R&S®FSW-K82/-K83 CDMA2000® Measurements
User Manual

1173.9334.02 — 09

Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 1.90 and higher:

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

The following firmware options are described:

- R&S FSW-K82 (1313.1468.02)
- R&S FSW-K83 (1313.1474.02)

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. R&S®FSW-K82 / R&S®FSW-K83 is abbreviated as R&S FSW-K82/-K83

Contents

1 Preface

1.1 About this Manual

This User Manual provides all the information **specific to the CDMA2000 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 CDMA2000 Measurements Application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **I/Q Data Import and Export**
  Description of general functions to import and export raw I/Q (measurement) data
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup
- **How to Perform Measurements in CDMA2000 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 CDMA2000 Measurements**
  Remote commands required to configure and perform CDMA2000 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 Rohde & Schwarz 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 Rohde & Schwarz 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 Rohde & Schwarz 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 CDMA2000 Applications

The CDMA2000 options are firmware applications that add functionality to the R&S FSW to perform measurements on downlink or uplink signals according to the CDMA2000 standard.

R&S FSW-K82 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-K83 performs **M**obile **S**tation (MS) measurements on reverse link signals on the basis of the 3GPP2 Standard (Third Generation Partnership Project 2).

The measurements are based on the "Physical Layer Standard for CDMA2000 Spread Spectrum Systems Release C" of version C.S0002-C V1.0 dated May 2002 and "Recommended Minimum Performance Standard for CDMA2000 Spread Spectrum Base Stations" of version C.S0010-B dated December 2002. This standard has been adopted by the following authorities with the specified norm:

TIA: TIA/EIA-97-E dated February 2003 (also known as IS-97-E)

Reference made to the CDMA2000 specification in the following text alludes to these standards.

The application firmware R&S FSW-82 supports radio configurations 1 to 5 and 10. Thus, IS95A/B signals conforming to radio configurations 1&2 can also be measured with this application firmware. Channels and modulation types of the 1xEV– DV enhancement are supported as well.

The application firmware R&S FSW-83 supports the radio configurations 3 and 4. Apart from CDMA2000 reverse link signals, the 1xEV-DV reverse link channels of Release C are also supported. Code Domain Analysis is also possible at signals where the pilot channel is active in at least one of the captured power control groups (pilot gating).

In addition to the code domain measurements described in the CDMA2000 standard, the CDMA2000 applications feature measurements in the spectral range such as channel power, adjacent channel power, occupied bandwidth and spectrum emission mask with predefined settings.

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S 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 CDMA2000 Applications

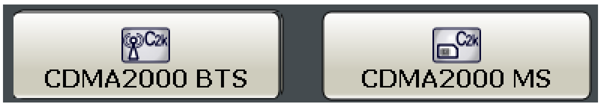
The CDMA2000 measurements require special applications on the R&S FSW.

To activate the CDMA2000 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 "cdma2000 BTS" or "cdma2000 MS" item.

   The R&S FSW opens a new measurement channel for the CDMA2000 application.

The measurement is started immediately with the default settings. It can be configured in the CDMA2000 "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see chapter 6.2.2, "Configuration Overview", on page 58).

Multiple Measurement Channels and Sequencer Function

When you activate a CDMA2000 application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application.

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

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

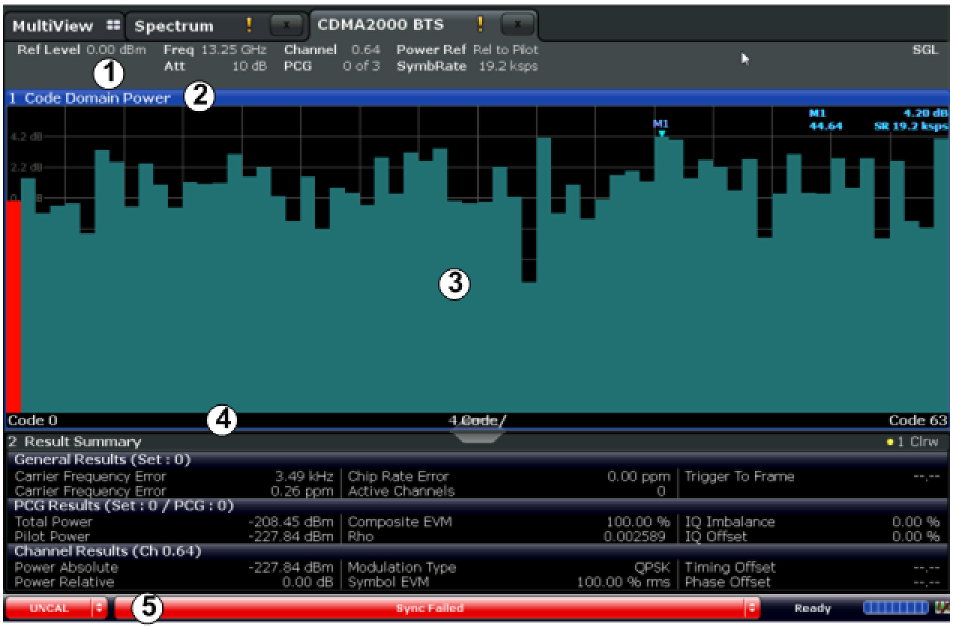
If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a symbol in the tab label. The result displays of the individual channels are updated in the tabs (as well as the "MultiView") as the measurements are performed. Sequential operation itself is 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 in the CDMA2000 BTS application. All different information areas are labeled. They are explained in more detail in the following sections.

(The basic screen elements are identical in the CDMA2000 MS application.)



1 = Channel bar for firmware and measurement settings
2 = Window title bar with diagram-specific (trace) information
3 = Diagram area with marker information
4 = Diagram footer with diagram-specific information, depending on measurement
5 = 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 CDMA2000 applications, the R&S FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in CDMA2000 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)
PCG	Power control group (see chapter 4.1, "PCGs and Sets", on page 39)
Power Ref	Reference used for power results
SymbRate	Symbol rate of the currently selected channel

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 CDMA2000 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 CDMA2000 applications provide several different measurements for signals according to the CDMA2000 standard. The main and default measurement is Code Domain Analysis. In addition to the code domain power measurements specified by the CDMA2000 standard, the CDMA2000 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 55.

Evaluation methods

The captured and processed data for each measurement can be evaluated with various different methods. All evaluation methods available for the selected CDMA2000 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 18.

3.1 Code Domain Analysis

The CDMA2000 firmware applications feature a Code Domain Analyzer. It can be used used to perform the measurements required in the CDMA2000 standards with regard to the power of the different codes and code channels (concentrated codes). In addition, the modulation quality (EVM and RHO factor), frequency errors and trigger–to–frame time, as well as the peak code domain errors are determined. Constellation evaluations and bitstream evaluations are also available. Furthermore, the timing and phase offsets of the channels to the pilot can also be calculated. The observation period can be set as multiples of the power control group (PCG).

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 PCGs)
- Results which take the overall signal into account over a power control group (PCG)
- Results which take one channel into account over the whole observation period (all PCGs)
- Results which take one channel into account over a power control group (PCG)

Remote command:

`CONF:CDP:MEAS CDP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 146

3.1.1 Code Domain Parameters

In the Result Summary, three different types of measurement results are determined and displayed:

- General results for the current set
- PCG results for the current set and PCG
- Channel results for the selected channel

In the Channel Table, channel results for *all* channels are displayed.

General Results

Under "General Results", the measurement results that concern the total signal (that is, all channels) for the entire period of observation (that is, all PCGs) are displayed:

Table 3-1: General code domain power results for the current set

Parameter	Description
Carrier Frequency Error	Shows 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	Shows 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 measurement result is also valid if the R&S FSW could not synchronize to the CDMA2000 signal.
Trigger to Frame	Reflects the time offset from the beginning of the recorded signal section to the start of the first PCG. In case of triggered data recording, this corresponds to the timing offset: *timing offset = frame trigger (+ trigger offset) – start of first PCG* If it was not possible to synchronize the R&S FSW to the CDMA2000 signal, this measurement result is meaningless. For the "Free Run" trigger mode, dashes are displayed.
Active Channels	Specifies the number of active channels found in the signal. Detected data channels as well as special channels are regarded as active. With transmit diversity, the result applies to the selected Antenna Diversity - Antenna Number.

PCG Results

PCG results concern the total signal (that is, all channels) for the selected PCG.

Table 3-2: Code domain power results for the current PCG

Parameter	Description
Total Power	Shows the total power of the signal.
Pilot Power	Shows the power of the pilot channel. If antenna 2 is selected, the power of the F-TDPICH is displayed, in all other cases that of the F-PICH. For details on antenna selection refer to "Antenna Diversity - Antenna Number" on page 61.
RHO	Shows the quality parameter RHO. According to the CDMA2000 standard, RHO is the normalized, correlated power between the measured and the ideally generated reference signal. When RHO is measured, the CDMA2000 standard requires that only the pilot channel be supplied.
Composite EVM	The composite EVM is the difference between the test signal and the ideal reference signal. For further details refer to the Composite EVM result display.
IQ Imbalance	Shows the IQ imbalance of the signal in %.
Offset	Shows the IQ offset of the signal in %.

Channel results

In the Result Summary, channel results of the selected channel and the selected PCG are displayed.

In the Channel Table, channel results for *all* channels are displayed. For details see "Channel Table" on page 19.

Not all channel results displayed in the Result Summary are also displayed in the Channel Table and vice versa.

Table 3-3: Channel-specific parameters

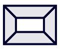
Parameter	Description
Channel	Channel number including the spreading factor (in the form <Channel>.<SF>)
Modulation Type	**(BTS application only):** Displays the modulation type of the channel and PCG: BPSK, QPSK, 8PSK, or 16QAM
Mapping	**(MS application only):** Indicates the selected branch (I or Q)
Phase Offset	Phase offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 111), 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.
Power Absolute	Absolute (dBm) power of the channel
Power Relative	Relative (dB) power of the channel (refers either to the pilot channel or the total power of the signal)

Parameter	Description
Symbol EVM	Peak or mean value of the EVM measurement result For further details refer to the result display "Symbol EVM" on page 29.
Timing Offset	Timing offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 111), 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.

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 CDMA2000 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.

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.

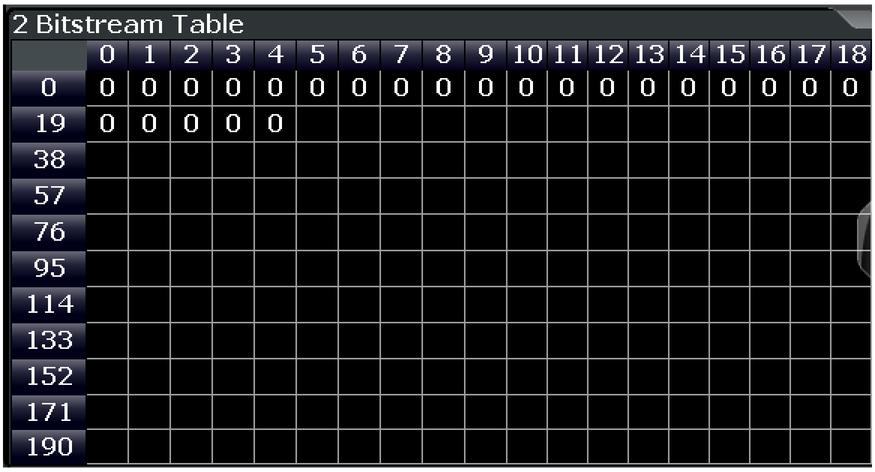
The selected evaluation not only affects the result display, but also the results of the trace data query (see `TRACe<n>[:DATA]?` on page 220).

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 PCG.

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


2 Bitstream Table

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0														
38																			
57																			
76																			
95																			
114																			
133																			
152																			
171																			
190																			

Fig. 3-1: Bitstream result display for 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 PCG 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 4, "Measurement Basics", on page 39.

Remote command:

`LAY:ADD? '1',RIGH, 'XTIM:CDP:BSTR'`, see `LAYout:ADD[:WINDow]?` on page 204

Channel Table

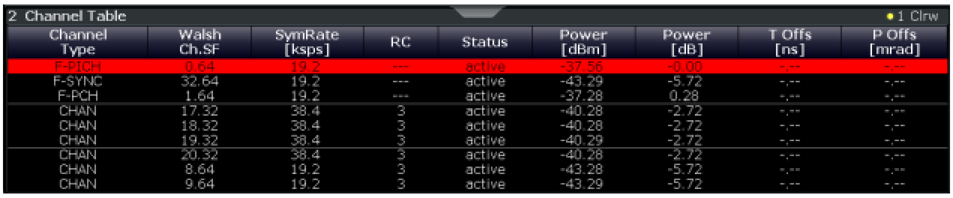
The "Channel Table" evaluation displays the detected channels and the results of the code domain power measurement over the selected PCG. The analysis results for all channels are displayed. Thus, the Channel Table may contain up to 128 entries, corresponding to the highest base spreading factor of 128.

The first entries of the table indicate the channels that must be available in the signal to be analyzed and any other control channels (PICH, SYNC etc.).

The lower part of the table indicates the data channels that are contained in the signal.

If the type of a channel can be fully recognized, based on pilot sequences or modulation type, the type is indicated in the table. In the BTS application, all other channels are of type CHAN.

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 "Table Configuration" on page 20.



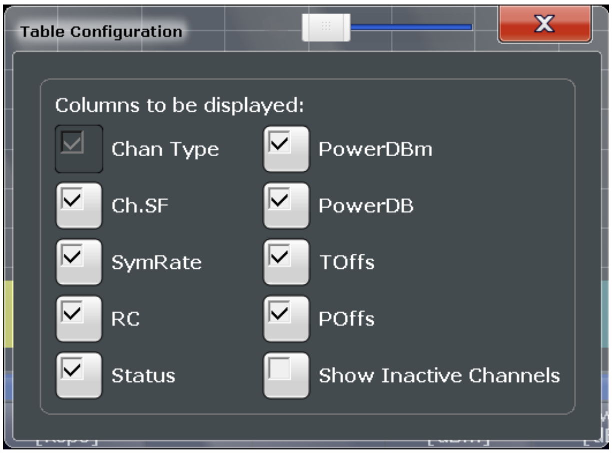
2 Channel Table ● 1 Clrw

Channel Type	Walsh Ch.SF	SymRate [ksps]	RC	Status	Power [dBm]	Power [dB]	T Offs [ns]	P Offs [mrad]
F-PICH	0.64	19.2	---	active	-37.56	-0.00	-,--	-,--
F-SYNC	32.64	19.2	---	active	-43.29	-5.72	-,--	-,--
F-PCH	1.64	19.2	---	active	-37.28	0.28	-,--	-,--
CHAN	17.32	38.4	3	active	-40.28	-2.72	-,--	-,--
CHAN	18.32	38.4	3	active	-40.28	-2.72	-,--	-,--
CHAN	19.32	38.4	3	active	-40.29	-2.72	-,--	-,--
CHAN	20.32	38.4	3	active	-40.28	-2.72	-,--	-,--
CHAN	8.64	19.2	3	active	-43.28	-5.72	-,--	-,--
CHAN	9.64	19.2	3	active	-43.29	-5.72	-,--	-,--

Fig. 3-2: Channel Table display for the BTS application

Remote command:
`LAY:ADD? '1',RIGH, CTABle`, see `LAYout:ADD[:WINDow]?` on page 204

Table Configuration ← Channel Table
You can configure which parameters are displayed in the Channel Table 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.

The following parameters of the detected channels are determined by the CDP measurement and can be displayed in the Channel Table result display. (For details see chapter 3.1.1, "Code Domain Parameters", on page 16.)

Table 3-4: Code domain power results in the channel table

Parameter	Description
Channel Type	Shows the channel type ('---' for inactive channels)
Walsh Ch.SF	Channel number including the spreading factor (in the form <Channel>.<SF>)
(P Offs [mrad])	Phase offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 111), 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.
Pwr [dBm])	Absolute (dBm) power of the channel
Pwr [dB]	Relative (dB) power of the channel (refers either to the pilot channel or the total power of the signal)

Parameter	Description
RC	**(BTS application only):** Radio configuration
Mapping	**(MS application only):** Branch the data is mapped to
Status	Channel status; Unassigned codes are identified as inactive channels
Symbol Rate [ksps]	Symbol rate at which the channel is transmitted (9.6 ksps to 307.2 ksps)
(T Offs [ns])	Timing offset between the selected channel and the pilot channel If enabled (see "Timing and phase offset calculation " on page 111), 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.

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 PCG.

"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 4.3, "Code Display and Sort Order", on page 41).

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

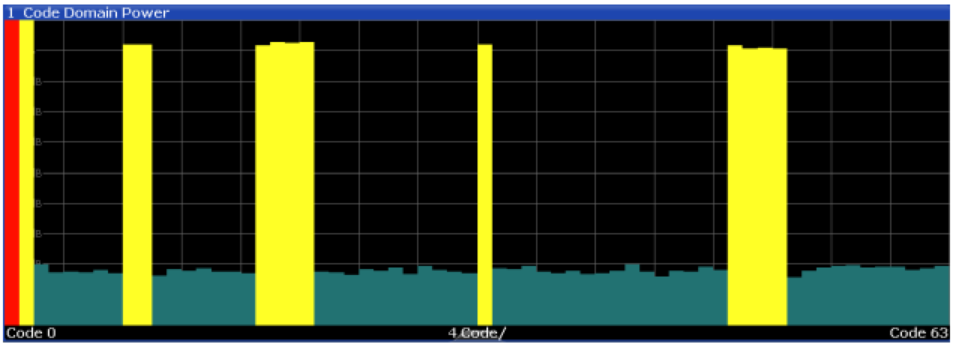


Fig. 3-3: Code Domain Power Display for the BTS application

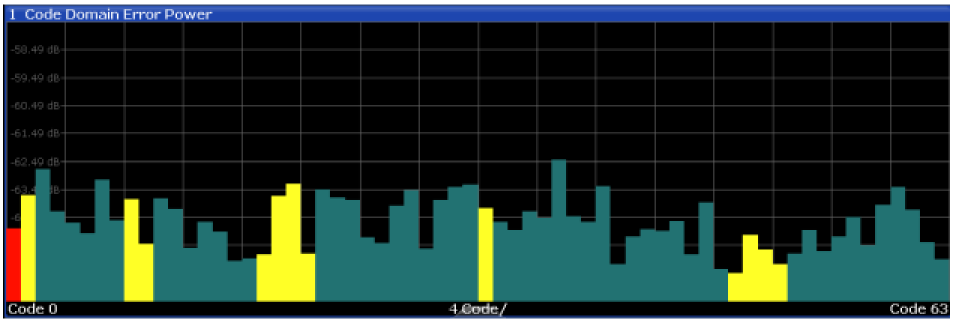


Fig. 3-4: Code Domain Error Power result display for the MS application

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. In addition, codes with alias power can occur (see "Alias power" on page 42).

Table 3-5: 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

Note: If codes with alias power are displayed, set the highest base spreading factor available in the Base Spreading Factor field.
It is not recommended that you select more detailed result displays (such as "Symbol Constell") for unassigned or inactive codes, since the results are not valid.

Remote command:
CDP:
`LAY:ADD? '1',RIGH, CDPower`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES? CDP` or `CALC:MARK:FUNC:CDP:RES? CDPR`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217
CDEP:
`LAY:ADD? '1',RIGH, CDEPower`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217.

Composite Constellation
In "Composite Constellation" evaluation the constellation points of the 1536 chips are displayed for the specified PCG. 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.

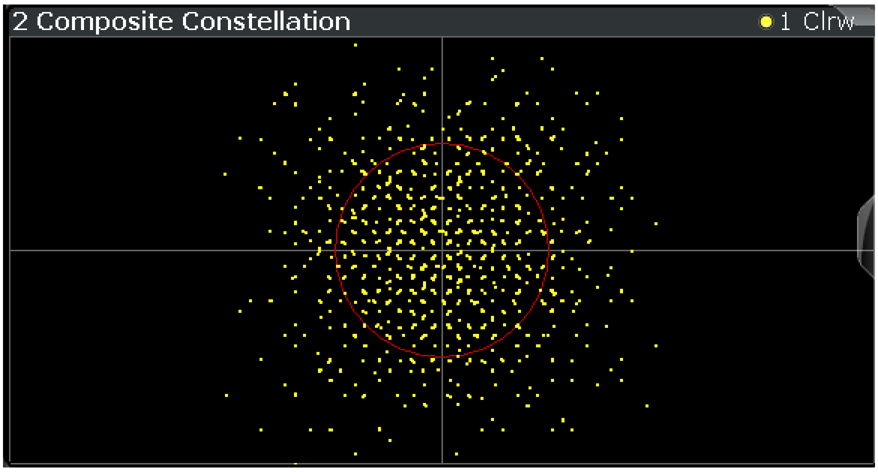


Fig. 3-5: Composite Constellation display for the BTS application

Remote command:
`LAY:ADD? '1',RIGH, CCON`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

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 PCG.

The measurement evaluates the total signal over the entire period of observation. The selected PCG is highlighted red. You can set the number of PCGs in the "Signal Capture" settings (see "Number of PCGs" on page 91).

Fig. 3-6: 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 setting.

Remote command:

`LAY:ADD? '1',RIGH, CEVM`, see `LAYout:ADD[:WINDow]?` on page 204

`CALC:MARK:FUNC:CDP:RES? MACCuracy`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

Mag Error vs Chip

Mag Error vs Chip activates the Magnitude Error versus chip display. The magnitude error is displayed for all chips of the selected slot.

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

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

where:

MAG_k	magnitude error of chip number k
s_k	complex chip value of received signal
x_k	complex chip value of reference signal
k	index number of the evaluated chip
N	number of chips at each CPICH slot
n	index number for mean power calculation of reference signal

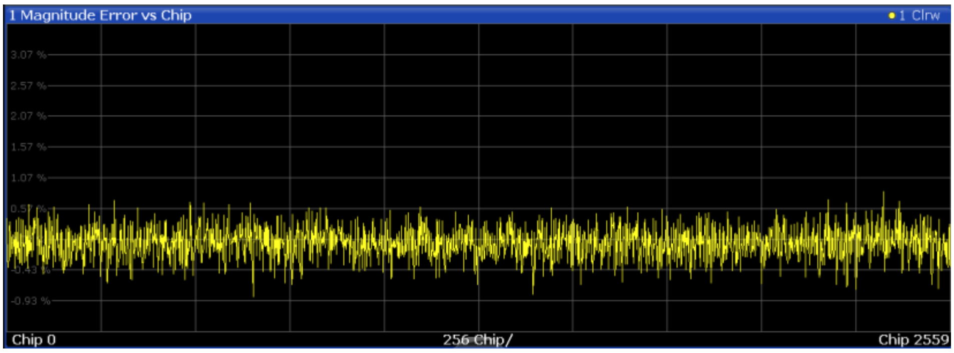


Fig. 3-7: Magnitude Error vs Chip display for CDMA2000 BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, MECHip`, see `LAYout:ADD[:WINDow]?` on page 204
TRACe<n>[:DATA]? TRACE<1...4>

Peak Code Domain Error

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

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

You can select the Base Spreading Factor and the number of evaluated PCGs in the Signal Capture settings (see "Number of PCGs" on page 91).

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

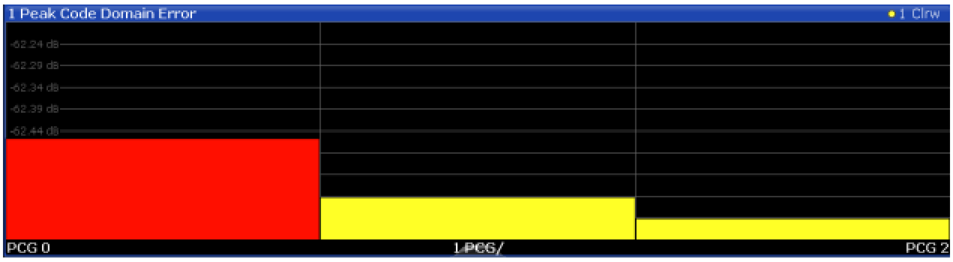


Fig. 3-8: Peak Code Domain Error display for the BTS application

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

Remote command:
`LAY:ADD? '1',RIGH, PCDerror`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES? PCDerror`; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

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

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

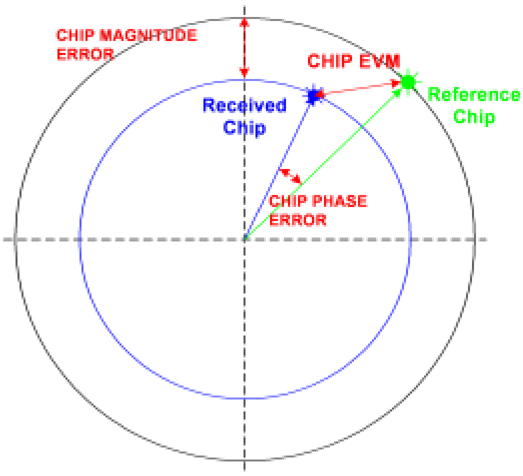
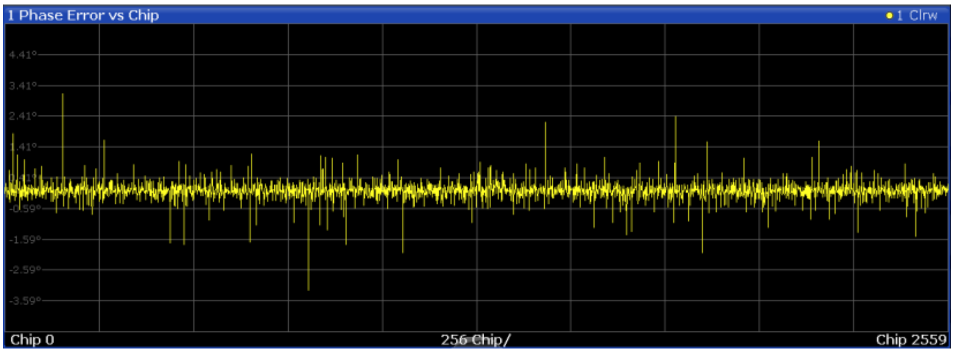


Fig. 3-9: Calculating the magnitude, phase and vector error per chip

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

where:

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



Remote command:
`LAY:ADD? '1',RIGH, PECHip`, see `LAYout:ADD[:WINDow]?` on page 204
TRACe<n>[:DATA]? TRACE<1...4>

Power vs PCG
In this result display, the power of the selected channel is averaged for each measured PCG and referred to the pilot power of the PCG. Therefore the unit of the y-axis is dB (relative to the Pilot Channel). The result display consists of the number of the PCGs in the measurement and the power value of each one.

For measurements in which antenna diversity is inactive (OFF) or set to "Antenna 1", the F-PICH channel is used as reference, while the F-TDPICH channel is used for measurements in which antenna diversity is set to "Antenna 2".

Note: For signals with enabled power control, use the default reference power setting. For details refer to "Power Reference" on page 112.

The measurement evaluates one code channel over the entire period of observation. The selected PCG is highlighted red.

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

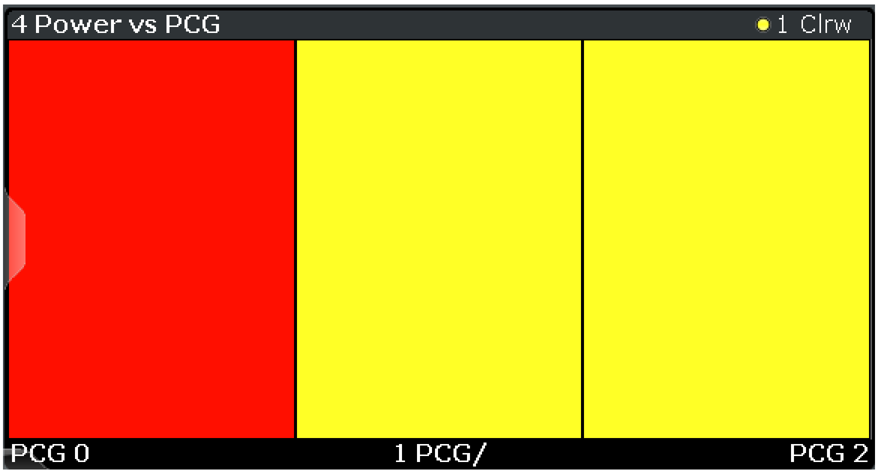


Fig. 3-10: Power vs PCG Display for the BTS application

Note: To detect the start of a power control group correctly, the external trigger must be used for power-regulated signals.

Remote command:
`LAY:ADD? '1',RIGH, PSLot`, see `LAYout:ADD[:WINDow]?` on page 204

Power vs Symbol

The "Power vs. Symbol" evaluation calculates the absolute power in dBm for each symbol in the selected channel and the selected PCG.

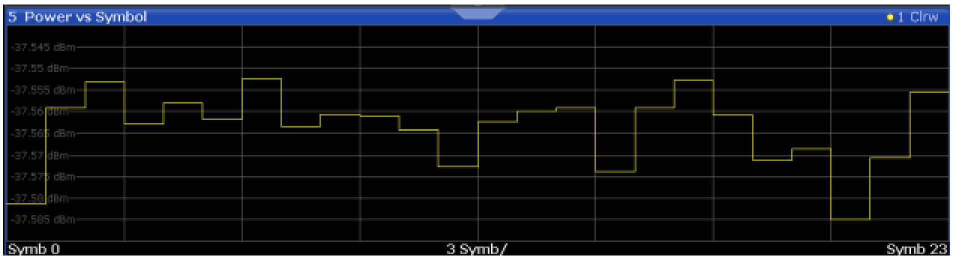


Fig. 3-11: Power vs Symbol result display

Remote command:

`LAY:ADD? '1',RIGH, PSYMbol`, see `LAYout:ADD[:WINDow]?` on page 204

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

Result Summary

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.

Fig. 3-12: Result Summary result display

Remote command:

`LAY:ADD? '1',RIGH, RSUMmary`, see `LAYout:ADD[:WINDow]?` on page 204

`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

Symbol Constellation

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

The BTS application supports BPSK, QPSK, 8PSK and 16QAM modulation types. The modulation type itself depends on the channel type. Refer to chapter 4.8.1, "BTS Channel Types", on page 46 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.

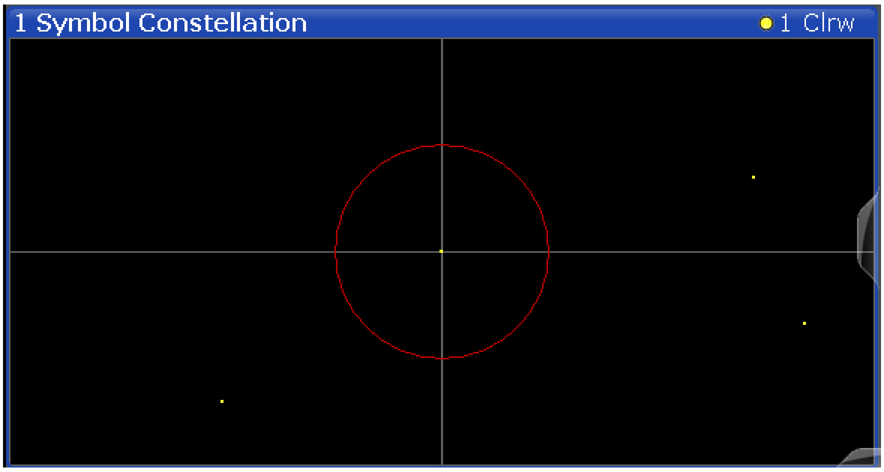


Fig. 3-13: Symbol Constellation display for the BTS application

The number of symbols is in the range from 6 (min) to 384 (max), depending on the symbol rate of the channel (see chapter 4, "Measurement Basics", on page 39).

Remote command:
`LAY:ADD? '1',RIGH, SCONst`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

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 PCG. A trace over all symbols of a PCG is drawn.

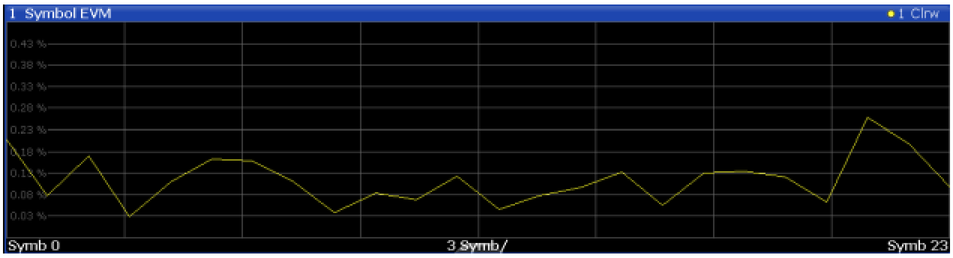


Fig. 3-14: Symbol EVM display for the BTS application

The number of symbols is in the range from 6 (min) to 384 (max), depending on the symbol rate of the channel (see chapter 4, "Measurement Basics", on page 39).

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

Remote command:
`LAY:ADD? '1',RIGH, SEVM`, see `LAYout:ADD[:WINDow]?` on page 204
`CALC:MARK:FUNC:CDP:RES?` ; see `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

Symbol Magnitude Error

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

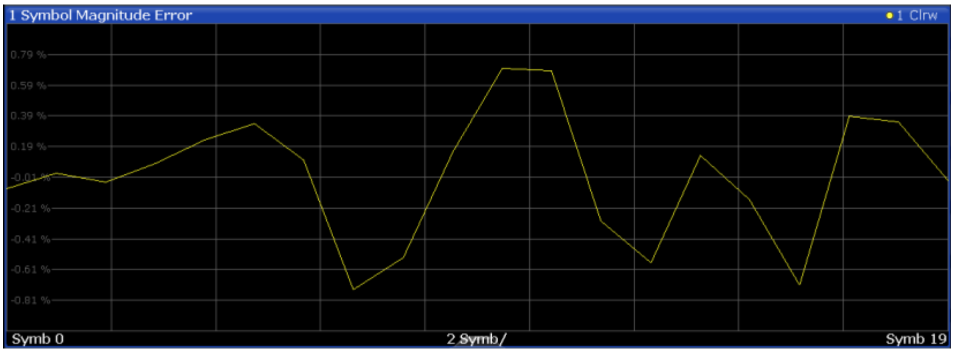


Fig. 3-15: Symbol Magnitude Error display for CDMA2000 BTS measurements

Remote command:

`LAY:ADD? '1',RIGH, SMERror`, see `LAYout:ADD[:WINDow]?` on page 204

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

Symbol Phase Error

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

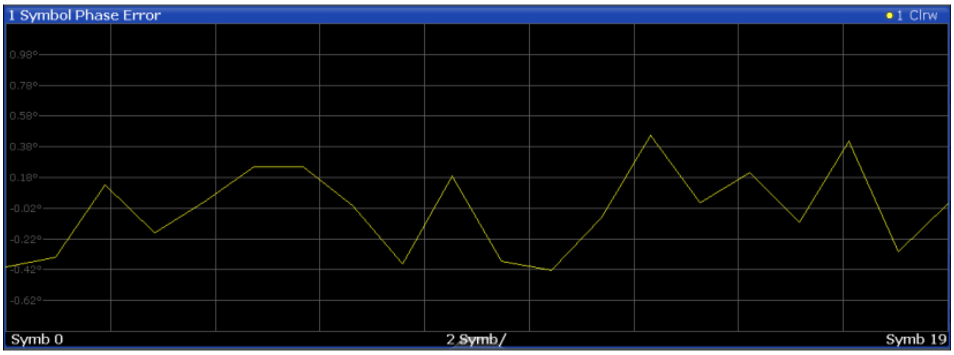


Fig. 3-16: Symbol Phase Error display for CDMA2000 BTS measurements

Remote command:

`LAY:ADD? '1',RIGH, SPERror`, see `LAYout:ADD[:WINDow]?` on page 204

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

3.2 RF Measurements

In addition to the Code Domain Analysis measurements, the CDMA2000 firmware applications also provide some RF measurements as defined in the CDMA2000 standard. RF measurements are identical to the corresponding measurements in the base unit, but configured according to the requirements of the CDMA2000 standard.

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

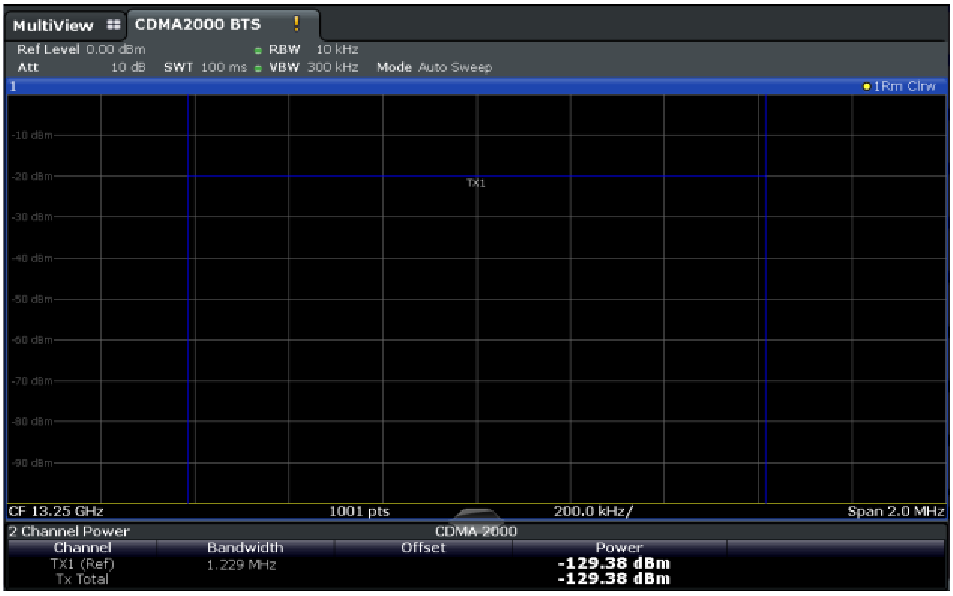
3.2.1 RF Measurement Types and Results

The CDMA2000 applications provide the following RF measurements:

Power

The Power measurement determines the CDMA2000 signal channel power.

To do so, the CDMA2000 application performs a Channel Power measurement as in the Spectrum application with settings according to the CDMA2000 standard. The bandwidth and the associated channel power are displayed in the Result Summary.

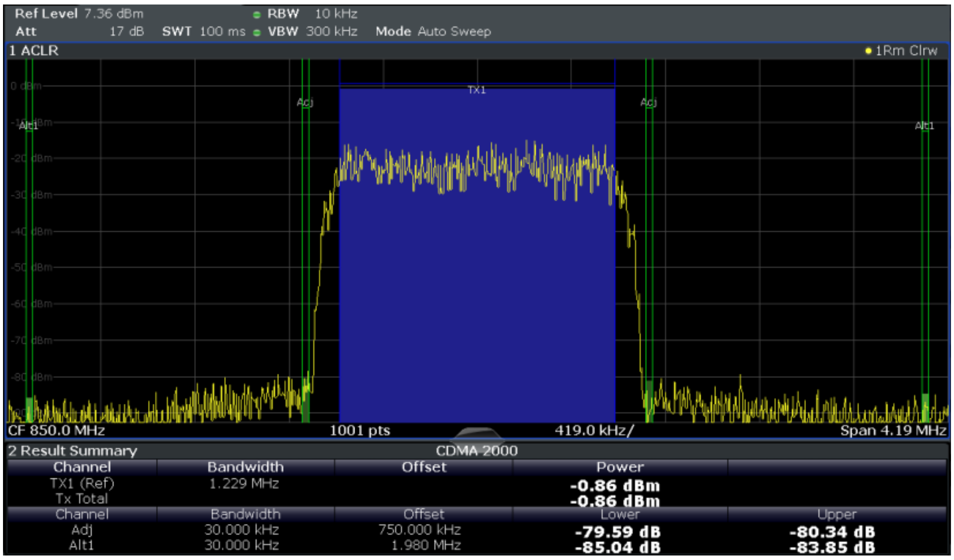


Remote command:
`CONF:CDP:MEAS POW`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 146
Querying results: `CALC:MARK:FUNC:POW:RES? CPOW`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236

Channel Power ACLR

Channel Power ACLR performs an adjacent channel power measurement in the default setting according to CDMA2000 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.



Remote command:
`CONF:CDP:MEAS ACLR`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 146
Querying results:
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236

Spectrum Emission Mask

The Spectrum Emission Mask measurement determines the power of the CDMA2000 signal in defined offsets from the carrier and compares the power values with a spectral mask specified by the CDMA2000 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 CDMA2000 standard does not distinguish between spurious and spectral emissions.

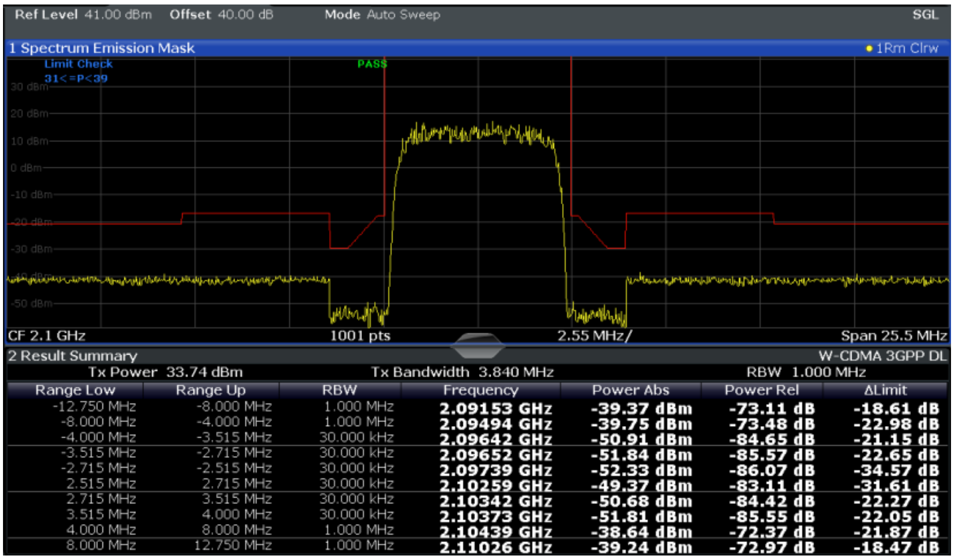


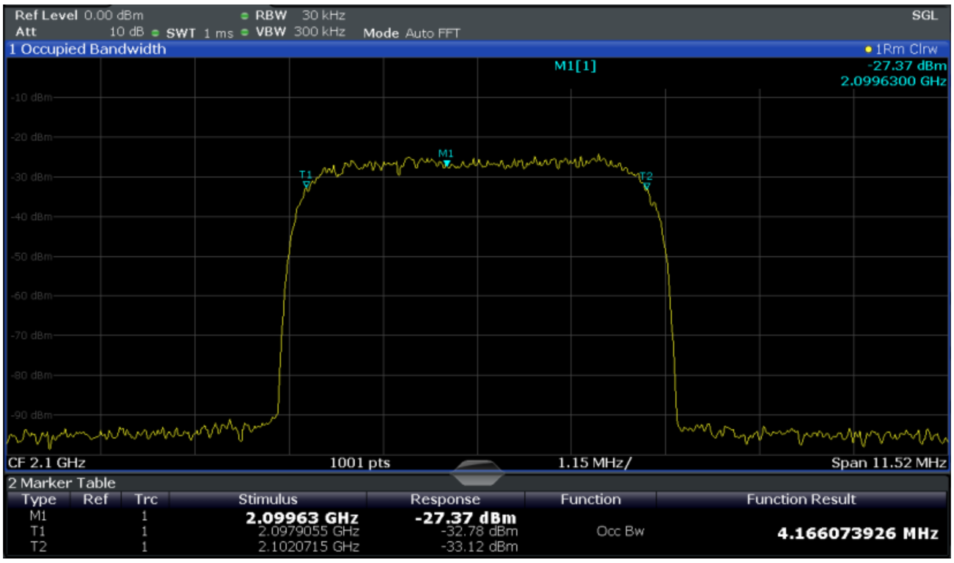
Fig. 3-17: SEM measurement results for the BTS application

Remote command:
`CONF:CDP:MEAS ESP`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 146
Querying results:
`CALC:MARK:FUNC:POW:RES? CPOW`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236
`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236
`CALCulate:LIMit<k>:FAIL?` on page 235

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.



Remote command:

`CONF:CDP:MEAS OBAN`, see `CONFigure:CDPower[:BTS]:MEASurement` on page 146

Querying results:

`CALC:MARK:FUNC:POW:RES? OBW`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236

`CALC:MARK:FUNC:POW:RES? ACP`, see `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 236

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.

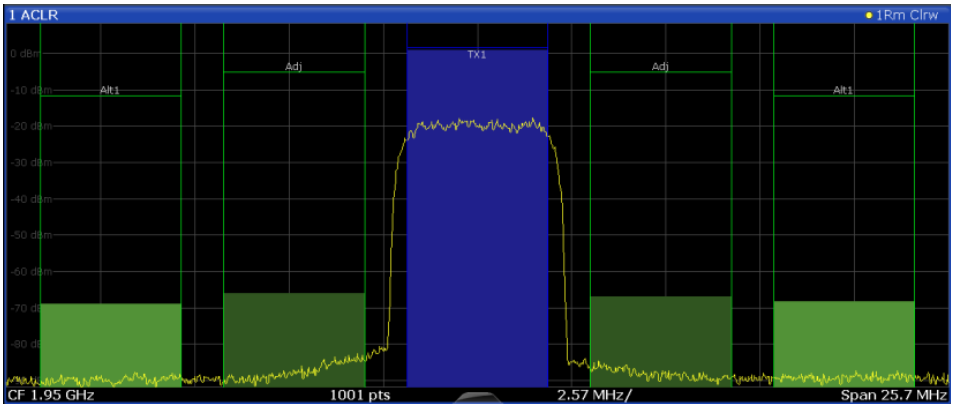
Fig. 3-18: CCDF measurement results for the BTS application

Remote command:
CONF:CDP:MEAS CCDF, see CONFigure:CDPower[:BTS]:MEASurement on page 146
Querying results:
CALCulate<n>:MARKer<m>:Y? on page 219
CALC:MARK:FUNC:POW:RES? ACP, see CALCulate:MARKer:FUNCtion:POWer:RESult? on page 236
CALC:MARK:FUNC:POW:RES? ACP, see CALCulate:MARKer:FUNCtion:POWer:RESult? on page 236
CALCulate:STATistics:RESult<t>? on page 238

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.



Remote command:

`LAY:ADD? '1',RIGH, DIAG`, see `LAYout:ADD[:WINDow]?` on page 204

Result Summary

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

2 Result Summary

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

Remote command:

`LAY:ADD? '1',RIGH, RSUM`, see `LAYout:ADD[:WINDow]?` on page 204

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 118).

2 Marker

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

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 204

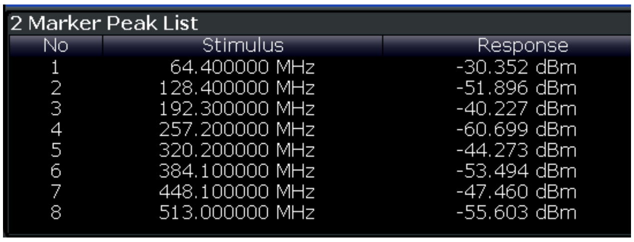
Results:

`CALCulate<n>:MARKer<m>:X` on page 241

`CALCulate<n>:MARKer<m>:Y?` on page 219

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

Remote command:

`LAY:ADD? '1',RIGH, PEAK`, see `LAYout:ADD[:WINDow]?` on page 204

Results:

`CALCulate<n>:MARKer<m>:X` on page 241

`CALCulate<n>:MARKer<m>:Y?` on page 219

4 Measurement Basics

CDMA2000® is based on code division multiplex access (CDMA), where all users share the same 1.25 MHz-wide channel, but use individual pseudo noise (PN) sequences for differentiation.

CDMA2000® 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

Some background knowledge on basic terms and principles used in CDMA2000 tests and measurements is provided here for a better understanding of the required configuration settings.

4.1 PCGs and Sets

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, for which the power remains constant, is called a power control group, or **PCG**. A PCG has a duration of 1.25 ms (or 1536 chips, same as slots in other standards).

The CDMA2000 applications can capture up to 31360 PCGs (about 26 seconds) in a single sweep. In order to improve performance during measurement and analysis, the captured PCGs are not processed by the CDMA2000 application all at once, but rather in **sets**, one at a time. One set consists of 64 PCGs. You can select how many sets are to be captured and which set is currently analyzed and displayed. The possible value range is from 1 to a maximum of 490 sets.

4.2 Channels, Codes and Symbols

In CDMA2000 applications, the data is transmitted in **channels**. These channels are based on orthogonal **codes** and can have different **symbol rates**. The symbol rate depends on the used modulation type and the spreading factor of the channel.

Spreading factors

Spreading factors determine whether the transmitted data is sent in short or long sequences. The spreading factor is re-assigned dynamically in certain time intervals according to the current demand of users and data to be transmitted. The higher the spreading factor, the lower the data rate; the lower the spreading factor, the higher the data rate.

A channel with a lower spreading factor consists of several combined codes. That means a channel can be described by its number and its spreading factor.

The spread bits are called **chips**.

Since a PCG is a fixed time unit, knowing the symbol rate you can calculate how many symbols are transmitted for each PCG.

For evaluations which display symbols on the x–axis, the maximum number of symbols varies according to the symbol rate of the selected code channel. With transmit diversity signals, the symbols of the signal are distrubuted on two antennas (see chapter 4.7.2, "Antenna Diversity", on page 45). Therefore the symbol number is reduced to half.

The following table shows the relationship between the code class, the spreading factor, the number of codes per channel, and the symbol rate.

Table 4-1: Relationship between various code parameters for CDMA2000 BTS signals

Code class	Spreading factor	No. codes / channel	Symbol rate [ksps]	Symbols per PCG (no transmit diversity)	Symbols per PCG (transmit diversity)
2	4	128	307.2	384	192
3	8	64	153.6	192	96
4	16	32	76.8	96	48
5	32	16	38.4	48	24
6	64	8	19.2	24	12
7	128	4	9.6	12	6

Table 4-2: Relationship between various code parameters for CDMA2000 MS signals

Code class	Spreading factor	No. codes / channel	Symbol rate [ksps]	Symbols per PCG
1	2	128	614.4	768
2	4	64	307.2	384
3	8	32	153.6	192
4	16	16	76.8	96
5	32	8	38.4	48
6	64	4	19.2	24

Number of bits per symbol

Depending on the modulation type, a symbol consists of the following number of bits:

- **BPSK**: 1 bit (for BTS signals, only the I-component is assigned)
- **QPSK**: 2 bits (I-component followed by the Q-component)
- **8PSK**: 3 bits
- **16QAM**: 4 bits

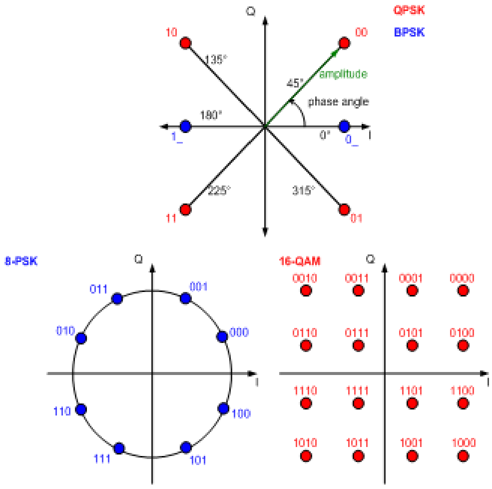


Fig. 4-1: Bits per symbol constellations for different modulation types in the BTS application

4.3 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. If the code belongs to a detected active channel, the entire channel is highlighted. (For details on active channels and channel detection see chapter 4.8, "Channel Detection and Channel Types", on page 46.)

However, in CDMA2000 signals, the codes that belong to the same channel need not lie next to each other in the code domain, they may be distributed.

Example: Example for Hadamard order

For a base spreading factor of 64, the following code order is displayed:

0.64, 1.64, 2.64, …, 63.64.

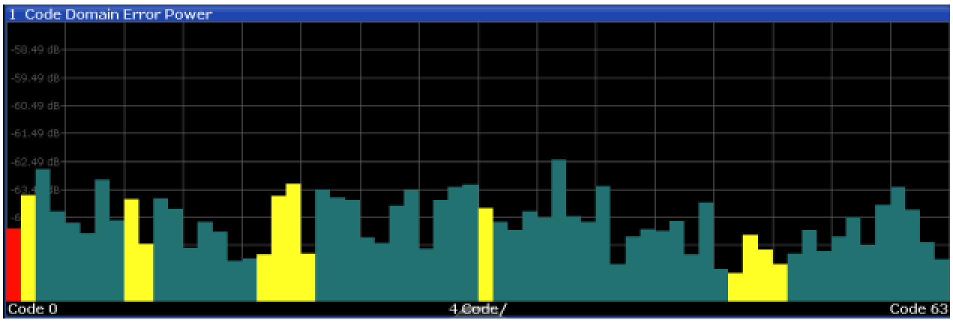


Fig. 4-2: Code Domain Error Power result display in Hadamard code sorting order

In order to compare all codes in the same channel visually, a **Bit-Reverse** sorting order is provided. In this case, all codes of a channel are displayed next to each other.

Example: Example for Bit-Reverse order

For a base spreading factor of 64, the following code order may be displayed:

0.64, 32.64, 16.64, 48.64, 8.64, 40.64, …, 15.64, 47.64,31.64, 63.64

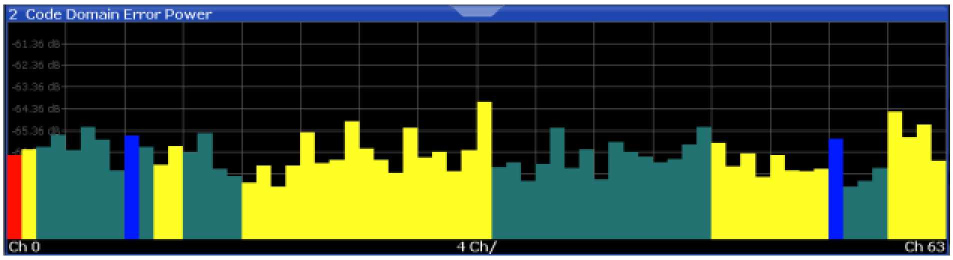


Fig. 4-3: Code Domain Error Power result display in BitReverse code sorting order

For the display in the CDMA2000 BTS application, the scale for code-based diagrams displays 64 codes by default (32 in the MS application). However, you can change the **base spreading factor** for the display, and thus the number of displayed codes.

Alias power

Note, however, that if you select a base spreading factor that is lower than the actual spreading factor used by the channel (e.g. 64 for channels with a base spreading factor of 128), the results are distorted. This is due to the fact that a wider area of the code domain is taken into consideration, for example when calculating the power level, than the code actually occupies. The excess power calculated due to a false spreading factor is referred to as **alias power**.

4.4 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 CDMA2000 BTS application if the "PN Offset" 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 and an offset. These settings are required by the CDMA2000 MS application to distinguish the senders and are defined in the signal description.

The long code offset also includes the PN offset (if any) and is defined in chips. The offset corresponds to the GPS timing since 6.1.1980 00:00:00 UTC. The offset in chips is calculated as follows:

```
tSinceStartGPS * 1.2288 MChips/s
```

where `tSinceStartGPS` is defined in seconds

The offset is applied at the next trigger pulse, which cannot occur until a setup time of 300 ms has elapsed.

A special **long code generation mode** is provided to analyze signals sent by an Agilent ESG 101 generator.

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

4.5 Code Mapping and Branches

Since MS 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 MS 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.

4.6 Radio Configuration

The radio configuration specifies various settings for transmission according to the CDMA2000 standard including:

- allowed data rates
- modulation types
- use of special channels
- transmit diversity

The standard describes nine RCs for BTS and six for MS signals, for different transmission scenarios.

In the BTS application, the radio configuration can be customized for two channel types: PDCH and CHAN (see chapter 4.8.1, "BTS Channel Types", on page 46). The applied RC is specified for each channel of these types in the channel tables. Predefined channel tables are provided for particular radio configurations (see chapter A.1, "Reference: Predefined Channel Tables", on page 257).

The following RCs are used in the BTS application:

Table 4-3: RCs used in the BTS application:

Channel type	Modulation	Manual operation	SCPI parameter
PDCH	QPSK	10	10
	8PSK	10	20
	16QAM	10	30
CHAN		1-2	1
		3-5	3
special channels		-	0

4.7 Transmission with Multiple Carriers and Multiple Antennas

The CDMA2000 standard allows for transmission using multiple carriers as well as transmission via multiple antennas.

4.7.1 Multicarrier Mode

The CDMA2000 applications can filter out and analyze one carrier out of a multicarrier signal, if a special multicarrier mode is activated in the signal description.

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

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

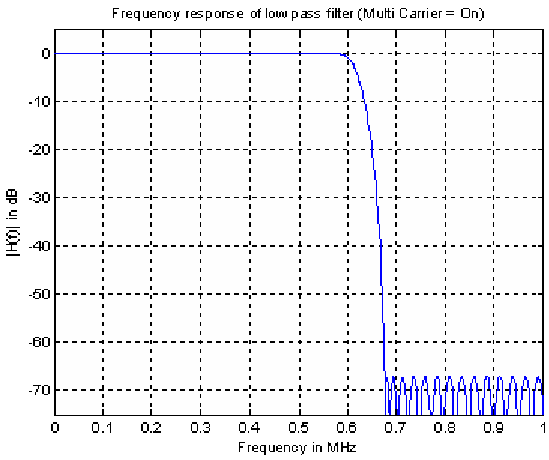


Fig. 4-4: Frequency response of the low-pass multicarrier filter

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

4.7.2 Antenna Diversity

The standard allows for transmission via multiple antennas (**transmit diversity**). If transmit diversity is implemented for the input signal, the CDMA2000 BTS application must know which antenna to analyze the input from. This information is provided by the signal description (**"Antenna Diversity"**). Depending on which antenna is selected for analysis, certain special channels are required for predefined channel tables (see also "Channel table definition for transmit diversity" on page 47):

Antenna	Required special channels
1	Pilot channel (F-PICH, 0.64) required and used as power reference Transmit diversity pilot channel (F-TDPICH, 16.128) not allowed
2	Transmit diversity pilot channel (F-TDPICH, 16.128) required and used as power reference Pilot channel (F-PICH, 0.64) not allowed
- (No diversity)	Pilot channel (F-PICH, 0.64) required and used as power reference Transmit diversity pilot channel (F-TDPICH, 16.128) required

4.8 Channel Detection and Channel Types

The CDMA2000 applications provide two basic methods of detecting active channels:

- **Automatic search using pilot sequences**
  The application performs an automatic search for active (DPCH) 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 93).
  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 CDMA2000 applications see chapter A.1, "Reference: Predefined Channel Tables", on page 257.

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 4.5, "Code Mapping and Branches", on page 43). 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.

4.8.1 BTS Channel Types

The CDMA2000 standard defines various BTS channel types. Some special channels are mandatory and must be contained in the signal, as they have control or synchronization functions. Thus, these channels always occupy a specific channel number and use a specific symbol rate by which they can be identified.

Special channels

The CDMA2000 BTS application expects at least the Pilot Channel (F-PICH) or the Transmit Diversity Pilot CHannel (F-TDPICH) for the Code Domain Power measurements.

The following channels are detected automatically during automatic channel detection:

Table 4-4: Common CDMA2000 BTS channels and their usage

Channel type	Ch.no. / SF	Modulation	Description
F-PICH	0.64	BPSK	Pilot channel
F-PCH	1.64	BPSK	Paging channel

Channel type	Ch.no. / SF	Modulation	Description
F-TDPICH	16.128	BPSK	Transmit Diversity Pilot CHannel
F-SYNC	32.64	BPSK	Synchronization channel
F-CHAN		BPSK (RC 1+2) QPSK (RC 3-5)	active data channel
INACTIVE		-	inactive channel
F-PDCCH		QPSK	Packet Data Control CHannel
F-PDCH	.32	QPSK, 8PSK, or 16-QAM	Packet Data CHannel

In addition, the following channel types can be defined in a predefined channel table for the CDMA2000 BTS application.

Channel type	Ch.no. / SF	Description
F-APICH	BPSK	Auxiliary Pilot CHannel
F-ATDPICH	BPSK	Auxiliary Ttransmit Diversity Pilot CHannel
F-BCH	QPSK	Broadcast CHannel
F-CACH	QPSK	Common Assignment Channel
F-CCCH	QPSK	Common Control CHannel
F-CPCCH	QPSK	Common Power Control CHannel

Channel table definition for transmit diversity

In a measurement scenario with two antennas (transmit diversity), the following conditions apply to the channel table definition:

- **Antenna 1** is used for transmission:
  - The pilot channel **F-PICH must** be included.
  - The pilot channel of antenna 2 **F-TDPICH must not** be included.
- **Antenna 2** is used for transmission:
  - The pilot channel of antenna 2 **F-TDPICH must** be included.
  - The pilot channel **F-PICH must not** be included.
- **Both antennas** are used for transmission:
  - The pilot channel **F-PICH must** be included.
  - The pilot channel of antenna 2 **F-TDPICH must** be included.

4.8.2 MS Channel Types

The following channel types can be detected in CDMA2000 MS signals by the CDMA2000 MS application.

Channel type	Ch.no / SF	Mapping	Description
ACKCH	16.64	Q	Reverse Acknowledgment Channel (1xEV-DV)
CCCH	2.8	Q	Reverse Common Control Channel
CQICH	12.16	I (if FCH availa-ble) /Q	Reverse Channel Quality Indicator Channel (1xEV-DV)
DCCH	8.16	I	Reverse Dedicated Control Channel
EACH	2.8	Q	Enhanced Access Channel
FCH	4.16	Q	Reverse Fundamental Channel
PICH	0.32	I	Reverse Pilot Channel
S1CH	1.2 or 2.4	Q	Reverse Supplemental 1 Channel
S2CH	2.4 or 6.8	I	Reverse Supplemental 2 Channel
Note: Since the EACH has the same mapping, the same channel number and the same spreading factor as the CCCH, it is not possible to distinguish them during an automatic search. In this case, both the EACH and CCCH are output.			

4.9 Test Setup for CDMA2000 Tests

Before a CDMA 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 CDMA2000 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 CDMA2000 BTS or CDMA2000 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.

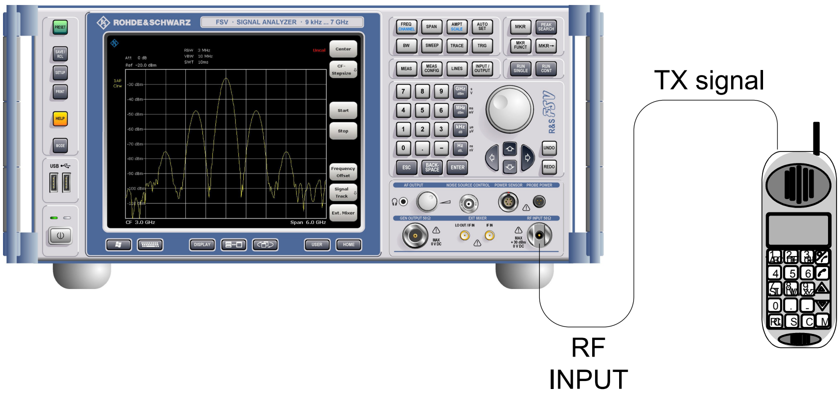
Required units and accessories

The measurements are performed with the following units and accessories:

- An R&S FSW equipped with the CDMA2000 BTS or MS option.
- R&S SMU signal generator equipped with option SMU-B9/B10/B11 baseband generator and SMUK46 CDMA2000 incl. 1xEVDV.
- 1 coaxial cable, 50 Ω, approximately 1 m, N connector
- 2 coaxial cables, 50 Ω, approximately 1 m, BNC connector

General Test Setup

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



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

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

- For signal measurements at the output of two-port networks, connect the reference frequency of the signal source to the rear reference input (REF INPUT) of the R&S FSW.
- The R&S FSW must be operated with an external frequency reference to ensure that the error limits of the CDMA2000 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 device under test (DUT) has a trigger output, connect the trigger output of the DUT to one of the trigger inputs (TRIGGER INPUT) of the R&S FSW (see "Trigger 2/3" on page 73).

Presettings

(For details see chapter 6.2, "Code Domain Analysis", on page 56)

- Enter the external attenuation.
- Enter the reference level.
- Enter the center frequency.
- Set the trigger.
- If used, enable the external reference.
- Select the CDMA2000 standard and the desired measurement.
- Set the PN offset.

4.10 CDA Measurements in MSRA Operating Mode

The CDMA2000 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 CDMA2000 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 CDMA2000 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 CDMA2000: 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**.

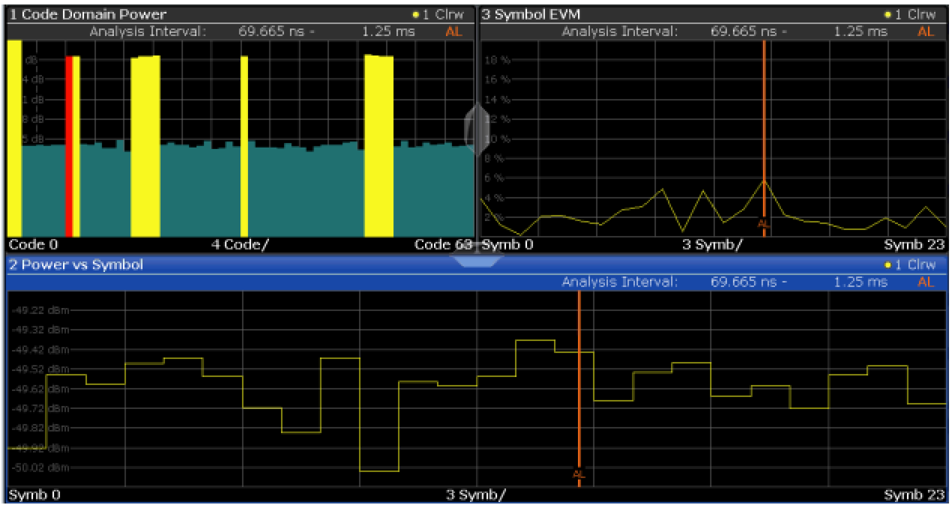
In the CDMA2000 BTS application the analysis interval is automatically determined according to the selected set, PCG or code to analyze which is defined for the evaluation range, depending on the result display. The analysis interval can not be edited directly in the CDMA2000 BTS application, but is changed automatically when you change the evaluation range.

Analysis line

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

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

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



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

5 I/Q Data Import and Export

Baseband signals mostly occur as so-called complex baseband signals, i.e. a signal representation that consists of two channels; the in phase (I) and the quadrature (Q) channel. Such signals are referred to as I/Q signals. I/Q signals are useful because the specific RF or IF frequencies are not needed. The complete modulation information and even distortion that originates from the RF, IF or baseband domains can be analyzed in the I/Q baseband.

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

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

As opposed to storing trace data, which may be averaged or restricted to peak values, I/Q data is stored as it was captured, without further processing. The data is stored as complex values in 32-bit floating-point format. Multi-channel data is not supported. The I/Q data is stored in a format with the file extension `.iq.tar`. For a detailed description see chapter A.4, "I/Q Data File Format (iq-tar)", on page 264.

5.1 Import/Export Functions

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

Some functions for particular data types are (also) available via softkeys or dialog boxes in the corresponding menus, e.g. trace data or marker peak lists.

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

Import
Provides functions to import data.

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

Note that the I/Q data must have a specific format as described in chapter A.4, "I/Q Data File Format (iq-tar)", on page 264.

Remote command:
MMEMory:LOAD:IQ:STATe on page 247

Export
Opens a submenu to configure data export.

I/Q Export ← Export
Opens a file selection dialog box to select an export file to which the IQ data will be stored. This function is only available in single sweep mode, and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

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

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

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

Remote command:
MMEMory:STORe:IQ:STATe on page 248
MMEMory:STORe:IQ:COMMent on page 248

6 Configuration

The CDMA2000 applications provide several different measurements for signals according to the CDMA2000 standard. The main and default measurement is Code Domain Analysis. In addition to the code domain power measurements specified by the CDMA2000 standard, the CDMA2000 applications offer measurements with predefined settings in the frequency domain, e.g. RF power measurements.

Only one measurement type can be configured per channel; however, several channels for CDMA2000 applications can be configured in parallel on the R&S FSW. Thus, you can configure one channel for a Code Domain Analysis, for example, and another for a Power measurement for the same input signal. Then you can use the Sequencer to perform all measurements consecutively and either switch through the results easily or monitor all results at the same time in the "MultiView" tab.

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

Selecting the measurement type

When you activate a measurement channel in a CDMA2000 application, Code Domain Analysis of the input signal is started automatically. However, the CDMA2000 applications also provide other measurement types.

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

6.1 Result Display

The captured signal can be displayed using various evaluation methods. All evaluation methods available for CDMA2000 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 CDMA2000 menu.

Up to 16 evaluation methods can be displayed simultaneously in separate windows. The CDMA2000 evaluation methods are described in chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 18.

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.

6.2 Code Domain Analysis

CDMA2000 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 CDMA2000 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 CDMA2000 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 for CDA measurements.

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 CDMA2000 can not only be measured by the CDMA2000 applications themselves, it can also be imported to the applications, provided it has the correct format. Furthermore, the evaluated I/Q data from the CDMA2000 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.

6.2.1 Default Settings for Code Domain Analysis

When you activate a CDMA2000 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 CDMA2000 application is activated, or after a Preset Channel:

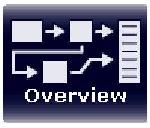
The following default settings of the Code Domain Analysis are activated:

Table 6-1: Default settings for CDMA2000 channels

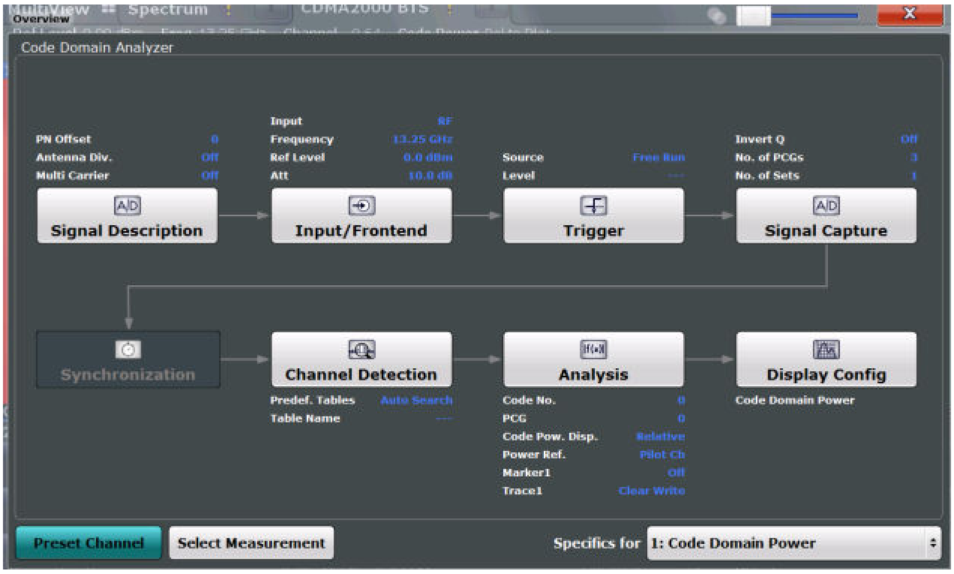
Parameter	Value
Common CDMA2000 settings	
Digital standard	CDMA 2000 MC1 (where MC1 stands for Multi–carrier 1 and thus describes CDMA2000 1X, i.e. a single carrier)
Measurement	Code Domain Analysis
Bandclass	BC 0: 800 MHz Cellular Band
Sweep	CONTINUOUS
Channel detection mode	AUTOSEARCH
Trigger settings	FREE RUN
Trigger offset	0

Parameter	Value
Threshold value	-60 dB
Number of PCGs	3
Number of Sets	1
PCG number	0
Code number	0
Code Order	Hadamard
Evaluations	Window 1: Code Domain Power Relative Window 2: Result Summary
BTS specific settings	
Symbol rate	19.2 ksps
PN offset	0 chips
Antenna Diversity	Off
MS specific settings	
Symbol rate	38.4 ksps
Long code mask	0
Long code offset	0
Evaluated Branch	I

6.2.2 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 6.3, "RF Measurements", on page 105.

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 55
2. "Signal Description"
   See chapter 6.2.3, "Signal Description", on page 60
3. "Input/ Frontend"
   See chapter 6.2.4, "Data Input and Output Settings", on page 65 and chapter 6.2.5, "Frontend Settings", on page 76
4. (Optionally:) "Trigger"
   See chapter 6.2.6, "Trigger Settings", on page 84
5. "Signal Capture"
   See chapter 6.2.7, "Signal Capture (Data Acquisition)", on page 90

   Note: The "Synchronization" button indicated in the Overview is not required for CDMA2000 measurements.
6. "Channel Detection"
   See chapter 6.2.9, "Channel Detection", on page 92

7. "Analysis"
   See chapter 7, "Analysis", on page 110
8. "Display Configuration"
   See chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 18

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

See chapter 6.2.1, "Default Settings for Code Domain Analysis", on page 57 for details.

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

Select Measurement
Selects a different measurement to be performed.

See "Selecting the measurement type" on page 55.

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

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

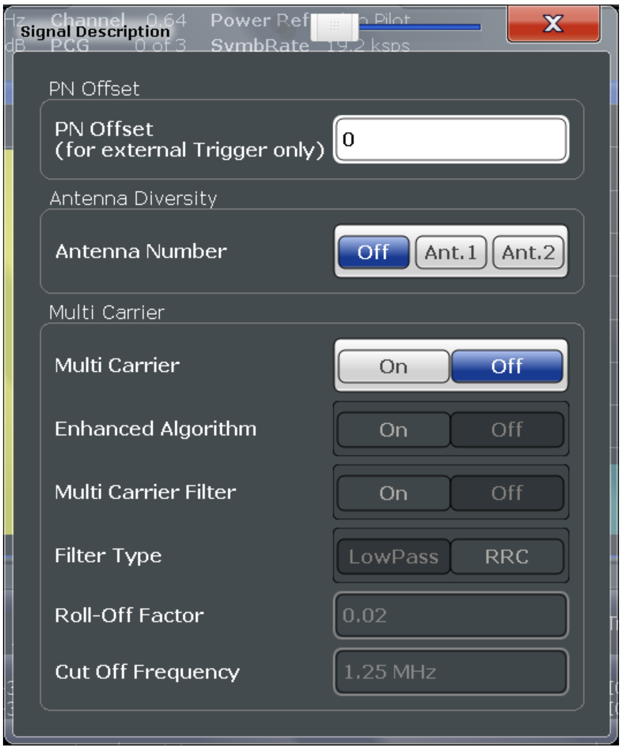
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

6.2.3 Signal Description

The signal description provides information on the expected input signal.

6.2.3.1 BTS Signal Description

These settings describe the input signal in BTS measurements.



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 4.4, "Scrambling via PN Offsets and Long Codes", on page 43.

Remote command:

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

Antenna Diversity - Antenna Number

Activates or deactivates the orthogonal transmit diversity (two-antenna system) and defines the antenna for which the results are displayed.

For details on antenna diversity see also chapter 4.7.2, "Antenna Diversity", on page 45.

"Antenna 1"	The signal of antenna 1 is fed in.
"Antenna 2"	The signal of antenna 2 is fed in.

"Off" The aggregate signal from both antennas is fed in.
The pilot channels of both antennas are required.
As reference for the code power (Power Reference), PICH is used.

Remote command:
[SENSe:]CDPower:ANTenna on page 149

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

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

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

This setting is only available if "Multicarrier" on page 62 is activated.

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

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

This setting is only available if "Multicarrier" on page 62 is activated.

For details see chapter 4.7.1, "Multicarrier Mode", on page 44.

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

Filter Type ← Multicarrier
Selects the filter type if Multicarrier Filter is activated.

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

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

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

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

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

This parameter is available for the RRC filter.

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

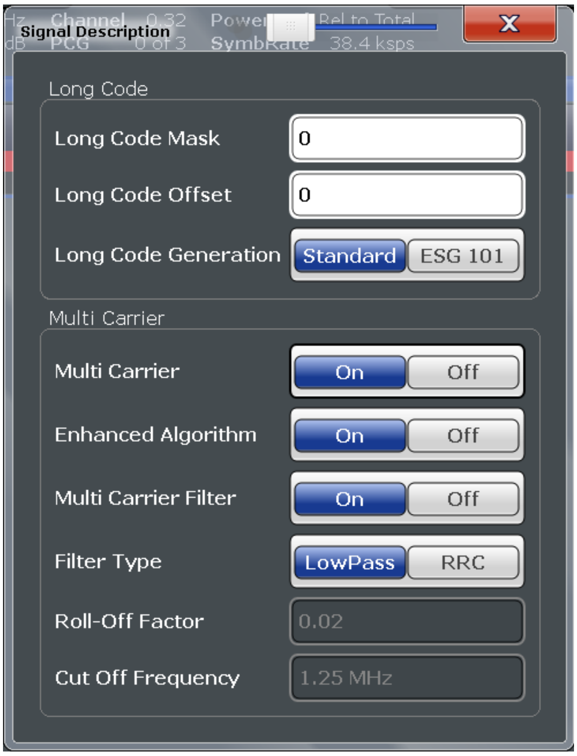
Cut Off Frequency ← Filter Type ← Multicarrier
Defines the frequency at which the passband of the RRC filter begins. Possible values are between 0.1 MHz and 2.4 MHz in 1 Hz steps. The default value is 1.25 MHz

This parameter is available for the RRC filter.

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

6.2.3.2 MS Signal Description

These settings describe the input signal in MS measurements.



Long Code Mask
Defines the long code mask of the mobile in hexadecimal form. The value range is from `0` to `4FFFFFFFFFF`.

For the default mask value of `0` the Long Code Offset is not taken into consideration.

For more information on long codes see "Long code scrambling" on page 43.

Remote command:
[SENSe:]CDPower:LCODe:MASK on page 150

Long Code Offset

Defines the long code offset, including the PN offset, in chips in hexadecimal format with a 52-bit resolution. This value corresponds to the GPS timing since 6.1.1980 00:00:00 UTC. This offset is applied at the next trigger pulse (which cannot occur until a setup time of 300 ms has elapsed). The default value is 0.

The setting is ignored if the Long Code Mask is set to 0.

For more information on long codes see "Long code scrambling" on page 43.

Remote command:
[SENSe:]CDPower:LCODe:OFFSet on page 151

Long Code Generation

Selects the mode of the long code generation.

"Standard"	The CDMA2000 standard long code generator is used.
"ESG 101"	The Agilent ESG option 101 long code is used; in this case, only signals from that generator can be analyzed.

Remote command:
[SENSe:]CDPower:LCODe:MODE on page 151

Multicarrier

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

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

Enhanced Algorithm ← Multicarrier

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

This setting is only available if "Multicarrier" on page 62 is activated.

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

Multicarrier Filter ← Multicarrier

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

This setting is only available if "Multicarrier" on page 62 is activated.

For details see chapter 4.7.1, "Multicarrier Mode", on page 44.

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

Filter Type ← Multicarrier

Selects the filter type if Multicarrier Filter is activated.

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

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

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

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

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

This parameter is available for the RRC filter.

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

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

This parameter is available for the RRC filter.

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

6.2.4 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).

6.2.4.1 Input Source Settings

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

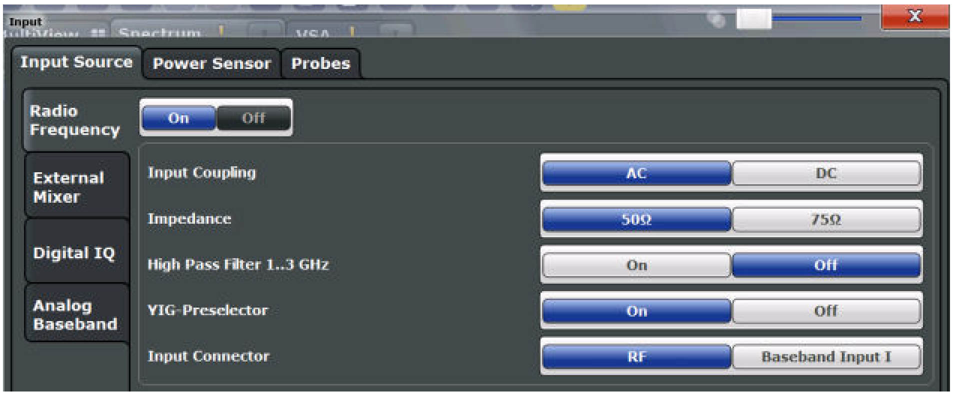
Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

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

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

Radio Frequency Input

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.

Remote command:
`INPut:SELect` on page 154

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) or from the Analog Baseband Interface (R&S FSW-B71).

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

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

Remote command:
`INPut:COUPling` on page 153

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 79).

This function is not available for input from the Digital Baseband Interface (R&S FSW-B17) or from the Analog Baseband Interface (R&S FSW-B71). For analog baseband input, an impedance of 50 Ω is always used.

Remote command:

`INPut:IMPedance` on page 154

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.)

Remote command:

`INPut:FILTer:HPASs[:STATe]` on page 153

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.

Remote command:

`INPut:FILTer:YIG[:STATe]` on page 154

Input Connector

Determines whether the RF input data is taken from the RF INPUT connector (default) or the optional BASEBAND INPUT I connector. This setting is only available if the Analog Baseband Interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67.

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

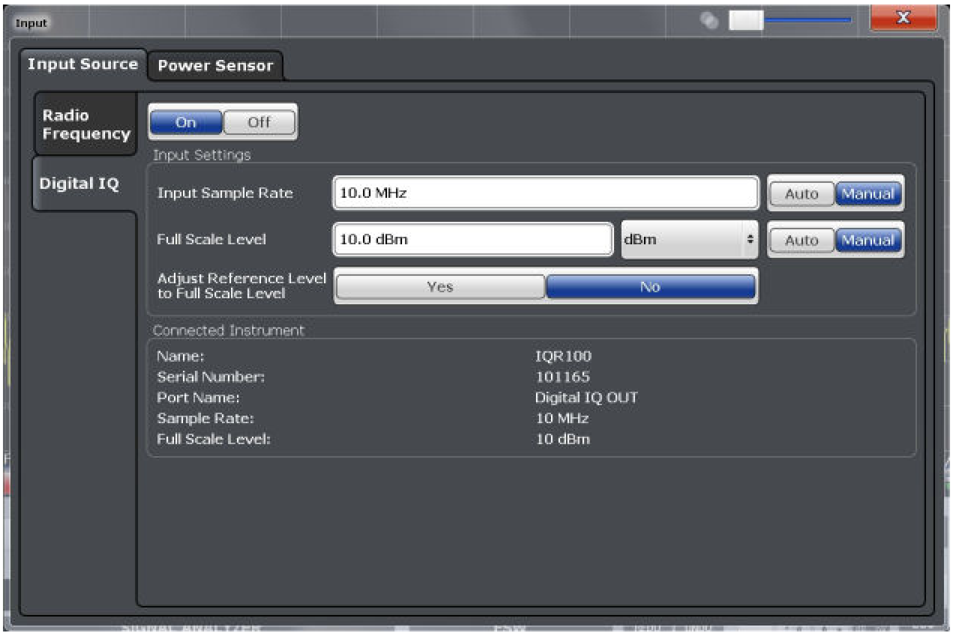
Remote command:

`INPut:CONNector` on page 153

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.



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

Digital I/Q Input State

Enables or disable the use of the "Digital IQ" input source for measurements. "Digital IQ" is only available if the Digital Baseband Interface (R&S FSW-B17) is installed.

Remote command:
`INPut:SELect` on page 154

Input Sample Rate

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

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

The allowed range is from 100 Hz to 10 GHz.

Remote command:
`INPut:DIQ:SRATe` on page 159
`INPut:DIQ:SRATe:AUTO` on page 159

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

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

Remote command:
`INPut:DIQ:RANGe[:UPPer]` on page 158
`INPut:DIQ:RANGe[:UPPer]:UNIT` on page 158
`INPut:DIQ:RANGe[:UPPer]:AUTO` on page 157

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

Remote command:
`INPut:DIQ:RANGe:COUPling` on page 158

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

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

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

Remote command:
`INPut:DIQ:CDEVice` on page 156

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".

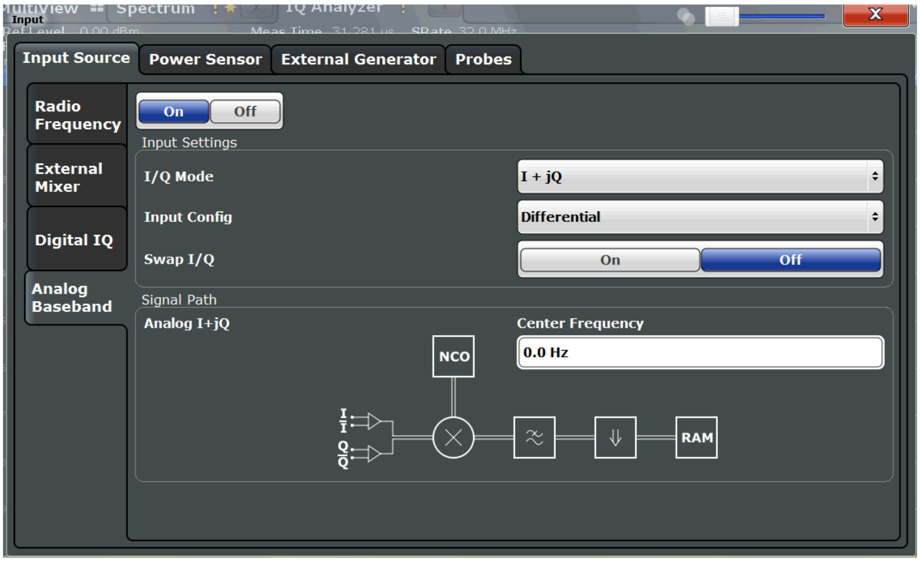
Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.

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.

Analog Baseband Input Settings

The following settings and functions are available to provide input via the Analog Baseband Interface (R&S FSW-B71) in the applications that support it.

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



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

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

Analog Baseband Input State

Enables or disable the use of the "Analog Baseband" input source for measurements. "Analog Baseband" is only available if the Analog Baseband Interface (R&S FSW-B71) is installed.

Remote command:
`INPut:SELect` on page 154

I/Q Mode

Defines the format of the input signal.

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

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

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

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

Remote command:
INPut:IQ:TYPE on page 165

Input configuration
Defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 simple-ended lines.

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

"Differential" I, Q and inverse I,Q data

"Single Ended" I, Q data only

Remote command:
INPut:IQ:BALanced[:STATe] on page 164

Center Frequency
Defines the center frequency for analog baseband input.

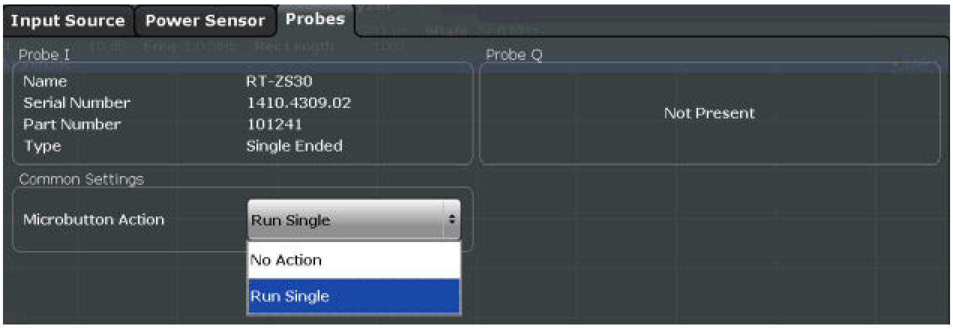
For real-type baseband input (I or Q only), the center frequency is always 0 Hz.

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

Remote command:
[SENSe:]FREQuency:CENTer on page 169

Probe Settings

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



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

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

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

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

Microbutton Action

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

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

"Run single" Starts one data acquisition.

"No action" Prevents unwanted actions due to unintended usage of the microbutton.

Remote command:

`[SENSe:]PROBe<p>:SETup:MODE` on page 166

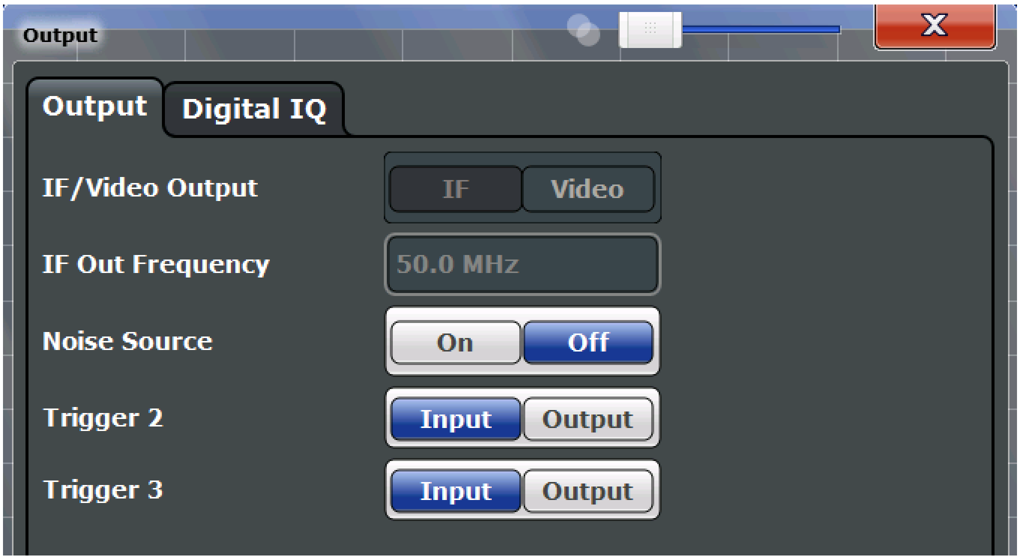
6.2.4.2 Output Settings

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.

Remote command:

`DIAGnostic:SERVice:NSOurce` on page 168

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

Defines the usage of the variable TRIGGER 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.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 184
`OUTPut:TRIGger<port>:DIRection` on page 183

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.

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 184

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 184

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 185

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.

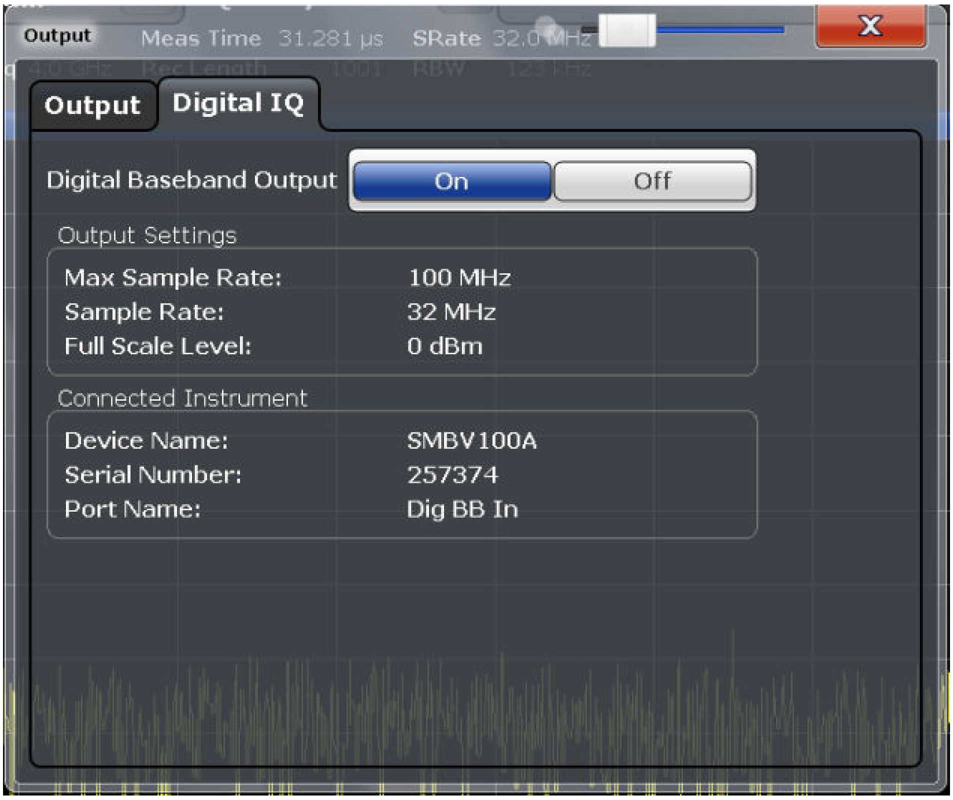
Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 184

6.2.4.3 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.

Digital output is not available if the bandwidth extension option R&S FSW-B500 is active.



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.

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

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

Remote command:
`OUTPut:DIQ` on page 159

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)

Remote command:
`OUTPut:DIQ:CDEVice` on page 159

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

Remote command:
`OUTPut:DIQ:CDEVice` on page 159

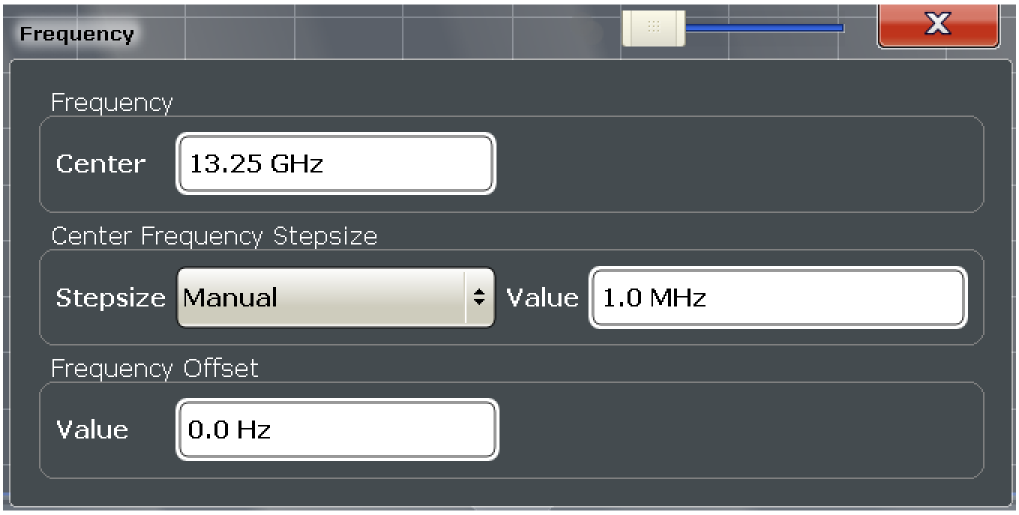
6.2.5 Frontend Settings

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

6.2.5.1 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 frequency

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.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 169

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 frequency and time domain measurements.

"X * Span" Sets the step size for the center frequency to a defined factor of the span. The "X-Factor" defines the percentage of the span.
Values between 1 and 100 % in steps of 1 % are allowed. The default setting is 10 %.

"= Center" Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 169

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.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 171

6.2.5.2 Amplitude Settings

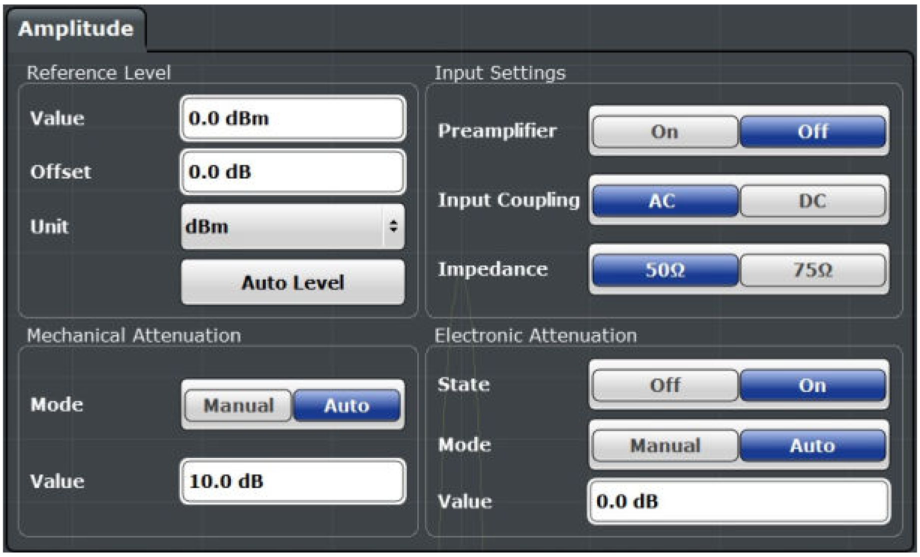
Amplitude settings determine how the R&S FSW must process or display the expected input power levels.

Amplitude settings for input from the Analog Baseband interface (R&S FSW-B71) are described in chapter 6.2.5.3, "Amplitude Settings for Analog Baseband Input", on page 81.

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 "IF OVLD" status display ("OVLD" for analog baseband or digitial baseband input).

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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 173

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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 173

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 (for analog baseband input: the full scale level) 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.

This function is only available for the MSRA/MSRT Master, not for the applications.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 103).

Remote command:

`[SENSe:]ADJust:LEVel` on page 197

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.

Remote command:

`INPut:ATTenuation` on page 174

`INPut:ATTenuation:AUTO` on page 175

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.

Remote command:
`INPut:EATT:STATe` on page 176
`INPut:EATT:AUTO` on page 176
`INPut:EATT` on page 175

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 6.2.4.1, "Input Source Settings", on page 65.

Preamplifier (option B24) ← Input Settings
If option R&S FSW-B24 is installed, a preamplifier can be activated for the RF input signal.

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

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

For R&S FSW 26 or higher 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:

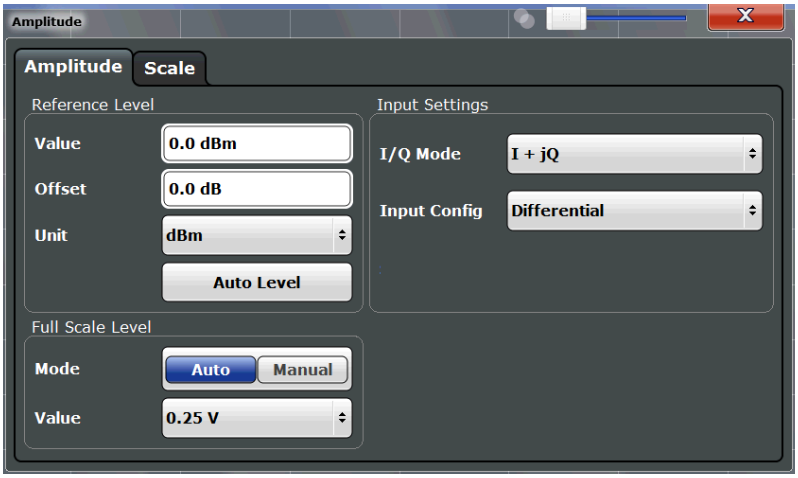
"Off"	Deactivates the preamplifier.
"15 dB"	The RF input signal is amplified by about 15 dB.
"30 dB"	The RF input signal is amplified by about 30 dB.

Remote command:
`INPut:GAIN:STATe` on page 173
`INPut:GAIN[:VALue]` on page 174

6.2.5.3 Amplitude Settings for Analog Baseband Input

The following settings and functions are available to define amplitude settings for input via the Analog Baseband Interface (R&S FSW-B71) in the applications that support it.

They can be configured via the AMPT key or in the "Amplitude" tab of the "Input" dialog box.



The input settings provided here are identical to those in the "Input Source" > "Analog Baseband" tab, see "Analog Baseband Input Settings" on page 70.

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

Reference Level

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

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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 173

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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 173

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 (for analog baseband input: the full scale level) 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.

This function is only available for the MSRA/MSRT Master, not for the applications.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 103).

Remote command:
`[SENSe:]ADJust:LEVel` on page 197

Full Scale Level Mode / Value
The full scale level defines the maximum power you can input at the Baseband Input connector without clipping the signal.

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

For manual input, the following values can be selected:

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

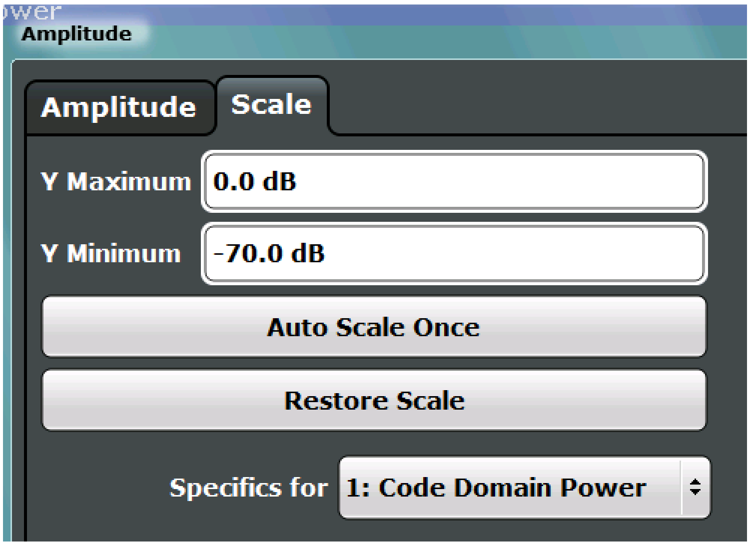
If probes are connected, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

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

Remote command:
`INPut:IQ:FULLscale:AUTO` on page 164
`INPut:IQ:FULLscale[:LEVel]` on page 165

6.2.5.4 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.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 172
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 172

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

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

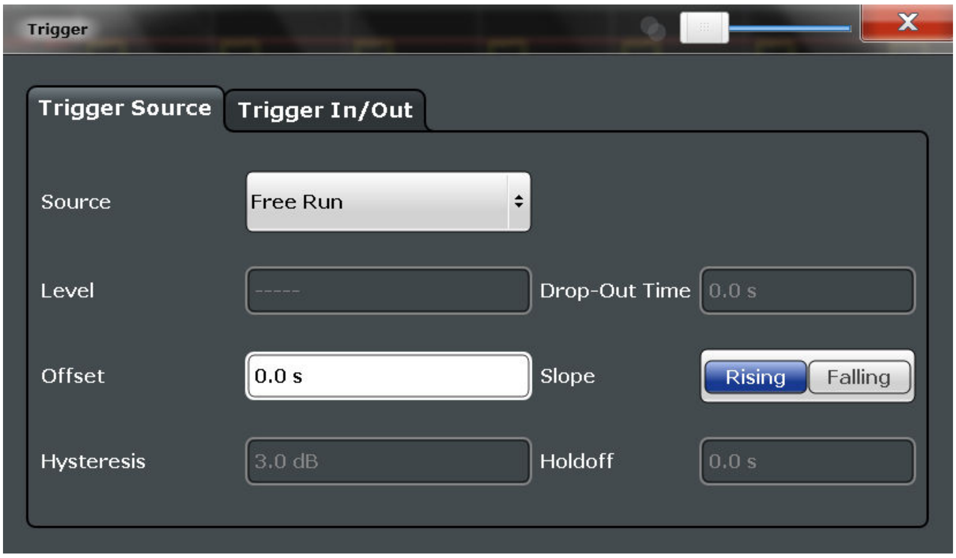
Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE` on page 172

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

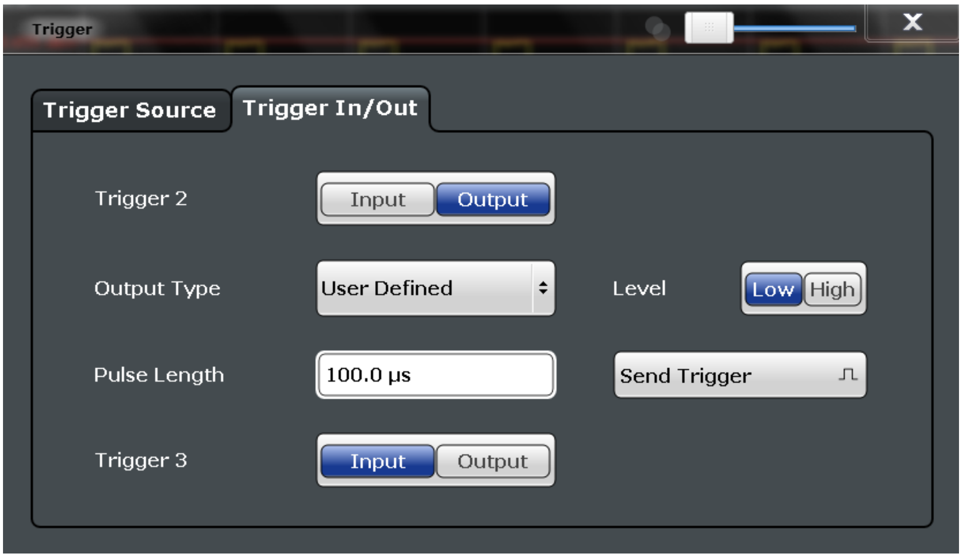
6.2.6 Trigger Settings

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.

Remote command:

`TRIGger[:SEQuence]:SOURce` on page 181

Free Run ← Trigger Source ← Trigger Source

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

Remote command:

`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 181

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 88).

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 73).

"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 73).

Remote command:

`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`

`TRIG:SOUR EXT3`

See `TRIGger[:SEQuence]:SOURce` on page 181

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.

Note:

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

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

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

Table 6-2: Assignment of general purpose bits to LVDS connector pins

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

Remote command:

`TRIG:SOUR GP0`, see `TRIGger[:SEQuence]:SOURce` on page 181

IF Power ← Trigger Source ← Trigger Source

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

This trigger source is only available for RF input.

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

It is not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71).

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

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

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

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

Remote command:

`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 181

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

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

Remote command:
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 179
For analog baseband (B71) or digital baseband (B17) input only:
For digital baseband (B17) input only:
`TRIGger[:SEQuence]:LEVel:BBPower` on page 178

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

Note: For input from the Analog Baseband Interface (R&S FSW-B71) using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 177

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)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 178

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 frequency and time domain measurements only.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 178

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

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 178

Slope ← Trigger Source
For all trigger sources except time and frequency mask (Realtime only) you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 180

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.

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

Remote command:
`[SENSe:]MSRA:CAPTure:OFFSet` on page 250

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

Defines the usage of the variable TRIGGER 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.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 184
`OUTPut:TRIGger<port>:DIRection` on page 183

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.

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 184

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

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 184

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 185

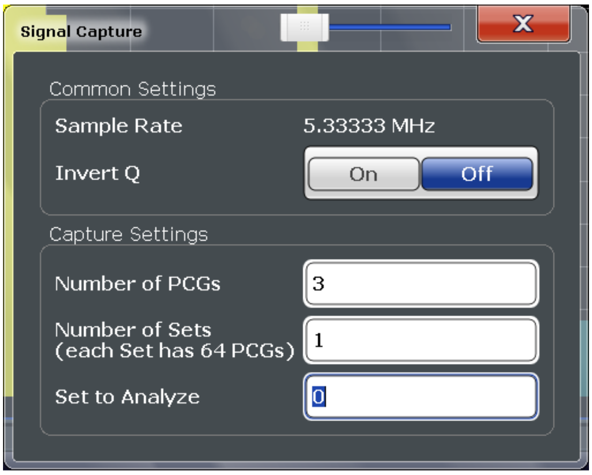
Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector 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.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 184

6.2.7 Signal Capture (Data Acquisition)

You must define 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 settings for the CDMA2000 BTS application in MSRA mode define the **application data** (see chapter 6.2.8, "Application Data (MSRA) ", on page 92).

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

Sample Rate

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

Invert Q

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

Remote command:

`[SENSe:]CDPower:QINVert` on page 186

Number of PCGs

Sets the number of PCGs you want to analyze. The input value is always in multiples of the PCGs. The maximum capture length is 64. The default value is 3.

If the "Number of Sets" on page 91 to capture is larger than 1, the number of PCGs is always 64.

For more information on PCGs and sets see chapter 4.1, "PCGs and Sets", on page 39.

Remote command:

`[SENSe:]CDPower:IQLength` on page 185

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 (CDMA2000 BTS application: 32) and is not available for modification.

Remote command:

`[SENSe:]CDPower:SET:COUNt` on page 186

Set to Analyze

Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 91 – 1.

Remote command:

`[SENSe:]CDPower:SET` on page 198

6.2.8 Application Data (MSRA)

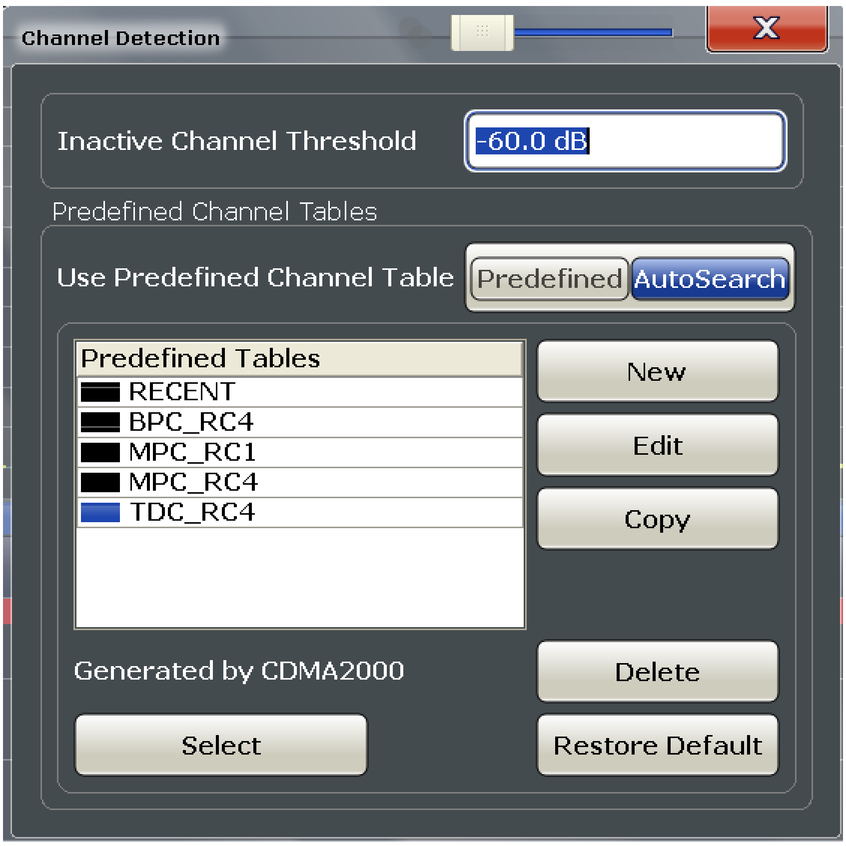
For the CDMA2000 BTS application in MSRA operating mode, the application data range is defined by the same settings used to define the signal capturing in Signal and Spectrum Analyzer mode (see "Number of Sets" on page 91).

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 CDMA2000 BTS measurement (see "Capture Offset" on page 89).

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

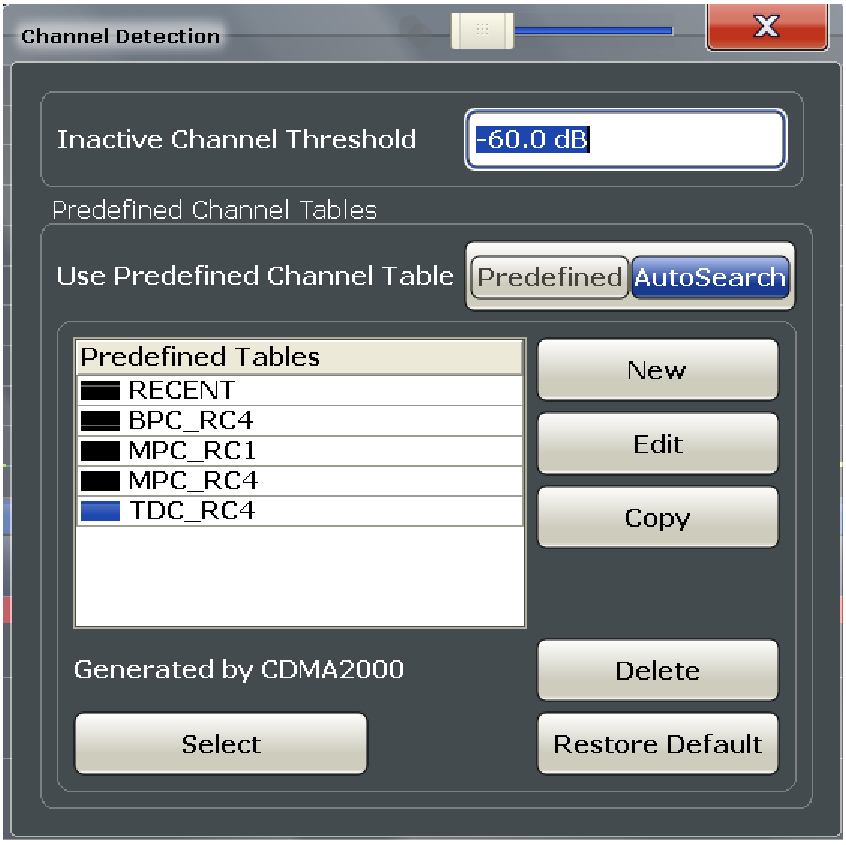
6.2.9 Channel Detection

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



6.2.9.1 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 CDMA2000 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.

Remote command:
`[SENSe:]CDPower:ICTReshold` on page 188

Using Predefined Channel Tables
Defines the channel search mode.

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

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

Remote command:
`CONFigure:CDPower[:BTS]:CTABle[:STATe]` on page 190

6.2.9.2 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 CDMA2000 applications see chapter A.1, "Reference: Predefined Channel Tables", on page 257.

The following channel tables are available by default:

"RECENT"
Contains the most recently selected channel table

"BPC_RC4, MPC_RC1, MPC_RC4, TDC_RC4"
Channel tables for BTS measurements; configured according to a specific radio configuration

"EACHOP, RCCCHOP, RTCHOP3, RTCHOP5"
Channel tables for MS mode; configured according to a specific radio configuration

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:CATalog?` on page 188

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

Remote command:
`CONFigure:CDPower[:BTS]:CTABle:SELect` on page 190

Creating a New Table

Creates a new channel table. For a description of channel table settings and functions see chapter 6.2.9.3, "Channel Table Settings and Functions", on page 95.

For step-by-step instructions on creating a new channel table, see "To define or edit a channel table" on page 124.

Remote command:

`CONFigure:CDPower[:BTS]:CTABle:NAME` on page 193

Editing a Table

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

Copying a Table

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

Remote command:

`CONFigure:CDPower[:BTS]:CTABle:COPY` on page 189

Deleting a Table

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

Remote command:

`CONFigure:CDPower[:BTS]:CTABle:DELete` on page 189

Restoring Default Tables

Restores the predefined channel tables delivered with the instrument.

Remote command:

`CONFigure:CDPower[:BTS]:CTABle:RESTore` on page 190

6.2.9.3 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 6.2.9.4, "BTS Channel Details", on page 96 or chapter 6.2.9.5, "MS Channel Details", on page 98.

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

Remote command:
CONFigure:CDPower[:BTS]:CTABle:NAME on page 193

Comment
Optional description of the channel table.

Remote command:
CONFigure:CDPower[:BTS]:CTABle:COMMent on page 191

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

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

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

Remote command:
CONFigure:CDPower[:BTS]:MEASurement on page 146

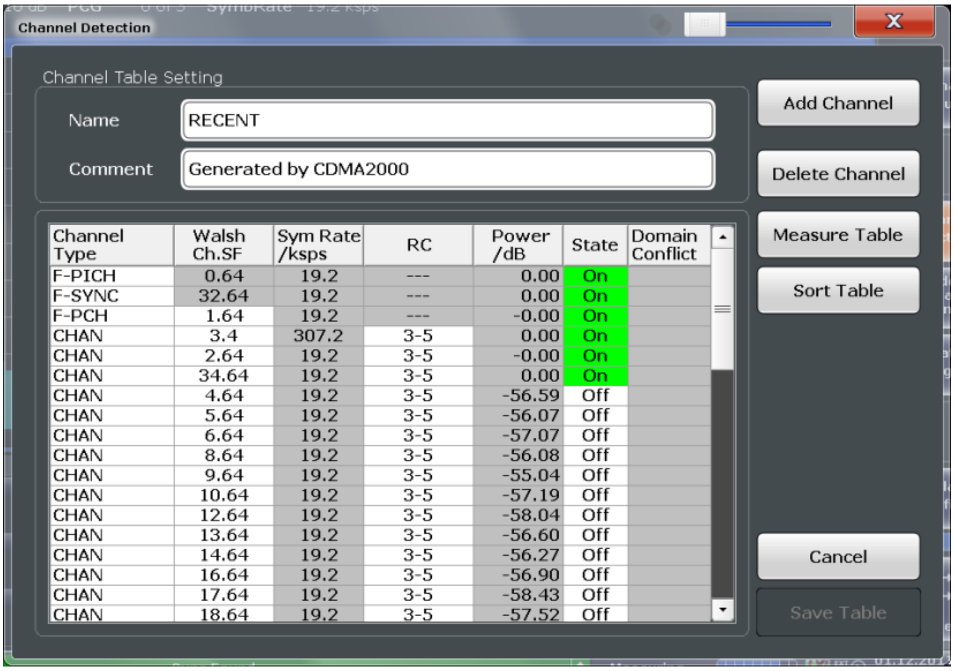
Sorting the Table
Sorts the channel table entries.

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

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

6.2.9.4 BTS Channel Details

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.



Channel Type

Type of channel according to CDMA2000 standard.

For a list of possible channel types see chapter 4.8.1, "BTS Channel Types", on page 46 or chapter 4.8.2, "MS Channel Types", on page 47.

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

Channel Number (Ch. SF)

Number of channel spreading code (0 to [spreading factor-1])

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

Symbol Rate

Symbol rate at which the channel is transmitted.

RC
The Radio Configuration (RC) can be customized for two channel types. For the PDCH you can set the configuration to either 10 (QPSK), 10 (8PSK) or 10 (16QAM). For CHAN channels, you can set the radio configuration to 1-2 or 3-5.

For details on radio configurations see chapter 4.6, "Radio Configuration", on page 44.

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 96).

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

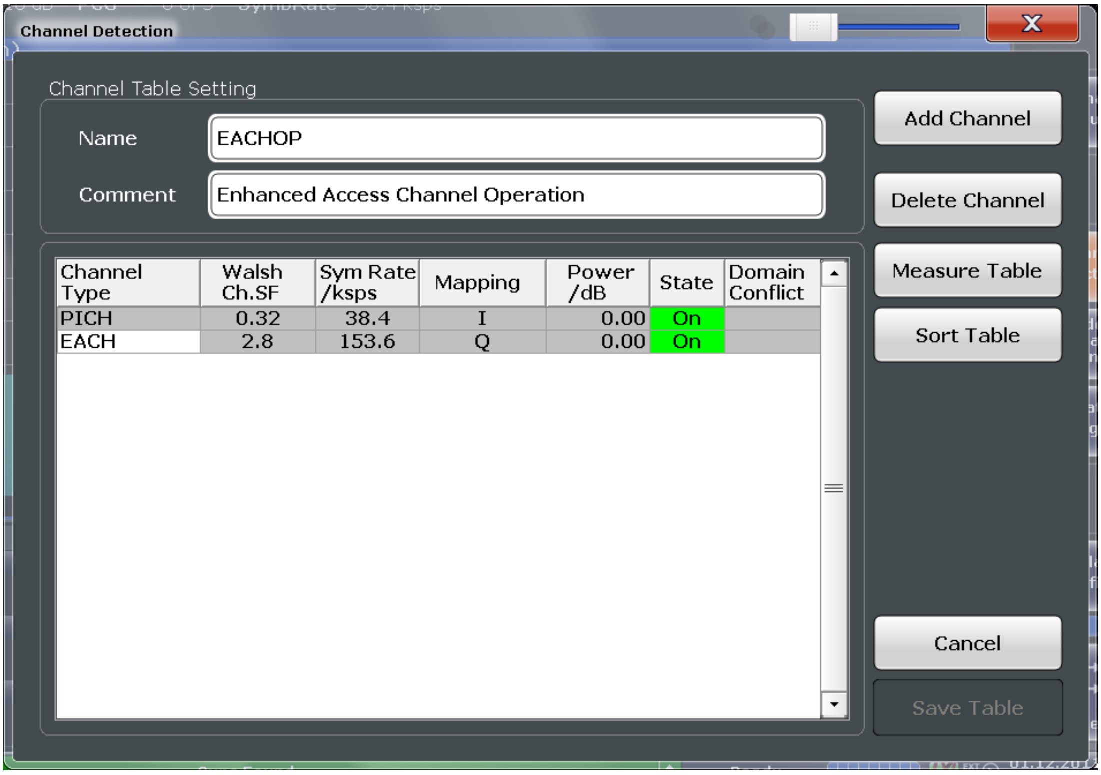
Status
Indicates the channel status. Codes that are not assigned are marked as inactive channels.

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

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

6.2.9.5 MS 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.



Channel Type

Type of channel according to CDMA2000 standard.

For a list of possible channel types see chapter 4.8.1, "BTS Channel Types", on page 46 or chapter 4.8.2, "MS Channel Types", on page 47.

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

Channel Number (Ch. SF)

Number of channel spreading code (0 to [spreading factor-1])

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

Symbol Rate
Symbol rate at which the channel is transmitted.

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 4.5, "Code Mapping and Branches", on page 43.

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

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 96).

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

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

Remote command:
BTS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191
MS application:
`CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192

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

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

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

Remote command:

[SENSe:]SWEep:COUNt on page 194

[SENSe:]AVERage:COUNt on page 194

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 controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

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

Remote command:

INITiate:CONTinuous on page 213

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 controls the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode.

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

Remote command:

INITiate[:IMMediate] on page 214

Continue Single Sweep

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

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

Remote command:

`INITiate:CONMeas` on page 213

6.2.11 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, CDMA2000 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:

- Auto Level
- "Auto Scale All" on page 103

This function is only available for the MSRA/MSRT Master, not for the applications.

Remote command:

`[SENSe:]ADJust:ALL` on page 195

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 (for analog baseband input: the full scale level) 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.

This function is only available for the MSRA/MSRT Master, not for the applications.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 103).

Remote command:

`[SENSe:]ADJust:LEVel` on page 197

Auto Scale Window

Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in the currently selected window. No new measurement is performed.

Auto Scale All

Automatically determines the optimal range and reference level position to be displayed for the *current* measurement settings in all displayed diagrams. No new measurement is performed.

Restore Scale (Window)

Restores the default scale settings in the currently selected window.

Resetting the Automatic Measurement Time (Meastime Auto)

Resets the measurement duration for automatic settings to the default value.

This function is only available for the MSRA/MSRT Master, not for the applications.

Remote command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 196

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.

This function is only available for the MSRA/MSRT Master, not for the applications.

Remote command:

`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 196
`[SENSe:]ADJust:CONFigure:DURation` on page 195

Upper Level Hysteresis

When the reference level is adjusted automatically using the 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.

This function is only available for the MSRA/MSRT Master, not for the applications.

Remote command:

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer on page 197

Lower Level Hysteresis

When the reference level is adjusted automatically using the 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.

This function is only available for the MSRA/MSRT Master, not for the applications.

Remote command:

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer on page 196

6.2.12 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.

Remote command:

DISPlay[:WINDow<n>]:ZOOM:STATe on page 211

DISPlay[:WINDow<n>]:ZOOM:AREA on page 210

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.

Remote command:

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe on page 212

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA on page 211

Restore Original Display

Restores the original display and closes all zoom windows.

Remote command:

DISPlay[:WINDow<n>]:ZOOM:STATe on page 211 (single zoom)

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe on page 212 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates zoom mode.

Tapping the screen no longer invokes a zoom, but selects an object.

Remote command:

DISPlay[:WINDow<n>]:ZOOM:STATe on page 211 (single zoom)

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe on page 212 (for each multiple zoom window)

6.3 RF Measurements

CDMA2000 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 CDMA2000 application, Code Domain Analysis of the input signal is started automatically. However, the CDMA2000 applications also provide various RF measurement types.

Selecting the measurement type

► To seler konnte sich ect an RF measurement type, do one of the following:
  - Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the required measurement.
  - Press the MEAS key on the front panel. In the "Select Measurement" dialog box, select the required measurement.

Some parameters are set automatically according to the CDMA2000 standard the first time a measurement is selected (since the last PRESET operation). A list of these parameters is given with each measurement type. The parameters can be changed, but are not reset automatically the next time you re-enter the measurement.

The main measurement configuration menus for the RF measurements are identical to the Spectrum application.

For details refer to "Measurements" in the R&S FSW User Manual.

The measurement-specific settings for the following measurements are available via the "Overview".

6.3.1 Signal Channel Power Measurements

The Power measurement determines the CDMA2000 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 CDMA2000 application performs a Channel Power measurement as in the Spectrum application with the following settings:

Table 6-3: Predefined settings for CDMA2000 Output Channel Power measurements

Setting	Default Value
ACLR Standard	CDMA2000 MC1
Number of adjacent channels	0
Frequency Span	2 MHz

For further details about the Power measurement refer to "Channel Power and Adjacent-Channel Power (ACLR) Measurements" in the R&S FSW User Manual.

6.3.2 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 CDMA2000 specifications (adjacent channel leakage ratio).

Table 6-4: Predefined settings for CDMA2000 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 CDMA2000 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 CDMA2000 standard.

For an overview of supported bandclasses and their usage see chapter A.3, "Reference: Supported Bandclasses", on page 263.

Remote command:
`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 202

6.3.3 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 CDMA2000 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 CDMA2000 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 CDMA2000 applications perform the SEM measurement as in the Spectrum application with the following settings:

Table 6-5: Predefined settings for CDMA2000 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 CDMA2000 standard.

For an overview of supported bandclasses and their usage see chapter A.3, "Reference: Supported Bandclasses", on page 263.

Remote command:

`CONFigure:CDPower[:BTS]:BCLass|BANDclass` on page 202

6.3.4 Occupied Bandwidth

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

Table 6-6: Predefined settings for CDMA2000 OBW measurements

Setting	Default value
% Power Bandwidth	99 %
Channel bandwidth	1.2288 MHz

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

For further details about the Occupied Bandwidth measurements refer to "Measuring the Occupied Bandwidth" in the R&S FSW User Manual.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset
- RBW, VBW
- Sweep time
- Span

6.3.5 CCDF

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

The measurement is useful to determine errors of linear amplifiers. The crest factor is defined as the ratio of the peak power and the mean power. The Result Summary displays the number of included samples, the mean and peak power and the crest factor.

The CCDF measurement is performed as in the Spectrum application with the following settings:

Table 6-7: Predefined settings for CDMA2000 CCDF measurements

CCDF	Active on trace 1
Analysis bandwidth	10 MHz
Number of samples	62500
VBW	5 MHz

For further details about the CCDF measurements refer to "Statistical Measurements" in the R&S FSW User Manual.

To restore adapted measurement parameters, the following parameters are saved on exiting and are restored on re-entering this measurement:

- Reference level and reference level offset
- Analysis bandwidth
- Number of samples

7 Analysis

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

The remote commands required to perform these tasks are described in chapter 11.10, "General Analysis", on page 238.

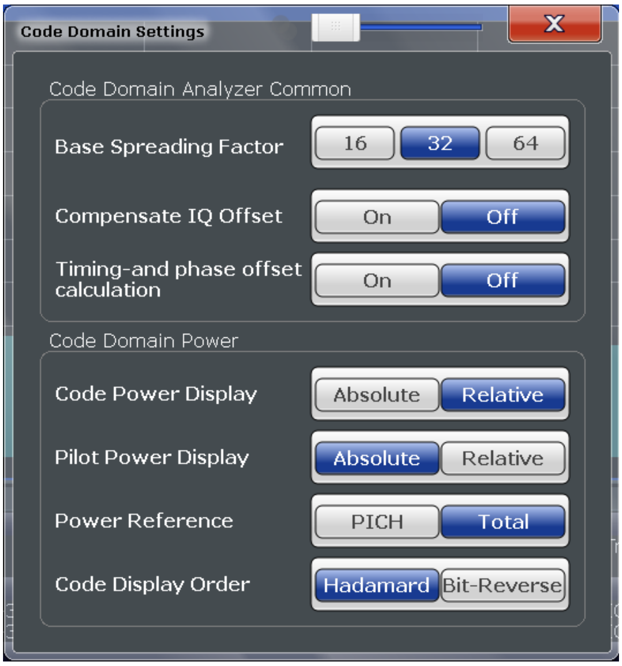
Analyzing RF Measurements

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 the CDMA2000 applications.

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

7.1 Code Domain Analysis Settings

Some evaluations provide further settings for the results. The settings for CDA measurements are described here.



Base Spreading Factor

Changes the base spreading factor, which also changes the scale for code-based result displays. If you set the base spreading factor too low (e.g. to 64 for channels with a base spreading factor of 128 = code class 7), an alias power is displayed in the Code Domain Power and Code Domain Error Power diagrams.

For more information see chapter 4.3, "Code Display and Sort Order", on page 41.

Remote command:
`[SENSe:]CDPower:SFACtor` on page 201

Compensate IQ Offset

If enabled, the I/Q offset is eliminated from the measured signal. This is useful to deduct a DC offset to the baseband caused by the DUT, thus improving the EVM. Note, however, that for EVM measurements according to standard, compensation must be disabled.

Remote command:
`[SENSe:]CDPower:NORMalize` on page 199

Timing and phase offset calculation

Activates or deactivates the timing and phase offset calculation of the channels to the pilot channel. If deactivated, or if more than 50 active channels are in the signal, the calculation does not take place and dashes are displayed instead of values as results.

Remote command:
`[SENSe:]CDPower:TPMeas` on page 201

Code Power Display

For "Code Domain Power" evaluation:

Defines whether the absolute power or the power relative to the chosen reference (in BTS application: relative to total power) is displayed.

Remote command:
`[SENSe:]CDPower:PDISplay` on page 200

Pilot Power Display (MS application only)

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

Defines whether the absolute power or the power relative to the chosen reference is displayed for the pilot channel.

Remote command:
`[SENSe:]CDPower:PPReference` on page 200

Power Reference

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

Defines the reference for relative power display.

"Total" Relative to the total signal power

"PICH" Relative to the power of the PICH

Remote command:

`[SENSe:]CDPower:PREFerence` on page 200

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 4.3, "Code Display and Sort Order", on page 41 and chapter A.2, "Reference: Code Tables", on page 260.

"Hadamard" By default, the codes are sorted in Hadamard order, i.e. in ascending order.
The power of each code is displayed; there is no visible distinction between channels. If a channel covers several codes, the display shows the individual power of each code.

"Bit-Reverse" Bundles the channels with concentrated codes, i.e. all codes of a channel are next to one another. Thus you can see the total power of a concentrated channel.

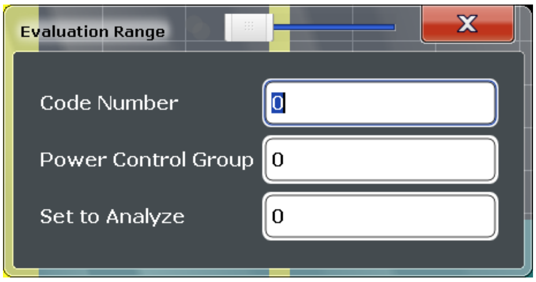
Remote command:

`[SENSe:]CDPower:ORDer` on page 199

7.2 Evaluation Range

The evaluation range defines which channel (Code Number), PCG or set is analyzed in the result display.

For CDMA2000 MS measurements, the branch to be analyzed can also be defined.



Code Number

Selects a code for the following evaluations (see also chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 18):

- 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 4.3, "Code Display and Sort Order", on page 41.

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

Power Control Group

Selects a PCG for the following evaluations:

- Bitstream
- Channel Table
- Code Domain Error Power
- Code Domain Power
- Composite Constellation
- Peak Code Domain Error
- Power vs PCG
- Power vs Symbol
- Result Summary
- Symbol Constellation
- Symbol EVM

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

Set to Analyze

Selects a specific set for further analysis. The value range is between 0 and "Number of Sets" on page 91 – 1.

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

Branch (MS application only)

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

This affects the following evaluations:

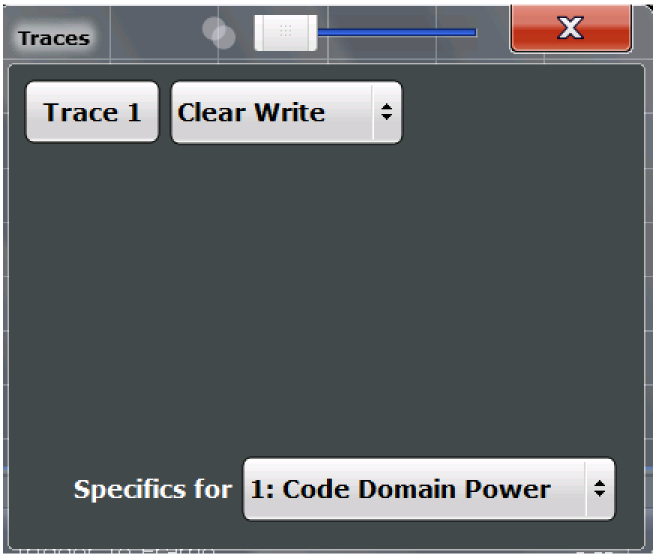
- Code Domain Power
- Code Domain Error Power
- Peak Code Domain Error
- Power vs PCG

- Result Summary

Remote command:
[SENSe:]CDPower:MAPPing on page 198

7.3 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.

"Max Hold" The maximum value is determined over several sweeps and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is greater than the previous one.

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S FSW saves each trace point in the trace memory only if the new value is lower than the previous one.

"Average" The average is formed over several sweeps.
The Sweep/Average Count determines the number of averaging procedures.

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

"Blank" Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 239

7.4 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.

7.4.1 Individual Marker Settings

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

Selected Marker

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

Remote command:

Marker selected via suffix <m> in remote commands.

Marker State

Activates or deactivates the marker in the diagram.

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 240

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 241

X-value

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

Remote command:

`CALCulate<n>:DELTamarker<m>:X` on page 242

`CALCulate<n>:MARKer<m>:X` on page 241

Marker Type

Toggles the marker type.

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

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

"Normal"	A normal marker indicates the absolute value at the defined position in the diagram.
"Delta"	A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 240

`CALCulate<n>:DELTamarker<m>[:STATe]` on page 241

All Markers Off

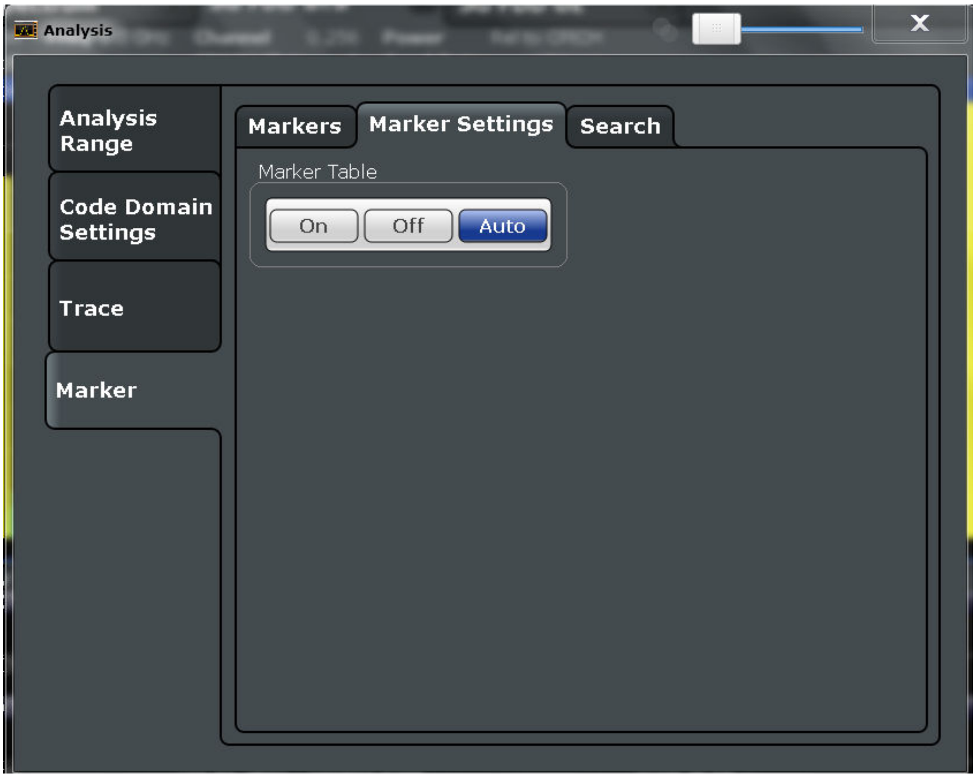
Deactivates all markers in one step.

Remote command:

`CALCulate<n>:MARKer<m>:AOFF` on page 240

7.4.2 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.

Remote command:

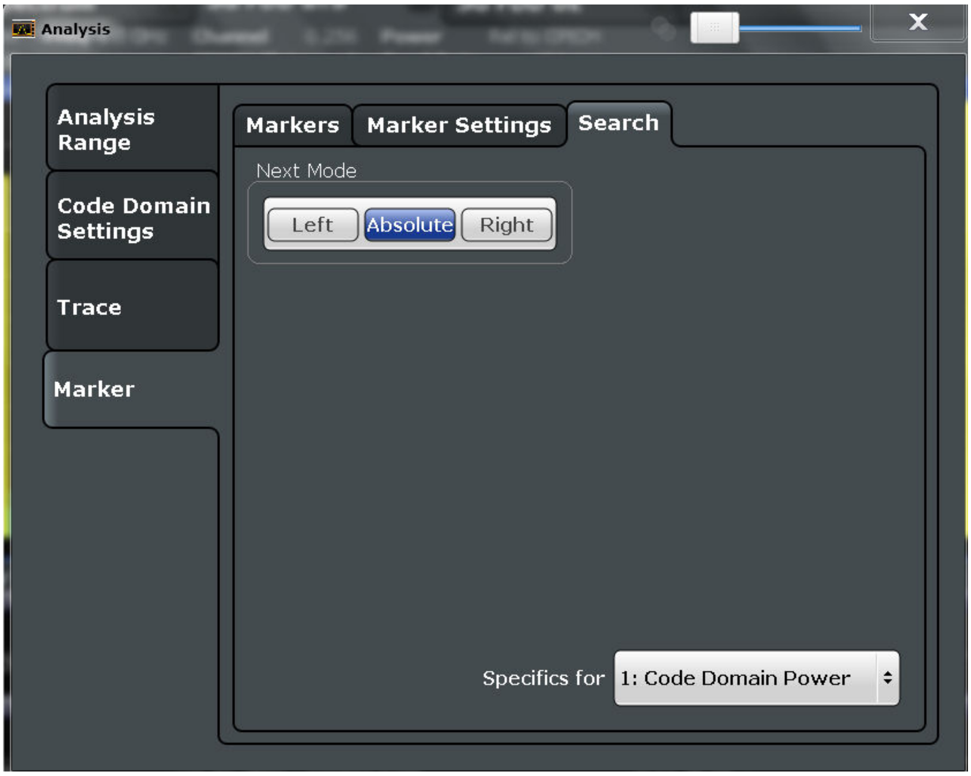
`DISPlay:MTABle` on page 243

7.4.3 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

Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:

`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 246
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 244
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 246
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 244
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 246
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 245
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 246
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 245
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 247
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 245
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 247
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 245

7.4.4 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.

Remote command:

`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 244

`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 246

Search Next Minimum

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

Remote command:

`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 245

`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 247

Peak Search

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

Remote command:

`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 245

`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 246

Search Minimum

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

Remote command:

`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 245

`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 247

Marker To PICH

Sets the marker to the PICH channel.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:PICH` on page 244

Marker To TDPICH

Sets the marker to the TDPICH channel.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:TDPIch` on page 244

8 Optimizing and Troubleshooting the Measurement

If the results do not meet your expectations, try the following methods to optimize the measurement:

Synchronization fails:

- Check the center frequency.
- Perform an automatic reference level adjustment.
- In BTS measurements, 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 measurements, check the "Long Code Mask" and "Long Code Offset".
- Make sure "Invert Q" is off.

8.1 Error Messages

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`.

A short explanation of the application-specific error messages for CDMA2000 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.

9 How to Perform Measurements in CDMA2000 Applications

The following step-by-step instructions describe how to perform measurements with the CDMA2000 applications.

To perform Code Domain Analysis

1. Press the MODE key on the front panel and select the "cdma2000 BTS" application for base station tests, or "cdma2000 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.
   In MSRA mode, define the application data instead, see "To select the application data for MSRA measurements" on page 125.
7. 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 124.
8. 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.
9. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.
10. Select the "Analysis" button in the "Overview" to configure how the data is evaluated in the individual result displays.
    - Select the set, PCG/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.
11. Start a new sweep with the defined settings.

In MSRA mode you may want to stop the continuous measurement mode by the Sequencer and perform a single data acquisition:

a) Select the Sequencer icon ( ) from the toolbar.
b) Set the Sequencer state to "OFF".
c) Press the RUN SINGLE key.

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) Select the existing channel table in the "Predefined Tables" list.
   b) Select the "Edit" button next to the "Predefined Tables" list.
3. In the "Channel Table" dialog box, define a name and, optionally, a comment that describes the channel table. The comment is displayed when you set the focus on the table in the "Predefined Tables" list.
4. Define the channels to be detected using one of the following methods:
   Select the "Measure Table" button to create a table that consists of the channels detected in the currently measured signal.
   Or:
   a) Select the "Add Channel" button to insert a row for a new channel below the currently selected row in the channel table.
   b) Define the channel specifications required for detection:
      - Channel type
      - Channel number and spreading factor used by the channel
      - Symbol rate
      - Which RC is used
        (BTS mode only)
      - Which mapping is applied **(MS mode only)**
      - The channel's code domain power (relative to the total signal power)
      - The channel's state (active or inactive)
5. Select the "Save Table" button to store the channel table.
   The table is stored and the dialog box is closed. The new channel table is included in the "Predefined Tables" list in the "Channel Detection" dialog box.
6. To activate the use of the new channel table:
   a) Select the table in the "Predefined Tables" list.
   b) Select the "Select" button.
      A checkmark is displayed next to the selected table.

c) Toggle the "Use Predefined Channel Table" setting to "Predefined".
d) Toggle the "Compare Meas Signal with Predefined Table" setting to "On".
e) Start a new measurement.

To perform an RF measurement

1. Press the MODE key on the front panel and select the "cdma2000 BTS" application for base station tests, or "cdma2000 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 CDMA2000 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 CDMA2000 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 CDMA2000 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.

10 Measurement Examples

The following measurement examples demonstrate the basic Code Domain Analysis functions for the CDMA2000 standard. These examples assume a basic test setup as described in chapter 4.9, "Test Setup for CDMA2000 Tests", on page 48.

The following measurement examples are basic CDMA2000 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 CDMA2000 signal with an R&S FSW equipped with the CDMA2000 BTS application.

Measurement examples for mobile station tests

The measurements can be performed for mobile station tests in a similar way with the CDMA2000 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-K82: CDMA2000 Base Station Test
- The Vector Signal Generator R&S SMU with option R&S SMU-B46: digital standard CDMA2000 (options R&S SMU-B20 and R&S SMU-B11 required)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

The following measurements are described:

10.1 Meas 1: Measuring the Signal Channel Power

In the Power measurement, the total channel power of the CDMA2000 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" = "cdma2000"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > cdma2000 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.

10.2 Meas 2: Measuring the Spectrum Emission Mask

The CDMA2000 specification calls for a measurement that monitors compliance with a spectral mask over a range of at least ±4.0 MHz around the CDMA2000 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 CDMA2000 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" = "cdma2000"
5. "DIGITAL STD > Set Default"

6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > cdma2000 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 "List Evaluation" shows the frequencies where spurious emissions occur.

10.3 Meas 3: Measuring the Relative Code Domain Power and Frequency Error

A Code Domain Power measurement analyzes the signal over a single Power Control Group (PCG). It also determines the power of all codes and channels.

The following examples show a Code Domain Power measurement on a test model with 9 channels. In this measurement, changing some parameters one after the other should demonstrate the resulting effects: values adapted to the measurement signal are changed to non-adapted values.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).

Settings on the R&S SMU

1. PRESET
2. "FREQ" = *878.49 MHz*
3. "LEVEL"= *0 dBm*
4. "DIGITAL STD" = "cdma2000"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > cdma2000 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 channels (or codes), while the y-axis shows the power of each channel.
   In the second window, the Result Summary is displayed. It shows the numeric results of the code domain power measurement, including the 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 Result Summary. After the reference frequencies of the devices have been synchronized, the frequency error should be smaller than 10 Hz.

Behavior with deviating center frequency setting

A measurement can only be valid if the center frequency of the DUT and the analyzer are balanced.

1. On the signal generator, change the center frequency in steps of 0.1 kHz and observe the analyzer display.
   Up to a frequency error of approximately 1.0 kHz, a Code Domain Power measurement on the R&S FSW is still possible. A frequency error within this range causes no apparent difference in the accuracy of the Code Domain Power measurement.
   In case of a frequency error of more than 1.0 kHz, the probability of incorrect synchronization increases. This is indicated by the "SYNC FAILED" error message.
   If the frequency error exceeds approximately 1.5 kHz, a Code Domain Power measurement cannot be performed. This is also indicated by the "SYNC FAILED" error message.
2. Reset the center frequency of the signal generator to *878.49 MHz*.

The center frequency of the DUT should not deviate by more than 1.0 kHz from that of the R&S FSW.

10.4 Meas 4: Measuring the Triggered Relative Code Domain Power

If the code domain power measurement is performed without external triggering, a section of the test signal is recorded at an arbitrary point of time and the firmware attempts to detect the start of a PCG. To detect this start, all possibilities of the PN sequence location have to be tested in Free Run trigger mode. This requires computing time. This computing time can be reduced by using an external (frame) trigger and entering the correct PN offset. If the search range for the start of the power control group and the PN offset are known then fewer possibilities have to be tested. This increases the measurement speed.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input 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" = "cdma2000"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > cdma2000 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 chapter 10.3, "Meas 3: Measuring the Relative Code Domain Power and Frequency Error", on page 129), the repetition rate of the measurement increases.
   In the second window, the 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.

10.4.1 Adjusting the Trigger Offset

The delay between the trigger event and the start of the PCG can be compensated for by adjusting the trigger offset.

1. "TRIG > External Trigger 1"
2. "TRIG > Trigger Offset" = *100 µs*

   The following results are displayed: the first window shows the power of the code domain of the signal.
   In the second window, the Result Summary is displayed. The "Trigger to Frame" offset between the trigger event and and the start of the PCG has been eliminated.

10.4.2 Behaviour With the Wrong PN Offset

The last adjustment is setting the PN (Pseudo Noise) offset correctly. The measurement is only valid if the PN offset on the analyzer is the same as that of the transmit signal.

► "Signal Description > PN Offset"= *200*.

   In the 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 Result Summary the "Trigger to Frame" value is now correct.

10.5 Meas 5: Measuring the Composite EVM

The Error Vector Magnitude (EVM) describes the quality of the measured signal compared to an ideal reference signal generated by the R&S FSW. In the I-Q plane, the error vector represents the ratio of the measured signal to the ideal signal on symbol level. The error vector is equal to the square root of the ratio of the measured signal to the reference signal. The result is given in %.

In the Composite EVM measurement the error is averaged over all channels (by means of the root mean square) for a given PCG. The measurement covers the entire signal during the entire observation time. In the graphical display the results are shown in a diagram, in which the x-axis represents the examined PCGs and the y-axis shows the EVM values.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input 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" = "cdma2000"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE"= "ON"

Settings on the R&S FSW

1. PRESET
2. "MODE > cdma2000 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)
7. "AMPT > Scale Config > Auto Scale Once"

   The following results are displayed: the first window shows the diagram of the Composite EVM measurement result. In the second window, the Result Summary is displayed. It shows the numeric results of the Code Domain Power measurement, including the values for the Composite EVM.

10.6 Meas 6: Measuring the Peak Code Domain Error and the RHO Factor

The Code Domain Error Power describes the quality of the measured signal compared to an ideal reference signal generated by the R&S FSW. In the I-Q plane, the error vector represents the difference of the measured signal and the ideal signal. The Code Domain Error is the difference in power on symbol level of the measured and the reference signal projected to the class of of the base spreading factor. The unit of the result is dB.

In the Peak Code Domain Error (PCDE) measurement, the maximum error value over all channels is determined and displayed for a given PCG. The measurement covers the entire signal during the entire observation time. In the graphical display the results are shown in a diagram, in which the x-axis represents the PCGs and the y-axis shows the PCDE values.

A measurement of the RHO factor is shown in the second part of the example. RHO is the normalized, correlated power between the measured and the ideal reference signal. The maximum value of RHO is 1. In that case the measured signal and the reference signal are identical. When measuring RHO, it is required that only the pilot channel is active.

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference input (REF) on the rear panel of the R&S SMU (coaxial cable with BNC connectors).
3. Connect the external trigger input 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" = "cdma2000"
5. "DIGITAL STD > Set Default"
6. "DIGITAL STD > LINK DIRECTION > DOWN/FORWARD"
7. "DIGITAL STD > cdma2000 > STATE" = "ON"

Settings on the R&S FSW

1. PRESET

2. "MODE > cdma2000 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 Result Summary is displayed.

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 Result Summary, by default in the second window.

11 Remote Commands for CDMA2000 Measurements

The following commands are required to perform measurements in CDMA2000 applications in a remote environment. It assumes that the R&S FSW has already been set up for remote operation in a network as described in the base unit manual.

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

In particular, this includes:

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

After a short introduction to remote commands, the tasks specific to CDMA2000 applications are described here:

11.1 Introduction

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

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

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

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

Remote command examples

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

11.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

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

11.1.2 Long and Short Form

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

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

Example:

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

11.1.3 Numeric Suffixes

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

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

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

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

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

11.1.4 Optional Keywords

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

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

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

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

With a numeric suffix in the optional keyword:

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

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

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

11.1.5 Alternative Keywords

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

Example:

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

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

11.1.6 SCPI Parameters

Many commands feature one or more parameters.

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

Example:

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

Parameters may have different forms of values.

11.1.6.1 Numeric Values

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

Example:

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

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

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

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

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

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.

- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

Querying numeric values

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

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

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

In some cases, numeric values may be returned as text.

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

11.1.6.2 Boolean

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

Querying boolean parameters

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

Example:

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

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

11.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see chapter 11.1.2, "Long and Short Form", on page 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`

11.1.6.4 Character Strings

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

Example:

`INSTRument:DELete 'Spectrum'`

11.1.6.5 Block Data

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

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires 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.

11.2 Common Suffixes

In CDMA2000 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

11.3 Activating the Measurement Channel

CDMA2000 measurements require a special application on the R&S FSW. The measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate

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

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

This command is not available if the MSRA Master channel is selected.

Example:
`INST:SEL 'Spectrum'`
`INST:CRE:DUPL`
Duplicates the channel named 'Spectrum' and creates a new measurement channel named 'Spectrum 2'.

Usage: Event

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

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType>
Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 143.

<ChannelName>
String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 143).

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 `INSTrument:LIST?` on page 143.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 143).

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 tables below).
Tip: to change the channel name, use the `INSTrument:REName` command.

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

Usage: Query only

Table 11-1: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

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
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
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
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA 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
Realtime Spectrum (R&S FSW-K160R)	RTIM	Realtime Spectrum
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 11-1.

Parameters:

<ChannelType> **BC2K**
cdma2000 BTS option, R&S FSW–K82
MC2K
cdma2000 MS option, R&S FSW–K83

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 operation: See "Preset Channel" on page 60

11.4 Selecting a Measurement

The following commands are required to define the measurement type in a remote environment. For details on available measurements see chapter 3, "Measurements and Result Displays", on page 15.

CONFigure:CDPower[:BTS]:MEASurement <Measurement>

This command selects the RF measurement type (with predefined settings according to the CDMA2000 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 CDMA2000 standard)

*RST: CDPower

Example:
`CONF:CDP:MEAS POW`
Selects Signal Channel Power measurement.

Manual operation:
See "Power" on page 31
See "Channel Power ACLR" on page 32
See "Spectrum Emission Mask" on page 33
See "Occupied Bandwidth" on page 34
See "CCDF" on page 35
See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 96

11.5 Configuring Code Domain Analysis

11.5.1 Signal Description

The signal description provides information on the expected input signal.

11.5.1.1 BTS Signal Description

The following commands describe the input signal in BTS measurements.

For more information see chapter 4.7, "Transmission with Multiple Carriers and Multiple Antennas", on page 44.

CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency <Frequency>

This command sets the cut-off frequency for the RRC filter.

Parameters:

<Frequency> Range: 0.1 MHz to 2.4 MHz
*RST: 1.25

Example:

`CONF:CDP:MCAR ON`
Activates multicarrier mode
`CONF:CDP:MCAR:FILT ON`
Activates an additional filter for multicarrier measurements
`CONF:CDP:MCAR:FILT:TYPE RRC`
Activates the RRC filter
`CONF:CDP:MCAR:FILT:COFR 1.5MHZ`
Sets the cut-off frequency to 1.5 MHz

Manual operation: See "Cut Off Frequency" on page 63

CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF <RollOffFactor>

This command sets the roll-off factor for the RRC filter.

Parameters:

<RollOffFactor> Range: 0.01 to 0.99
*RST: 0.02

Example:
CONF:CDP:MCAR ON
Activates multicarrier mode
CONF:CDP:MCAR:FILT ON
Activates an additional filter for multicarrier measurements
CONF:CDP:MCAR:FILT:TYPE RRC
Activates the RRC filter
CONF:CDP:MCAR:FILT:ROFF 0.05
Sets the roll-off factor to 0.05

Manual operation: See "Roll-Off Factor" on page 62

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

This command activates or deactivates the usage of a filter for multicarrier measurements.

Parameters:

<State> ON | OFF
*RST: OFF

Example:
CONF:CDP:MCAR ON
Activates multicarrier mode
CONF:CDP:MCAR:FILT OFF
Activates an additional filter for multicarrier measurements

Manual operation: See "Multicarrier Filter" on page 62

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

This command sets the filter type to be used in multicarrier mode.

You can set the parameters for the RRC filter with the CONFigure:CDPower[:BTS]:MCARrier:FILTer:COFRequency and CONFigure:CDPower[:BTS]:MCARrier:FILTer:ROFF commands.

Parameters:

<Type> LPASs | RCC
*RST: LPAS

Example:
CONF:CDP:MCAR ON
Activates multicarrier mode
CONF:CDP:MCAR:FILT ON
Activates an additional filter for multicarrier measurements
CONF:CDP:MCAR:FILT:TYPE RRC
Activates the RRC filter

Manual operation: See "Filter Type" on page 62
See "Roll-Off Factor" on page 62
See "Cut Off Frequency" on page 63

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

This command activates or deactivates the enhanced algorithm for the filters in multicarrier mode.

Parameters:

<State> ON | OFF

*RST: ON

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

Manual operation: See "Enhanced Algorithm" on page 62

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

This command activates or deactivates the multicarrier mode.

Parameters:

<State> ON | OFF

*RST: OFF

Example:
`CONF:CDP:MCAR ON`
Activates the multicarrier settings.

Manual operation: See "Multicarrier" on page 62

[SENSe:]CDPower:ANTenna <AntennaState>

This command deactivates the orthogonal transmit diversity (two-antenna system) or defines the antenna for which the result display is evaluated.

For details on antenna diversity see also chapter 4.7.2, "Antenna Diversity", on page 45.

Parameters:

<AntennaState> OFF | 1 | 2

OFF
The aggregate signal from both antennas is fed in.

1
The signal of antenna 1 is fed in.

2
The signal of antenna 2 is fed in.

*RST: OFF

For further details refer to "Antenna Diversity - Antenna Number" on page 61.

Example: `CDP:ANT 2`
Selects antenna 2.

Manual operation: See "Antenna Diversity - Antenna Number" on page 61

[SENSe:]CDPower:PNOFfset <Offset>

This command sets the PN offset of the base station in multiples of 64 chips.

Parameters:

<Offset> Range: 0 to 511
*RST: 0

Example: `CDP:PNOF 45`
Sets PN offset.

Manual operation: See "PN Offset" on page 61

11.5.1.2 MS Signal Description

The following commands describe the input signal in MS measurements.

For more information see "Long code scrambling" on page 43.

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

Remote commands exclusive to describing MS signals:

[SENSe:]CDPower:LCODe:MASK <Mask>

Defines the long code mask of the mobile in hexadecimal form.

Note: For the default mask value of 0 the long code offset (see) is not taken into consideration.

Parameters:

<Mask> Range: #H0 to #H4FFFFFFFFFF
*RST: #H0

Example:

`INST:SEL MC2K`
'Activate cdma2000 MS; by default, "CDP relative" is displayed in screen A and "Result Summary" in screen B.
`INIT:CONT OFF`
'Select single sweep
`TRIG:SOUR:EXT`
'Select external trigger source
`CDP:LCOD:MASK '#HF'`
'Define long code mask
`INIT;*WAI`
'Start measurement with synchronization

Manual operation: See "Long Code Mask" on page 63

[SENSe:]CDPower:LCODe:MODE <Mode>

This command selects the mode of the long code generation.

Parameters:

<Mode>

STANdard
The cdma2000 standard long code generator is used.

ESG101
The Agilent ESG option 101 long code is used; in this case, only signals from that generator can be analysed.

*RST: STANdard

Manual operation: See "Long Code Generation" on page 64

[SENSe:]CDPower:LCODe:OFFSet <CodeOffset>

Defines the long code offset, including the PN offset. This offset is applied at the next trigger pulse (which cannot occur until a setup time of 300 ms has elapsed).

This command is ignored if `[SENSe:]CDPower:LCODe:MODE` is set to 0.

Parameters:

<CodeOffset>

Offset in chips in hexadecimal format with a 52-bit resolution. The chips offset is calculated as follows: tSinceStartGPS * 1.2288 MChips/s, where tSinceStartGPS is defined in seconds.
This value corresponds to the GPS timing since 6.1.1980 00:00:00 UTC.

*RST: #H0

Example: The hexadecimal offset of 258000 h chips is set for the first even second clock trigger:
`INST:SEL MC2K`
'Activate cdma2000 MS; by default, "CDP relative" is displayed in screen A and "Result Summary" in screen B.
`INIT:CONT OFF`
'Select single sweep
`TRIG:SOUR:EXT`
'Select external trigger source
`CDP:LCOD:MASK '#H2'`
'Define long code mask
`CDP:LCOD:OFFS '#H258000'`
'Define long code offset
`INIT;*WAI`
'Start measurement with synchronization

Manual operation: See "Long Code Offset" on page 64

11.5.2 Configuring the Data Input and Output

The following commands are required to configure data input and output. For more information see chapter 6.2.4, "Data Input and Output Settings", on page 65.

11.5.2.1 RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition 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:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input.

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

Parameters:

<ConnType>
- **RF**
  RF input connector
- **AIQI**
  Analog Baseband I connector

*RST: RF

Example: `INP:CONN:AIQI`
Selects the analog baseband input.

Usage: SCPI confirmed

Manual operation: See "Input Connector" on page 67

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 operation: See "Input Coupling" on page 66

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 operation: See "High-Pass Filter 1...3 GHz" on page 67

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 67.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

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

Manual operation: See "YIG-Preselector" on page 67

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 operation: See "Impedance" on page 67

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.

AIQ
Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)
For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual operation:
See "Radio Frequency State" on page 66
See "Digital I/Q Input State" on page 68
See "Analog Baseband Input State" on page 70

11.5.2.2 Remote Commands for the Digital Baseband Interface (R&S FSW-B17)

The following commands are required to control the Digital Baseband Interface (R&S FSW-B17) in a remote environment.They are only available if this option is installed.

Information on the `STATus:QUEStionable:DIQ` register can be found in "STATus:QUEStionable:DIQ Register" on page 160.

Configuring Digital I/Q Input and Output

Remote commands for the R&S DigIConf software

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:

`SOURce:EBOX:*RST`

`SOURce:EBOX:*IDN?`

Result:

"Rohde&Schwarz,DigIConf,02.05.436 Build 47"

Example 2:

`SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ`

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEVice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface (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 sample rate is displayed

1
Current sample rate is displayed

<FullScaleLevel> The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device);
If not available, `9.97e37` is returned

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

Manual operation: See "Connected Instrument" on page 69

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

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

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Full Scale Level" on page 69

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 operation: See "Adjust Reference Level to Full Scale Level" on page 69

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 operation: See "Full Scale Level" on page 69

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

Defines the unit of the full scale level (see "Full Scale Level" on page 69). 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 operation: See "Full Scale Level" on page 69

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 68).

Parameters:

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

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See "Input Sample Rate" on page 68

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 operation: See "Input Sample Rate" on page 68

OUTPut:DIQ <State>

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

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

If digital baseband output is active, the sample rate is restricted to 100 MHz (200 MHz if enhanced mode is possible; max. 160 MHz bandwidth).

Parameters:

<State> ON | OFF
*RST: OFF

Example: `OUTP:DIQ ON`

Manual operation: See "Digital Baseband Output" on page 75

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 operation: See "Output Settings Information" on page 76
See "Connected Instrument" on page 76

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 162 and STATus:QUEStionable:DIQ[:EVENt]? on page 163.

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	**Digital I/Q Input PLL unlocked** This bit is set if the PLL of the Digital I/Q input is out of lock due to missing or unstable clock provided by the connected Digital I/Q TX device. To solve the problem the Digital I/Q connection has to be newly initialized after the clock has been restored.
4	**Digital I/Q Input DATA Error** This bit is set if the data from the Digital I/Q input module is erroneous. Possible reasons: ● Bit errors in the data transmission. The bit will only be set if an error occurred at the current measurement. ● Protocol or data header errors. May occurred at data synchronization problems or vast transmission errors. The bit will be set constantly and all data will be erroneous. To solve the problem the Digital I/Q connection has to be newly initialized. NOTE: If this error is indicated repeatedly either the Digital I/Q LVDS connection cable or the receiving or transmitting device might be defect.
5	not used
6	**Digital I/Q Input FIFO Overload** This bit is set if the sample rate on the connected instrument is higher than the input sample rate setting on the R&S FSW. Possible solution: ● Reduce the sample rate on the connected instrument ● Increase the input sample rate setting on the R&S FSW
7	not used
8	**Digital I/Q Output Device connected** This bit is set if a device is recognized and connected to the Digital I/Q Output.
9	**Digital I/Q Output Connection Protocol in progress** This bit is set while the connection between analyzer and digital I/Q data signal source (e.g. R&S 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.

Bit No.	Meaning
11	**Digital I/Q Output FIFO Overload** This bit is set if an overload of the Digital I/Q Output FIFO occurred. This happens if the output data rate is higher than the maximal data rate of the connected instrument. Reduce the sample rate to solve the problem.
12-14	not used
15	This bit is always set to 0.

STATus:QUEStionable:DIQ:CONDition? <ChannelName>

This command reads out the CONDition section of the `STATus:QUEStionable:DIQ:CONDition` status register.

The command does not delete the contents of the EVENt section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: `STAT:QUES:DIQ:COND?`

Usage: Query only

STATus:QUEStionable:DIQ:ENABle <BitDefinition>, <ChannelName>

This command controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<SumBit> Range: 0 to 65535

Usage: SCPI confirmed

STATus:QUEStionable:DIQ:NTRansition <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<BitDefinition> Range: 0 to 65535

STATus:QUEStionable:DIQ:PTRansition <BitDefinition>,<ChannelName>

This command controls the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Setting parameters:

<BitDefinition> Range: 0 to 65535

STATus:QUEStionable:DIQ[:EVENt]? <ChannelName>

This command queries the contents of the "EVENt" section of the `STATus:QUEStionable:DIQ` register for IQ measurements.

Readout deletes the contents of the "EVENt" section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Example: `STAT:QUES:DIQ?`

Usage: Query only

11.5.2.3 Configuring Input via the Analog Baseband Interface (R&S FSW-B71)

The following commands are required to control the Analog Baseband Interface (R&S FSW-B71) in a remote environment.They are only available if this option is installed.

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

Useful commands for Analog Baseband data described elsewhere:

- `INP:SEL AIQ` (see `INPut:SELect` on page 154)
- `[SENSe:]FREQuency:CENTer` on page 169

Commands for the Analog Baseband calibration signal are described in the R&S FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

---

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 simple-ended lines.

Parameters:

<State>
: **ON**
Differential
: **OFF**
Simple-ended
: *RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input configuration" on page 71

INPut:IQ:FULLscale:AUTO <State>

This command defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:

<State>
: **ON**
Automatic definition
: **OFF**
Manual definition according to `INPut:IQ:FULLscale[:LEVel]` on page 165
: *RST: ON

Example: `INP:IQ:FULL:AUTO OFF`

Manual operation: See "Full Scale Level Mode / Value" on page 83

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see `INPut:IQ:FULLscale:AUTO` on page 164).

Parameters:

<PeakVoltage> 0.25 V | 0.5 V | 1 V | 2 V

Peak voltage level at the connector.
For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.

*RST: 1V

Example: `INP:IQ:FULL 0.5V`

Manual operation: See "Full Scale Level Mode / Value" on page 83

INPut:IQ:TYPE <DataType>

This command defines the format of the input signal.

Parameters:

<DataType> IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0 (see `[SENSe:]FREQuency:CENTer` on page 169), the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: `INP:IQ:TYPE Q`

Manual operation: See "I/Q Mode" on page 70

11.5.2.4 Setting up Probes

Probes can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband interface (option R&S FSW-B71) is installed.

[SENSe:]PROBe<p>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<PartNumber> Part number in a string.

Usage: Query only

[SENSe:]PROBe<p>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<SerialNo> Serial number in a string.

Usage: Query only

[SENSe:]PROBe<p>:SETup:MODE <Mode>

Select the action that is started with the micro button on the probe head.

See also: "Microbutton Action" on page 72.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

<Mode> **RSINgle**
Run single: starts one data acquisition.
NOACtion
Nothing is started on pressing the micro button.
*RST: RSINgle

Manual operation: See "Microbutton Action" on page 72

[SENSe:]PROBe<p>:SETup:NAME?

Queries the name of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<Name> Name string

Usage: Query only

[SENSe:]PROBe<p>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not detected). To switch the probe on, i.e. activate input from the connector, use `INP:SEL:AIQ` (see `INPut:SELect` on page 154).

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<State> DETected | NDETected
*RST: NDETected

Usage: Query only

[SENSe:]PROBe<p>:SETup:TYPE?

Queries the type of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<Type> String containing one of the following values:
– None (no probe detected)
– active differential
– active single-ended

Usage: Query only

11.5.2.5 Configuring the Outputs

Configuring trigger input/output is described in chapter 11.5.4.2, "Configuring the Trigger Output", on page 183.

DIAGnostic: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 operation: See "Noise Source" on page 73

11.5.3 Frontend Configuration

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

For more information see chapter 6.2.5, "Frontend Settings", on page 76.

11.5.3.1 Frequency

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

DOWN
Decreases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Usage: SCPI confirmed

Manual operation: See "Center Frequency" on page 71
See "Center frequency" on page 77

[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 169.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency Stepsize" on page 77

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

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

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:
```
FREQ:CENT:STEP:AUTO ON
```
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

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

Parameters:

<CouplingType>

SPAN
Couples the step size to the span. Available for measurements in the frequency domain.

RBW
Couples the step size to the resolution bandwidth. Available for measurements in the time domain.

OFF
Decouples the step size.

*RST: SPAN

Example:
```
FREQ:CENT:STEP:LINK SPAN
```

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <Factor>

This command defines a step size factor if the center frequency step size is coupled to the span or the resolution bandwidth.

Parameters:

<Factor> 1 to 100 PCT

*RST: 10

Example: `FREQ:CENT:STEP:LINK:FACT 20PCT`

[SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

See also "Frequency Offset" on page 78.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA applications, only the query command is available.

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

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 78

11.5.3.2 Amplitude and Scaling Settings

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 153
- `INPut:IMPedance` on page 154
- `[SENSe:]ADJust:LEVel` on page 197

Remote commands exclusive to amplitude settings:

CALCulate<n>:UNIT:POWer <Unit>

This command selects the unit of the y-axis.

The unit applies to all measurement windows.

Parameters:

<Unit> DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere

*RST: dBm

Example: `CALC:UNIT:POW DBM`

Sets the power unit to dBm.

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 operation: See "Auto Scale Once" on page 84

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 operation: See "Y-Maximum, Y-Minimum" on page 84

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 operation: See "Y-Maximum, Y-Minimum" on page 84

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 WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`

Sets the grid spacing to 10 units (e.g. dB) per division

(For example 10 dB in the Code Domain Power result display.)

DISPlay[:WINDow<n>]:TRACe: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 operation: See "Reference Level" on page 79

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 operation: See "Shifting the Display (Offset)" on page 79

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 operation: See "Preamplifier (option B24)" on page 81

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 173).

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 FSW8/13: 15dB and 30 dB • R&S FSW13: 15dB and 30 dB
• R&S FSW26 or higher: 30 dB
All other values are rounded to the nearest of these two.
*RST: OFF

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

Usage: SCPI confirmed

Manual operation: See "Preamplifier (option B24)" on page 81

11.5.3.3 Configuring the Attenuation

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 176).

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 operation: See "Attenuation Mode / Value" on page 80

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 | 0 | 1
*RST: 1

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

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 80

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 176).

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 operation: See "Using Electronic Attenuation (Option B25)" on page 80

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 | 0 | 1 *RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 80

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 operation: See "Using Electronic Attenuation (Option B25)" on page 80

11.5.4 Configuring Triggered Measurements

The following commands are required to configure a triggered measurement in a remote environment. The tasks for manual operation are described in chapter 6.2.6, "Trigger Settings", on page 84.

The `*OPC` command should be used after commands that retrieve data so that subsequent commands to change the selected trigger source are held off until after the sweep is completed and the data has been returned.

11.5.4.1 Configuring the Triggering Conditions

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

This command defines the holding time before the baseband power trigger event.

The command requires the **Digital Baseband Interface (R&S FSW-B17)** or the **Analog Baseband Interface (R&S FSW-B71)**.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 178 command for new remote control programs.

Parameters:

<Period>	Range:	150 ns to 1000 s
	*RST:	150 ns

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

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

For input from the Analog Baseband Interface (R&S FSW-B71) using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:

<DropoutTime>	Dropout time of the trigger.	
	Range:	0 s to 10.0 s
	*RST:	0 s

Manual operation: See "Drop-Out Time" on page 88

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 operation: See "Trigger Offset" on page 88

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 88

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

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis" on page 88

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

This command sets the level of the baseband power trigger.

This command is available for the **Digital Baseband Interface (R&S FSW-B17)** and the **Analog Baseband Interface (R&S FSW-B71)**.

Parameters:

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

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

Manual operation: See "Trigger Level" on page 88

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Note that the variable INPUT/OUTPUT connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<port>:DIRection` command.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel>	Range:	0.5 V to 3.5 V
	*RST:	1.4 V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 88

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

For compatibility reasons, this command is also available for the "baseband power" trigger source when using the Analog Baseband Interface (R&S FSW-B71).

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -10 dBm

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

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm

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

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

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

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

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

This command defines the level the video signal must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<Level> Range: 0 PCT to 100 PCT
*RST: 50 PCT

Example: `TRIG:LEV:VID 50PCT`

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 89

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)
Not available for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71).

IFPower
Second intermediate frequency
(For frequency and time domain measurements only.)
Not available for input from the Digital Baseband Interface (R&S FSW-B17). For input from the Analog Baseband Interface (R&S FSW-B71), this parameter is interpreted as `BBPower` for compatibility reasons.

TIME
Time interval
(For frequency and time domain measurements only.)

PSEN
External power sensor
(For frequency and time domain measurements only.)

GP0 | GP1 | GP2 | GP3 | GP4 | GP5
For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the 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 87.

*RST: IMMediate

Example:

`TRIG:SOUR EXT`
Selects the external trigger input as source of the trigger signal

Manual operation: See "Trigger Source" on page 86
See "Free Run" on page 86
See "Trigger 1/2/3" on page 86
See "Digital I/Q" on page 87
See "IF Power" on page 87

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.

11.5.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 73.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:

<port> 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 operation: See "Trigger 2/3" on page 73

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> 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 operation: See "Trigger 2/3" on page 73
See "Level" on page 74

OUTPut:TRIGger<port>:OTYPe <OutputType>

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

Suffix:

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

Parameters:

<OutputType> **DEVice**
Sends a trigger signal when the R&S FSW has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user defined trigger signal. For more information see `OUTPut:TRIGger<port>:LEVel`.

*RST: DEVice

Manual operation: See "Output Type" on page 74

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

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

Usage: Event

Manual operation: See "Send Trigger" on page 74

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

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

Suffix:

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

Parameters:

<Length> Pulse length in seconds.

Manual operation: See "Pulse Length" on page 74

11.5.5 Signal Capturing

The following commands configure how much and how data is captured from the input signal.

MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition commands for the CDMA2000 application in MSRA mode define the **application data** (see chapter 11.12, "Configuring the Application Data Range (MSRA mode only)", on page 249).

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

[SENSe:]CDPower:IQLength <CaptureLength>

This command sets the capture length in multiples of the power control group.

Parameters:

<CaptureLength> Range: 2 to 64
*RST: 3

Example: `SENS:CDP:IQLength 3`

Manual operation: See "Number of PCGs" on page 91

[SENSe:]CDPower:QINVert <State>

This command inverts the Q component of the signal.

Parameters:

ON | OFF — *RST: OFF

Example: `CDP:QINV ON`
Activates inversion of Q component.

Manual operation: See "Invert Q" on page 91

[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 91 for more information.

Parameters:

<NumberSets> — Range: 1 to 1500 (BTS mode) or 810 (MS mode)
*RST: 1

Example: `CDP:SET:COUN 10`
Sets the number of sets to be captured to 10.

Manual operation: See "Number of Sets" on page 91

11.5.6 Channel Detection

The channel detection settings determine which channels are found in the input signal. The commands for working with channel tables are described here.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, the following abbreviations and assignments to a numeric value are used:

Table 11-2: BTS channel types and their assignment to a numeric parameter value

Parameter	Channel type
0	PICH
1	SYNC
2	PCH
3	TDPICH
4	APICH
5	ATDPICH
6	BCH
7	CPCCH
8	CACH
9	CCCH

Parameter	Channel type
10	CHAN
11	INACTIVE
12	PDCCH
13	PDCH

Table 11-3: Allowed RC values depending on channel type for BTS measurements

RC	Channel type	Modulation
0	all special channels (not CHAN, PDCH)	
1 | 2 | 3 | 4 | 5	CHAN	
10	PDCH	QPSK
20	PDCH	8PSK
30	PDCH	16QAM

Table 11-4: MS channel types and their assignment to a numeric parameter value

Parameter	Channel type
0	PICH
1	EACH
2	CCCH
3	DCCH
4	ACKCH
5	CQICH
6	FCH
7	S1CH
8	S2CH
9	INACTIVE

11.5.6.1 General Channel Detection

The following commands configure how channels are detected in general.

Useful commands for general channel detection described elsewhere:

- `CONFigure:CDPower[:BTS]:CTABle[:STATe]` on page 190
- `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 190

Remote commands exclusive to general channel detection:

[SENSe:]CDPower:ICTReshold <ThresholdLevel>

This command defines the minimum power that 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 dB to 0 dB
*RST: -60 dB

Example: `CDP:ICTR -50`
Sets the Inactice Channel Threshold to -50 dB.

Manual operation: See "Inactive Channel Threshold" on page 93

11.5.6.2 Managing Channel Tables

CONFigure:CDPower[:BTS]:CTABle:CATalog?

This command reads out the names of all channel tables stored on the instrument. The first two result values are global values for all channel tables, the subsequent values are listed for each individual table.

Return values:

<TotalSize> Sum of file sizes of all channel table files (in bytes)

<FreeMem> Available memory left on hard disk (in bytes)

<FileName> File name of individual channel table file

<FileSize> File size of individual channel table file (in bytes)

Example: `CONF:CDP:CTAB:CAT?`
Sample result (description see table below):
```
52853,2634403840,3GB_1_16.XML,
3469,3GB_1_32.XML,5853,3GB_1_64.XML,
10712,3GB_2.XML,1428,3GB_3_16.XML,
3430,3GB_3_32.XML,5868,3GB_4.XML,
678,3GB_5_2.XML,2554,3GB_5_4.XML,
4101,3GB_5_8.XML,7202,3GB_6.XML,
7209,MYTABLE.XML,349
```

Usage: Query only

Manual operation: See "Predefined Tables" on page 94

Table 11-5: Description of query results in example:

Value	Description
52853	Total size of all channel table files: 52583 bytes
2634403840	Free memory on hard disk: 2.6 Gbytes
3GB_1_16.XML	Channel table 1: `3GB_1_16.XML`
3469	File size for channel table 1: 3469 bytes
3GB_1_32.XML	Channel table 2: `3GB_1_32.XML`
5853	File size for channel table 2: 5853 bytes
3GB_1_64.XML	Channel table 3: `3GB_1_64.XML`
10712	File size for channel table 3: 10712 bytes
...	Channel table x: ...

CONFigure:CDPower[:BTS]:CTABle:COPY <FileName>

This command copies one channel table into another one. The channel table to be copied is selected with command `CONFigure:CDPower[:BTS]:CTABle:NAME` on page 193.

Parameters:

<FileName> string with a maximum of 8 characters
name of the new channel table

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be copied.
`CONF:CDP:CTAB:COPY 'CTAB_2'`
Copies channel table 'NEW_TAB' to 'CTAB_2'.

Usage: Event

Manual operation: See "Copying a Table" on page 95

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 193.

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

Manual operation: See "Deleting a Table" on page 95

CONFigure:CDPower[:BTS]:CTABle:RESTore

This command restores the predefined channel tables to their factory-set values. In this way, you can undo unintentional overwriting.

Example: `CONF:CDP:CTAB:REST`
Restores the channel table.

Usage: Event

Manual operation: See "Restoring Default Tables" on page 95

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 190.

Parameters:
<FileName> *RST: RECENT

Example: `CONF:CDP:CTAB ON`
Switches the channel table on.
`CONF:CDP:CTAB:SEL 'CTAB_1'`
Selects the predefined channel table 'CTAB_1'.

Manual operation: See "Selecting a Table" on page 94

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

This command switches the channel table on or off.

When switched on, the measured channel table is stored under the name "RECENT" and is selected for use. After the "RECENT" channel table is switched on, another channel table can be selected with the command `CONFigure:CDPower[:BTS]:CTABle:SELect` on page 190.

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

Example: `CONF:CDP:CTAB ON`

Manual operation: See "Using Predefined Channel Tables" on page 93

11.5.6.3 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 193.

Parameters:
<Comment>

Example:

`CONF:CDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name.
`CONF:CDP:CTAB:COMM 'Comment for table 1'`
Defines a comment for the table.
`CONF:CDP:CTAB:DATA 8,0,0,0,0,0,1,0.00,8,1,0,0,0,0,1,0.00,7,1,0,256,8,0,1,0.00`
Defines the table values.

Manual operation: See "Comment" on page 96

CONFigure:CDPower[:BTS]:CTABle:DATA <ChannelType>, <CodeClass>, <CodeNumber>, <Modulation>, <Reserved1>, <Reserved2>, <Status>, <CDPRelative>

This command defines a channel table.

The following description applies to cdma2000 BTS mode only. For MS mode, see `CONFigure:CDPower[:BTS]:CTABle:DATA` on page 192.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:NAME` command.

For a detailed description of the parameters refer to chapter 6.2.9.4, "BTS Channel Details", on page 96.

Parameters:

<ChannelType> Numeric channel type according to table 11-2

<CodeClass> 2..7
Code class depending on spreading factor; see table 4-1

<CodeNumber> 0…spreading factor-1
Channel number (without SF)

<Modulation>	Modulation type including mapping Modulation types QPSK/8-PSK/16-QAM have complex values **0** BPSK-I **1** BPSK-Q **2** QPSK **3** 8-PSK **4** 16-QAM
<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.

Mode: BTS application only

Manual operation: See "Channel Type" on page 97
See "Channel Number (Ch. SF)" on page 97
See "Power" on page 98
See "Status" on page 98

CONFigure:CDPower[:BTS]:CTABle:DATA <ChannelType>, <CodeClass>, <CodeNumber>, <Mapping>, <Reserved1>, <Reserved2>, <Status>, <CDPRelative>

This command defines a channel table. The following description applies to MS mode only. For BTS mode, see `CONFigure:CDPower[:BTS]:CTABle:DATA` on page 191.

Before using this command, you must set the name of the channel table using the `CONFigure:CDPower[:BTS]:CTABle:NAME` command.

For a detailed description of the parameters refer to chapter 6.2.9.5, "MS Channel Details", on page 98.

Parameters:

<ChannelType> Numeric channel type according to table 11-4

<CodeClass>	2 to 4 Code class depending on spreading factor; see table 4-2
<CodeNumber>	0…spreading factor-1 Channel number (without SF)
<Mapping>	**0** I branch **1** Q branch
<Reserved1>, <Reserved2>	Always 0 (reserved for future use)
<Status>	0: inactive, 1: active Can be used in a setting command to disable a channel temporarily
<CDPRelative>	Power value in dB.

Example:
```
"INST:SEL M2K"
```
'Activate cdma2000 MS mode
```
"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"
```

Mode: MS mode only

Manual operation:
See "Channel Type" on page 97
See "Channel Number (Ch. SF)" on page 97
See "Power" on page 98
See "Status" on page 98

CONFigure:CDPower[:BTS]:CTABle:NAME <Name>

This command creates a new channel table file or selects an existing channel table in order to copy or delete it.

Parameters:

<Name>	string with a maximum of 8 characters name of the channel table *RST: RECENT

Example:
```
CONF:CDP:CTAB:NAME 'NEW_TAB'
```

Manual operation:
See "Creating a New Table" on page 95
See "Name" on page 96

11.5.7 Sweep Settings

[SENSe:]AVERage:COUNt <AverageCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the application 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 operation: See "Sweep/Average Count" on page 100

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application 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 operation: See "Sweep/Average Count" on page 100

11.5.8 Automatic Settings

MSRA operating mode

In MSRA operating mode, the following automatic commands are not available, as they require a new data acquisition. However, CDMA2000 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 172

Remote commands exclusive to adjusting settings automatically:

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

- Reference level
- Scaling

Example: `ADJ:ALL`

Usage: Event

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 102

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 103

[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 195.

*RST: AUTO

Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 103
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 103

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

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 197 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:LOW 2`
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 104

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

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 197 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold> Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:UPP 2`

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 103

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 80

11.5.9 Evaluation Range

The evaluation range defines which data is evaluated in the result display.

[SENSe:]CDPower:CODE <CodeNo>

This command selects the code number.

For further details refer to "Code Number" on page 113.

Parameters:

<CodeNo> <numeric value>

Range: 0 to base spreading factor - 1
Increment: 1
*RST: 0

Example: `CDP:CODE 8`
Selects the eighth channel.

Manual operation: See "Code Number" on page 113

[SENSe:]CDPower:MAPPing <SignalComponent>

This command switches between the I and Q branch of the signal.

Parameters:

<SignalComponent> I | Q

*RST: Q

Example: `CDP:MAPP Q`

Manual operation: See "Mapping" on page 100
See "Branch (MS application only)" on page 113

[SENSe:]CDPower:SET <SetNo>

This command selects a specific set for further analysis. The number of sets has to be defined with the `[SENSe:]CDPower:SET:COUNt` command before using this command.

Parameters:

<SetNo> Range: 0 to SET COUNT -1
Increment: 1
*RST: 0

Example: `CDP:SET:COUN 10`
Selects the 11th set for further analysis (counting starts with 0).

Manual operation: See "Set to Analyze" on page 91

[SENSe:]CDPower:SLOT <numeric value>

This command selects the slot (PCG) to be analyzed.

Parameters:

<numeric value> Range: 0 to 63
Increment: 1
*RST: 0

Example: `CDP:SLOT 7`
Selects slot number 7 for analysis.

Manual operation: See "Power Control Group" on page 113

11.5.10 Code Domain Analysis Settings

Some evaluations provide further settings for the results. The commands for Code Domain Analysis are described here.

[SENSe:]CDPower:NORMalize <State>

If enabled, the I/Q offset is eliminated from the measured signal. This is useful to deduct a DC offset to the baseband caused by the DUT, thus improving the EVM. Note, however, that for EVM measurements according to standard, compensation must be disabled.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SENS:CDP:NORM ON`

Activates the elimination of the I/Q offset.

Manual operation: See "Compensate IQ Offset" on page 111

[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 4.3, "Code Display and Sort Order", on page 41.

Example:

`CDP:ORD HAD`

Sets Hadamard order.

`TRAC? TRACE2`

Reads out the results in Hadamard order.

`CDP:ORD BITR`

Sets BitReverse order.

`TRAC? TRACE2`

Reads out the results in BitReverse order.

Manual operation: See "Code Display Order" on page 112

[SENSe:]CDPower:PDISplay <Mode>

This command defines how the pilot channel power is displayed in the Result Summary. In relative mode, the reference power is the total power.

Parameters:

<Mode> ABS | REL

*RST: REL

Example: `CDP:PDIS REL`
Pilot channel power is displayed in relation to the total power.

Manual operation: See "Code Power Display" on page 111

[SENSe:]CDPower:PPReference <Mode>

This command is only available for "Code Domain Power" evaluation in MS mode.

This command defines how the pilot channel power is displayed in the absolute summary. In relative mode, the reference power is the total power.

Parameters:

<Mode> ABS | REL

*RST: ABS

Example: `CDP:PPR REL`
Pilot channel power is displayed in relation to the total power.

Manual operation: See "Pilot Power Display (MS application only)" on page 111

[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.
Which pilot channel is used as reference depends on the antenna diversity (for details see `[SENSe:]CDPower:ANTenna` on page 149 command).

TOTal
The reference power is the total power of the signal.

*RST: PICH

For further information refer to "Power Reference" on page 112.

Example: `CDP:PREF TOT`
Sets total power as reference power.

Manual operation: See "Power Reference" on page 112

[SENSe:]CDPower:SFACtor <SpreadingFactor>

This command defines the base spreading factor. If the base spreading factor of 64 is used for channels with a spreading factor of 128 (code class 7), an alias power is displayed in the Code Domain Power and Code Domain Error Power diagrams.

For more information see chapter 4.3, "Code Display and Sort Order", on page 41.

Parameters:

<SpreadingFactor> 64 | 128

*RST: 64

Example: `CDP:SFAC 128`

Selects base spreading factor 128.

Manual operation: See "Base Spreading Factor" on page 111

[SENSe:]CDPower:TPMeas <State>

This command activates or deactivates the timing and phase offset evaluation of the channels to the pilot.

The results are queried using the `TRAC:DATA? CTAB` command or the `CALC:MARK:FUNC:CDP[:BTS]:RES?` command.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

`CDP:TPM ON`

Activates timing and phase offset.

`CDP:SLOT 2`

Selects slot 2.

`CDP:CODE 11`

Selects code number 11.

`CALC:MARK:FUNC:CDP:RES? TOFF`

Reads out timing offset of the code with number 11 in slot 2.

`CALC:MARK:FUNC:CDP:RES? POFF`

Reads out the phase offset of the code with number 11 in slot 2.

Manual operation: See "Timing and phase offset calculation " on page 111

11.6 Configuring RF Measurements

RF measurements are performed in the Spectrum application, with some predefined settings as described in chapter 3.2, "RF Measurements", 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 cdma2000 RF measurements must be activated in a CDMA2000 application, see chapter 11.3, "Activating the Measurement Channel", on page 142.

The individiual measurements are activated using the `CONFigure:CDPower[:BTS]:MEASurement` on page 146 command (see chapter 11.4, "Selecting a Measurement", on page 145).

11.6.1 Special RF Configuration Commands

In addition to the common RF measurement configuration commands described for the base unit, the following special commands are available in cdma2000 applications:

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 CDMA2000 standard.

Parameters:

<Bandclass> For an overview of available bandclasses and the corresponding parameter values see chapter A.3, "Reference: Supported Bandclasses", on page 263.

*RST: 0

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

Manual operation: See "Bandclass" on page 107

11.6.2 Analysis for RF Measurements

General result analysis settings concerning the trace, markers, lines etc. for RF measurements are identical to the analysis functions in the Spectrum application except for some special marker functions and spectrograms, which are not available in the CDMA2000 applications.

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

11.7 Configuring the Result Display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in chapter 3, "Measurements and Result Displays", on page 15.

11.7.1 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 145).

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 207).

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`

11.7.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 145).

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.

Example: `LAY:ADD? '1',BEL,'XPOW:CDP:ABSolute'`
Adds a Code Domain Power display below window 1.

Usage: Query only

Manual operation: See "Bitstream" on page 19
See "Channel Table" on page 19
See "Code Domain Power / Code Domain Error Power" on page 21
See "Composite Constellation" on page 22
See "Composite EVM" on page 23
See "Mag Error vs Chip" on page 24
See "Peak Code Domain Error" on page 25
See "Phase Error vs Chip" on page 26
See "Power vs PCG" on page 27
See "Power vs Symbol" on page 28
See "Result Summary" on page 28
See "Symbol Constellation" on page 28
See "Symbol EVM" on page 29
See "Symbol Magnitude Error" on page 30
See "Symbol Phase Error" on page 30
See "Diagram" on page 36
See "Result Summary" on page 37
See "Marker Table" on page 37
See "Marker Peak List" on page 37

Table 11-6: <WindowType> parameter values for CDMA2000 application

Parameter value	Window type
BITStream	Bitstream
CCONst	Composite Constellation
CDEPower	Code Domain Error Power
CDPower	Code Domain Power
CEVM	Composite EVM
CTABle	Channel Table
LEValuation	List evaluation (SEM, Power vs Time)
MECHip	Magnitude Error vs Chip
MTABle	Marker table
PCDerror	Peak Code Domain Error
PECHip	Phase Error vs Chip
PPCG	Power vs PCG

Parameter value	Window type
PSYMbol	Power vs Symbol
RSUMmary	Result Summary
SCONst	Symbol Constellation
SEVM	Symbol EVM
SMERror	Symbol Magnitude Error
SPERror	Symbol Phase Error

LAYout:CATalog[:WINDow]?

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

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

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 204 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 203 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.

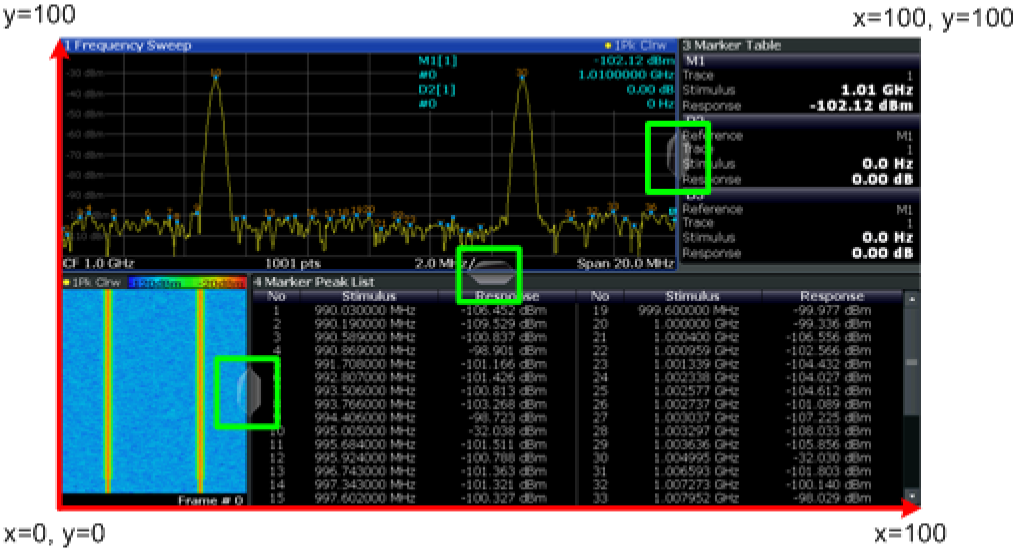


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See figure 11-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.
Range: 0 to 100

Example:

```
LAY:SPL 1,3,50
```

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:

```
LAY:SPL 1,4,70
```

Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.

```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction>	LEFT | RIGHt | ABOVe | BELow
<WindowType>	Type of measurement window you want to add. See `LAYout:ADD[:WINDow]?` on page 204 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 204 for a list of available window types.

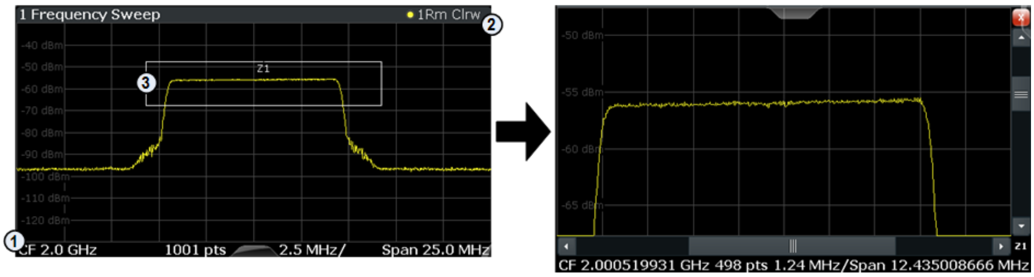
11.7.3 Zooming into the Display

11.7.3.1 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 operation: See "Single Zoom" on page 104

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.

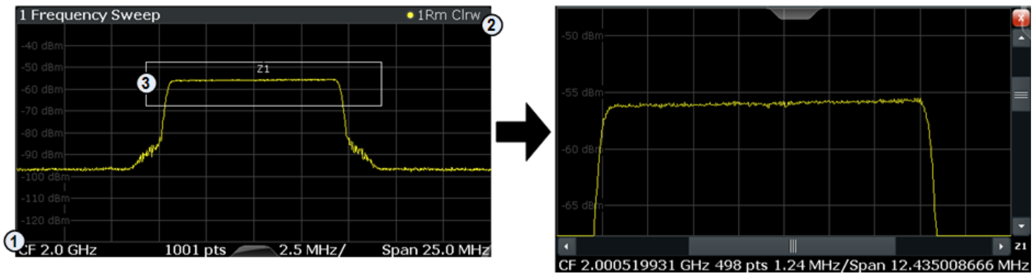
Manual operation: See "Single Zoom" on page 104
See "Restore Original Display" on page 105
See "Deactivating Zoom (Selection mode)" on page 105

11.7.3.2 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 operation: See "Multiple Zoom" on page 104

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 operation: See "Multiple Zoom" on page 104
See "Restore Original Display" on page 105
See "Deactivating Zoom (Selection mode)" on page 105

11.8 Starting a Measurement

The measurement is started immediately when a cdma2000 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 214 command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: 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.

Manual operation: See "Continue Single Sweep" on page 102

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 214) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous sweep

OFF | 0
Single sweep

*RST: 1

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

Manual operation: See "Continuous Sweep/RUN CONT" on page 101

INITiate[:IMMediate]

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

Manual operation: See "Single Sweep/ RUN SINGLE" on page 101

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 214.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 216.

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 216).

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Usage: Event

INITiate: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 216).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

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

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer` SYST:SEQ:OFF) and only in MSRA or MSRT mode.

The data in the capture buffer is re-evaluated by all active MSRA/MSRT 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/MSRT channels.

Usage: Event

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

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

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

11.9 Retrieving Results

The following commands retrieve the results from a cdma2000 measurement in a remote environment.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, abbreviations or assignments to a numeric value are used as described in chapter 11.5.6, "Channel Detection", on page 186.

Specific commands:

11.9.1 Retrieving Calculated CDA Results

The following commands describe how to retrieve the calculated results from the CDA measurements.

CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult? <Measurement>

This command queries individual values of the measured and calculated results of the CDMA2000 code domain power measurement.

Query parameters:

<Measurement>

ACTive
Number of active channels

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

DMType
Domain type

EVMRms
Error vector magnitude RMS in %

EVMPeak
Error vector mag. peak in %

FERPpm
Frequency error in ppm

FERRor
Frequency error in Hz

IQIMbalance
IQ imbalance in %

IQOFfset
IQ offset in %

MACCuracy
Composite EVM in %

PCDerror
Peak code domain error in dB

POFFset
Phase offset in rad

PPICh
Pilot power in dBm

PTOTal
Total power in dBm

RHO
RHO

SFACtor
Spreading factor of channel

SLOT
PCG number

SRATe
Symbol rate in ksps

TFRame I

Trigger to frame

TOFFset
Timing offset in s

Example: `CALC:MARK:FUNC:CDP:RES? PTOT`

Usage: Query only

Manual operation: See "Code Domain Power / Code Domain Error Power" on page 21
See "Composite Constellation" on page 22
See "Composite EVM" on page 23
See "Peak Code Domain Error" on page 25
See "Power vs Symbol" on page 28
See "Result Summary" on page 28
See "Symbol Constellation" on page 28
See "Symbol EVM" on page 29

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 213.

Return values:
<Result> Result at the marker position.

Example: `INIT:CONT OFF`
Switches to single measurement mode.
`CALC:MARK2 ON`
Switches marker 2.
`INIT;*WAI`
Starts a measurement and waits for the end.
`CALC:MARK2:Y?`
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "CCDF" on page 35
See "Marker Table" on page 37
See "Marker Peak List" on page 37

11.9.2 Retrieving CDA Trace Results

The following commands describe how to retrieve the trace data from the CDA measurements. Note that for these measurements, only 1 trace per window can be configured.

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

TRACe<n>[:DATA]? <ResultType>

This command reads trace data from the R&S FSW.

For details on reading trace data for other than code domain measurements refer to the `TRACe:DATA` command in the base unit description.

Query parameters:

<ResultType>

TRACE1 | TRACE2 | TRACE3 | TRACE4

Reads out the trace data of the corresponding trace in the specified measurement window. The results of the trace data query depend on the evaluation method in the specified window, which is selected by the `LAY:ADD:WIND` command. The individual results are described in chapter 11.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 221.

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

SCPI confirmed

Manual operation:

See "Mag Error vs Chip" on page 24

See "Phase Error vs Chip" on page 26

See "Symbol Magnitude Error" on page 30

See "Symbol Phase Error" on page 30

11.9.3 Measurement Results for TRACe<n>[:DATA]? TRACE<n>

The results of the trace data query (TRACe<n>[:DATA]? TRACE<n>) depend on the evaluation method in the specified window, which is selected by the `LAY:ADD:WIND` command.

For each evaluation method the returned values for the trace data query are described in the following sections.

For details on the graphical results of these evaluation methods, see chapter 3, "Measurements and Result Displays", on page 15.

11.9.3.1 Bitstream

When the trace data for this evaluation is queried, the bit stream of one PCG (i.e. one value per bit for each symbol) is transferred. Each symbol contains two consecutive bits in the case of a QPSK modulated PCG and 4 consecutive bits in the case of a 16QAM modulated PCG. One value is transferred per bit (range 0, 1). The number of symbols is not constant and may vary for each sweep. Individual symbols in the bit stream may be invalid depending on the channel type and the bit rate (symbols without power). The assigned invalid bits are marked by one of the digits "6", "7" or "9".

11.9.3.2 Channel Table

Two different commands are available to retrieve the channel table results:

- `TRAC:DATA? TRACEx` commands return detailed trace information for each channel
- `TRAC:DATA? CTABle` provides the maximum values of the timing/phase offset between each assigned channel and the pilot channel

Results for TRACEx Parameters

The command returns 8 values for each channel in the following order:

<channel type>, <code class>, <code number>, <radio configuration>, <absolute level>, <relative level>, <timing offset>, <phase offset>

Value	Description	Range/Unit
<channel type>	channel type (see table 11-2 and table 11-4)	{0..13} (BTS) {0..9} (MS)
<code class>	code class of the channel (see chapter 4.2, "Channels, Codes and Symbols", on page 39)	{2...7} (BTS) {1..6} (MS)
<code number>	code number within the channel	{0..127} (BTS) {0..63}(MS)

Value	Description	Range/Unit
<radio config> (BTS only)	radio configuration (see chapter 4.6, "Radio Configuration", on page 44)	
<mapping> (MS only)	channel mapping	0 = I branch 1 = Q branch
<absolute level>	absolute power level of the channel	{-∞...∞} dBm
<relative level>	relative power level of the channel, referred to either Total or Pilot power	{-∞...∞} dB
<timing offset>	referred to the pilot channel	s
<phase offset>	referred to the pilot channel	9 for: • CDP:TPM OFF • > 50 active channels found • inactive channel rad

In **BTS measurements**, 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 **MS measurements**, 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 of the base spreading factor

Measurement Example: Retrieving the BTS Channel Table Values

The example shows the results of the query for 5 channels with the following configuration:

Chan. type	Ch.no./SF	Code class	Power
PICH	0.64	6	-7.0 dB
PCH	1.64	6	-7.3 dB
CHAN	8.32	5	-8.0 dB

Chan. type	Ch.no./SF	Code class	Power
CHAN	24.128	7	-9.0 dB (alias with 24.64)
SYNC	32.64	6	-13.3 dB

```
INST:SEL BC2K
//Activate cdma2000 BTS, default is CDP relative in window 1 and
//Result Summary in window 2
INIT:CONT OFF
//Select single sweep
INIT:CONT OFF
//Select single sweep
LAY:REPL:WIND '1',CTAB
//Replace CDP by Channel Table evaluation in window 1
INIT;*WAI
//Start measurement with synchronization
TRAC? TRACE1
//Read out channel table
//Result:
//0 , 6, 0, 0,       0.0, -7.0, 9, 9,
//1 , 6, 32, 0,     -6.3, -13.3, 9, 9,
//2 , 6, 1, 0,      -0.3, -7.3, 9, 9,
//10, 5, 8, 3,      -1.0, -8.0, 9, 9,
//10, 7, 24, 3,     -2.0, -9.0, 9, 9,
//11, 6, 2, 3,      -47.6, -54.6, 9, 9,
//....
//11, 6, 63, 3,     -47.7, -54.7, 9, 9
```

Measurement Example: Retrieving the MS Channel Table Values

The example shows the results of the query for 2 channels with the following configuration:

Chan. type	Ch.no./SF	Code class	Mapping	Power
PICH	0.32	5	I	-7.0 dB
CCCH	2.8	3	Q	-10:0 dB

```
INIT:CONT OFF
//Select single sweep
INIT:CONT OFF
//Select single sweep
LAY:REPL:WIND '1',CTAB
//Replace CDP by Channel Table evaluation in window 1
INIT;*WAI
//Start measurement with synchronization
TRAC? TRACE1
//Read out channel table
```

```
//Result:
//0 , 5, 0, 0,        0.0, -7.0, 9, 9,
//2 , 2, 2, 1,       -3.0, -10.0, 9, 9,
//9 , 5, 0, 1,       -46.3, -53.3, 9, 9,
//9 , 5, 1, 0,       -48.0, -55.0, 9, 9,
//9 , 5, 1, 1,       -43.2, -50.2, 9, 9,
//9 , 5, 2, 0,       -42.0, -49.0, 9, 9,
//9 , 5, 3, 0,       -47.6, -54.6, 9, 9,
//....
//9 , 5, 31, 1,      -47.7, -54.7, 9, 9
```

Results for CTABle Parameter

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	Range/ Unit
<time offset>	maximum time offset	s
<code number>	code number of the channel with maximum time offset	{0..127} (BTS) {0..63}(MS)
<code class>	code class of the channel with maximum time offset	{2...7} (BTS) {1..6} (MS)
<phase offset>	maximum phase offset	rad
<code number>	code number of the channel with maximum phase offset	{0..127} (BTS) {0..63}(MS)
<code class>	code class of the channel with maximum phase offset	{2...7} (BTS) {1..6} (MS)
<reserved 1...6>	reserved for future use	0

Measurement example for TRAC:DATA? CTAB

```
INIT:CONT OFF
//Select single sweep
INIT:CONT OFF
//Select single sweep
LAY:REPL:WIND '1',CTAB
//Replace CDP by Channel Table evaluation in window 1
INIT;*WAI
//Start measurement with synchronization
TRAC? CTAB
//Read out maximum timing and phase offsets
//Result: 1.20E-009,2,2,-3.01E-003,15,4,0,0,0,0,0,0
//where:
//1.20E-009,2,2,
```

```
//Max. time offset with code number and
//code class of associated channel
//-3.01E-003,15,4,
//Max. phase offset with code number
//and code class of associated channel
//0,0,0,0,0,0
//6 reserved values
```

11.9.3.3 Code Domain Error Power

The command returns four values for each channel:

<code class>, <code number>, <error power>, <power ID>

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.

Value	Description	Range/ Unit
<code class>	code class of the channel (see chapter 4.2, "Channels, Codes and Symbols", on page 39)	{2...7} (BTS) {1..6} (MS)
<code number>	code number within the channel	{0..127} (BTS) {0..63}(MS)
<signal level>	error power	{-∞...∞}dB
<power ID>	type of power detection: 0 - inactive channel 1 - power of own antenna 2 - alias power of own antenna 3 - alias power of other antenna 4 - alias power of own and other antenna	

To avoid alias power, set the base spreading factor correctly.

For details on these parameters see `TRACe<n>[:DATA]?` on page 220.

11.9.3.4 Code Domain Power

The command returns four values for each channel:

<code class>, <code number>, <signal level>, <power ID>

The number of displayed values depends on the spreading factor.

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.

Value	Description	Range/ Unit
<code class>	code class of the channel (see chapter 4.2, "Channels, Codes and Symbols", on page 39)	{2...7} (BTS) {1..6} (MS)
<code number>	code number within the channel	{0..127} (BTS) {0..63}(MS)
<signal level>	absolute or relative power, depending on the setting (See `[SENSe:]CDPower:PREFerence`) Hadamard order: power values for each code BitReverse order: power values for combined channels	{-∞...∞}dB or dBm
<power ID>	type of power detection: 0 - inactive channel 1 - power of own antenna 2 - alias power of own antenna 3 - alias power of other antenna 4 - alias power of own and other antenna	

To avoid alias power, set the base spreading factor correctly.

For details on these parameters see `TRACe<n>[:DATA]?` on page 220.

Measurement Example: Retrieving the Code Domain Power in the BTS Application

The example shows the results of the query for 5 channels with the following configuration:

Chan. type	Ch.no./SF	Code class	Power
PICH	0.64	6	-7.0 dB
PCH	1.64	6	-7.3 dB
CHAN	8.32	5	-8.0 dB

Chan. type	Ch.no./SF	Code class	Power
CHAN	24.128	7	-9.0 dB (alias with 24.64)
SYNC	32.64	6	-13.3 dB

```
INST:SEL BC2K
//Activate cdma2000 BTS, default is CDP relative in window 1 and
//Result Summary in window 2
INIT:CONT OFF
//Select single sweep
CDP:ORD HAD
//Set order to Hadamard
INIT;*WAI
//Start measurement with synchronization
TRAC? TRACE1
//Read out CDP relative/Hadamard;
//Channel 8.32 is distributed to 8.64 and 40.64, in each case with half power:
//-8dB - 3dB = -11.0 dB
//Result:
//6, 0, -7.0,1,      6, 1, -7.3,1,
//6, 2,-54.6,0,      6, 3,-55.3,0,
//          ....     6, 7,-58.2,0,
//6, 8,-11.0,1,      6, 9,-53.4,0,
//          ....     6,24, -9.0,2,
//          ....     6,32,-13.3,1,
//          ....     6,40,-11.0,1,
//          ....     6,63,-54.7,0
CDP:ORD BITR
//Set order to BitReverse
TRAC? TRACE1
//Read out CDP relative/BitReverse
//Channel 8.32 can now be directly read out with its total power.
//The sort order changes in accordance with BitReverse.
//Result:
//6, 0, -7.0,1,      6,32,-13.3,1,
//6,16,-56.3,0,      6,48,-52.8,0,
//5, 8, -8.0,1,      6,24, -9.0,2,
//          ....     6, 1, -7.3,1,
//          ....     6,63,-54.7,0
```

```
INST:SEL BC2K
//Activate cdma2000 BTS, default is CDP relative in window 1 and
//Result Summary in window 2
INIT:CONT OFF
//Select single sweep
CDP:ORD HAD
//Set order to Hadamard
INIT;*WAI
//Start measurement with synchronization
```

```
TRAC? TRACE1
//Read out CDP relative/Hadamard
//Channel 8.32 is distributed to 8.64 and 40.64, in each case with half power:
// -8dB - 3dB = -11.0dB
//Result:
//6, 0, -7.0,1, 6, 1, -7.3,1,
//6, 2,-54.6,0, 6, 3,-55.3,0,
//.... 6, 7,-58.2,0,
//6, 8,-11.0,1, 6, 9,-53.4,0,
//.... 6,24, -9.0,2,
//.... 6,32,-13.3,1,
//.... 6,40,-11.0,1,
//.... 6,63,-54.7,0
CDP:ORD BITR
//Set order to BitReverse
TRAC? TRACE1
//Read out CDP relative/BitReverse
//Channel 8.32 can now be directly read out with its total power.
//The sort order changes in accordance with BitReverse.
//Result:
//6, 0, -7.0,1, 6,32,-13.3,1,
//6,16,-56.3,0, 6,48,-52.8,0,
//5, 8, -8.0,1, 6,24, -9.0,2,
//.... 6, 1, -7.3,1,
//.... 6,63,-54.7,0
```

Measurement Example: Retrieving the Code Domain Power (MS mode)

The example shows the results of the query for 2 channels with the following configuration:

Chan. type	Ch.no./SF	Code class	Mapping	Power
PICH	0.32	5	I	-7.0 dB
CCCH	2.8	3	Q	-10:0 dB

```
INST:SEL MC2K
//Activate cdma2000 MS, default is CDP relative in window 1 and
//Result Summary in window 2
//Mapping set to I
INIT:CONT OFF
//Select single sweep
CDDP:MAPP Q
//Select Q branch
CDP:ORD HAD
//Set order to Hadamard
INIT;*WAI
//Start measurement with synchronization
TRAC? TRACE1
//Read out CDP relative/Hadamard/Q
```

```
//Result:
//5, 0,-52.3,3,      5, 1,-53.3,0,
//5, 2,-16.1,1,      5, 3,-55.3,0,
//          ....      5, 9,-58.2,0,
//5,10,-16.0,1,      5,11,-53.4,0,
//          ....      5,17,-49.0,0,
//5,18,-15.8,1,      5,19,-53.3,0,
//          ....      5,25,-51.0,0,
//5,26,-16.1,1,      5,27,-54.7,0
         ....      5,31,-51.7,0
//Code 0 is quasi-inactive since PICH is set to I
//Channel 2.8 is distributed between the active codes
//2.32, 10.32, 18.32 and 26.32
//each with one quarter of the power: -10dB - 6dB = -16.0dB
CDP:ORD BITR
//Set order to BitReverse
TRAC? TRACE1
//Read out CDP relative/BitReverse/Q
//Sorting is changed according to BitReverse.
//Result:
//5, 0,-52.3,3,      5,16,-57.3,0
//5, 8,-56.3.0,      ....
//3, 2,-10.0,1,      5, 6,-55.3,0,
         ....      5,31,-51.7,0
//Code 0 is quasi-inactive since PICH is set to I
//Channel 2.8 can now be read out directly with its total power
CDP:OVER ON
//Activate Overview mode
//CDP relative on window 1 I branch
//CDP relative on window 2 Q branch
TRAC? TRACE1
//Read out CDP relative of I branch
//Result:
//5, 0, -7.0,1,      5,16,-52.3,0
//5, 8,-57.1.0,      ....
//5, 2,-49.0,3,      5,18,-49.0,3,
//5,10,-49.0,3,      5,26,-49.0,3
//5, 6,-55.3,0,      5, 6,-53.4,0,
         ....      5,31,-51.7,0
//PICH is active
//Codes of channel 2.8 are quasi-inactive
TRAC? TRACE2
//Read out CDP relative of Q branch
//Result:
//5, 0,-52.3,3,      6,16,-57.3,0
//5, 8,-56.3.0,      ....
//3, 2,-10.0,1,      6, 3,-55.3,0,
         ....      5,31,-51.7,0
```

11.9.3.5 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 chip number of 1536 chips in a power control group.

11.9.3.6 Composite EVM (RMS)

When the trace data for this evaluation is queried, one pair of PCG and level value is transferred for each PCG:

<PCG number>, <level value in %>

The number of value pairs corresponds to the number of captured PCGs.

11.9.3.7 EVM vs Chip

When the trace data for this evaluation is queried, a list of vector error values of all chips at the selected PCG is returned (=2560 values). The values are calculated as the square root of the square difference between the received signal and the reference signal for each chip, normalized to the square root of the average power at the selected PCG.

11.9.3.8 Frequency Error vs PCG

When the trace data for this evaluation is queried, one pair of PCG and error value is transferred for each PCG:

<PCG number>, <value in Hz>

11.9.3.9 Mag Error vs Chip

When the trace data for this evaluation is queried, a list of magnitude error values of all chips at the selected slot is returned (=2560 values). The values are calculated as the magnitude difference between the received signal and the reference signal for each chip in %, and are normalized to the square root of the average power at the selected slot.

11.9.3.10 Power vs PCG

When the trace data for this evaluation is queried, one pair of PCG and level values is transferred for each PCG:

<PCG number>, <level value in dB>

The number of value pairs corresponds to the number of captured PCGs.

11.9.3.11 Peak Code Domain Error

The command returns 2 values for each PCG in the following order:

<PCG number>, <level value in dB>

The number of value pairs corresponds to the number of captured PCGs.

11.9.3.12 Phase Discontinuity vs PCG

When the trace data for this evaluation is queried, one pair of PCG and value is transferred for each PCG:

<PCG number>, <value in deg>

11.9.3.13 Phase Error vs Chip

When the trace data for this evaluation is queried, a list of phase error values of all chips in the selected slot is returned (=2560 values). The values are calculated as the phase difference between the received signal and the reference signal for each chip in degrees, and are normalized to the square root of the average power at the selected slot.

11.9.3.14 Power vs Symbol

When the trace data for this evaluation is queried. One power value per symbol is returned.

The number of values depends on the number of symbols and therefore the spreading factor. With transmit diversity activated, the number of values is reduced to half.

For details see "Number of bits per symbol" on page 41.

11.9.3.15 Result Summary

When the trace data for this evaluation is queried, the results of the result summary are output in the following order:

<PCG>, <PTOTal>, <PPICh>, <RHO>, <MACCuracy>, <PCDerror>, <ACTive>, <FERRor>, <FERPpm>, <TFRame>, <CERRor>, <IQOFfset>, <IQIMbalance>, <SRATe>, <CHANnel>, <SFACtor>, <TOFFset>, <POFFset>, <CDPRelative>, <CDPabsolute>, <EVMRms>, <EVMPeak>

Value	Description	Range / Unit
<PCG>	Number of the PCG	
<PTOTal>	Total power	{-∞...∞} dBm
<PPICh>	Pilot power	{-∞...∞} dBm
<RHO>	RHO	{0...1}

Value	Description	Range / Unit
<MACCuracy>	Composite EVM	%
<PCDerror>	Peak Code Domain Error	dB
<ACTive>	Number of active channels	
<FERRor>	Frequency error	Hz
<FERPpm>	Frequency error	ppm
<TFRame>	Trigger to Frame	Returns a '9' if the trigger is set to Free Run
<CERRor>	Chip rate error	ppm
<IQOFfset>	IQ offset	%
<IQIMbalance>	IQ imbalance	%
<SRATe>	Symbol rate	ksps
<CHANnel>	Channel number	
<SFACtor>	Spreading factor of the channel	
<TOFFset>	Timing offset	returns a '9' if the timing/phase offset measurement is switched off or the number of active channel exceeds 50 unit: s
<POFFset>	Phase offset	returns a '9' if the timing/phase offset measurement is switched off or the number of active channel exceeds 50 unit: rad
<CDPRelative>	Relative (to total or pilot power) channel power	{-∞...∞} dBm
<CDPabsolute>	Absolute channel power	{-∞...∞} dB
<EVMRms>	Error vector magnitude (RMS)	%
<EVMPeak>	Error vector magnitude peak	%

Read out the modulation type with the command: `CALCulate<n>:MARKer<m>:FUNCtion:CDPower[:BTS]:RESult?` on page 217

11.9.3.16 Symbol Constellation

When the trace data for this evaluation is queried, the real and the imaginary branches of each symbol are transferred:

<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. With transmit diversity activated, the number of values is reduced to half.

For details see "Number of bits per symbol" on page 41.

11.9.3.17 Symbol EVM

When the trace data for this evaluation is queried. one EVM value per symbol is returned.

The number of values depends on the number of symbols and therefore the spreading factor. With transmit diversity activated, the number of values is reduced to half.

For details see "Number of bits per symbol" on page 41.

11.9.3.18 Symbol Magnitude Error

When the trace data for this evaluation is queried, the magnitude error in % of each symbol at the selected slot is transferred. The number of the symbols depends on the spreading factor of the selected channel:

NOFSymbols=10*2$^{(8\text{-CodeClass})}$

11.9.3.19 Symbol Phase Error

When the trace data for this evaluation is queried, the phase error in degrees of each symbol at the selected slot is transferred. The number of the symbols depends on the spreading factor of the selected channel:

NOFSymbols=10*2$^{(8\text{-CodeClass})}$

11.9.4 Exporting Trace Results

Trace results can be exported to a file.

For more commands concerning data and results storage see the R&S FSW User Manual.

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

Trace export is only available for RF measurements.

For details on the file format see "Reference: ASCII File Export Format" in the R&S FSW User Manual.

Secure User Mode

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

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

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

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'C:\TEST.ASC'`
Stores trace 3 from window 1 in the file `TEST.ASC`.

Usage: SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> **COMMa**
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator.
Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

11.9.5 Retrieving RF Results

The following commands retrieve the results of the cdma2000 RF measurements.

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:MARKer<m>:Y?` on page 219

Remote commands exclusive to retrieving RF results:

CALCulate: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 213.

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:
Query only
SCPI confirmed

Manual operation: See "Spectrum Emission Mask" on page 33

CALCulate:MARKer: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 213.

Query parameters:

<Measurement>

ACPower | MCACpower

ACLR measurements (also known as adjacent channel power or multicarrier adjacent channel measurements).

Returns the power for every active transmission and adjacent channel. The order is:

• power of the transmission channels

• power of adjacent channel (lower,upper)

• power of alternate channels (lower,upper)

MSR ACLR results:

For MSR ACLR measurements, the order of the returned results is slightly different:

• power of the transmission channels

• total power of the transmission channels for each subblock

• power of adjacent channels (lower, upper)

• power of alternate channels (lower, upper)

• power of gap channels (lower1, upper1, lower2, upper2)

The unit of the return values depends on the scaling of the y-axis:

• logarithmic scaling returns the power in the current unit

• linear scaling returns the power in W

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.

Usage: Query only

Manual operation: See "Power" on page 31
See "Channel Power ACLR" on page 32
See "Spectrum Emission Mask" on page 33
See "Occupied Bandwidth" on page 34
See "CCDF" on page 35

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

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

Parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example: `CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 35

11.10 General Analysis

The following commands configure general result analysis settings concerning the trace and markers for CDA measurements.

For RF measurements, see the Remote Commands - Analysis chapter in the R&S FSW User Manual.

11.10.1 Traces

The trace settings determine how the measured data is analyzed and displayed on the screen. In cdma2000 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 operation: See "Trace Mode" on page 114

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

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

11.10.2 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. In cdma2000 applications, only 4 markers per window can be configured for Code Domain Analysis.

11.10.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

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

Usage: Event

Manual operation: See "All Markers Off" on page 117

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 operation: See "Marker State" on page 116
See "Marker Type" on page 117

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 operation: See "Marker Table" on page 37
See "Marker Peak List" on page 37
See "X-value" on page 116

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 operation: See "Marker State" on page 116
See "Marker Type" on page 117

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 operation: See "X-value" on page 116

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 213.

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

11.10.2.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:
<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 118

11.10.2.3 Marker Search and Positioning Settings

CALCulate<n>:MARKer<m>:FUNCtion:PICH

This command sets the marker to channel 0.64.

Example: `CALC:MARK:FUNC:PICH`
Activates marker and positions it at pilot 0.64.
`CALC:MARK:Y?`
Queries value of the relative Code Domain Power of the pilot channel.

Mode: BTS application only

Manual operation: See "Marker To PICH" on page 121

CALCulate<n>:MARKer<m>:FUNCtion:TDPIch

This command sets the marker to channel 16.128.

Example: `CALC:MARK:FUNC:TDPI`
Activates marker and positions it at TDPICH 16.128.
`CALC:MARK:Y?`
Queries value of the relative Code Domain Power of the transmit diversity pilot channel.

Mode: BTS application only

Manual operation: See "Marker To TDPICH" on page 121

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 119
See "Search Next Peak" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 119
See "Search Next Minimum" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 119
See "Search Next Peak" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

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

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 119
See "Search Next Minimum" on page 120

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 operation: See "Search Mode for Next Peak" on page 119

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

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 120

11.11 Importing and Exporting I/Q Data and Results

For details on importing and exporting I/Q data see chapter 5, "I/Q Data Import and Export", on page 53.

MMEMory:LOAD:IQ:STATe 1,<FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

Parameters:
<FileName> String containing the path and name of the source file.

Example:
```
MMEM:LOAD:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```
Loads IQ data from the specified file.

Usage: Setting only

Manual operation: See "I/Q Import" on page 53

MMEMory:STORe:IQ:COMMent <Comment>

This command adds a comment to a file that contains I/Q data.

Parameters:
<Comment> String containing the comment.

Example:
```
MMEM:STOR:IQ:COMM 'Device test 1b'
```
Creates a description for the export file.
```
MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```
Stores I/Q data and the comment to the specified file.

Manual operation: See "I/Q Export" on page 54

MMEMory:STORe:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Secure User Mode

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

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

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

Parameters:
1

<FileName> String containing the path and name of the target file.

Example:
```
MMEM:STOR:IQ:STAT 1, 'C:
\R_S\Instr\user\data.iq.tar'
```
Stores the captured I/Q data to the specified file.

Manual operation: See "I/Q Export" on page 54

11.12 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 CDMA2000 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 186). 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.

The **analysis line** is displayed by default but can be hidden or re-positioned.

Remote commands exclusive to MSRA applications

The following commands are only available for MSRA application channels:

CALCulate:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA applications and the MSRA Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active application remains in the window title bars.

Parameters:

<State> ON | OFF
*RST: ON

CALCulate:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA applications and the MSRA Master.

Parameters:

<Position> Position of the analysis line in seconds. The position must lie within the measurement time of the MSRA measurement.

Default unit: s

CALCulate:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the index <n>. 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 in seconds

Default unit: s

<IntStop> Stop value of the analysis interval in seconds

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 operation: See "Capture Offset" on page 89

11.13 Querying the Status Registers

The following commands query the status registers specific to the CDMA2000 applications. In addition, the CDMA2000 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 160.

The `STATus:QUEStionable:SYNC` register contains information on the error situation in the code domain analysis of the cdma2000 applications. The bits can be queried with commands `STATus:QUEStionable:SYNC:CONDition?` on page 252 and `STATus:QUEStionable:SYNC[:EVENt]?` on page 252.

Table 11-7: Status error bits in STATus:QUEStionable:SYNC register for CDMA2000 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 Swap IQ • Invalid signal at input
2 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 <BitDefinition>, <ChannelName>

This command controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:NTRansition <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:PTRansition <BitDefinition>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

11.14 Commands for Compatibility

The following commands are provided for compatibility to other signal analyzers only. For new remote commands programs use the specified alternative commands.

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see chapter 11.7.2, "Working with Windows in the Display", on page 204).

Parameters:

<Evaluation> Type of evaluation you want to display.
See the table below for available parameter values.

Example: `CALC:FEED 'XPOW:CDP'`
Selects the Code Domain Power result display.

Table 11-8: <Evaluation> parameter values

String Parameter	Text Parameter	Evaluation
'XTIM:CDP:BSTReam'	BITStream	Bitstream
'XTIM:CDP:COMP:CONStellation'	CCONst	Composite Constellation
'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:ERR:PCDomain'	PCDerror	Peak Code Domain Error
'XTIM:CDP:PVSYmbol'	PSYMbol	Power vs Symbol
'XTIM:CDP:ERR:SUMMary'	RSUMmary	Result Summary
‘XPOW:CDP:RATio'	SCONst	Symbol Constellation
'XTIM:CDP:SYMB:EVM'	SEVM	Symbol EVM

[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 197.

[SENSe:]CDPower:PRESet

This command resets the CDMA2000 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

11.15 Programming Examples for CDMA2000 BTS Measurements

The following programming example demonstrates how to perform Code Domain Analysis on a CDMA2000 signal in a remote environment. It assumes the network has been set up for remote control.

Note that some commands may not be necessary as they reflect the default instrument settings; however, they are included to demonstrate their use.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate a CDMA2000 BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BC2K,'BTSMeasurement'
//Select the code domain analysis measurement
CONF:CDP:BTS:MEAS CDP
//Stop continuous sweep
INIT:CONT OFF

//---------------- Configuring the Measurement-----
//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0
//Set the center frequency to 878.49 MHz
FREQ:CENT 878.49 MHz

//---------- Trigger settings --------------------
// Use these settings only if an external trigger is connected
// to the TRIGGER INPUT connector on the front panel of the R&S FSW.
// Otherwise ignore these commands.
// Define the use of an external trigger.
TRIGger:SOURce EXT

//------------ Signal Description -------------------
//IF KNOWN, define the pseudo noise offset of the base station from the external
//trigger of 2 (*64 chips) to accelerate calculation
//SENS:CDP:PNOF 2

//Capture data only from signal at antenna 1.
SENS:CDP:ANT 1
//Switch to multi-carrier signal detection and disable enhanced signal detection
//algorithm to accelerate calculation
CONF:CDP:BTS:MCAR ON
CONF:CDP:BTS:MCAR:MALG OFF
//Activate multicarrier RRC filter with rolloff 0.02 and cutoff at 1.25 MHz
CONF:CDP:BTS:MCAR:FILT ON
CONF:CDP:BTS:MCAR:FILT:TYPE RRC
CONF:CDP:BTS:MCAR:FILT:ROFF 0.02
CONF:CDP:BTS:MCAR:FILT:COFR 1.25MHZ

//----------- Channel detection --------------------------
//Configure an inactive threshold of -60.0 dB
SENS:CDP:ICTR -60

//---------- Configuring the result display ------------
// Activate the following result displays:
// 1: Code Domain Power (default, upper left)
```

```
// 2: Result Summary (default, below CDP)
// 3: Code Domain Error Power (next to CDP)
// 4: Bitstream Table (next to Result Summary)
LAYout:ADD:WINDow? '1',RIGH,PCD
LAYout:ADD:WINDow? '2',RIGH,BITS

//----------- Code domain settings ---------------------------
//Use a base spreading factor of 128
SENS:CDP:SFAC 128
//Configure compensation for I/Q offset
SENS:CDP:NORM ON
//Calculate timing and phase offset
SENS:CDP:TPM ON
//Define relative code power results, referred to total power of the signal
SENS:CDP:PDIS REL
SENS:CDP:PREF TOT
//Use bit-reverse sort order for code display
SENS:CDP:ORD BITR

//------------- Data acquisition -------------------------
//Configure data capture for 3 PCGs, analyze set 0, code number 3
SENS:CDP:IQL 3
SENS:CDP:SET 0
SENS:CDP:CODE 3

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and waits until the sweep has finished.
INIT;*WAI

//---------------Retrieving Results-------------
//Retrieve the composite EVM
CALC:MARK:FUNC:CDP:BTS:RES? MACC
//Retrieve the channel power, relative to total power
CALC:MARK:FUNC:CDP:BTS:RES? CDPR
//Retrieve the total power
CALC:MARK:FUNC:CDP:BTS:RES? PTOT
//Retrieve the peak error vector magnitude in percent
CALC:MARK:FUNC:CDP:BTS:RES? EVMP
//Retrieve the trace data of the Code Domain Error Power display
TRAC3:DATA? TRACE1
```

A Annex - Reference Data

A.1 Reference: Predefined Channel Tables

Predefined channel tables provide quick configuration for the channel search in commonly used measurement scenarios in accordance with the cdma2000 specification.

To use channels other than those in the predefined channel tables, you can copy the original tables and modify the channels in the copy.

A.1.1 BTS Channel Tables

The cdma2000 BTS Analysis application provides the following set of channel tables compliant with the cdma2000 specification:

The standard does not specify a channel number for the data channels.

Channel table	Contents
RECENT	Contains the most recently selected channel table
MPC_RC1	Base Station **M**ain **P**ath 6 **C**hannels **R**adio **C**onfiguration **1** Channel table with F-PICH/F-SYNC/F-PCH and 6 data channels.
MPC_RC4	Base Station **M**ain **P**ath 6 **C**hannels **R**adio **C**onfiguration **4** Channel table with F-PICH/F-SYNC/F-PCH and 6 data channels.
TDC_RC4	Base Station **T**ransmit **D**iversity Path 6 **C**hannels **R**adio **C**onfiguration 4 Channel table with F-PICH/F-SYNC/F-PCH and 6 data channels.
BPC_RC4	Base Station **B**oth **P**aths 6 **C**hannels **R**adio **C**onfiguration 4 Channel table with F-PICH/F-TDPICH/F-SYNC/F-PCH and 6 data channels

Table 1-1: Base station channel table for main branch in radio configuration 1 (MPC_RC1)

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PICH	1	0.64	-
F-SYNC	1	32.64	-

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PCH	1	1.64	-
F-CHAN	6	9.64 10.64 11.64 15.64 17.64 25.64	1 1 1 1 1 1

Table 1-2: Base station channel table for main branch in radio configuration 4 (MPC_RC4)

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PICH	1	0.64	-
F-SYNC	1	32.64	-
F-PCH	1	1.64	-
F-CHAN	6	9.128 10.128 11.128 15.128 17.128 25.128	4 4 4 4 4 4

Table 1-3: Base station test model for aggregate signal in radio configuration 4 (TDC_RC4)

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PICH	1	16.128	-
F-SYNC	1	32.64	-
F-PCH	1	1.64	-
F-CHAN	6	9.128 10.128 11.128 15.128 17.128 25.128	4 4 4 4 4 4

Table 1-4: Base station test model for aggregate signal in radio configuration 4 (BPC_RC4)

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PICH	1	0.64	-
TDPICH	1	16.128	-
F-SYNC	1	32.64	-

Channel Type	Number of Channels	Code Channel (Walsh Code.SF)	Radio Configuration
F-PCH	1	1.64	-
F-CHAN	6	9.128 10.128 11.128 15.128 17.128 25.128	4 4 4 4 4 4

A.1.2 MS Channel Tables

The cdma2000 MS application provides the following set of channel tables compliant with the cdma2000 specification:

Channel table	Contents
RECENT	Contains the channels that were automatically created during the last measurement with the "Auto Search" option activated (for details refer to "Using Predefined Channel Tables" on page 93).
EACHOP	Channel table for **E**nhanced **A**ccess **CH**annel **OP**eration with PICH and EACH
RCCCHOP	Channel table for **R**everse **C**ommon **C**ontrol **CH**annel **OP**eration with PICH and CCCH
RTCHOP3	Channel table for **R**everse **T**raffic **CH**annel **OP**eration with the following 3 channels: ● PICH ● DCCH ● FCH
RTCHOP5	Channel table for **R**everse **T**raffic **CH**annel **OP**eration with the following 5 channels: ● PICH ● DCCH ● FCH ● S1CH ● S2CH

Table 1-5: Channel table for enhanced access channel operation

Channel type	Code channel (Walsh Code.SF)	Mapping
PICH	0.32	I
EACH	2.8	Q

Table 1-6: Channel table for reverse commom control channel operation

Channel type	Code channel (Walsh Code.SF)	Mapping
PICH	0.32	I
CCCH	2.8	Q

Table 1-7: Channel table for REVERSE TRAFFIC CHANNEL OPERATION 3

Channel type	Code channel (Walsh Code.SF)	Mapping
PICH	0.32	I
FCH	4.16	Q
S1CH	2.4	Q

Table 1-8: Channel table for REVERSE TRAFFIC CHANNEL OPERATION 5

Channel type	Code channel (Walsh Code.SF)	Mapping
PICH	0.32	I
DCCH	8.16	I
FCH	4.16	Q
S1CH	2.4	Q
S2CH	6.8	I

A.2 Reference: Code Tables

Hadamard and BitReverse Code Tables

The following tables show the code sequences with Hadamard and BitReverse orders for the Code Domain Power and Code Domain Error Power result displays.

As an example, the corresponding cells for channel 8.32 (channel number 8 for spreading factor 32) are marked to show where the different codes of this channel are located.

HADAMARD								BITREVERSE							
0	000000	0	0	0	0	0	0	0	0	0	0	0	0	000000	0
1	000001	0	0	0	0	0	1	1	0	0	0	0	0	100000	32
2	000010	0	0	0	0	1	0	0	1	0	0	0	0	010000	16
3	000011	0	0	0	0	1	1	1	1	0	0	0	0	110000	48
4	000100	0	0	0	1	0	0	0	0	1	0	0	0	001000	8
5	000101	0	0	0	1	0	1	1	0	1	0	0	0	101000	40
6	000110	0	0	0	1	1	0	0	1	1	0	0	0	011000	24
7	000111	0	0	0	1	1	1	1	1	1	0	0	0	111000	56
8	001000	0	0	1	0	0	0	0	0	0	1	0	0	000100	4
9	001001	0	0	1	0	0	1	1	0	0	1	0	0	100100	36
10	001010	0	0	1	0	1	0	0	1	0	1	0	0	010100	20
11	001011	0	0	1	0	1	1	1	1	0	1	0	0	110100	52
12	001100	0	0	1	1	0	0	0	0	1	1	0	0	001100	12
13	001101	0	0	1	1	0	1	1	0	1	1	0	0	101100	44
14	001110	0	0	1	1	1	0	0	1	1	1	0	0	011100	28
15	001111	0	0	1	1	1	1	1	1	1	1	0	0	111100	60
16	010000	0	1	0	0	0	0	0	0	0	0	1	0	000010	2
17	010001	0	1	0	0	0	1	1	0	0	0	1	0	100010	34
18	010010	0	1	0	0	1	0	0	1	0	0	1	0	010010	18
19	010011	0	1	0	0	1	1	1	1	0	0	1	0	110010	50
20	010100	0	1	0	1	0	0	0	0	1	0	1	0	001010	10
21	010101	0	1	0	1	0	1	1	0	1	0	1	0	101010	42
22	010110	0	1	0	1	1	0	0	1	1	0	1	0	011010	26
23	010111	0	1	0	1	1	1	1	1	1	0	1	0	111010	58
24	011000	0	1	1	0	0	0	0	0	0	1	1	0	000110	6
25	011001	0	1	1	0	0	1	1	0	0	1	1	0	100110	38
26	011010	0	1	1	0	1	0	0	1	0	1	1	0	010110	22
27	011011	0	1	1	0	1	1	1	1	0	1	1	0	110110	54
28	011100	0	1	1	1	0	0	0	0	1	1	1	0	001110	14
29	011101	0	1	1	1	0	1	1	0	1	1	1	0	101110	46
30	011110	0	1	1	1	1	0	0	1	1	1	1	0	011110	30
31	011111	0	1	1	1	1	1	1	1	1	1	1	0	111110	62
32	100000	1	0	0	0	0	0	0	0	0	0	0	1	000001	1
33	100001	1	0	0	0	0	1	1	0	0	0	0	1	100001	33
34	100010	1	0	0	0	1	0	0	1	0	0	0	1	010001	17
35	100011	1	0	0	0	1	1	1	1	0	0	0	1	110001	49
36	100100	1	0	0	1	0	0	0	0	1	0	0	1	001001	9
37	100101	1	0	0	1	0	1	1	0	1	0	0	1	101001	41
38	100110	1	0	0	1	1	0	0	1	1	0	0	1	011001	25
39	100111	1	0	0	1	1	1	1	1	1	0	0	1	111001	57
40	101000	1	0	1	0	0	0	0	0	0	1	0	1	000101	5
41	101001	1	0	1	0	0	1	1	0	0	1	0	1	100101	37
42	101010	1	0	1	0	1	0	0	1	0	1	0	1	010101	21
43	101011	1	0	1	0	1	1	1	1	0	1	0	1	110101	53
44	101100	1	0	1	1	0	0	0	0	1	1	0	1	001101	13
45	101101	1	0	1	1	0	1	1	0	1	1	0	1	101101	45
46	101110	1	0	1	1	1	0	0	1	1	1	0	1	011101	29
47	101111	1	0	1	1	1	1	1	1	1	1	0	1	111101	61
48	110000	1	1	0	0	0	0	0	0	0	0	1	1	000011	3
49	110001	1	1	0	0	0	1	1	0	0	0	1	1	100011	35
50	110010	1	1	0	0	1	0	0	1	0	0	1	1	010011	19
51	110011	1	1	0	0	1	1	1	1	0	0	1	1	110011	51
52	110100	1	1	0	1	0	0	0	0	1	0	1	1	001011	11
53	110101	1	1	0	1	0	1	1	0	1	0	1	1	101011	43
54	110110	1	1	0	1	1	0	0	1	1	0	1	1	011011	27
55	110111	1	1	0	1	1	1	1	1	1	0	1	1	111011	59
56	111000	1	1	1	0	0	0	0	0	0	1	1	1	000111	7
57	111001	1	1	1	0	0	1	1	0	0	1	1	1	100111	39
58	111010	1	1	1	0	1	0	0	1	0	1	1	1	010111	23
59	111011	1	1	1	0	1	1	1	1	0	1	1	1	110111	55
60	111100	1	1	1	1	0	0	0	0	1	1	1	1	001111	15
61	111101	1	1	1	1	0	1	1	0	1	1	1	1	101111	47
62	111110	1	1	1	1	1	0	0	1	1	1	1	1	011111	31
63	111111	1	1	1	1	1	1	1	1	1	1	1	1	111111	63

Fig. 1-1: Codetable for base spreading factor 64

	HADAMARD								BITREVERSE								
0	0000000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000000	0
1	0000001	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1000000	64
2	0000010	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0100000	32
3	0000011	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1100000	96
4	0000100	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0010000	16
5	0000101	0	0	0	0	1	0	1	1	0	1	0	0	0	0	1010000	80
6	0000110	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0110000	48
7	0000111	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1110000	112
8	000 1000	0	0	0	1	0	0	0	0	0	0	1	0	0	0	000 1000	8
9	0001001	0	0	0	1	0	0	1	1	0	0	1	0	0	0	100 1000	72
10	0001010	0	0	0	1	0	1	0	0	1	0	1	0	0	0	010 1000	40
11	0001011	0	0	0	1	0	1	1	1	1	0	1	0	0	0	110 1000	104
12	0001100	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0011000	24
13	0001101	0	0	0	1	1	0	1	1	0	1	1	0	0	0	1011000	88
14	0001110	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0111000	56
15	0001111	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1111000	120
16	0010000	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0000100	4
17	0010001	0	0	1	0	0	0	1	1	0	0	0	1	0	0	1000100	68
18	0010010	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0100100	36
19	0010011	0	0	1	0	0	1	1	1	1	0	0	1	0	0	1100100	100
20	0010100	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0010100	20
21	0010101	0	0	1	0	1	0	1	1	0	1	0	1	0	0	1010100	84
22	0010110	0	0	1	0	1	1	0	0	1	1	0	1	0	0	0110100	52
23	0010111	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1110100	116
24	0011000	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0001100	12
25	0011001	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1001100	76
26	0011010	0	0	1	1	0	1	0	0	1	0	1	1	0	0	0101100	44
27	0011011	0	0	1	1	0	1	1	1	1	0	1	1	0	0	1101100	108
28	0011100	0	0	1	1	1	0	0	0	0	1	1	1	0	0	0011100	28
29	0011101	0	0	1	1	1	0	1	1	0	1	1	1	0	0	1011100	92
30	0011110	0	0	1	1	1	1	0	0	1	1	1	1	0	0	0111100	60
31	0011111	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1111100	124
32	0100000	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0000010	2
33	0100001	0	1	0	0	0	0	1	1	0	0	0	0	1	0	1000010	66
34	0100010	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0100010	34
35	0100011	0	1	0	0	0	1	1	1	1	0	0	0	1	0	1100010	98
36	0100100	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0010010	18
37	0100101	0	1	0	0	1	0	1	1	0	1	0	0	1	0	1010010	82
38	0100110	0	1	0	0	1	1	0	0	1	1	0	0	1	0	0110010	50
39	0100111	0	1	0	0	1	1	1	1	1	1	0	0	1	0	1110010	114
40	010 1000	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0001010	10
41	0101001	0	1	0	1	0	0	1	1	0	0	1	0	1	0	1001010	74
42	0101010	0	1	0	1	0	1	0	0	1	0	1	0	1	0	0101010	42
43	0101011	0	1	0	1	0	1	1	1	1	0	1	0	1	0	1101010	106
44	0101100	0	1	0	1	1	0	0	0	0	1	1	0	1	0	0011010	26
45	0101101	0	1	0	1	1	0	1	1	0	1	1	0	1	0	1011010	90
46	0101110	0	1	0	1	1	1	0	0	1	1	1	0	1	0	0111010	58
47	0101111	0	1	0	1	1	1	1	1	1	1	1	0	1	0	1111010	122
48	0110000	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0000110	6
49	0110001	0	1	1	0	0	0	1	1	0	0	0	1	1	0	1000110	70
50	0110010	0	1	1	0	0	1	0	0	1	0	0	1	1	0	0100110	38
51	0110011	0	1	1	0	0	1	1	1	1	0	0	1	1	0	1100110	102
52	0110100	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0010110	22
53	0110101	0	1	1	0	1	0	1	1	0	1	0	1	1	0	1010110	86
54	0110110	0	1	1	0	1	1	0	0	1	1	0	1	1	0	0110110	54
55	0110111	0	1	1	0	1	1	1	1	1	1	0	1	1	0	1110110	118
56	0111000	0	1	1	1	0	0	0	0	0	0	1	1	1	0	0001110	14
57	0111001	0	1	1	1	0	0	1	1	0	0	1	1	1	0	1001110	78
58	0111010	0	1	1	1	0	1	0	0	1	0	1	1	1	0	0101110	46
59	0111011	0	1	1	1	0	1	1	1	1	0	1	1	1	0	1101110	110
60	0111100	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0011110	30
61	0111101	0	1	1	1	1	0	1	1	0	1	1	1	1	0	1011110	94
62	0111110	0	1	1	1	1	1	0	0	1	1	1	1	1	0	0111110	62
63	0111111	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1111110	126

Fig. 1-2: Code table for base spreading factor 128 (part1)

	HADAMARD								BITREVERSE								
64	1000000	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0000001	1
65	1000001	1	0	0	0	0	0	1	1	0	0	0	0	0	1	1000001	65
66	1000010	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0100001	33
67	1000011	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1100001	97
68	1000100	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0010001	17
69	1000101	1	0	0	0	1	0	1	1	0	1	0	0	0	1	1010001	81
70	1000110	1	0	0	0	1	1	0	0	1	1	0	0	0	1	0110001	49
71	1000111	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1110001	113
72	1001000	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0001001	9
73	1001001	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1001001	73
74	1001010	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0101001	41
75	1001011	1	0	0	1	0	1	1	1	1	0	1	0	0	1	1101001	105
76	1001100	1	0	0	1	1	0	0	0	0	1	1	0	0	1	0011001	25
77	1001101	1	0	0	1	1	0	1	1	0	1	1	0	0	1	1011001	89
78	1001110	1	0	0	1	1	1	0	0	1	1	1	0	0	1	0111001	57
79	1001111	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1111001	121
80	1010000	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0000101	5
81	1010001	1	0	1	0	0	0	1	1	0	0	0	1	0	1	1000101	69
82	1010010	1	0	1	0	0	1	0	0	1	0	0	1	0	1	0100101	37
83	1010011	1	0	1	0	0	1	1	1	1	0	0	1	0	1	1100101	101
84	1010100	1	0	1	0	1	0	0	0	0	1	0	1	0	1	0010101	21
85	1010101	1	0	1	0	1	0	1	1	0	1	0	1	0	1	1010101	85
86	1010110	1	0	1	0	1	1	0	0	1	1	0	1	0	1	0110101	53
87	1010111	1	0	1	0	1	1	1	1	1	1	0	1	0	1	1110101	117
88	1011000	1	0	1	1	0	0	0	0	0	0	1	1	0	1	0001101	13
89	1011001	1	0	1	1	0	0	1	1	0	0	1	1	0	1	1001101	77
90	1011010	1	0	1	1	0	1	0	0	1	0	1	1	0	1	0101101	45
91	1011011	1	0	1	1	0	1	1	1	1	0	1	1	0	1	1101101	109
92	1011100	1	0	1	1	1	0	0	0	0	1	1	1	0	1	0011101	29
93	1011101	1	0	1	1	1	0	1	1	0	1	1	1	0	1	1011101	93
94	1011110	1	0	1	1	1	1	0	0	1	1	1	1	0	1	0111101	61
95	1011111	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1111101	125
96	1100000	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0000011	3
97	1100001	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1000011	67
98	1100010	1	1	0	0	0	1	0	0	1	0	0	0	1	1	0100011	35
99	1100011	1	1	0	0	0	1	1	1	1	0	0	0	1	1	1100011	99
100	1100100	1	1	0	0	1	0	0	0	0	1	0	0	1	1	0010011	19
101	1100101	1	1	0	0	1	0	1	1	0	1	0	0	1	1	1010011	83
102	1100110	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0110011	51
103	1100111	1	1	0	0	1	1	1	1	1	1	0	0	1	1	1110011	115
104	1101000	1	1	0	1	0	0	0	0	0	0	1	0	1	1	0001011	11
105	1101001	1	1	0	1	0	0	1	1	0	0	1	0	1	1	1001011	75
106	1101010	1	1	0	1	0	1	0	0	1	0	1	0	1	1	0101011	43
107	1101011	1	1	0	1	0	1	1	1	1	0	1	0	1	1	1101011	107
108	1101100	1	1	0	1	1	0	0	0	0	1	1	0	1	1	0011011	27
109	1101101	1	1	0	1	1	0	1	1	0	1	1	0	1	1	1011011	91
110	1101110	1	1	0	1	1	1	0	0	1	1	1	0	1	1	0111011	59
111	1101111	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1111011	123
112	1110000	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0000111	7
113	1110001	1	1	1	0	0	0	1	1	0	0	0	1	1	1	1000111	71
114	1110010	1	1	1	0	0	1	0	0	1	0	0	1	1	1	0100111	39
115	1110011	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1100111	103
116	1110100	1	1	1	0	1	0	0	0	0	1	0	1	1	1	0010111	23
117	1110101	1	1	1	0	1	0	1	1	0	1	0	1	1	1	1010111	87
118	1110110	1	1	1	0	1	1	0	0	1	1	0	1	1	1	0110111	55
119	1110111	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1110111	119
120	1111000	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0001111	15
121	1111001	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1001111	79
122	1111010	1	1	1	1	0	1	0	0	1	0	1	1	1	1	0101111	47
123	1111011	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1101111	111
124	1111100	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0011111	31
125	1111101	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1011111	95
126	1111110	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0111111	63
127	1111111	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1111111	127

Fig. 1-3: Code table for base spreading factor 128 (part 2)

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 CDMA2000 standard. The used bandclass is defined in the SEM or ACLR measurement settings (see "Bandclass" on page 107).

Table 1-9: Supported bandclasses for CDMA2000 RF measurements

Bandclass	SCPI para	Description
0	0	800 MHz Cellular Band
1	1	1.9 GHz PCS Band
2	2	TACS Band

Bandclass	SCPI para	Description
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

A.4 I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

A.4.1 I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>FSV-K10</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
```

```
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute fileFormatVersion that contains the number of the file format definition. Currently, fileFormatVersion "2" is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is xs:dateTime (see RsIqTar.xsd).
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: ● A complex number represented as a pair of I and Q values ● A complex number represented as a pair of magnitude and phase values ● A real number represented as a single real value See also Format element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute unit must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see DataFilename element). Every sample must be in the same format. The format can be one of the following: ● complex: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless ● real: Real number (unitless) ● polar: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires DataType = float32 or float64
DataType	Specifies the binary format used for samples in the I/Q data binary file (see DataFilename element and chapter A.4.2, "I/Q Data Binary File", on page 268). The following data types are allowed: ● int8: 8 bit signed integer data ● int16: 16 bit signed integer data ● int32: 32 bit signed integer data ● float32: 32 bit floating point data (IEEE 754) ● float64: 64 bit floating point data (IEEE 754)
ScalingFactor	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the ScalingFactor. For polar data only the magnitude value has to be multiplied. For multi-channel signals the ScalingFactor must be applied to all channels. The attribute unit must be set to "V". The ScalingFactor must be > 0. If the ScalingFactor element is not defined, a value of 1 V is assumed.

Element	Description
NumberOfChan-nels	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see chapter A.4.2, "I/Q Data Binary File", on page 268). If the `NumberOfChannels` element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> ● <xyz> = a valid Windows file name ● <Format> = complex, polar or real (see `Format` element) ● <Channels> = Number of channels (see `NumberOfChannels` element) ● <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: ● xyz.complex.1ch.float32 ● xyz.polar.1ch.float64 ● xyz.real.1ch.int16 ● xyz.complex.16ch.int8
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFac-tor
Minimum (negative) int16 value	$- 2^{15}$ = - 32768	-1 V
Maximum (positive) int16 value	2^{15}-1= 32767	0.999969482421875 V

Example: PreviewData in XML

```
<PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
```

```
            </Min>
            <Max>
              <ArrayOfFloat length="256">
                <float>-70</float>
                <float>-71</float>
                ...
                <float>-69</float>
              </ArrayOfFloat>
            </Max>
          </PowerVsTime>
          <Spectrum>
            <Min>
              <ArrayOfFloat length="256">
                <float>-133</float>
                <float>-111</float>
                ...
                <float>-111</float>
              </ArrayOfFloat>
            </Min>
            <Max>
              <ArrayOfFloat length="256">
                <float>-67</float>
                <float>-69</float>
                ...
                <float>-70</float>
                <float>-69</float>
              </ArrayOfFloat>
            </Max>
          </Spectrum>
          <IQ>
            <Histogram width="64" height="64">0123456789...0</Histogram>
          </IQ>
        </Channel>
      </ArrayOfChannel>
    </PreviewData>
```

A.4.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                    // Real sample 0
I[1],                    // Real sample 1
```

```
I[2],                         // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                   // Real and imaginary part of complex sample 0
I[1], Q[1],                   // Real and imaginary part of complex sample 1
I[2], Q[2],                   // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],               // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],               // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],               // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],            // Channel 0, Complex sample 0
I[1][0], Q[1][0],            // Channel 1, Complex sample 0
I[2][0], Q[2][0],            // Channel 2, Complex sample 0

I[0][1], Q[0][1],            // Channel 0, Complex sample 1
I[1][1], Q[1][1],            // Channel 1, Complex sample 1
I[2][1], Q[2][1],            // Channel 2, Complex sample 1

I[0][2], Q[0][2],            // Channel 0, Complex sample 2
I[1][2], Q[1][2],            // Channel 1, Complex sample 2
I[2][2], Q[2][2],            // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

A.5 Abbreviations

For a comprehensive glossary refer to the cdma2000 standard.

APICH	auxiliary pilot channel
ATDPCH	auxiliary transmit diversity pilot channel
BCH	broadcast channel
CACH	common assignment channel
CCCH	common control channel (2.8)
CDEP	code domain error power
CDP	code domain power
Composite EVM	in accordance with the cdma2000 specifications, determines the square root of the squared error between the real and the imaginary parts of the test signal and an ideally generated reference signal (EVM referred to the total signal) in a composite EVM measurement.
CPCCH	common power control channel
Crest factor	ratio of peak to average value of the signal
EACH	Enhanced access channel 2.8
FCH	Fundamental channel 4.16
Inactive Channel Threshold	minimum power that a single channel must have compared with the total signal to be recognized as an active channel.
MC1	multi-carrier1 (one carrier system 1X).
MC2	multi-carrier3 (three carrier system 3X).
OTD	orthogonal transmit diversity, two antennas used
PCG	power control group: name in cdma2000 system for 1536 chips or 1.25 ms interval; transmitter power is constant during a power control group
PCH	paging channel
PDCH	packet data channel
PDCCH	packet data control channel
PICH	pilot channel 0.64 (MS: 0.32)
RC	radio configuration; definition of sampling rate, permissible data rates, modulation types and use of special channels, and transmit diversity
S1CH	Supplemental 1 channel 1.2 or 2.4 (in higher layers this channel is also referred to as supplemental channel 0 – SCH0).
S2CH	Supplemental 2 channel 2.4 or 6.8 (in higher layers this channel is also referred to as supplemental channel 1 – SCH1).
SCH0	Refer to S1CH
SCH1	Refer to S2CH

Set	a group of 64 consecutive PCGs
SF	spreading factor
SYNC	synchronisation channel 32.64
TD	transmit diversity, two antennas used
TDPICH	transmit diversity pilot channel 16.128
x.y	Walsh code x.y, with code number x and spreading factor y of the channel

List of Remote Commands (CDMA2000)

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