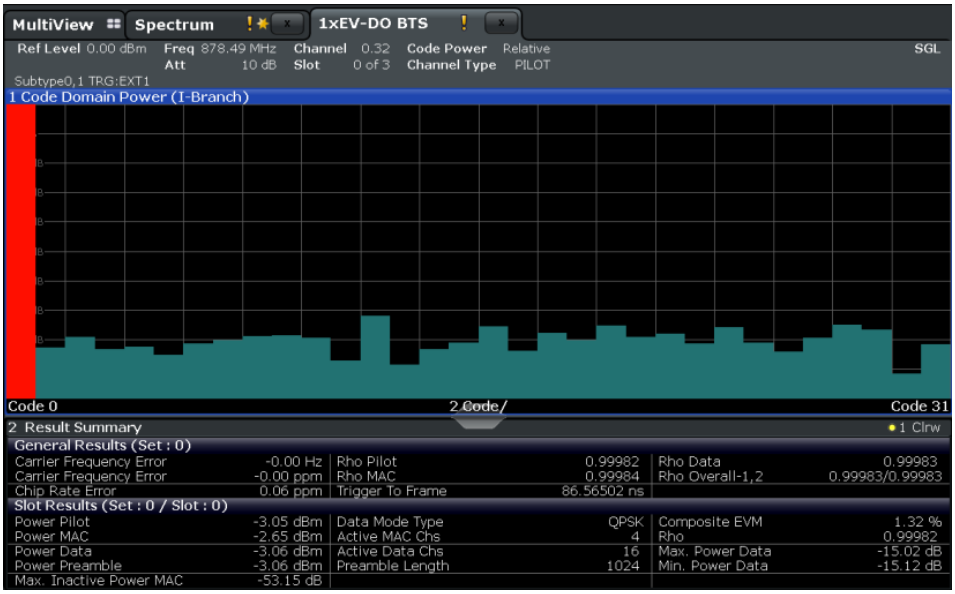


Fig. 9-5: Meas 4: Measuring the Triggered Relative Code Domain Power

9.4.1 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.

9.4.2 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.

9.5 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 on the front panel of the R&S FSW (TRIGGER INPUT) to the external trigger output on the front panel 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.

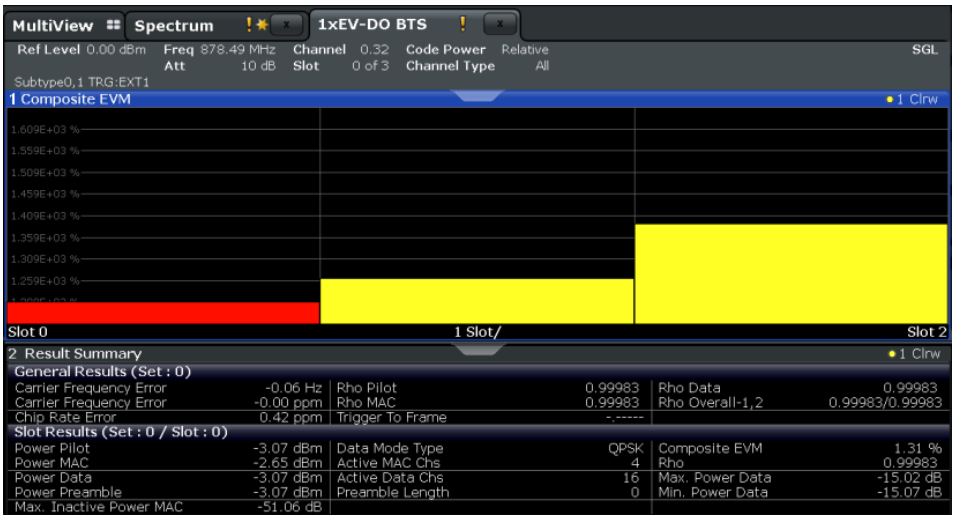


Fig. 9-6: Meas 5: Measuring the Composite EVM

9.6 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 on the front panel of the R&S FSW (TRIGGER INPUT) to the external trigger output on the front panel 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.

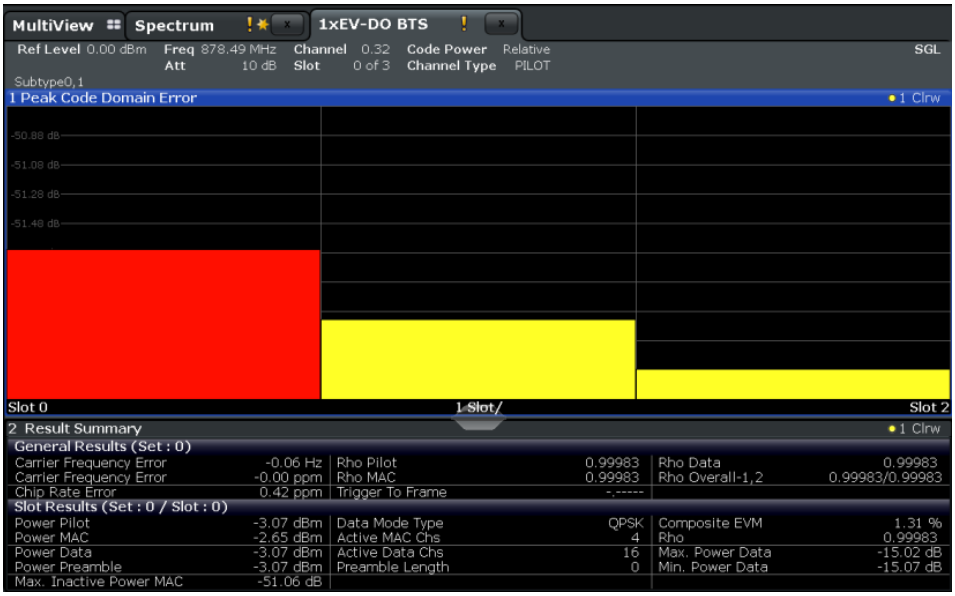


Fig. 9-7: Meas 6: Measuring the Peak Code Domain Error and the RHO Factor

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.

10 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.

Common Suffixes

In 1xEV-DO applications, the following common suffixes are used in remote commands (and not described for each command individually):

Suffix	Value range	Description
<n>	1..16	Window
<t>	1 (CDA) 6 (RF)	Trace
<m>	1..4 (CDA) 1..16 (RF)	Marker
<ch>	1..18 (TX channel) 1..11 (ALT channel)	Channel in RF measurements
<k>	1..8 (Limit line) 1 | 2 (Display line)	Line in RF measurements

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:

10.1 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.

10.1.1 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`.

10.1.2 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.

10.1.3 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.

10.1.4 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`.

10.1.5 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.

10.1.5.1 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.

10.1.5.2 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`

10.1.5.3 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 10.1.1, "Long and Short Form", on page 138.

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`

10.1.5.4 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'
```

10.1.5.5 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 a 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.

10.2 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[: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 table 10-1.

<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 table 10-1).

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

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

This command replaces a measurement channel with another one.

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 table 10-1.

<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 table 10-1).

Example: `INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'`
Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

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 'Spectrum4'`
Deletes the spectrum channel with the name 'Spectrum4'.

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 table 10-1).
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','SANALYZER','Spectrum'`

Usage: Query only

Table 10-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a 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 can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'Spectrum2','Spectrum3'`
Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

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 142.

For a list of available channel types see table 10-1.

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

Usage: Event

Manual control: See "Preset Channel" on page 58

10.3 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 control:

See "Power vs Time (BTS application only)" on page 32
See "Power" on page 32
See "Channel Power ACLR" on page 33
See "Spectrum Emission Mask" on page 34
See "Occupied Bandwidth" on page 35
See "CCDF" on page 36
See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 89

10.4 Configuring Code Domain Analysis

10.4.1 Signal Description

The signal description provides information on the expected input signal.

10.4.1.1 BTS Signal Description

The following commands describe the input signal in BTS measurements.

For more information see chapter 4.6, "Multi-Carrier Mode", on page 48.

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 multi-carrier mode
```
CONF:CDP:MCAR:FILT ON
```
Activates an additional filter for multi-carrier 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 control:
See "Multi Carrier" on page 60
See "Filter Type" on page 60
See "Cut Off Frequency" on page 60

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 multi-carrier mode
CONF:CDP:MCAR:FILT ON
Activates an additional filter for multi-carrier 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 control: See "Multi Carrier" on page 60
See "Filter Type" on page 60
See "Roll-Off Factor" on page 60

CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe] <State>

This command activates or deactivates the usage of a filter for multi-carrier measurements.

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

Example: CONF:CDP:MCAR ON
Activates multi-carrier mode
CONF:CDP:MCAR:FILT OFF
Activates an additional filter for multi-carrier measurements

Manual control: See "Multi Carrier" on page 60
See "Multi Carrier Filter" on page 60

CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE <Type>

This command sets the filter type to be used in multi-carrier 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 multi-carrier mode
CONF:CDP:MCAR:FILT ON
Activates an additional filter for multi-carrier measurements
CONF:CDP:MCAR:FILT:TYPE RRC
Activates the RRC filter

Manual control: See "Multi Carrier" on page 60
See "Filter Type" on page 60
See "Roll-Off Factor" on page 60
See "Cut Off Frequency" on page 60

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 multi-carrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multi-carrier measurements
`CONF:CDP:MCAR:MALG OFF`
Deactivates the enhanced algorithm

Manual control: See "Multi Carrier" on page 60
See "Enhanced Algorithm" on page 60

CONFigure:CDPower[:BTS]:MCARrier[:STATe] <State>

This command activates or deactivates the multi-carrier mode.

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

Example: `CONF:CDP:MCAR ON`
Activates the multi-carrier settings.

Manual control: See "Multi Carrier" on page 60

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 47.

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 control: See "Subtype" on page 59

[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 control: See "PN Offset" on page 59

10.4.1.2 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 147
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF` on page 147
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer:TYPE` on page 148
- `CONFigure:CDPower[:BTS]:MCARrier:FILTer[:STATe]` on page 148
- `CONFigure:CDPower[:BTS]:MCARrier:MALGo` on page 149
- `CONFigure:CDPower[:BTS]:MCARrier[:STATe]` on page 149
- `CONFigure:CDPower[:BTS]:SUBType` on page 149

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 #H4FFFFFFFFF
*RST: #H0

Example: `CDP:LCOD:I '#HF'`
'Define long code mask

Manual control: See "Long Code Mask I / Long Code Mask Q" on page 62

[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 #H4FFFFFFFFF
*RST: #H0

Example: `CDP:LCOD:Q '#HF'`
'Define long code mask

Manual control: See "Long Code Mask I / Long Code Mask Q" on page 62

10.4.2 Configuring the Data Input and Output

The following commands are required to configure data input and output. For more information see chapter 5.2.4, "Data Input and Output Settings", on page 63.

10.4.2.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured 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:COUPling <CouplingType>

This command selects the coupling type of the RF input.

The command is not available for measurements with the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<CouplingType>
AC
AC coupling
DC
DC coupling
*RST: AC

Example: `INP:COUP:DC`

Usage: SCPI confirmed

Manual control: See "Input Coupling" on page 64

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 option R&S FSW-B13.

(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 filter.)

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual control: See "High-Pass Filter 1...3 GHz" on page 65

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 65.

Parameters:

<State> ON | OFF
*RST: ON (OFF for I/Q Analyzer, GSM and MC Group Delay measurements)

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

Manual control: See "YIG-Preselector" on page 65

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input.

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 Digital Baseband Interface (R&S FSW-B17).

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual control: See "Impedance" on page 64

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

Parameters:

<Source> **RF**
Radio Frequency ("RF INPUT" connector)

DIQ
Digital IQ data (only available with optional Digital Baseband Interface R&S FSW-B17)
For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual control: See "Radio Frequency State" on page 64
See "Digital I/Q Input State" on page 66

10.4.2.2 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 158.

Configuring Digital I/Q Input and Output

Useful commands for digital I/Q data described elsewhere:

- `TRIG:SEQ:LEV:BBP`TRIGger[:SEQuence]:LEVel:BBPower on page 171

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 (R&S FSW-B17).

For details see the section "Interface Status Information" for the Digital Baseband Interface (R&S FSW-B17) 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 sampling rate is displayed **1** Current sampling 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, `9.97e37` is returned

Example:	`INP:DIQ:CDEV?`
	Result:
	`1,SMU200A,103634,Out A,70000000,100000000,Passed,Not Started,0,0`

Manual control:	See "Connected Instrument" on page 67

INPut:DIQ:RANGe: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 (option R&S FSW-B17) is installed.

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

Manual control: See "Full Scale Level" on page 66

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 (R&S FSW-B17) is installed.

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

Manual control: See "Adjust Reference Level to Full Scale Level" on page 67

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 (R&S FSW-B17) is installed.

Parameters:
<Level> <numeric value>
Range: 1 µV to 7.071 V
*RST: 1 V

Manual control: See "Full Scale Level" on page 66

INPut:DIQ:RANGe[:UPPer]:UNIT <Unit>

Defines the unit of the full scale level (see "Full Scale Level" on page 66). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface (R&S FSW-B17) is installed.

Parameters:
<Level> VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere
*RST: Volt

Manual control: See "Full Scale Level" on page 66

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the Digital Baseband Interface (R&S FSW-B17, see "Input Sample Rate" on page 66).

Parameters:

<SampleRate> Range: 1 Hz to 10 GHz
*RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Manual control: See "Input Sample Rate" on page 66

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 (R&S FSW-B17) is installed.

Parameters:

<State> ON | OFF
*RST: OFF

Manual control: See "Input Sample Rate" on page 66

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the Digital Baseband Interface (R&S FSW-B17) on and off.

Using the digital input and digital output simultaneously is not possible.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `OUTP:DIQ ON`

Manual control: See "Digital Baseband Output" on page 70

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 (R&S FSW-B17).

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,SMU200A,103634,Out A,70000000,100000000,Passed,Not Started,0,0`

Manual control:	See "Output Settings Information" on page 70 See "Connected Instrument" on page 71

STATus:QUEStionable:DIQ Register

This register contains information about the state of the digital I/Q input and output. This register is available with option Digital Baseband Interface (R&S FSW-B17)Digital Baseband Interface (R&S FSW-B17).

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 159 and `STATus:QUEStionable:DIQ[:EVENt]?` on page 160.

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 SMU, R&S Ex-I/Q-Box) is established.
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 SMU, R&S Ex-I/Q-Box) is established.
3-5	not used
6	**Digital I/Q Input FIFO Overload** This bit is set if the input transfer rate is too high.
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 SMU, 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 SMU, R&S Ex-I/Q-Box) is established.
11-14	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 <SumBit>,<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 <SumBit>,<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:

<SumBit> Range: 0 to 65535

STATus:QUEStionable:DIQ:PTRansition <SumBit>,<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:

<SumBit> 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

10.4.2.3 Configuring the Outputs

Configuring trigger input/output is described in chapter 10.4.4.2, "Configuring the Trigger Output", on page 175.

DIAGnostic<n>:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual control: See "Noise Source" on page 68

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the Digital Baseband Interface (R&S FSW-B17) on and off.

Using the digital input and digital output simultaneously is not possible.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `OUTP:DIQ ON`

Manual control: See "Digital Baseband Output" on page 70

10.4.3 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 5.2.5, "Frontend Settings", on page 71.

10.4.3.1 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 control: See "Center" on page 72

[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 162.

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 control: See "Center Frequency Stepsize" on page 72

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

Parameters:

<State> ON | OFF

*RST: ON

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 72.

Parameters:

<Offset> Range: -100 GHz to 100 GHz
*RST: 0 Hz

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

Manual control: See "Frequency Offset" on page 72

10.4.3.2 Amplitude and Scaling Settings

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 152
- `INPut:IMPedance` on page 153
- `[SENSe:]ADJust:LEVel` on page 190

Remote commands exclusive to amplitude settings:

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again.

Usage: SCPI confirmed

Manual control: See "Auto Scale Once" on page 77

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for the selected result display.

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 control: See "Y-Maximum, Y-Minimum" on page 77

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for the selected result display.

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 control: See "Y-Maximum, Y-Minimum" on page 77

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

Parameters:

<Value> numeric value; the unit depends on 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:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level.

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`

Usage: SCPI confirmed

Manual control: See "Reference Level" on page 74

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset.

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual control: See "Reference Level" on page 74
See "Shifting the Display (Offset)" on page 74

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17).

Parameters:

<State> ON | OFF
*RST: OFF

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual control: See "Input Settings" on page 76
See "Preamplifier (option B24)" on page 76

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 166).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

Example: `INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual control: See "Input Settings" on page 76
See "Preamplifier (option B24)" on page 76

10.4.3.3 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 169).

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 Digital Baseband Interface (R&S FSW-B17) 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 control: See "RF Attenuation" on page 75
See "Attenuation Mode / Value" on page 75

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 Digital Baseband Interface (R&S FSW-B17) is active.

Parameters:

<State> ON | OFF

*RST: ON

Example: `INP:ATT:AUTO ON`
Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual control: See "RF Attenuation" on page 75
See "Attenuation Mode / Value" on page 75

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 168).

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 is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 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 control: See "Using Electronic Attenuation (Option B25)" on page 75

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 is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<State> ON | OFF

*RST: ON

Example: `INP:EATT:AUTO OFF`

Manual control: See "Using Electronic Attenuation (Option B25)" on page 75

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command is only available with option R&S FSW-B25.

It is not available if R&S FSW-B17 is active.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:EATT:STAT ON`

Switches the electronic attenuator into the signal path.

Manual control: See "Using Electronic Attenuation (Option B25)" on page 75

10.4.4 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 5.2.6, "Trigger Settings", on page 77.

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.

10.4.4.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual control: See "Trigger Source" on page 79
See "Drop-Out Time" on page 80

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (data capturing).

Parameters:

<Offset> *RST: 0 s

Example:
```
TRIG:HOLD 500us
```

Manual control: See "Trigger Source" on page 79
See "Trigger Offset" on page 80

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

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> *RST: 150 ns

Example:
```
TRIG:SOUR IFP
```
Sets the IF power trigger source.
```
TRIG:IFP:HOLD 200 ns
```
Sets the holding time to 200 ns.

Manual control: See "Trigger Source" on page 79
See "Trigger Holdoff" on page 81

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis.

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 control: See "Trigger Source" on page 79
See "Hysteresis" on page 80

TRIGger[:SEQuence]:LEVel:BBPower <Level>

This command sets the level of the baseband power trigger.

This command is available with the **Digital Baseband Interface (R&S FSW-B17)**.

Parameters:
<Level> Range: -50 dBm to +20 dBm
*RST: -20 DBM

Example: `TRIG:LEV:BB -30DBM`

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> 1 | 2 | 3
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 control: See "Trigger Source" on page 79
See "Trigger Level" on page 80

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.

Parameters:

<TriggerLevel> Range: -50 dBm to 20 dBm
*RST: -20 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.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> Range: -50 dBm to -10 dBm
*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 all trigger sources except time 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 control: See "Trigger Source" on page 79
See "Slope" on page 81

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

EXTern
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".

IFPower
Second intermediate frequency

TIME
Time interval

BBPower
Baseband power (for digital input via the Digital Baseband Interface R&S FSW-B17)

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 Digital Baseband Interface (R&S FSW-B17) 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 80.

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual control:

See "Trigger Source" on page 79
See "Trigger Source" on page 79
See "Free Run" on page 79
See "External Trigger 1/2/3" on page 79
See "Digital I/Q" on page 80

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 sweep starts every 50 s.

10.4.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 68.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual control: See "Trigger 2/3" on page 68

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the 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> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Level>

HIGH
TTL signal.

LOW
0 V

*RST: LOW

Manual control: See "Trigger 2/3" on page 68
See "Output Type" on page 69
See "Level" on page 69

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:

<port>

2 | 3
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 control: See "Trigger 2/3" on page 68
See "Output Type" on page 69

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual control: See "Trigger 2/3" on page 68
See "Output Type" on page 69
See "Send Trigger" on page 69

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:
<port> 2 | 3
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.

Manual control: See "Trigger 2/3" on page 68
See "Output Type" on page 69
See "Pulse Length" on page 69

10.4.5 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 10.10, "Configuring the Application Data Range (MSRA mode only)", on page 239).
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 195

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 control: See "Number of Slots" on page 83

[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 control: See "Invert Q" on page 83

[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 84 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 control: See "Number of Sets" on page 84

10.4.6 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 42.

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 control: See "Sync To" on page 84

10.4.7 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 10-2: 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 10-3: MS channel types and their assignment to a numeric parameter value

Parameter	Channel type
0	PICH
1	RRI

Parameter	Channel type
2	DATA
3	ACK
4	DRC
5	INACTIVE
6	DSC
7	Auxiliary pilot

10.4.7.1 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 control: See "Predefined Tables" on page 87

Table 10-4: 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 186.

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 control: See "Copying a Table" on page 88

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 186.

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be deleted.
`CONF:CDP:CTAB:DEL`
Deletes the table.

Manual control: See "Deleting a Table" on page 88

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 control: See "Restoring Default Tables" on page 88

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 182.

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 control: See "Selecting a Table" on page 87

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 control: See "Using Predefined Channel Tables" on page 86

[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 control: See "Inactive Channel Threshold" on page 86

10.4.7.2 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 186.

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 control: See "Comment" on page 88

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 185.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 182 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 control:

See "Channel Type" on page 90
See "Channel Number (Walsh Ch./SF)" on page 90
See "Modulation" on page 90
See "Power" on page 90
See "Status" on page 90
See "Modulation" on page 92

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 183.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 182 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 10-5.

<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 control: See "Channel Type" on page 91
See "Channel Number (Walsh Ch./SF)" on page 91
See "Status" on page 92
See "Activity" on page 92

Table 10-5: 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 control: See "Creating a New Table" on page 87
See "Name" on page 88

10.4.8 Sweep Settings

[SENSe:]AVERage<n>:COUNt <AverageCount>

This command defines the number of sweeps that the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

The average count is valid for all measurement traces in a particular measurement window.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Usage: SCPI confirmed

Manual control: See "Sweep/Average Count" on page 92

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps the R&S FSW uses to average traces.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the sweep count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Example: `SWE:COUN 64`
Sets the number of sweeps to 64.
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual control: See "Sweep/Average Count" on page 92
See "No of HalfSlots" on page 98

10.4.9 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:Y[:SCALe]:AUTO ONCE` on page 164

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 control: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 94

[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 control: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 95

[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 188.

*RST: AUTO

Manual control: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 95
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 95

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 190 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 control: See "Lower Level Hysteresis" on page 95

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 190 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 control: See "Upper Level Hysteresis" on page 95

[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 control: See "Reference Level" on page 74
See "Setting the Reference Level Automatically (Auto Level)" on page 74

10.4.10 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 control: See "CDP Average" on page 105

[SENSe:]CDPower:NORMalize <State>

This command switches elimination of I/Q offset on or off.

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

Example: `SENS:CDP:NORM ON`
Activates the elimination of the I/Q offset.

Manual control: See "Compensate IQ Offset" on page 105

[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 45.

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 control: See "Operation Mode" on page 107

[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 49.

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 control: See "Code Display Order" on page 106

[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: ABS

Example: `CDP:PDIS REL`

Pilot channel power is displayed in relation to the total power.

Manual control: See "Code Power Display" on page 105

[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 107.

Example: `CDP:PREF TOT`

Sets total power as reference power.

Manual control: See "Power Reference" on page 107

[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 control: See "Timing and phase offset calculation " on page 105

10.4.11 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 249.

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 control: See "Channel" on page 108

[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 control: See "Channel Type" on page 109

[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 control: See "Mapping" on page 92
See "Branch" on page 111

[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 109).

*RST: AUTO

Example: `CDP:MMODe COMP`
The pilot channel type (and all other channel types) is analyzed in complex mode

Manual control: See "Mapping" on page 109

[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 control: See "Set to Analyze" on page 84

[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 control: See "(Half-)Slot" on page 108

10.5 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 31.

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 10.2, "Activating the Measurement Channel", on page 142.

The individual measurements are activated using the `CONFigure:CDPower[:BTS]:MEASurement` on page 145 command (see chapter 10.3, "Selecting a Measurement", on page 145).

In addition to the common RF measurement configuration commands described for the base unit, some special commands are available in 1xEV-DO applications.

10.5.1 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 187

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.

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 control: See "Reference Mean Pwr" on page 99
See "Reference Manual" on page 99
See "Set Mean to Manual" on page 99

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 196).

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 control: See "Reference Manual" on page 99

CONFigure:CDPower[:BTS]:PVTime:BURSt <State>

This command activates an automatic burst alignment to the center of the diagram.

Parameters:

<State> ON | OFF

*RST: OFF

Manual control: See "Burst Fit" on page 99

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 control: See "Restart on Fail" on page 99

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 control: See "RF:Slot" on page 98

10.5.2 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 250.

*RST: 0

Example: CONF:CDP:BCL 1
Selects band class 1, 1900 MHz

Manual control: See "Bandclass" on page 101

10.6 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 5.1, "Result Display", on page 54.

10.6.1 General Window Commands

The following commands are required to configure general window layout, independant of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 144).

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: SPL

Example: `DISP:FORM SING`

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 203).

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:LARG`

DISPlay[:WINDow<n>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: `DISP:WIND1:SEL`
Sets the window 1 active.

Usage: Setting only

10.6.2 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 144).

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

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 control:
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 "Peak Code Domain Error" on page 27
See "Power vs Chip (BTS application only)" on page 27
See "Power vs Halfslot (MS application only)" on page 28
See "Power vs Symbol" on page 28
See "Result Summary (MS application only)" on page 29
See "Symbol Constellation" on page 30
See "Symbol EVM" on page 30
See "Diagram" on page 37
See "Result Summary" on page 38
See "Marker Table" on page 38
See "Marker Peak List" on page 38
See "Evaluation List" on page 39

Table 10-6: <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)

Parameter value	Window type
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)
LEValuation	List evaluation (SEM, Power vs Time)
MTABle	Marker table
PCDerror	Peak Code Domain Error
PCHip	Power vs Chip (BTS application only)
PHSLot	Power vs Halfslot (MS application only)
PPCG	Power vs PCG
PSYMbol	Power vs Symbol
RSUMmary	Result Summary
SCONst	Symbol Constellation
SEVM	Symbol EVM

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<Index_1>..<WindowName_n>,<Index_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<Index> **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.

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.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

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 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, 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 200 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.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 199 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.

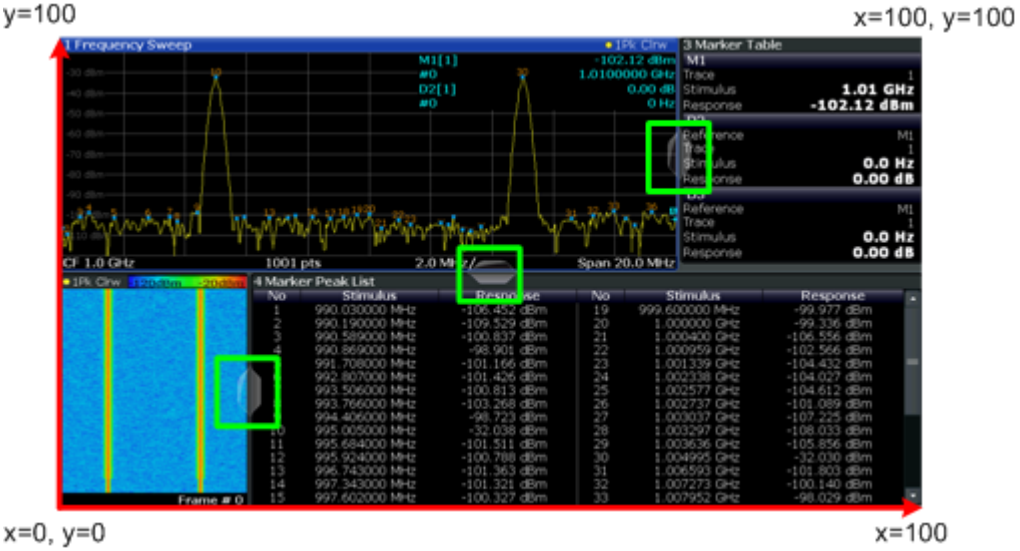


Fig. 10-1: SmartGrid coordinates for remote control of the splitters

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 10-1.)
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, as opposed to `LAYout:ADD[:WINDow]?`, the suffix <n> determines the existing window next to which the new window is added.

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.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 200 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).

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

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.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 200 for a list of available window types.

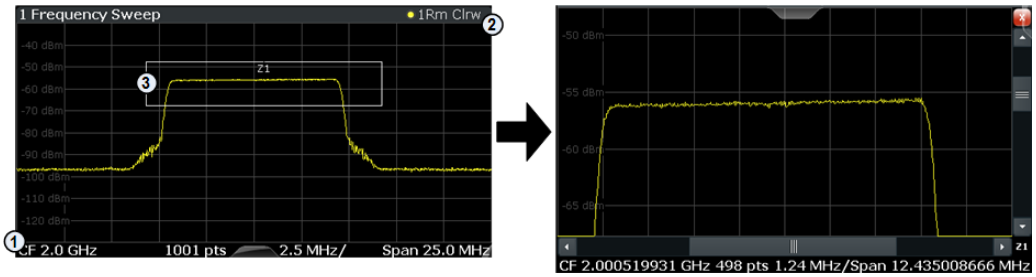
10.6.3 Zooming into the Display

10.6.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>, <x2>,<y2> — Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual control: See "Single Zoom" on page 96

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State> — ON | OFF

*RST: OFF

Example: `DISP:ZOOM ON`
Activates the zoom mode.

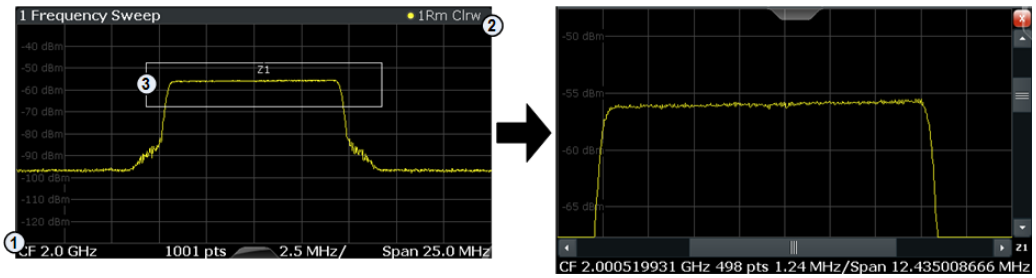
Manual control: See "Single Zoom" on page 96
See "Restore Original Display" on page 96
See "Deactivating Zoom (Selection mode)" on page 96

10.6.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> — 1...4
Selects the zoom window.

Parameters:

<x1>,<y1>, <x2>,<y2>
Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual control: See "Multiple Zoom" on page 96

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:

<zoom>
1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State>
ON | OFF

*RST: OFF

Manual control: See "Multiple Zoom" on page 96
See "Restore Original Display" on page 96
See "Deactivating Zoom (Selection mode)" on page 96

10.7 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 a current measurement 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:SEQuencer:ABORt` on page 211 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 (GPIB, LAN or other interface) 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: SCPI confirmed

INITiate:CONMeas

This command restarts a (single) measurement that has been stopped (using `INIT:CONT OFF`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate[: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.

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM;*WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual control: See "Continue Single Sweep" on page 93

INITiate:CONTinuous <State>

This command controls the sweep mode.

Note that in single sweep mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 211) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF

ON
Continuous sweep

OFF
Single sweep

*RST: ON

Example:
`INIT:CONT OFF`
Switches the sweep mode to single sweep.
`INIT:CONT ON`
Switches the sweep mode to continuous sweep.

Manual control: See "Continuous Sweep/RUN CONT" on page 93

INITiate[: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.

Example: (For Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Sets the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.

Manual control: See "Single Sweep/ RUN SINGLE" on page 93

INITiate: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:SEQuencer:IMMediate` on page 211.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 213.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the `INITiate[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 213).

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.

Usage: Event

INITiate: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 213).

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` Sequencer mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

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 Sequencer mode so each active measurement will be performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.

INITiate: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 applications.

Example:

```
SYST:SEQ:OFF
```
Deactivates the scheduler
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a new data measurement and waits for the end of the sweep.
```
INIT:SEQ:REFR
```
Refreshes the display for all MSRA 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

ON
The Sequencer is activated and a sequential measurement is started immediately.

OFF
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: OFF

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
```

10.8 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 10.4.7, "Channel Detection", on page 179.

Specific commands:

10.8.1 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.

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 control:
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 28
See "Power vs Symbol" on page 28
See "Result Summary (MS application only)" on page 29
See "Symbol Constellation" on page 30
See "Symbol EVM" on page 30

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 sweeps. See also `INITiate:CONTinuous` on page 210.

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 control: See "CCDF" on page 36

10.8.2 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.

*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.

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 10.8.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 219.

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

10.8.3 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.

10.8.3.1 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 249).

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".

10.8.3.2 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 10-2)
<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 10-2)
<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

Value	Description
<code class>	code class of the channel with maximum phase offset
<reserved 1...6>	0: reserved for future use

10.8.3.3 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 249).

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.

10.8.3.4 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 10-3)
<code number>	code number of the channel

Value	Description
<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.

10.8.3.5 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 249).

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 49.

10.8.3.6 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 10-3)
<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 49.

10.8.3.7 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.

10.8.3.8 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

10.8.3.9 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.

10.8.3.10 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.

10.8.3.11 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.

10.8.3.12 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.

10.8.3.13 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.

10.8.3.14 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.

10.8.3.15 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 249).

10.8.3.16 Power vs Time (BTS application)

The command returns two values for each sweep point:

<power value in dBm>, <measurement time in µs>

10.8.3.17 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.

10.8.3.18 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.

10.8.3.19 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 249).

10.8.3.20 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 249).

10.8.4 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.

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,'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.

10.8.5 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 217

Remote commands exclusive to

CALCulate<n>:LIMit<k>:FAIL

This command queries the result of a limit check.

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 sweeps. See also `INITiate:CONTinuous` on page 210.

Return values:

<Result>

0
PASS

1
FAIL

Example: `INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC:LIM3:FAIL?`
Queries the result of the check for limit line 3.

Usage: SCPI confirmed

Manual control: See "Spectrum Emission Mask" on page 34

CALCulate<n>:MARKer<m>:FUNCtion:POWer: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 sweeps. See also `INITiate:CONTinuous` on page 210.

Query parameters:

<Measurement>

ACPower | MCACpower
ACLR measurements (also known as adjacent channel power or multi-carrier adjacent channel measurements).
Returns the power for every active transmission and adajcent channel. The order is:
• power of the transmission channel
• power of lower adjacent channel
• power of upper adjacent channel
• power of lower alternate channel 1
• power of upper alternate channel 1 *(etc.)*
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

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.

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.

OBANdwidth | OBWidth
Occupied bandwidth.
Returns the occupied bandwidth in Hz.

Manual control: See "Power" on page 32
See "Channel Power ACLR" on page 33
See "Spectrum Emission Mask" on page 34
See "Occupied Bandwidth" on page 35
See "CCDF" on page 36

CALCulate<n>:STATistics:RESult<t> <ResultType>

This command queries the results of a CCDF or ADP measurement.

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

Manual control: See "CCDF" on page 36

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

10.9 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 1xEV-DO applications.

For details see the "Analysis" chapter in the R&S FSW User Manual.

10.9.1 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.

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 control: See "Trace Mode" on page 113

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Example:
```
DISP:TRAC3 ON
```

Usage: SCPI confirmed

10.9.2 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.

10.9.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual control: See "All Markers Off" on page 116

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.

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

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual control: See "Marker State" on page 115
See "Marker Type" on page 115

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.

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 control: See "Stimulus" on page 115

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

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.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual control: See "Marker State" on page 115
See "Marker Type" on page 115

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.

Example: `CALC:DELT:X?`
Outputs the (absolute) x-value of delta marker 1.

Manual control: See "Stimulus" on page 115

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.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

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 sweeps. See also `INITiate:CONTinuous` on page 210.

The unit depends on the application of the command.

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

10.9.2.2 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 control: See "Marker Table Display" on page 116

10.9.2.3 Marker Search and Positioning Settings

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117
See "Search Next Peak" on page 118

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Peak Search" on page 119

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117
See "Search Next Minimum" on page 118

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Search Minimum" on page 119

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117
See "Search Next Peak" on page 118

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Peak Search" on page 119

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117
See "Search Next Minimum" on page 118

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker hasn't been active yet, the command first activates the marker.

Usage: Event

Manual control: See "Search Minimum" on page 119

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.

Usage: Event

Manual control: See "Search Mode for Next Peak" on page 117

10.10 Configuring the Application Data Range (MSRA mode only)

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications define an extract of the captured data for analysis, referred to as the **application data**.

For the 1xEV-DO BTS application, the 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 178). 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 application data for the 3GPP FDD 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.

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the current window. This command is only available in application measurement channels, not the MSRA View or MSRA Master.

Return values:

<IntStart> Start value of the analysis interval
Default unit: us

<IntStop> Stop value of the analysis interval
Default unit: us

Usage: Query only

INITiate:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only for applications in MSRA mode, not the MSRA Master.

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

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 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 application data. The offset must be a positive value, as the application can only analyze data that is contained in the capture buffer.

Range: 0 to <Record length>
*RST: 0

Manual control: See "Trigger Source" on page 79
See "Capture Offset" on page 81

10.11 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 158.

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 242 and `STATus:QUEStionable:SYNC[:EVENt]?` on page 242.

Table 10-7: 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.

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.

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 <SumBit>,<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:

<SumBit> 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 <SumBit>,<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:

<SumBit> 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 <SumBit>,<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.

Parameters:

<SumBit> 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.

10.12 Commands for Compatibility

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 10.6.2, "Working with Windows in the Display", on page 200).

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 10-8: <Evaluation> parameter values

String Parameter	Text Parameter	Evaluation
'XTIM:CDP:BSTReam'	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
'XTIM:CDP:PVSLot'	PSLot	Power vs Slot (BTS mode only)
'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 10.6.2, "Working with Windows in the Display", on page 200).

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 190.

[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

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 1-1: Base station channel table DOQPSK with QPSK modulation in DATA area

Channel Type	No. 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

Channel Type	No. of Channels	Code Channel (Walsh Code.SF)	Modulation/Mapping
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 1-2: 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 1-3: 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

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Modulation/ Mapping
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 1-4: 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 1-5: Mobile station channel table PICH

Channel type	Code channel (Walsh Code.SF)	Mapping	Activity
PICH	0.16	I	1111 1111 1111 1111

Table 1-6: 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 1-7: 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
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 1-8: Relationship between various parameters in 1xEV-DO BTS application

Channel type	Code class	Sub-type	SF	Symbol rate	Modulation type	Chips per slot	Sym-bols 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:			
						64: 128: 256: 512: 1024:	0.5 1 2 4 8	0.5 1 2 4 8	1 2 4 8 16
DATA	4	0/1/2	16	76.8 ksps	QPSK, 8-PSK, 16-QAM	400*4 - PreambleChips= **DataNettoChips**		**Mapping always complex** **Modulation type:**	

Channel type	Code class	Sub-type	SF	Symbol rate	Modulation type	Chips per slot	Sym-bols per slot and code	Bits per slot and code			
								Mapping I or Q		Mapping complex	
								QPSK	8-PSK	16-QAM	64-QAM
		3	16		64-QAM	1600-0 = 1600	100	200	300	400	500
						1600-64 = 1536	96	192	288	384	480
						1600-128 = 1472	92	184	276	368	460
						1600-256 = 1344	84	168	252	336	420
						1600-512 = 1088	68	136	204	272	340
						1600-1024 = 576	36	72	104	144	180

MS signals

Table 1-9: 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 1-10: 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
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 101).

Table 1-11: 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
15	15	AWS Band
16	16	US 2.5 GHz Band
17	17	US 2.5 GHz Forward Link Only Band

List of Remote Commands (1xEV-DO)

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