R&S®VSE-K72
3GPP FDD Measurements Application
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the R&S®VSE base software (1320.7500.02) version 1.13 and higher.

The following firmware options are described:

- R&S VSE-K72 (1320.7580.02)

The software contained in this product makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®VSE is abbreviated as R&S VSE. "R&S VSE-K72" is abbreviated as R&S VSE-K72.

Contents

1 Preface

1.1 About this Manual

This R&S VSE 3GPP FDD User Manual provides all the information **specific to the application**. All general software functions and settings common to all applications and operating modes are described in the R&S VSE Base Software User Manual.

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

- **Welcome to the R&S VSE 3GPP FDD 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
- **How to Perform Measurements in the R&S VSE 3GPP FDD Measurements application**
  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
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the measurement configuration
- **Remote Commands for 3GPP FDD Measurements**
  Remote commands required to configure and perform 3GPP FDD measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks in the software are provided in the R&S VSE Base Software User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphahabetical list of all remote commands described in the manual
- **Index**

1.2 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.

2 Welcome to the 3GPP FDD Applications

The R&S VSE 3GPP FDD Measurements application applications add functionality to the R&S VSE to perform code domain analysis or power measurements according to the 3GPP standard (FDD mode). The application firmware is in line with the 3GPP standard (Third Generation Partnership Project) with Release 5. Signals that meet the conditions for channel configuration of test models 1 to 4 according to the 3GPP standard, e.g. W-CDMA signals using FDD, can be measured with the 3GPP FDD BTS application.

R&S VSE-K72 performs **B**ase **T**ransceiver **S**tation (**BTS**) measurements (for downlink signals), as well as **U**ser **E**quipment (UE) measurements (for uplink signals).

In particular, the R&S VSE 3GPP FDD Measurements application features:

- Code domain analysis, providing results like code domain power, EVM, peak code domain error etc.
- Time alignment error determination

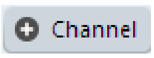
This user manual contains a description of the functionality that the application provides, including remote control operation.

Functions that are not discussed in this manual are the same as in the I/Q Analyzer application and are described in the R&S VSE Base Software User Manual. The latest version is available for download at the product homepage (http://www2.rohde-schwarz.com/product/VSE.html).

2.1 Starting the 3GPP FDD Application

The 3GPP FDD measurements require a special application on the R&S VSE. It is activated by creating a new measurement channel in 3GPP FDD mode.

To activate the 3GPP FDD application

1. 

   Select the "Add Channel" function in the Sequence tool window.

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

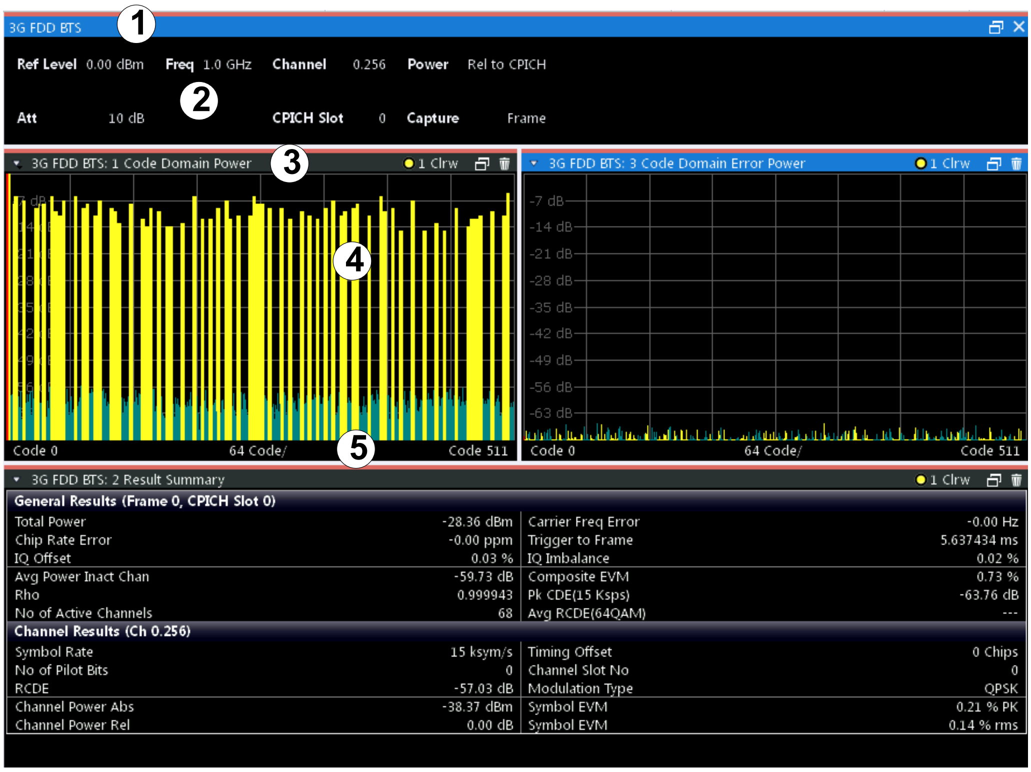
2. Select the 3GPP FDD BTS or 3GPP FDD UE item.

The R&S VSE opens a new measurement channel for the 3GPP FDD application.

2.2 Understanding the Display Information

The following figure shows a measurement diagram during a 3GPP FDD BTS measurement. All different information areas are labeled. They are explained in more detail in the following sections.

(The basic screen elements are identical for 3GPP FDD UE measurements)



1 = Color coding for windows of same channel
2 = Channel bar with measurement settings
3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information, depending on result display

Channel bar information

In 3GPP FDD applications, when performing Code Domain Analysis, the R&S VSE screen display shows the following settings:

Table 2-1: Hardware settings displayed in the channel bar in 3GPP FDD applications for Code Domain Analysis

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Center frequency for the RF signal
Channel	Channel number (code number and spreading factor)
CPICH Slot / **Slot** (UE)	Slot of the (CPICH) channel
Power	Power result mode: ● Absolute ● Relative to CPICH (BTS application only) ● Relative to total power
SymbRate	Symbol rate of the current channel
Capture	**(UE application only):** basis for analysis (slot or frame)

Window title bar information

For each diagram, the header provides the following information:

Fig. 2-1: Window title bar information in 3GPP applications

0 = Color coding for windows of same channel
1 = Edit result display function
2 = Channel name
3 = Window number
4 = Window type
5 = Trace color, trace number, trace mode
6 = Dock/undock window function
7 = Close window function

Diagram area

The diagram area displays the results according to the selected result displays (see chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14).

Diagram footer information

For most graphical evaluations the diagram footer (beneath the diagram) contains scaling information for the x-axis, where applicable:

- Start channel/chip/frame/slot
- Channel/chip/frame/slot per division
- Stop channel/chip/frame/slot

For the **Bitstream** evaluation, the diagram footer indicates:

- Channel format (type and modulation type (HS-PDSCH only))
- Number of data bits
- Number of TPC bits
- Number of TFCI bits
- Number of pilot bits

(The bit numbers are indicated in the order they occur.)

Status bar information

The software status, errors and warnings and any irregularities in the software are indicated in the status bar at the bottom of the R&S VSE window.

3 Measurements and Result Display

The 3GPP FDD applications provide several different measurements for signals according to the 3GPP FDD standard. The main and default measurement is Code Domain Analysis. Furthermore, a Time Alignment Error measurement is provided.

Result display windows

For each measurement, a separate measurement channel is activated. Each measurement channel can provide multiple result displays, which are displayed in individual windows. The measurement windows can be rearranged and configured in the R&S VSE to meet your requirements. All windows that belong to the same measurement (including the channel bar) are indicated by a colored line at the top of the window title bar.

► To add further result displays for the 3GPP FDD channel, select the "Add Window" icon from the toolbar, or select the "Window > New Window" menu item.

For details on working with channels and windows see the "Operating Basics" chapter in the R&S VSE Base Software User Manual.

Evaluation range

You can restrict evaluation to a specific channel, frame or slot, depending on the evaluation method. See chapter 6.1, "Evaluation Range", on page 85.

3.1 Code Domain Analysis

The Code Domain Analysis measurement provides various evaluation methods and result diagrams.

The code domain power measurements are performed as specified by the 3GPP standards. A signal section of approximately 20 ms is recorded for analysis and then searched through to find the start of a 3GPP FDD frame. If a frame start is found in the signal, the code domain power analysis is performed for a complete frame starting from slot 0. The different evaluations are calculated from the captured I/Q data set. Therefore it is not necessary to start a new measurement in order to change the evaluation.

The 3GPP FDD applications provide the peak code domain error measurement and composite EVM specified by the 3GPP standard, as well as the code domain power measurement of assigned and unassigned codes. The power can be displayed either for all channels in one slot, or for one channel in all slots. The composite constellation diagram of the entire signal can also be displayed. In addition, the symbols demodulated in a slot, their power, and the determined bits or the symbol EVM can be displayed for an active channel.

The power of a code channel is always measured in relation to its symbol rate within the code domain. It can be displayed either as absolute values or relative to the total signal or the CPICH channel. By default, the power relative to the CPICH channel is displayed. The total power may vary depending on the slot, since the power can be controlled on a per-slot-basis. The power in the CPICH channel, on the other hand, is constant in all slots.

For all measurements performed in a slot of a selected channel (bits, symbols, symbol power, EVM), the actual slot spacing of the channel is taken as a basis, rather than the CPICH slots. The time reference for the start of a slot is the CPICH slot. If code channels contain a timing offset, the start of a specific slot of the channel differs from the start of the reference channel (CPICH). Thus, the power-per-channel display may not be correct. If channels with a timing offset contain a power control circuit, the channel-power-versus-time display may provide better results.

The composite EVM, peak code domain error and composite constellation measurements are always referenced to the total signal.

Remote command:

`CONF:WCDP:MEAS WCDP`, see `CONFigure:WCDPower[:BTS]:MEASurement` on page 118

3.1.1 Code Domain Parameters

Two different types of measurement results are determined and displayed in the Result Summary: global results and channel results (for the selected channel).

The number of the CPICH slot at which the measurement is performed is indicated globally for the measurement in the channel bar.

The spreading code of the selected channel is indicated with the channel number in the channel bar and above the channel-specific results in the Result Summary.

In the Channel Table, the analysis results for all active channels are displayed.

Table 3-1: General code domain power results for a specific frame and slot

Parameter	Description
Total Power:	The total signal power (average power of total evaluated slot).
Carrier Freq Error:	The frequency error relative to the center frequency of the analyzer. The absolute frequency error is the sum of the analyzer and DUT frequency error. The specified value is averaged for one (CPICH) slot. See also the note on "Carrier Frequency Error" on page 13.
Chip Rate Error:	The chip rate error in the frame to analyze in ppm. As a result of a high chip rate error, symbol errors arise and the CDP measurement is possibly not synchronized to the 3GPP FDD BTS signal. The result is valid even if synchronization of the analyzer and signal failed.

Parameter	Description
Trigger to Frame:	The time difference between the beginning of the recorded signal section to the start of the analyzed frame. In case of triggered data collection, this difference is identical with the time difference of frame trigger (+ trigger offset) – frame start. If synchronization of the analyzer and input signal fails, the value of "Trigger to Frame" is not significant.
IQ Offset:	DC offset of the signal in the selected slot in %
IQ Imbalance:	I/Q imbalance of signals in the selected slot in %
Avg Power Inact Chan	Average power of the inactive channels
Composite EVM:	The composite EVM is the difference between the test signal and the ideal reference signal in the selected slot in %. See also "Composite EVM" on page 19
Pk CDE (15 ksps):	The Peak Code Domain Error projects the difference between the test signal and the ideal reference signal onto the selected spreading factor in the selected slot (see "Peak Code Domain Error" on page 23). The spreading factor onto which projection is performed can be derived from the symbol rate indicated in brackets.
RHO	Quality parameter RHO for each slot.
No of Active Chan:	The number of active channels detected in the signal in the selected slot. Both the detected data channels and the control channels are considered active channels.
Avg. RCDE	Average Relative Code Domain Error over all channels detected with 64 QAM (UE: 4PAM) modulation in the selected frame.

Carrier Frequency Error

The maximum frequency error that can be compensated is specified in table 3-2 as a function of the synchronization mode. Transmitter and receiver should be synchronized as far as possible.

Table 3-2: Maximum frequency error that can be compensated

SYNC mode	ANTENNA DIV	Max. Freq. Offset
CPICH	X	5.0 kHz
SCH	OFF	1.6 kHz
SCH	ANT 1	330 Hz
SCH	ANT 2	330 Hz

Table 3-3: Channel-specific code domain power results

Symbol Rate:	Symbol rate at which the channel is transmitted
Channel Slot No:	**(BTS measurements only):** Channel slot number; determined by combining the value of the selected CPICH and the channel's timing offset
Channel Mapping	**(UE measurements only):** Branch onto which the channel is mapped (I or Q, specified by the standard)
Chan Power Abs:	Channel power, absolute

Chan Power Rel:	Channel power, relative (referenced to CPICH or total signal power)
Timing Offset:	Offset between the start of the first slot in the channel and the start of the analyzed 3GPP FDD BTS frame
RCDE	Relative Code Domain Error for the complete frame of the selected channel
Symbol EVM:	Peak and average of the results of the error vector magnitude evaluation
No of Pilot Bits:	Number of pilot bits of the selected channel
Modulation Type:	BTS measurements: Modulation type of an HSDPA channel. High speed physical data channels can be modulated with QPSK, 16 QAM or 64 QAM modulation. UE measurements: the modulation type of the selected channel. Valid entries are: ● BPSK I for channels on I-branch ● BPSK Q for channels on Q-branch ● NONE for inactive channels

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.

The selected evaluation also affects the results of the trace data query (see chapter 10.8.2, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 181).

Bitstream

The Bitstream evaluation displays the demodulated bits of a selected channel for a given slot. Depending on the symbol rate the number of symbols within a slot can vary from 12 (min) to 384 (max). For QPSK modulation a symbol consists of 2 bits (I and Q). For BPSK modulation a symbol consists of 1 bit (only I used).

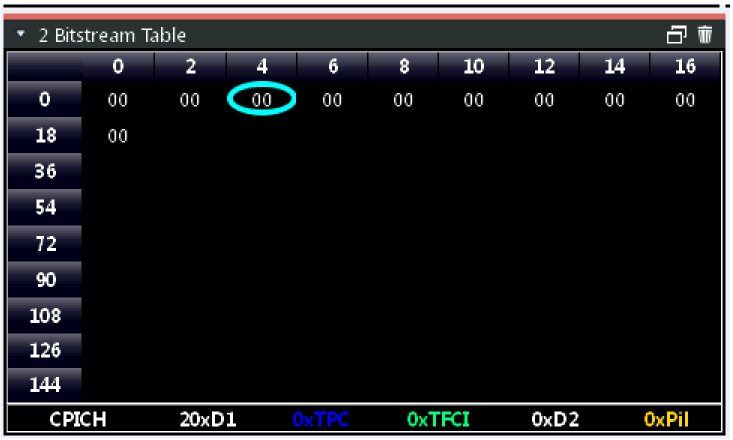


Fig. 3-1: Bitstream display for 3GPP FDD BTS measurements

TIP: Select a specific symbol using a marker for the display. Enter the symbol number as the x-value. The marker is moved to the selected symbol, which is highlighted by a blue circle.

The diagram footer indicates:

- Channel format (type and modulation type (HS-PDSCH only))
- Number of data bits (D1 / D2)
- Number of TPC bits (TPC)
- Number of TFCI bits (TFCI)
- Number of pilot bits (Pil)

Remote command:

`LAY:ADD? '1',RIGH, BITS`, see `LAYout:ADD[:WINDow]?` on page 171

TRACe<n>[:DATA]? ABITstream

Channel Table

The Channel Table evaluation displays the detected channels and the results of the code domain power measurement. The channel table can contain a maximum of 512 entries.

In BTS measurements, this corresponds to the 512 codes that can be assigned within the class of spreading factor 512.

In UE measurements, this corresponds to the 256 codes that can be assigned within the class of spreading factor 256, with both I and Q branches.

The first entries of the table indicate the channels that must be available in the signal to be analyzed and any other control channels (see chapter 4.2, "BTS Channel Types", on page 35 and chapter 4.3, "UE Channel Types", on page 39).

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 BTS measurements, 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 unassigned codes are always displayed at the end of the table.

Chan Type	Ch.SF	PwrAbs [dBm]	PwrRel [dB]	State	Mod Type	SymRate [ksps]	Toffs [Chips]	TFCI	PilotL [Bits]
CPICH	0.256	-38.37	0.00	ON	QPSK	15	0.00	OFF	0
PSCH		-41.36	-2.99	ON	NONE	0	0.00	OFF	0
SSCH		-41.35	-2.98	ON	NONE	0	0.00	OFF	0
PCCPCH	1.256	-38.37	0.00	ON	QPSK	15	0.00	OFF	0
SCCPCH	3.256	-46.37	-8.00	ON	QPSK	15	0.00	OFF	0
PICH	16.256	-46.38	-8.00	ON	QPSK	15	30720.0	OFF	0
DPCH	2.128	-44.37	-5.99	ON	QPSK	30	22016.0	OFF	8
DPCH	4.128	-45.37	-7.00	ON	QPSK	30	23296.0	OFF	8
DPCH	7.128	-47.36	-8.99	ON	QPSK	30	21248.0	OFF	8
DPCH	9.128	-46.38	-8.00	ON	QPSK	30	1792.00	OFF	8
DPCH	11.128	-44.37	-5.99	ON	QPSK	30	34304.0	OFF	8
DPCH	12.128	-48.38	-10.01	ON	QPSK	30	8192.00	OFF	8
DPCH	13.128	-49.39	-11.01	ON	QPSK	30	6400.00	OFF	8

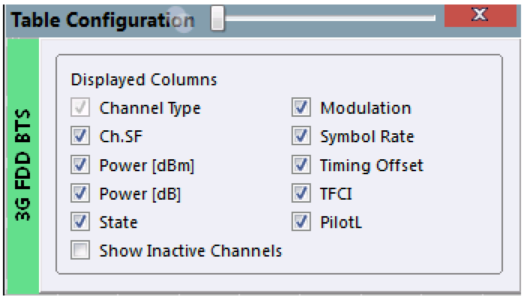
Fig. 3-2: Channel Table display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, CTABle`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? CTABle
TRACe<n>[:DATA]? PWCDp
TRACe<n>[:DATA]? CWCDp

Table Configuration ← Channel Table

You can configure which parameters are displayed in the Channel Table by clicking (**not double-clicking**!) a column header.

A "Table Configuration" dialog box is displayed in which you can 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 evaluation. (For details see chapter 3.1.1, "Code Domain Parameters", on page 12.)

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

Label	Description
Chan Type	Type of channel (active channels only)
Ch. SF	Number of channel spreading code (0 to [spreading factor-1])
Symbol Rate [ksps]	Symbol rate at which the channel is transmitted In BTS measurements: always
State	Active: channel is active and all pilot symbols are correct Inactive: channel is not active Pilotf: channel is active, but pilot symbols incomplete or missing
TFCI	**(BTS measurements only):** Data channel uses TFCI symbols
Mapping	**(UE measurements only):** Branch the channel is mapped to (I or Q)
PilotL [Bits]	Number of pilot bits in the channel (UE measurements: only for control channel DPCCH)
Pwr Abs [dBm]/Pwr Rel [dBm]	Absolute and relative channel power (referred to the CPICH or the total power of the signal)
T Offs [Chips]	**(BTS measurements only):** Timing offset

Code Domain Power

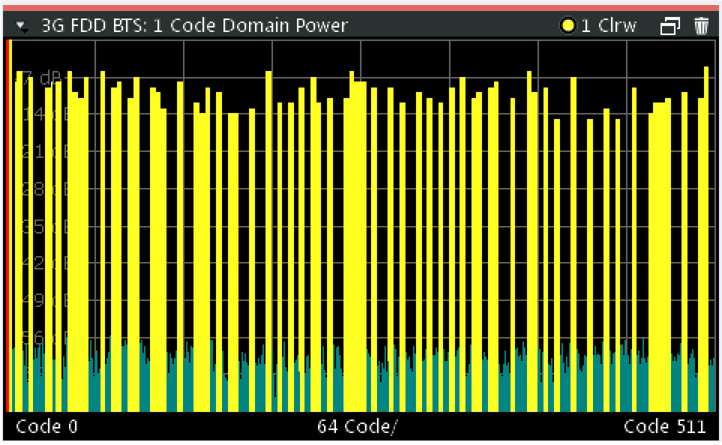


Fig. 3-3: Code Domain Power Display for 3GPP FDD BTS measurements

The Code Domain Power evaluation shows the power of all possible code channels in the selected channel slot. The x-axis shows the possible code channels from 0 to the highest spreading factor. Due to the circumstance that the power is regulated from slot to slot, the result power may differ between different slots. Detected channels are displayed yellow. The selected code channel is highlighted red. The codes where no channel could be detected are displayed green.

Note: Effects of missing or incomplete pilot symbols. In "Autosearch" channel detection mode, the application expects specific pilot symbols for DPCH channels. If these

symbols are missing or incomplete, the channel power in the Code Domain Power evaluation is displayed green at the points of the diagram the channel should appear due to its spreading code, and a message ("INCORRECT PILOT") is displayed in the status bar. In this case, check the pilot symbols for those channels using the Power vs Slot or the Bitstream evaluations.
Optionally, all QPSK-modulated channels can also be recognized without pilot symbols (see "HSDPA/UPA" on page 49).

Remote command:
`LAY:ADD? '1',RIGH, CDPower`, see `LAYout:ADD[:WINDow]?` on page 171
`CALC:MARK:FUNC:WCDP:RES? CDP`, see `CALCulate<n>:MARKer<m>:FUNCtion:WCDPower[:BTS]:RESult?` on page 177
`CALC:MARK:FUNC:WCDP:MS:RES? CDP`, see `CALCulate<n>:MARKer<m>:FUNCtion:WCDPower:MS:RESult?` on page 179
TRACe<n>[:DATA]? CTABle
TRACe<n>[:DATA]? PWCDp
TRACe<n>[:DATA]? CWCDp

Code Domain Error Power
Code Domain Error Power is the difference in power between the measured and the ideal signal. The unit is dB. There are no other units for the y-axis.

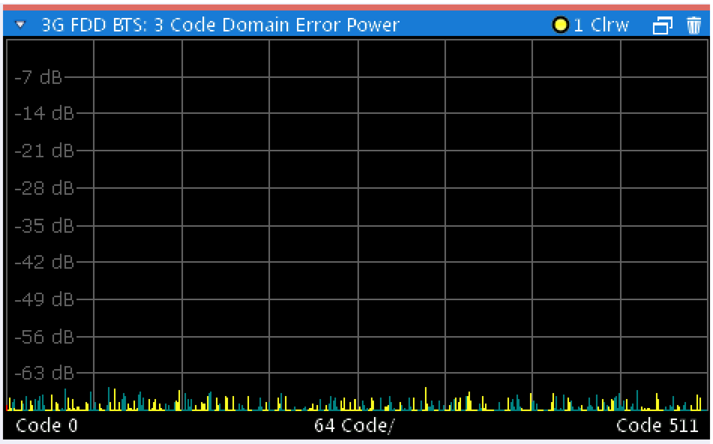


Fig. 3-4: Code Domain Error Power Display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, CDEPower`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Composite Constellation
The Composite Constellation evaluation analyzes the entire signal for one single slot. If a large number of channels is to be analyzed, the results are superimposed. In that case the benefit of this evaluation is limited (senseless).

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

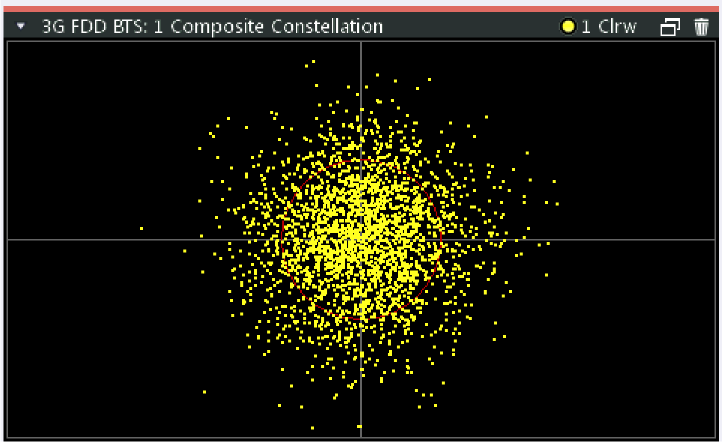


Fig. 3-5: Composite Constellation display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, CCONst`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Composite EVM

The Composite EVM evaluation displays the root mean square composite EVM (modulation accuracy) according to the 3GPP specification. The square root is determined of the mean squared errors between the real and imaginary components of the received signal and an ideal reference signal (EVM referenced to the total signal). The error is averaged over all channels for individual slots. The Composite EVM evaluation covers the entire signal during the entire observation time.

$$EVM_{RMS} = \sqrt{\frac{\sum_{n=0}^{N} |s_n - x_n|^2}{\sum_{n=0}^{N-1} |x_n|^2}} * 100\% \quad | \quad N = 2560$$

where:

EVM_{RMS}	root mean square of the vector error of the composite signal
s_n	complex chip value of received signal
x_n	complex chip value of reference signal
n	index number for mean power calculation of received and reference signal.
N	number of chips at each CPICH slot

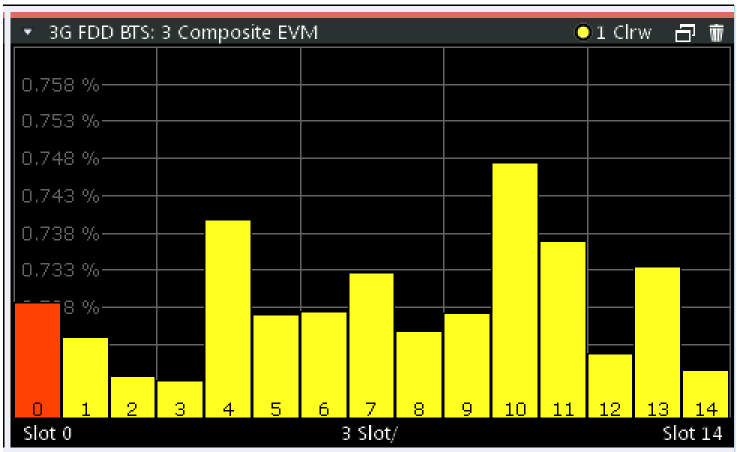


Fig. 3-6: Composite EVM display for 3GPP FDD BTS measurements

The measurement result consists of one composite EVM measurement value per slot. In this case, the measurement interval is the slot spacing of the CPICH (timing offset of 0 chips referenced to the beginning of the frame). Only the channels recognized as active are used to generate the ideal reference signal. If an assigned channel is not recognized as active since pilot symbols are missing or incomplete, the difference between the measurement and reference signal and the composite EVM is very high.

Remote command:
`LAY:ADD? '1',RIGH, CEVM`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

EVM vs Chip
EVM vs Chip activates the Error Vector Magnitude (EVM) versus chip display. The EVM is displayed for all chips of the selected slot.

Note: In UE measurements, if the measurement interval "Halfslot" is selected for evaluation, 30 slots are displayed instead of the usual 15 (see "Measurement Interval" on page 89).

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

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

where:

EVM_k	vector error of the chip EVM 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

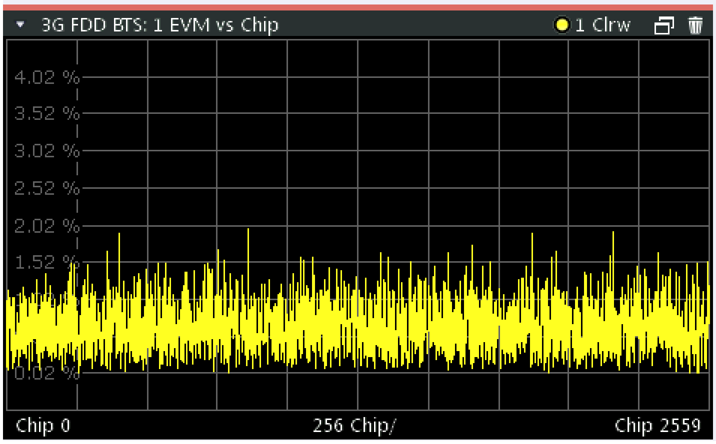


Fig. 3-7: EVM vs Chip display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, EVMChip`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Frequency Error vs Slot
For each value to be displayed, the difference between the frequency error of the corresponding slot to the frequency error of the first (zero) slot is calculated (based on CPICH slots). This helps eliminate a static frequency offset of the whole signal to achieve a better display of the actual time-dependant frequency diagram.

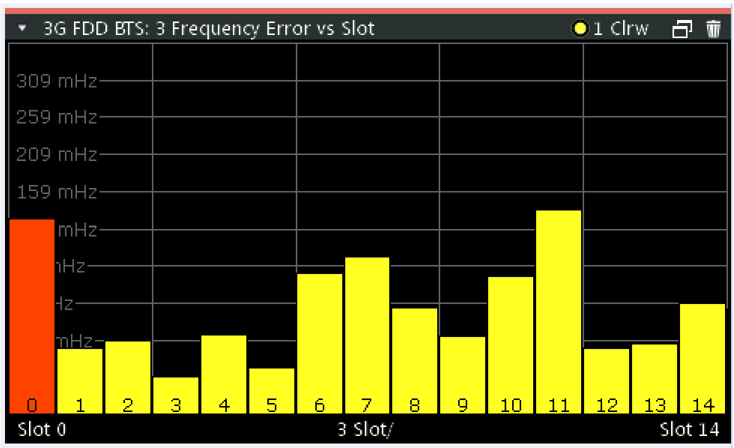


Fig. 3-8: Frequency Error vs Slot display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, FESLot`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? ATRACE

Mag Error vs Chip

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

Note: In UE measurements, if the measurement interval "Halfslot" is selected for evaluation, 30 slots are displayed instead of the usual 15 (see "Measurement Interval" on page 89).

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

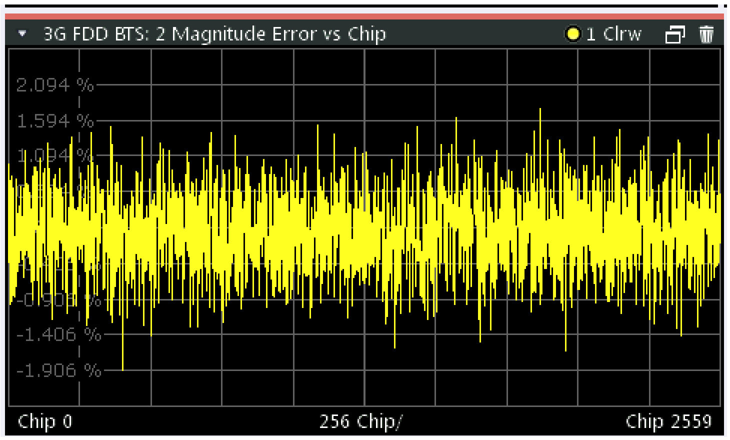


Fig. 3-9: Magnitude Error vs Chip display for 3GPP FDD BTS measurements

Remote command:

`LAY:ADD? '1',RIGH, MECHip`, see `LAYout:ADD[:WINDow]?` on page 171

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

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 94).

3 Marker Table

Wnd	Type	Ref	X-Value	Y-Value
1	M1		0.256	0.00 dB
1	D2	M1	415.512	-1.94 dB
1	D3	M1	489.512	-1.95 dB
1	D4	M1	266.512	-2.00 dB

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 171
Results:
`CALCulate<n>:MARKer<m>:X` on page 197
`CALCulate<n>:MARKer<m>:Y?` on page 197

Peak Code Domain Error
In line with the 3GPP specifications, the error between the measurement signal and the ideal reference signal for a given slot and for all codes is projected onto the various spreading factors. The result consists of the peak code domain error value per slot. The measurement interval is the slot spacing of the CPICH (timing offset of 0 chips referenced to the beginning of the frame). Only the channels recognized as active are used to generate the ideal reference signal for the peak code domain error. If an assigned channel is not recognized as active since pilot symbols are missing or incomplete, the difference between the measurement and reference signal is very high. This display is a bar diagram over slots. The unit is dB. The Peak Code Domain Error evaluation covers the entire signal and the entire observation time.

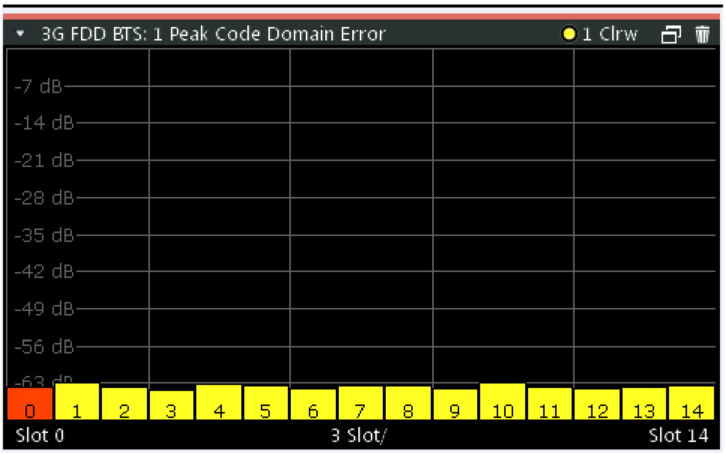


Fig. 3-10: Peak Code Domain Error display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, PCDerror`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Phase Discontinuity vs Slot
The Phase Discontinuity vs Slot is calculated according to 3GPP specifications. The phase calculated for each slot is interpolated to both ends of the slot using the frequency shift of that slot. The difference between the phase interpolated for the beginning of one slot and the end of the preceding slot is displayed as the phase discontinuity of that slot.

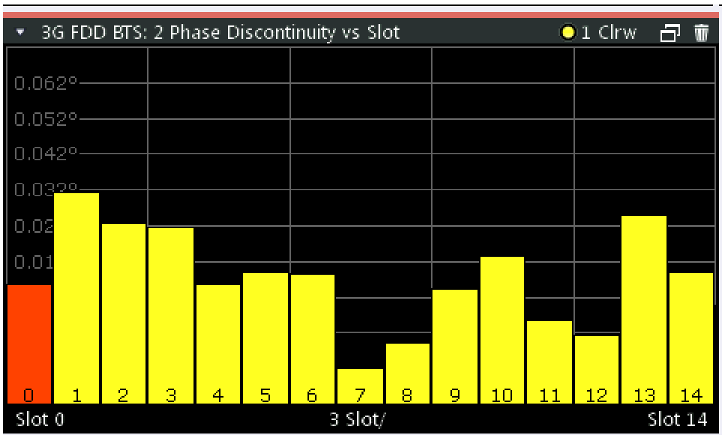


Fig. 3-11: Phase Discontinuity vs Slot display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, PDSLot`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

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.

Note: In UE measurements, if the measurement interval "Halfslot" is selected for evaluation, 30 slots are displayed instead of the usual 15 (see "Measurement Interval" on page 89).

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°.

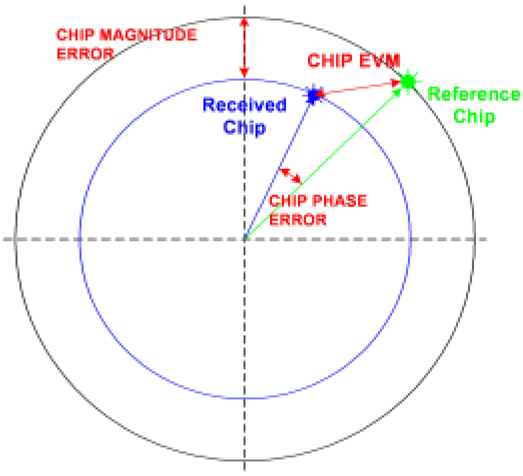
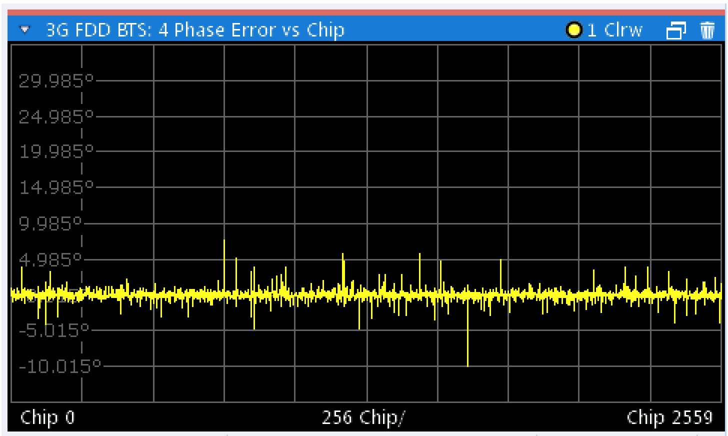


Fig. 3-12: Calculating the magnitude, phase and vector error per chip

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

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 171
TRACe<n>[:DATA]? TRACE<1...4>

Power vs Slot

The Power vs Slot evaluation displays the power of the selected channel for each slot. The power is displayed either absolute or relative to the total power of the signal or to the CPICH channel.

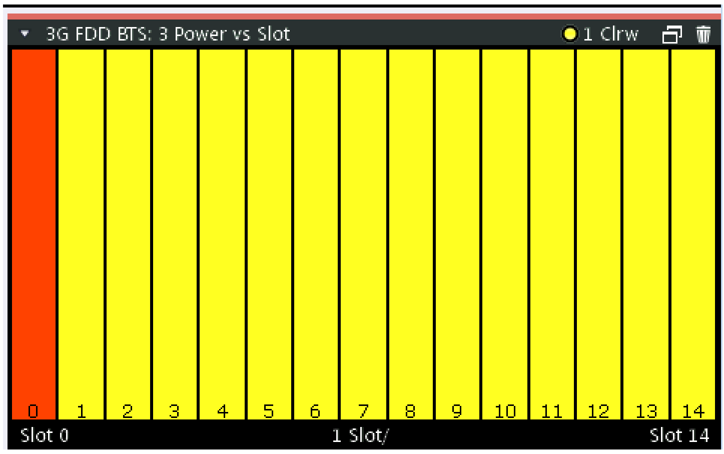


Fig. 3-13: Power vs Slot Display for 3GPP FDD BTS measurements

If a timing offset of the selected channel in relation to the CPICH channel occurrs, the power is calculated and displayed per channel slot (as opposed to the Code Domain Power evaluation). However, for reference purposes, the grid in the Power vs Slot diagram indicates the CPICH slots. The first CPICH slot is always slot 0, the grid and labels of the grid lines do not change. Thus, the channel slots may be shifted in the diagram grid. The channel slot numbers are indicated within the power bars. The selected slot is highlighted in the diagram.

Remote command:

`LAY:ADD? '1',RIGH, PSLot`, see `LAYout:ADD[:WINDow]?` on page 171

TRACe<n>[:DATA]? TPVSlot

Power vs Symbol

The Power vs. Symbol evaluation shows the power over the symbol number for the selected channel and the selected slot. The power is not averaged here. The trace is drawn using a histogram line algorithm, i.e. only vertical and horizontal lines, no diagonal, linear Interpolation (polygon interpolation). Surfaces are NOT filled.

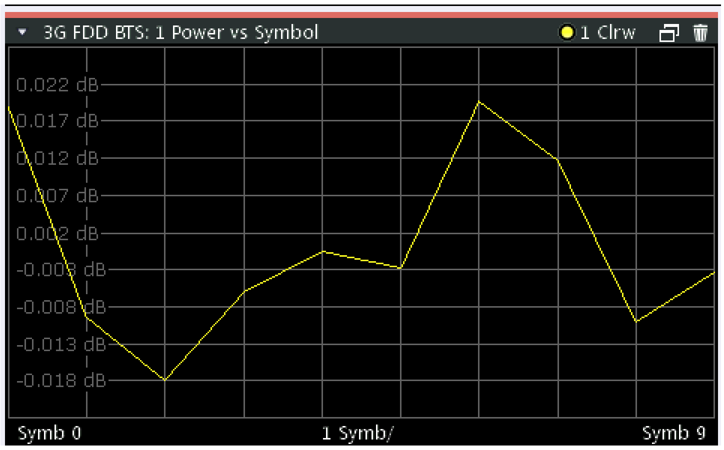


Fig. 3-14: Power vs Symbol display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, PSYMbol`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Result Summary

The Result Summary evaluation displays a list of measurement results on the screen. For details see chapter 3.1.1, "Code Domain Parameters", on page 12.

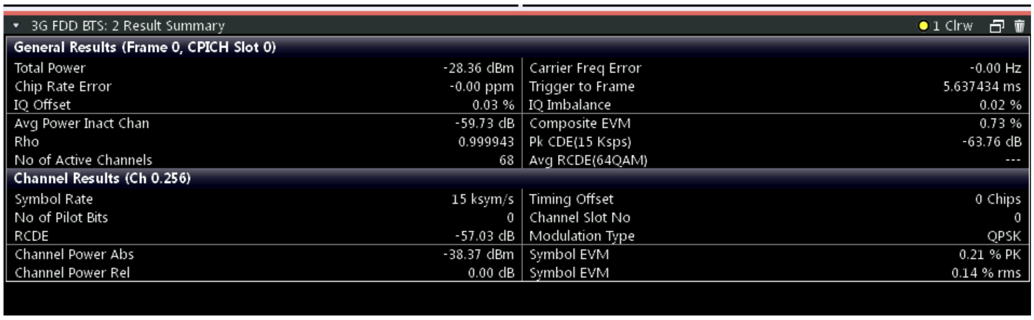


Fig. 3-15: Result Summary display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, RSUMmary`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>
`CALCulate<n>:MARKer<m>:FUNCtion:WCDPower[:BTS]:RESult?` on page 177

Symbol Constellation

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

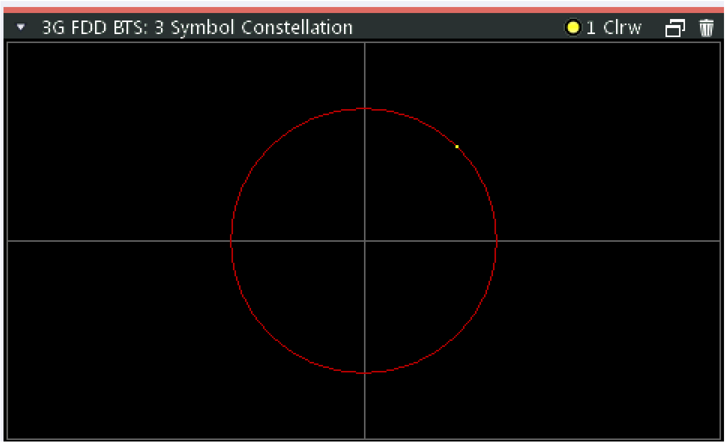


Fig. 3-16: Symbol Constellation display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SCONst`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

Symbol EVM

The Symbol EVM evaluation shows the error between the measured signal and the ideal reference signal in percent for the selected channel and the selected slot. A trace over all symbols of a slot is drawn. The number of symbols is in the range from 12 (min) to 384 (max). It depends on the symbol rate of the channel.

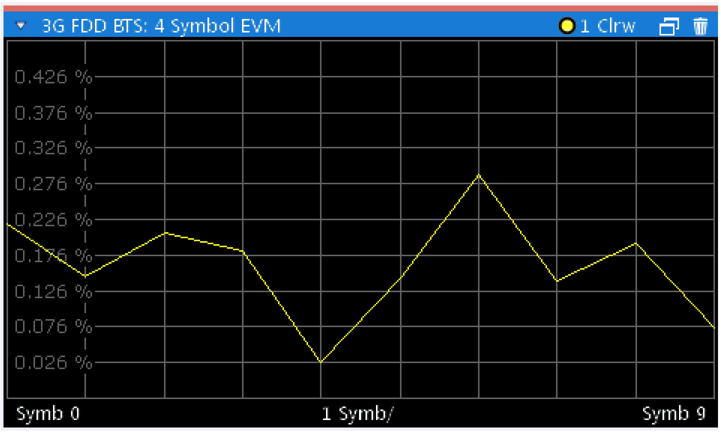


Fig. 3-17: Symbol EVM display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SEVM`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

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.

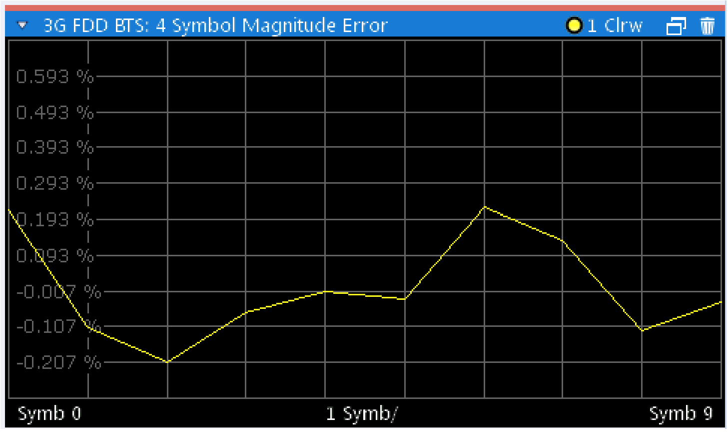


Fig. 3-18: Symbol Magnitude Error display for 3GPP FDD BTS measurements

Remote command:

`LAY:ADD? '1',RIGH, SMERror`, see `LAYout:ADD[:WINDow]?` on page 171

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.

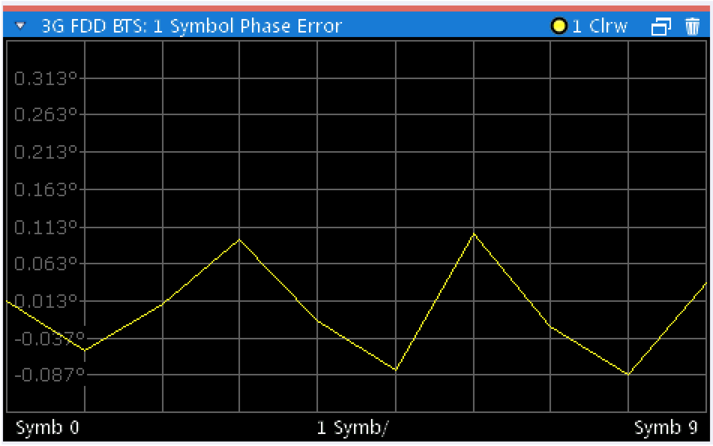


Fig. 3-19: Symbol Phase Error display for 3GPP FDD BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SPERror`, see `LAYout:ADD[:WINDow]?` on page 171
TRACe<n>[:DATA]? TRACE<1...4>

3.2 Time Alignment Error Measurements

Time Alignment Error Measurements are a special type of Code Domain Analysis used to determine the time offset between the signals of both antennas of a base station.

They are only available in 3GPP FDD BTS measurements.

The result is displayed numerically on the screen, a graphical result is not available.

Synchronization errors

A synchronization check is performed for both antennas which must have the result "Sync OK" to ensure a proper TAE result. Synchronization problems are indicated by the messages "No antenna 1 sync", "No antenna 2 sync" and "No sync".

For more information see chapter 4.8, "Time Alignment Error Measurements", on page 44.

Evaluation Methods

For Time Alignment Error measurements, the following evaluation methods are available:

Result List

Indicates the time delay (in chips) of the signal at antenna 2 relative to the signal at antenna 1.

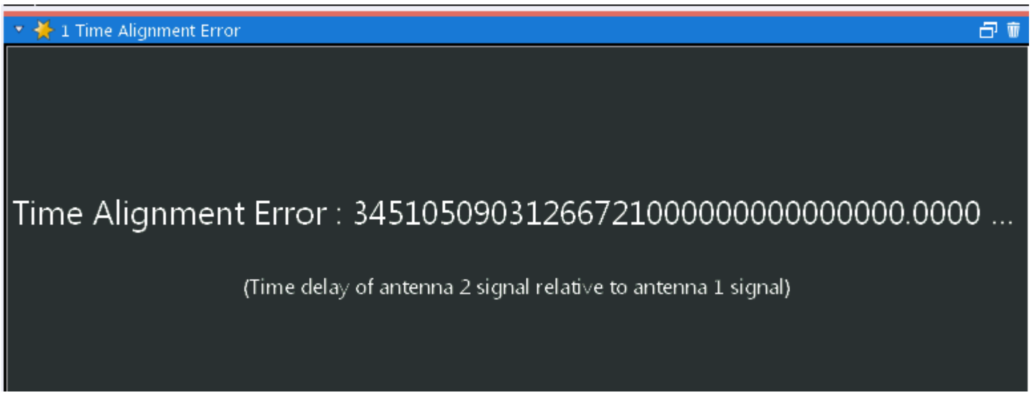


Fig. 3-20: Time Alignment Error display for 1 base station

Remote command:
`CONF:WCDP:MEAS TAER`, see `CONFigure:WCDPower[:BTS]:MEASurement` on page 118
`CALCulate<n>:MARKer<m>:FUNCtion:TAERror:RESult?` on page 177

4 Measurement Basics

Some background knowledge on basic terms and principles used in 3GPP FDD tests and measurements is provided here for a better understanding of the required configuration settings.

Basic principle

The basic principle of 3GPP FDD (frequency division duplex) is that the communication between a base station and several mobile stations is performed in the same frequency band and in the same time slots. The seperation of the data for the different mobile stations is achieved by using CDMA (Code Division Multiple Access). In this technique, channels are distinguished by using different orthogonal codes.

Scrambling codes

Each base station uses a unique scrambling code. The mobile station can only demodulate the base station signal if it knows which scrambling code was used by the base station.

Thus, in order to demodulate the data in the 3GPP FDD applications, you must either specify the scrambling code explicitely, or the application can perform an automatic search to detect the scrambling code itself.

Channels, codes and symbol rate

In signals according to the 3GPP FDD standard, the data is transmitted in channels. These channels are based on orthogonal codes and can have different data rates. The data 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.

The smallest available spreading factor is 4, the largest is 512. So we can say that the code domain consists of 512 basic codes. 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 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 code class, spreading factor, codes per channel and symbol rate for 3GPP FDD signals

Code class	Spreading factor	No. codes / channel	Symbol rate
2	4	128	960 ksps
3	8	64	480 ksps
4	16	32	240 ksps
5	32	16	120 ksps
6	64	8	60 ksps
7	128	4	30 ksps
8	256	2	15 ksps
9	512	1	7.5 ksps

In the measurement settings and results, the spreading factor is often represented by the corresponding symbol rate (in kilo symbols per second, ksps). The power of a channel is always measured in relation to its symbol rate (or spreading factor).

In the 3GPP FDD applications, the channel number consists of the used spreading factor and the channel's sequential number in the code domain, assuming the code domain is divided into equal divisions:

<sequence number>.<spreading factor>

Example:

For a channel number of 5.32, for example, imagine a code domain of 512 codes with a scale of 16 codes per division. Each division represents a possible channel with spreading factor 32. Since channel numbering starts at 0, channel number 5 is the sixth division on the scale.

Selected codes and channels

In the result displays that refer to channels, the currently selected channel is highlighted in the diagram. You select a channel by entering a channel number and spreading factor in the "Evaluation Range" settings. In the example above, if you select the channel number 5.32, the sixth division on the scale with 16 codes per division is highlighted.

For the display in the 3GPP FDD applications, the scale for code-based diagrams contains 512 divisions, one for each code. The selected channel in the example (5.32) would thus correspond to codes 80-96. (The division starts at 5*16=80 and is 16 codes wide.)

If no spreading factor is given for the channel number, the default factor 512 is assumed. Channel number 5 would thus refer to the sixth division on the scale, which is the sixth code in the code domain. If the code belongs to a detected channel, the entire channel is highlighted.

If the selected channel is not active, only the first code belonging to the corresponding division is highlighted. In the example, for the inactive channel number 5.32, the first code in the sixth division on the scale with 16 codes per division is highlighted. That corresponds to code number 80 with the scale based on 512 divisions.

Special channels - PCCPCH, SCH, CPICH, DPCH

In order to control the data transmission between the sender and the receiver, specific symbol must be included in the transmitted data, for example the scrambling code of the sender or the used spreading factor, as well as synchronization data for different channels. This data is included in special data channels defined by the 3GPP standard which use fixed codes in the code domain. Thus, they can be detected easily by the receiver.

The **P**rimary **C**ommon **C**ontrol **P**hysical **Ch**annel (PCCPCH) must always be contained in the signal. As the name implies, it is responsible for common control of the channels during transmission.

The **S**ynchronization **Ch**annel (SCH) is a time reference and responsible for synchronizing the individual channels.

Another important channel is the **C**ommon **Pi**lot **Ch**annel (CPICH), which continuously transmits the sender's scrambling code. This channel is used to identify the sender, but also as a reference in 3GPP FDD signal measurements.

The user data is contained in the **D**edicated **P**hysical **Ch**annel (DPCH).

More details on channel types are provided in chapter 4.2, "BTS Channel Types", on page 35.

Chips, frames and slots

The user data is spread across the available bandwidth using the spreading factor before transmission. The spreaded bits are referred to as "chips".

A time span of 10 ms is also known as a "frame". A frame is a basic time unit in the transmission process. Each frame is divided into 15 time "slots". Various channel parameters are put in relation to frames or the individual slots in the 3GPP standard, as well as some measurement results for 3GPP FDD signals. A slot contains 2560 chips.

Channel slots versus CPICH slots

The time slots of the individual channels may not be absolutely synchronous. A time offset may occur, so that the slots in a data channel are slightly shifted in relation to the CPICH slots, for example. In the 3GPP FDD BTS application, the CPICH slot number is provided as a reference with the measurement settings in the channel bar. In the Result Summary, the actual slot number of the evaluated channel is indicated as the "Channel Slot No".

Pilot symbols

Some slots contain a fixed sequence of symbols, referred to as "pilot symbols". These pilot symbols allow the receiver to identify a particular channel, if the unique pilot symbols can be detected in the input signal.

Power control

While the spreading factors are adjusted for each frame, i.e. every 10 ms, the power levels for transmission must be adapted to the current requirements (such as interference) much more dynamically. Thus, power control bits are transmitted in each slot, allowing for much higher change rates. As the CPICH channel continuously transmits the same data, the power level need not be adapted. Thus, the power control bits can lead to a timing offset between the CPICH slots and other channel slots.

4.1 Channel Detection

The 3GPP FDD 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. The search is based on the presence of known symbol sequences (pilot symbols) in the despread symbols of a channel. A data channel is considered to be active if the pilot symbols as specified by the 3GPP FDD standard are found at the end of each slot. In this mode, channels without or with incomplete pilot symbols are therefore not recognized as being active.
  An exception to this rule is seen in the special channels PICH and SCCPCH, which can be recognized as active in the automatic search mode although they do not contain pilot symbols. Optionally, all QPSK-modulated channels can also be recognized without pilot symbols (see "HSDPA/UPA" on page 49).
  In addition, the channel must exceed a minimum power in order to be considered active (see "Inactive Channel Threshold (BTS measurements only)" on page 72).
  In UE measurements, 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.

4.2 BTS Channel Types

The 3GPP FDD standard defines various BTS channel types. Some 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.

Control and synchronization channels

The 3GPP FDD BTS application expects the following control and synchronization channels for the Code Domain Power measurements:

Table 4-2: Common 3GPP FDD BTS control channels and their usage

Channel type	Description
PSCH	**P**rimary **S**ynchronization **Ch**annel The Primary Synchronization Channel is used to synchronize the signal in the case of SCH synchronization. It is a non-orthogonal channel. Only the power of this channel is determined.
SSCH	**S**econdary **S**ynchronization **Ch**annel The Secondary Synchronization Channel is a non-orthogonal channel. Only the power of this channel is determined.
PCCPCH	**P**rimary **C**ommon **C**ontrol **P**hysical **Ch**annel The Primary Common Control Physical Channel is also used to synchronize the signal in the case of SCH synchronization. It is expected at code class 8 and code number 1.
SCCPCH	**S**econdary **C**ommon **C**ontrol **P**hysical **Ch**annel The Secondary Common Control Physical Channel is a QPSK-modulated channel without any pilot symbols. In the 3GPP test models, this channel can be found in code class 8 and code number 3. However, the code class and code number need not be fixed and can vary. For this reason, the following rules are used to indicate the SCCPCH. ● Only one QPSK-modulated channel without pilot symbols is detected and displayed as the SCCPCH. Any further QPSK-modulated channels without pilot symbols are not detected as active channels. ● If the signal contains more than one channel without pilot symbols, the channel that is received in the highest code class and with the lowest code number is displayed as the SCCPCH. It is expected that only one channel of this type is included in the received signal. According to this assumption, this channel is probably the SCCPCH. ● If the application is configured to recognize all QPSK-modulated channels without pilot symbols (see "HSDPA/UPA" on page 49), and one of these channels is received at code class 8 and code number 3, it is displayed as the SCCPCH.
CPICH	**C**ommon **Pi**lot **Ch**annel The Common Pilot Channel is used to synchronize the signal in the case of CPICH synchronization. It is expected at code class 8 and code number 0. If it is not contained in the signal configuration, the firmware application must be configured to sychronize to the SCH channel (see "Synchronization Type" on page 70).

Other channels are optional and contain the user data to be transmitted. A data channel is any channel that does not have a predefined channel number and symbol rate. The following channel types can be detected by the 3GPP FDD BTS application.

Table 4-3: Common 3GPP FDD BTS data channels and their usage

Channel type	Description
PICH	**P**aging **I**ndication **Ch**annel The Paging Indication Channel is expected at code class 8 and code number 16. The lower part of the table indicates the data channels contained in the signal. A data channel is any channel that does not have a predefined channel number and symbol rate. There are different types of data channels, which are indicated in the column "Chan Type".
DPCH	**D**edicated **P**hysical **Ch**annel of a standard frame The Dedicated Physical Channel is a data channel that contains pilot symbols. The displayed channel type is DPCH.
CPRSD	Dedicated Physical Channel (DPCH) in **com**p**res**s**d** mode Compressed mode channels usually do not transmit valid symbols in all slots. There are different lengths of the transmitting gap. One to fourteen slots can be switched off in each frame. In some cases outside the gap the symbol rate is increased by 2 to ensure a constant average symbol rate of this channel. In any case all of the transmitted slots contain a pilot sequence defined in the 3GPP specification. There are different types of compressed mode channels. To evaluate compressed mode channels, the associated measurement mode needs to be activated (see "Compressed Mode" on page 50).
CPR-TPC	DPCH in **compres**s**ed** mode where **TPC** symbols are sent in the first slot of the transmitting gap
CPR-SF/2	DPCH in **compres**s**ed** mode using half spreading factor (**SF/2)** to increase the symbol rate of the active slots by two
CPR-SF/2-TPC	DPCH in **compres**s**ed** mode using half spreading factor (**SF/2**) to increase the symbol rate of the active slots by two, where **TPC** symbols are sent in the first slot of the transmitting gap
HS-PDSCH	HSDPA: **H**igh **S**peed **P**hysical **D**ownlink **S**hared **Ch**annel The High Speed Physical Downlink Shared Channel (HSDPA) does not contain any pilot symbols. It is a channel type that is expected in code classes lower than 7. The modulation type of these channels can vary depending on the selected slot. **HSPDSCH-QPSK_:** QPSK-modulated slot of an HS PDSCH channel **HSPDSCH-16QAM_:** 16QAM-modulated slot of an HS PDSCH channel **HSPDSCH-NONE_:** slot without power of an HS PDSCH channel
HS-SCCH	HSDPA: **H**igh **S**peed **S**hared **C**ontrol **Ch**annel The High Speed Shared Control Channel (HSDPA) does not contain any pilot symbols. It is a channel type that is expected in code classes equal to or higher than 7. The modulation type should always be QPSK. The channel does not contain any pilot symbols. If the application is configured to recognize all QPSK-modulated channels without pilot symbols (see "HSDPA/UPA" on page 49), the channels of HSDPA will be found among the data channels. If the type of a channel can be fully recognized, as for example with a DPCH (based on pilot sequences) or HS-PDSCH (based on modulation type), the type is entered in the field TYPE. All other channels without pilot symbols 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. There-fore, the unassigned codes are always to be found at the end of the table. If the modulation type for a channel can vary, the measured value of the modulation type will be appended to the type of the channel.

Channel type	Description
EHICH-ERGCH	HSUPA: **E**nhanced **H**ARQ Hybrid Acknowledgement **I**ndicator **Ch**annel **E**nhanced **R**elative **G**rant **Ch**annel
EAGCH	**E**nhanced **A**bsolute **G**rant **Ch**annel
SCPICH	**S**econdary **C**ommon **Pi**lot **Ch**annel
CHAN	If the application is configured to recognize all QPSK-modulated channels without pilot symbols (see "HSDPA/UPA" on page 49), all QPSK-modulated channels without pilot symbols and a code class higher than or equal to 7 are marked with the channel type CHAN.

MIMO channel types

Optionally, single antenna MIMO measurement channels can also be detected. In this case, HS-PDSCH channels with exclusively QPSK or exclusively 16 QAM on both transport streams are automatically detected and demodulated. The corresponding channel types are denoted as "HS-MIMO-QPSK" and "HS-MIMO-16QAM".

The MIMO constellations resulting on a single antenna consist of three amplitudes per dimension (-1, 0, 1) in the case of QPSK x QPSK, and seven amplitudes per dimension (-3, -2, -1, 0, 1, 2, 3) in the case of 16 QAM x 16 QAM. The symbol decisions of these constellations can be retrieved via the bitstream output. The mapping between bits and constellation points is given by the following table.

Table 4-4: Mapping between bits and constellation points for MIMO-QPSK

Constellation point (normalized)	Bit sequence
0,0	0,1,0,1
1,0	0,1,0,0
-1,0	0,1,1,1
0,1	0,0,0,1
1,1	0,0,0,0
-1,1	0,0,1,1
0,-1	1,1,0,1
1,-1	1,1,0,0
-1,-1	1,1,1,1

For MIMO-16QAM, the bit sequence is the same in both I and Q. Only one dimension is given here.

Table 4-5: Mapping between bits and constellation points for MIMO-16QAM

Constellation point (normalized)	Bit sequence
-3	1,1,1
-2	1,1,0
-1	1,0,0

Constellation point (normalized)	Bit sequence
0	1,0,1
1	0,0,1
2	0,0,0
3	0,1,0

4.3 UE Channel Types

The following channel types can be detected in 3GPP FDD uplink signals by the 3GPP FDD UE application.

Control channels

The 3GPP FDD UE application expects the following control channels for the Code Domain Power measurements:

Table 4-6: Common 3GPP FDD UE control channels and their usage

Channel type	Description
DPCCH	The **D**edicated **P**hysical **C**ontrol **Ch**annel is used to synchronize the signal. It carries pilot symbols and is expected in the Q branch at code class 8 with code number 0. This channel must be contained in every channel table.
HSDPCCH	The **H**igh **S**peed **D**edicated **P**hysical **C**ontrol **Ch**annel (for HS-DCH) is used to carry control information (CQI/ACK/NACK) for downlink high speed data channels (HS-DCH). It is used in HSDPA signal setup. The symbol rate is fixed to 15ksps. The code allocation depends on the number of active DPCH. The HS-DPCCH can be switched on or off after the duration of 1/5 frame or 3 slots or 2ms. Power control is applicable too.
EDPCCH	The **E**nhanced **D**edicated **P**hysical **C**ontrol **Ch**annel is used to carry control information for uplink high speed data channels (EDPDCH). It is used in HSUPA signal setup. The symbol rate is fixed to 15ksps.

Other channels are optional and contain the user data to be transmitted. A data channel is any channel that does not have a predefined channel number and symbol rate.

The following channel types can be detected by the 3GPP FDD UE application:

Table 4-7: Common 3GPP FDD UE data channels and their usage

Channel type	Description
DPDCH	The **D**edicated **P**hysical **D**ata **Ch**annel is used to carry UPLINK data from the UE to the BS. The code allocation depends on the total required symbol rate.
EDPDCH	The **E**nhanced **D**edicated **P**hysical **D**ata **Ch**annel is used to carry UPLINK data for high speed channels (EDPDCH). It is used in HSUPA signal setup. The symbol rate and code allocation depends on the number of DPDCH and HS-DPCCH.

As specified in 3GPP, the channel table can contain up to 6 DPDCHs or up to 4 E-DPDCHs.

4.4 3GPP FDD BTS Test Models

For measurements on base-station signals in line with 3GPP, test models with different channel configurations are specified in the document "Base station conformance testing (FDD)" (3GPP TS 25.141 V5.7.0). An overview of the test models is provided here.

Table 4-8: Test model 1

Channel type	Number of channels	Power (%)	Level (dB)	Spreading code	Timing offset (×256Tchip)
PCCPCH+SCH	1	10	-10	1	0
Primary CPICH	1	10	-10	0	0
PICH	1	1.6	-18	16	120
SCCPCH (SF=256)	1	1.6	-18	3	0
DPCH (SF=128)	16/32/64	76.8 total	see TS 25.141	see TS 25.141	see TS 25.141

Table 4-9: Test model 2

Channel type	Number of channels	Power (%)	Level (dB)	Spreading code	Timing offset (x256Tchip)
PCCPCH+SCH	1	10	-10	1	0
Primary CPICH	1	10	-10	0	0
PICH	1	5	-13	16	120
SCCPCH (SF=256)	1	5	-13	3	0
DPCH (SF=128)	3	2 × 10, 1 × 50	2 × -10, 1 × -3	24, 72, 120	1, 7, 2

Table 4-10: Test model 3

Channel type	Number of channels	Power (%) 16/32	Level (dB) 16/32	Spreading code	Timing offset (×256Tchip)
PCCPCH+SCH	1	12.6/7.9	-9/-11	1	0
Primary CPICH	1	12.6/7.9	-9/-11	0	0
PICH	1	5/1.6	-13/-18	16	120
SCCPCH (SF=256)	1	5/1.6	-13/-18	3	0
DPCH (SF=256)	16/32	63,7/80,4 total	see TS 25.141	see TS 25.141	see TS 25.141

Table 4-11: Test model 4

Channel type	Number of channels	Power (%) 16/32	Level (dB) 16/32	Spreading code	Timing offset (×256Tchip)
PCCPCH+SCH	1	50 to 1.6	-3 to -18	1	0
Primary CPICH*	1	10	-10	0	0

Table 4-12: Test model 5

Channel type	Number of channels	Power (%)	Level (dB)	Spreading code	Timing offset (×256Tchip)
PCCPCH+SCH	1	7.9	-11	1	0
Primary CPICH	1	7.9	-11	0	0
PICH	1	1.3	-19	16	120
SCCPCH (SF=256)	1	1.3	-19	3	0
DPCH (SF=256)	30/14/6	14/14.2/14.4 total	see TS 25.141	see TS 25.141	see TS 25.141
HS_SCCH	2	4 total	see TS 25.141	see TS 25.141	see TS 25.141
HS_PDSCH (16QAM)	8/4/2	63.6/63.4/63.2 total	see TS 25.141	see TS 25.141	see TS 25.141

4.5 Setup for Base Station Tests

This section describes how to set up the analyzer for 3GPP FDD BTS tests. As a prerequisite for starting the test, the instrument in use must be correctly set up and connected to the AC power supply as described in the instrument's Getting Started manual. Furthermore, the 3GPP FDD BTS application must be available.

Standard Test Setup

- Connect the antenna output (or Tx output) of the BTS to the RF input of the analyzer via a power attenuator of suitable attenuation.
  The following values are recommended for the external attenuator to ensure that the RF input of the analyzer is protected and the sensitivity of the analyzer is not reduced too much.

Max. power	Recommended ext. 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

Max. power	Recommended ext. attenuation
≥30 to 35 dBm	10 to 15 dB
≥25 to 30 dBm	5 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 of the analyzer (EXT REF IN/OUT).
- To ensure that the error limits specified by the 3GPP standard are met, the analyzer should use an external reference frequency for frequency measurements on base stations. For instance, a rubidium frequency standard may be used as a reference source.
- If the base station is provided with a trigger output, connect this output to the trigger input of the analyzer.

Presetting

Configure the R&S VSE as follows:

- Set the external attenuation (Reference level offset).
- Set the reference level.
- Set the center frequency.
- Set the trigger.
- Select the BTS standard and measurement.

4.6 3GPP FDD UE Test Models

The possible channel configurations for the mobile station signal are limited by 3GPP. Only two different configurations for data channels DPDCH are permissible according to the specification. In addition to these two channel configurations, the HS-DPCCH channel can be transmitted to operate the mobile station in HSDPA mode. Thus, the 3GPP FDD UE application checks for these channel configurations only during the automatic channel search. Therefore, channels whose parameters do not correspond to one of these configurations are not automatically detected as active channels.

The two possible channel configurations are summarized below:

Table 4-13: Channel configuration 1: DPCCH and 1 DPDCH

Channel type	Number of channels	Symbol rate	Spreading code(s)	Mapping
DPCCH	1	15 ksps	0	Q
DPDCH	1	15 ksps – 960 ksps	[spreading-factor/4]	I

Table 4-14: Channel configuration 2: DPCCH and up to 6 DPDCH

Channel type	Number of channels	Symbol rate	Spreading code(s)	Mapping
DPCCH	1	15 ksps	0	Q
DPDCH	1	960 ksps	1	I
DPDCH	1	960 ksps	1	Q
DPDCH	1	960 ksps	3	I
DPDCH	1	960 ksps	3	Q
DPDCH	1	960 ksps	2	I
DPDCH	1	960 ksps	2	Q

Table 4-15: Channel configuration 3: DPCCH, up to 6 DPDCH and 1 HS-DPCCH The channel configuration is as above in table 4-2. On HS-DPCCH is added to each channel table.

Number of DPDCH	Symbol rate all DPDCH	Symbol rate HS-DPCCH	Spreading code HS-DPCCH	Mapping (HS-DPCCH)
1	15 – 960 ksps	15 ksps	64	Q
2	1920 ksps	15 ksps	1	I
3	2880 ksps	15 ksps	32	Q
4	3840 ksps	15 ksps	1	I
5	4800 ksps	15 ksps	32	Q
6	5760 ksps	15 ksps	1	I

Table 4-16: Channelization code of HS-DPCCH

Nmax-dpdch (as defined in subclause 4.2.1)	Channelization code C_{ch}
1	$C_{ch,256,64}$
2,4,6	$C_{ch,256,1}$
3,5	$C_{ch,256,32}$

4.7 Setup for User Equipment Tests

This section describes how to set up the R&S VSE for 3GPP FDD UE user equipment tests. As a prerequisite for starting the test, the instrument in use must be correctly set up and connected to the AC power supply as described in the analyzer's Getting Started manual. Furthermore, the 3GPP FDD UE application must be installed.

Standard Test Setup

- Connect antenna output (or Tx output) of UE to RF input of the analyzer via a power attenuator of suitable attenuation.

The following values are recommended for the external attenuator to ensure that the RF input of the analyzer is protected and the sensitivity of the analyzer is not reduced too much.

Max. power	Recommended ext. attenuation
³55 to 60 dBm	35 to 40 dB
³50 to 55 dBm	30 to 35 dB
³45 to 50 dBm	25 to 30 dB
³40 to 45 dBm	20 to 25 dB
³35 to 40 dBm	15 to 20 dB
³30 to 35 dBm	10 to 15 dB
³25 to 30 dBm	5 to 10 dB
³20 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 external reference input connector of the analyzer (REF INPUT).
- To ensure that the error limits specified by the 3GPP standard are met, the analyzer should use an external reference frequency for frequency measurements on user equipment. For instance, a rubidium frequency standard may be used as a reference source.
- If the user equipment is provided with a trigger output, connect this output to one of the TRIGGER INPUT connectors of the analyzer.

Presetting

Configure the R&S VSE as follows:

- Set the external attenuation (Reference level offset).
- Set the reference level.
- Set the center frequency.
- Set the trigger.
- Select the UE standard and measurement.

4.8 Time Alignment Error Measurements

Time Alignment Error Measurements are a special type of Code Domain Analysis used to determine the time offset between the signals of both antennas of a base station.

4.8.1 Measurement Setup for Two Antennas in a Base Station

The antenna signals of the two BTS transmitter branches are fed to the analyzer via a combiner. Each antenna must provide a common pilot channel, i.e. P-CPICH for antenna 1 and P-CPICH or S-CPICH for antenna 2. The Time Alignment Error Measurement setup for one base station using an R&S FSW shows the measurement setup.

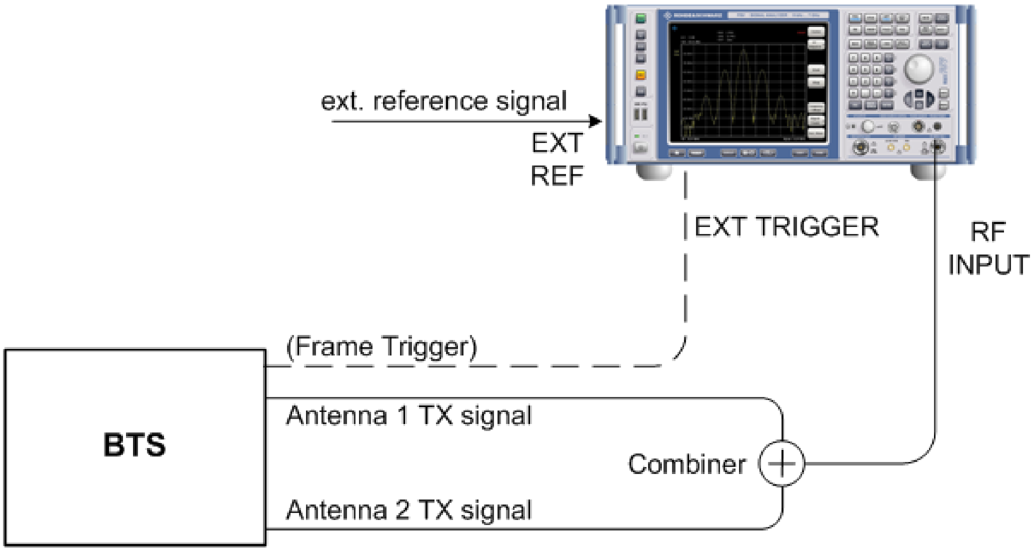


Fig. 4-1: Time Alignment Error Measurement setup for one base station using an R&S FSW

Synchronization check

A synchronization check is performed for both antennas which must have the result "Sync OK" to ensure a proper TAE result. Synchronization problems are indicated by the messages "No antenna 1 sync", "No antenna 2 sync" and "No sync". Errors can also be read remotely via bits 1 and 2 of the `Sync` status register (see chapter 10.10, "Querying the Status Registers", on page 206).

5 Configuration

The 3GPP FDD applications provide several different measurements for signals according to the 3GPP FDD application. The main and default measurement is Code Domain Analysis. Furthermore, a Time Alignment Error measurement is provided. In addition to the code domain power measurements specified by the 3GPP standard, the 3GPP FDD options offer measurements with predefined settings in the frequency domain, e.g. RF power measurements.

Multiple access paths to functionality

The easiest way to configure a measurement channel is via the "Overview" dialog box, which is displayed when you select the "Overview" icon from the main toolbar or the "Meas Setup" > "Overview" menu item.

Alternatively, you can access the individual dialog boxes from the corresponding menu items, or via tools in the toolbars, if available.

In this documentation, only the most convenient method of accessing the dialog boxes is indicated - usually via the "Overview". For an overview of all available menu items and toolbar icons see chapter A, "Reference", on page 218.

Selecting the measurement type

When you activate an 3GPP FDD application, Code Domain Analysis of the input signal is started automatically. However, the 3GPP FDD applications also provide other measurement types.

► To select a different measurement type, do one of the following:
   - In the "Overview", select the "Select Measurement" button. Select the required measurement.
   - From the "Meas Setup" menu, select "Select Measurement". Select the required measurement.

5.1 Code Domain Analysis

3GPP FDD measurements require a special application on the R&S VSE.

General R&S VSE functions

The application-independent functions for general tasks on the R&S VSE are also available for 3GPP FDD measurements and are described in the R&S VSE Base Software User Manual. In particular, this comprises the following functionality:

- Controlling Instruments and Capturing I/Q Data
- Data Management
- General Software Preferences and Information

5.1.1 Configuration Overview

Access: "Meas Setup" > "Overview"

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

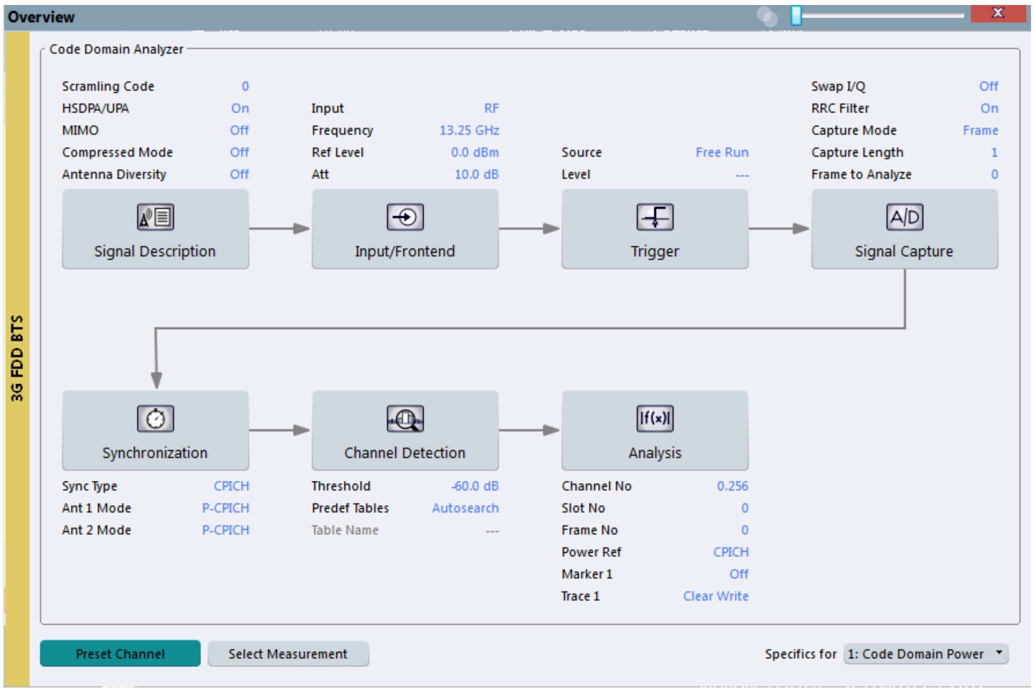


Fig. 5-1: Configuration "Overview" for CDA measurements

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 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 Time Alignment Error Measurements see chapter 5.2.1, "Configuration Overview", on page 83.

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.

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 119

Select Measurement

Selects a different measurement to be performed.

See chapter 3, "Measurements and Result Display", on page 11.

Specifics for

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

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

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

5.1.2 Signal Description

Access: "Overview" > "Signal Description"

or: "Meas Setup" > "Signal Description"

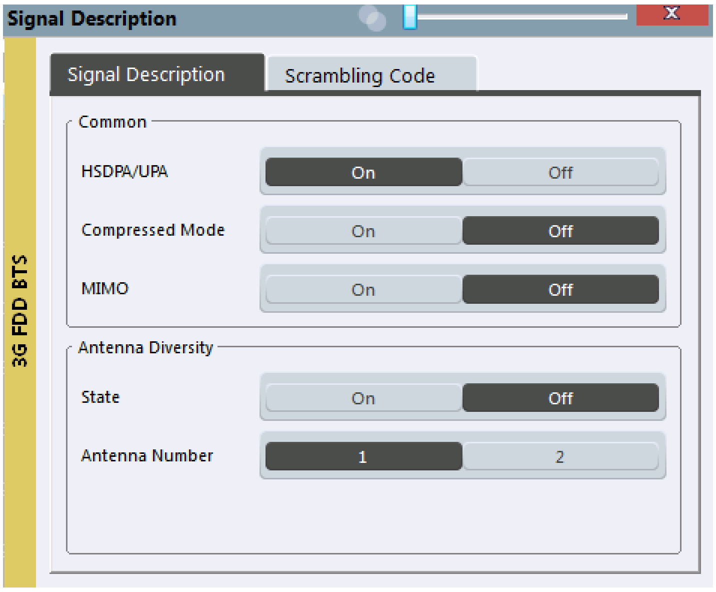
The signal description provides information on the expected input signal.

5.1.2.1 BTS Signal Description

Access: "Overview" > "Signal Description"

or: "Meas Setup" > "Signal Description"

The settings available to describe the input signal in BTS measurements are described here.



HSDPA/UPA
If enabled, the application detects all QPSK-modulated channels without pilot symbols (HSDPA channels) and displays them in the channel table. If the type of a channel can be fully recognized, as for example with a HS-PDSCH (based on modulation type), the type is indicated in the table. All other channels without pilot symbols are of type "CHAN".

Remote command:
`[SENSe:]CDPower:HSDPamode` on page 120

Compressed Mode

If compressed mode is switched on, some slots of a channel are suppressed. To keep the overall data rate, the slots just before or just behind a compressed gap can be sent with half spreading factor (SF/2). This mode must be enabled to detect compressed mode channels (see chapter 4.2, "BTS Channel Types", on page 35).

Remote command:
`[SENSe:]CDPower:PCONtrol` on page 122

MIMO

Activates or deactivates single antenna MIMO measurement mode.

If activated, HS-PDSCH channels with exclusively QPSK or exclusively 16 QAM on both transport streams are automatically detected and demodulated. The corresponding channel types are denoted as "HS-MIMO-QPSK" and "HS-MIMO-16QAM", respectively.

For details see "MIMO channel types" on page 38.

Remote command:
`[SENSe:]CDPower:MIMO` on page 122

Antenna Diversity

This option switches the antenna diversity mode on and off.

Remote command:
`[SENSe:]CDPower:ANTenna` on page 120

Antenna Number

This option switches between diversity antennas 1 and 2. Depending on the selected setting, the 3GPP FDD application synchronizes to the CPICH of antenna 1 or antenna 2.

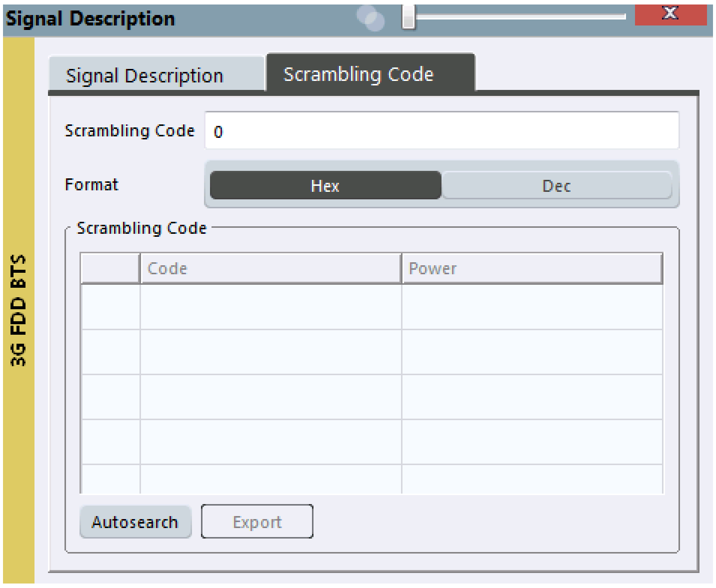
Remote command:
`[SENSe:]CDPower:ANTenna` on page 120

5.1.2.2 BTS Scrambling Code

Access: "Overview" > "Signal Description" > "Scrambling Code" tab

or: "Meas Setup" > "Signal Description" > "Scrambling Code" tab

The scrambling code identifies the base station transmitting the signal. You can either define the used scrambling code manually, or perform a search on the input signal to detect a list of possible scrambling codes automatically.



Scrambling Code

Defines the scrambling code. The scrambling codes are used to distinguish between different base stations. Each base station has its own scrambling code.

Remote command:
`[SENSe:]CDPower:LCODe:DVALue` on page 123

Format Hex/Dec

Switch the display format of the scrambling codes between hexadecimal and decimal.

Remote command:
`[SENSe:]CDPower:LCODe:DVALue` on page 123
`[SENSe:]CDPower:LCODe[:VALue]` on page 123

Scrambling Codes

This table includes all found scrambling codes from the last autosearch sequence. In the first column each detected scrambling code can be selected for export.

Remote command:
`[SENSe:]CDPower:LCODe:SEARch:LIST?` on page 121

Autosearch for Scrambling Code

Starts a search on the measured signal for all scrambling codes. The scrambling code that leads to the highest signal power is chosen as the new scrambling code.

Searching requires that the correct center frequency and level are set. The scrambling code search can automatically determine the primary scrambling code number. The secondary scrambling code number is expected as 0. Alternative scrambling codes can not be detected. Therefore the range for detection is 0x0000 – 0x1FF0h, where the last digit is always 0.

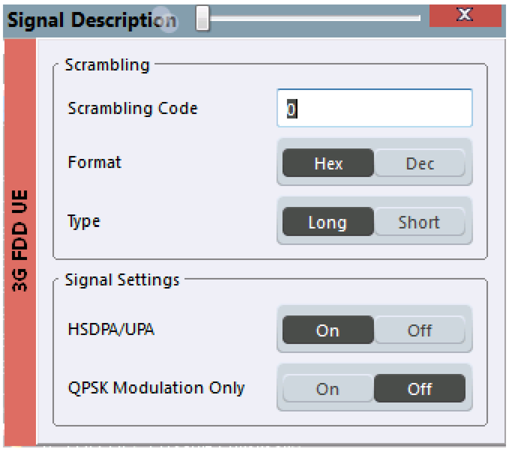
Remote command:
[SENSe:]CDPower:LCODe:SEARch[:IMMediate]? on page 121

Export
Writes the detected scrambling codes together with their powers into a text file in the R&S user directory (C:\R_S\Instr\User\ScrCodes.txt)

5.1.2.3 UE Signal Description (UE Measurements)

Access: "Overview" > "Signal Description" > "Signal Description"

The settings available to describe the input signal in UE measurements are described here.



Scrambling Code
Defines the scrambling code used to transmit the signal in the specified format.

The scrambling code identifies the user equipment transmitting the signal. If an incorrect scrambling code is defined, a CDP measurement of the signal is not possible.

Remote command:
[SENSe:]CDPower:LCODe[:VALue] on page 123

Format

Switches the display format of the scrambling codes between hexadecimal and decimal.

Remote command:
SENS:CDP:LCOD:DVAL <numeric value> (see [SENSe:]CDPower:LCODe:DVALue on page 123)

Type

Defines whether the entered scrambling code is to be handled as a long or short scrambling code.

Remote command:
[SENSe:]CDPower:LCODe:TYPE on page 124

HSDPA/UPA

If enabled, the application detects all QPSK-modulated channels without pilot symbols (HSDPA channels) and displays them in the channel table. If the type of a channel can be fully recognized, as for example with a HS-PDSCH (based on modulation type), the type is indicated in the table. All other channels without pilot symbols are of type "CHAN".

Remote command:
[SENSe:]CDPower:HSDPamode on page 120

QPSK Modulation Only

If enabled, it is assumed that the signal uses QPSK modulation only. Thus, a special QPSK-based synchronization can be performed and the measurement therefore runs with optimized speed.

Do not enable this mode for signals that do not use QPSK modulation.

Remote command:
[SENSe:]CDPower:QPSK on page 124

5.1.3 Data Input and Output Settings

Access: "Overview" > "Input/Frontend"

or: "Input & Output"

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

5.1.3.1 Input Source Settings

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

or: "Input & Output" > "Input Source"

The R&S VSE can control the input sources of the connected instruments.

Radio Frequency Input

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

or: "Input & Output" > "Input Source" > "IQ File"

The default input source for the instrument in use is "Radio Frequency". Depending on the instrument in use, different input parameters are available.

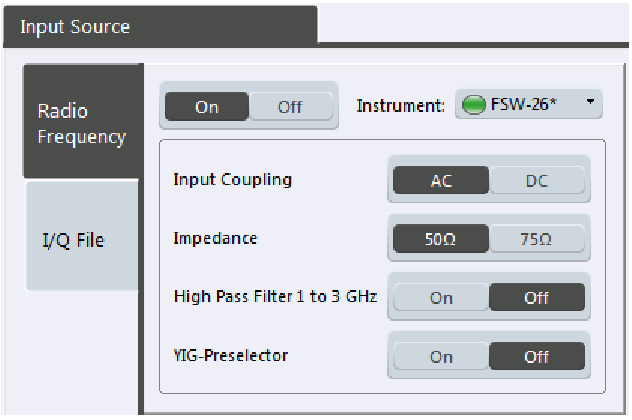


Fig. 5-2: RF input source settings for an R&S FSW

Input Type
Selects an instrument or a file as the type of input provided to the channel.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce` on page 128
`INPut:SELect` on page 127

Instrument
Specifies a configured instrument to be used for input.

Input Coupling
The RF input of the instrument in use can be coupled by alternating current (AC) or direct current (DC).

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 125

Impedance
For some measurements, the reference impedance for the measured levels of the instrument in use 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).

Remote command:
`INPut:IMPedance` on page 126

High-Pass Filter 1...3 GHz
Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer in order to measure the harmonics for a DUT, for example.

This function may require an additional hardware option on the instrument in use.

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 126

YIG-Preselector
Activates or deactivates the YIG-preselector, if available on the instrument in use.

An internal YIG-preselector at the input of the instrument in use 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 instrument in use, which may lead to image-frequency display.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 126

Preselector State
Turns the preselector on and off.

When you turn the preselector on, you can configure the characteristics of the preselector and add the preamplifier into the signal path.

When you turn the preselector off, the signal bypasses the preselector and the preamplifier, and is fed into the input mixer directly.

Remote command:
`INPut:PRESelection[:STATe]` on page 127

Preselector Mode

Selects the preselection filters to be applied to the measurement.

"Auto" Performs a measurement by automatically applying all available bandpass filters.
Available with the optional preamplifier.

"Auto Wide" Performs a measurement by automatically applying the wideband filters consecutively:
- Lowpass 40 MHz
- Bandpass 30 MHz to 2250 MHz
- Bandpass 2 GHz to 8 GHz
- Bandpass 8 GHz to 26.5 GHz

Available with the optional preselector.

"Auto Narrow" Performs a measurement by automatically applying the most suitable narrowband preselection filters, depending on the bandwidth you have selected.
For measurement frequencies up to 30 MHz, the instrument in use uses combinations of lowpass and highpass filters. For higher frequencies, the instrument in use uses bandpass filters.
Available with the optional preselector.

"Manual" Performs a measurement with the filter settings you have defined manually.

Remote command:
`INPut:PRESelection:SET` on page 127

10 dB Minimum Attenuation

Turns the availabilty of attenuation levels of less than 10 dB on and off.

When you turn the feature on, the attenuation level is always at least 10 dB to protect the input mixer and avoid accidental setting of 0 dB, especially if you measure DUTs with high RFI voltage.

When you turn it off, you can also select attenuation levels of less than 10 dB.

The setting applies to a manual selection of the attenuation as well as the automatic selection of the attenuation.

Remote command:
`INPut:ATTenuation:PROTection[:STATe]` on page 125

Input Selection

Selects the RF input you would like to use for a measurement.

Note that you can not use both RF inputs simultaneously.

Remote command:
Global: `INPut:TYPE` on page 127

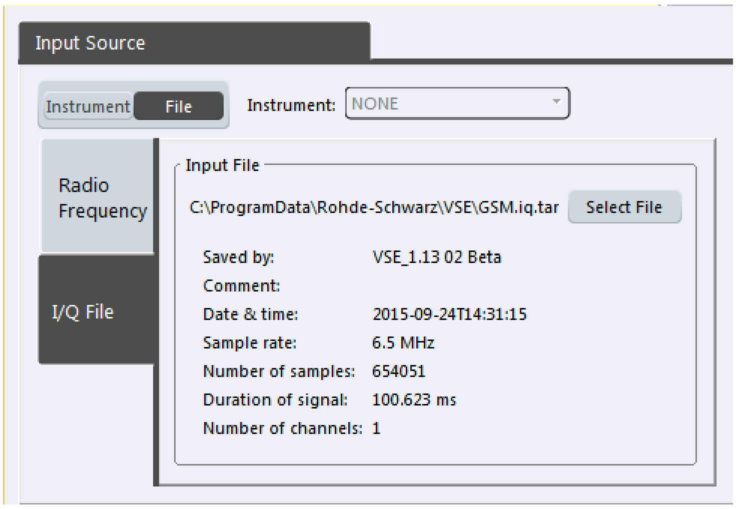
I/Q File Input

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

or: "Input & Output" > "Input Source" > "IQ File"

Alternatively to "live" data input from a connected instrument, measurement data to be analyzed by the R&S VSE software can also be provided "offline" by a stored data file. This allows you to perform a measurement on any instrument, store the results to a file, and analyze the stored data partially or as a whole at any time using the R&S VSE software.

The "Input Source" settings defined in the "Input" dialog box are identical to those configured for a specific channel in the "Measurement Group Setup" window.



Input Type
Selects an instrument or a file as the type of input provided to the channel.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce` on page 128
`INPut:SELect` on page 127

Input File
Specifies the I/Q data file to be used for input.

Select "Select File" to open the "Load I/Q File" dialog box.

5.1.3.2 Output Settings

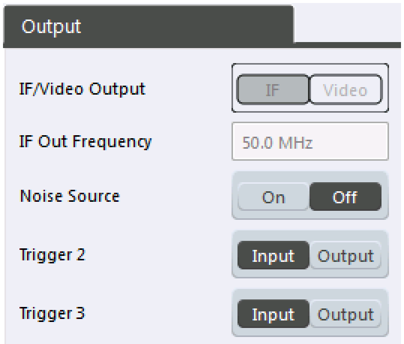
Access: "Overview" > "Input/ Frontend" > "Output"

or: "Input & Output" > "Output"

The R&S VSE can control the output provided by the instrument in use to special connectors for other devices.

Which output settings and connectors are available depends on the instrument in use.

For details on the output connectors refer to the instrument's Getting Started manual.



Noise Source

Switches the supply voltage for an external noise source on the instrument in use on or off, if available.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the instrument in use itself, for example when measuring the noise level of a DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 128

Trigger 2/3

Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

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

"Output" The instrument in use 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 140
`OUTPut:TRIGger<port>:DIRection` on page 140

Output Type ← Trigger 2/3

Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the instrument in use triggers.

"Trigger Armed"	Sends a (high level) trigger when the instrument in use 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) of the instrument in use, if available.
"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 140

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 140

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 141

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 141

5.1.4 Frontend Settings

Access: "Overview" > "Input/Frontend"

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

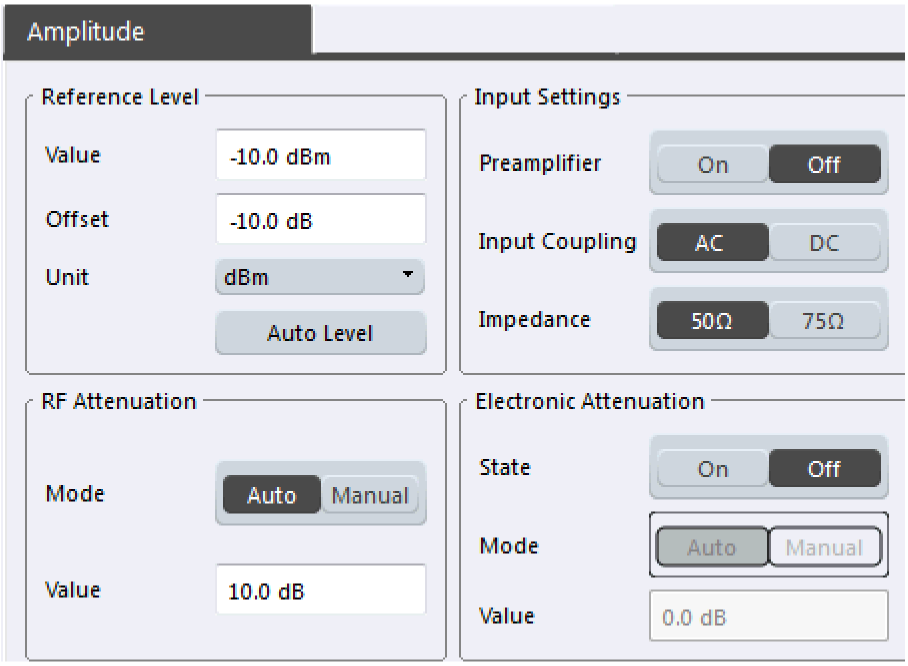
5.1.4.1 Amplitude Settings

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

or: "Input & Output" > "Amplitude"

Amplitude settings determine how the instrument in use must process or display the expected input power levels.

Which amplitude settings are available depends on the instrument in use.



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 hardware of the instrument in use 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).

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 132

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 132

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
The instrument in use automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized. This function is not available on all supported instruments.

Remote command:
`[SENSe:]ADJust:LEVel` on page 161

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

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

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

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

Remote command:
`INPut:ATTenuation` on page 133
`INPut:ATTenuation:AUTO` on page 134

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the instrument in use, you can also activate an electronic attenuator.

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

Note: Note that restrictions may apply concerning which frequencies electronic attenuation is available for, depending on which instrument is connected to the R&S VSE software. Check your instrument documentation for details.
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.

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 135
`INPut:EATT:AUTO` on page 134
`INPut:EATT` on page 134

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 "Radio Frequency Input" on page 54.

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

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

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

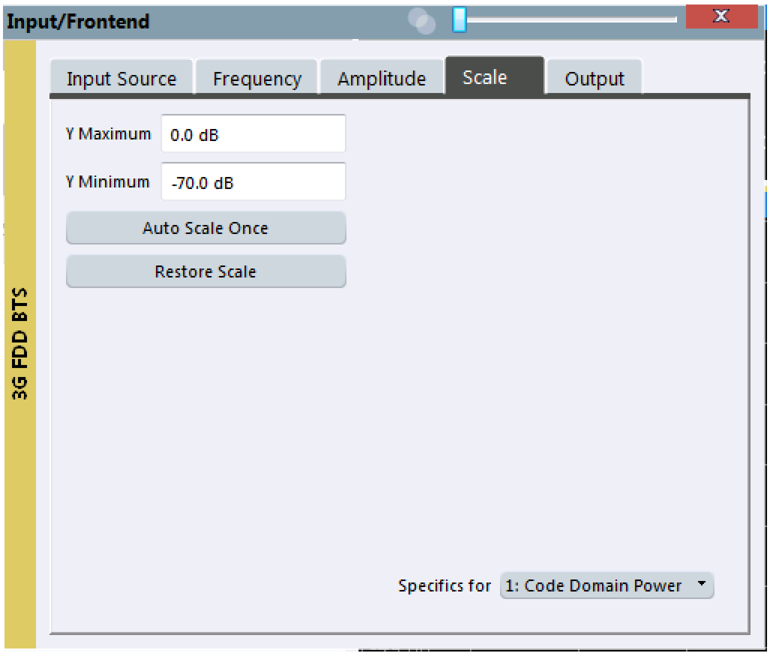
Remote command:
`INPut:GAIN:STATe` on page 132
`INPut:GAIN[:VALue]` on page 133

5.1.4.2 Y-Axis Scaling

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

or: "Input & Output" > "Scale"

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



Y-Maximum, Y-Minimum

Defines the amplitude range to be displayed on the y-axis of the evaluation diagrams.

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 131

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 131

Auto Scale Once

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

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

Remote command:

`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 131

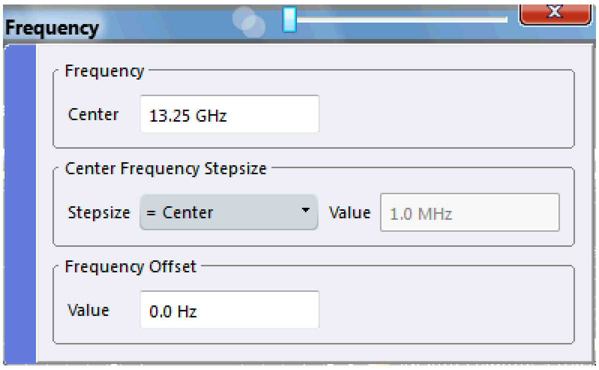
Restore Scale (Window)

Restores the default scale settings in the currently selected window.

5.1.4.3 Frequency Settings

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

or: "Input & Output" > "Frequency"



Center frequency

Defines the center frequency of the signal in Hertz.

0 Hz ≤ f_{center} ≤ f_{max}

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

Note: For file input you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the channel's current analysis bandwidth.

$$CFshift_{max} = CF_{file} \pm \frac{ABW_{file} - ABW_{channel}}{2}$$

If the file does not provide the center frequency, it is assumed to be 0 Hz.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 129

Center Frequency Stepsize

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

When you use the mouse wheel, 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 129

Frequency Offset

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

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

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

The allowed values range from -100 GHz to 100 GHz. The default setting is 0 Hz.

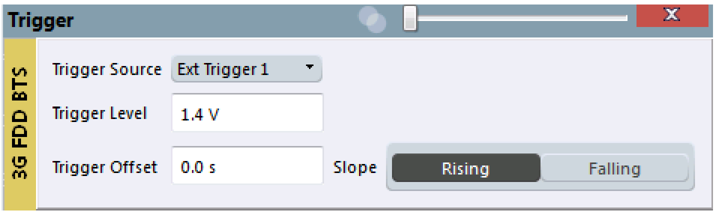
Remote command:
`[SENSe:]FREQuency:OFFSet` on page 130

5.1.5 Trigger Settings

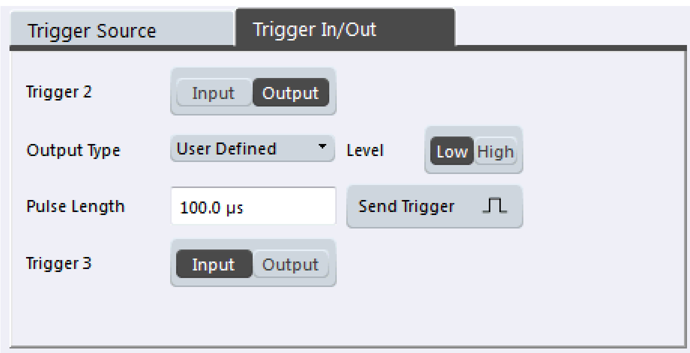
Access: "Overview" > "Signal Capture" > "Trigger Source"

or: INPUT & OUTPUT > "Trigger"

Trigger settings determine when the input signal is measured.



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



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

Trigger Source ← Trigger Settings
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 138

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

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 138

External Trigger<X> ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the specified input connector or input channel of the instrument in use meets or exceeds the specified trigger level.

(See "Trigger Level" on page 66).

Note: Which input and output connectors are available depends on the connected instrument. For details see the "Instrument Tour" chapter in the instrument's Getting Started manual.

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`, `TRIG:SOUR EXT4`
See `TRIGger[:SEQuence]:SOURce` on page 138

Trigger Level ← Trigger Settings
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 137

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

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

(If supported by the instrument in use.)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 136

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

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 138

Trigger 2/3
Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

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

"Output" The instrument in use 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 140
`OUTPut:TRIGger<port>:DIRection` on page 140

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

"Device Triggered" (Default) Sends a trigger when the instrument in use triggers.

"Trigger Armed" Sends a (high level) trigger when the instrument in use 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) of the instrument in use, if available.

"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 140

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 140

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 141

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.

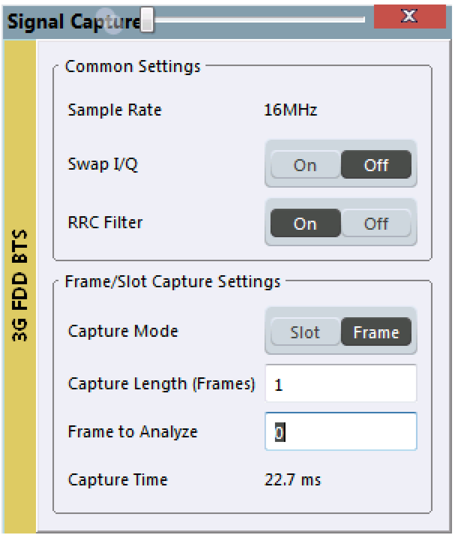
Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 141

5.1.6 Signal Capture (Data Acquisition)

Access: "Overview" > "Signal Capture"

or: "Meas Setup" > "Capture"

How much and how data is captured from the input signal are defined in the "Signal Capture" settings.



Sample Rate
The sample rate is always 16 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 143

RRC Filter State
Selects if a root raised cosine (RRC) receiver filter is used or not. This feature is useful if the RRC filter is implemented in the device under test (DUT).

"ON" If an unfiltered signal is received (normal case), the RRC filter should be used to get a correct signal demodulation. (Default settings)

"OFF" If a filtered signal is received, the RRC filter should not be used to get a correct signal demodulation. This is the case if the DUT filters the signal.

Remote command:
`[SENSe:]CDPower:FILTer[:STATe]` on page 142

Capture Mode
Captures a single slot or one complete frame.

Remote command:
`[SENSe:]CDPower:BASE` on page 142

Capture Length (Frames)
Defines the capture length (amount of frames to record).

Remote command:
`[SENSe:]CDPower:IQLength` on page 142

Frame To Analyze
Defines the frame to be analyzed and displayed.

Remote command:
`[SENSe:]CDPower:FRAMe[:VALue]` on page 161

Capture Time
This setting is read-only.

It indicates the capture time determined by the capture length and sample rate.

Capture / Average Count
Defines the number of captures to be performed in the single capture mode. Values from 0 to 32767 are allowed. If the values 0 or 1 are set, one capture is performed.

The "Capture / Average Count" is available from the "Meas Setup" menu.

The"Capture / Average 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 capture mode, if "Capture / Average Count" = 0 (default), averaging is performed over 10 captures. For "Capture / Average Count" =1, no averaging, maxhold or minhold operations are performed.

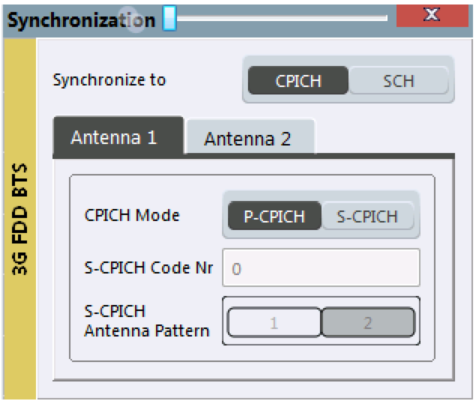
Remote command:
[SENSe:]SWEep:COUNt on page 143
[SENSe:]AVERage<n>:COUNt on page 143

5.1.7 Synchronization (BTS Measurements Only)

Access: "Overview" > "Synchronization" > "Antenna1"/"Antenna2"

or: "Meas Setup" > "Sync"

For BTS tests, the individual channels in the input signal need to be synchronized to detect timing offsets in the slot spacings. These settings are described here.



Synchronization Type

Defines whether the signal is synchronized to the CPICH or the synchronization channel (SCH).

"CPICH" The 3GPP FDD application assumes that the CPICH control channel is present in the signal and attempts to synchronize to this channel. If the signal does not contain CPICH, synchronization fails.

"SCH" The 3GPP FDD application synchronizes to the signal without assuming the presence of a CPICH. This setting is required for measurements on test model 4 without CPICH. While this setting can also be used with other channel configurations, it should be noted that the probability of synchronization failure increases with the number of data channels.

Remote command:
[SENSe:]CDPower:STYPe on page 145

Antenna1 / Antenna2
Synchronization is configured for each diversity antenna individually, on separate tabs.

The 3GPP FDD standard defines two different CPICH patterns for diversity antenna 1 and antenna 2. The CPICH pattern used for synchronization can be defined depending on the antenna (standard configuration), or fixed to either pattern, independantly of the antenna (user-defined configuration).

Remote command:
`[SENSe:]CDPower:ANTenna` on page 120

CPICH Mode ← Antenna1 / Antenna2
Defines whether the common pilot channel (CPICH) is defined by its default position or a user-defined position.

"P-CPICH"	Standard configuration (CPICH is always on channel 0)
"S-CPICH"	User-defined configuration. Enter the CPICH code number in the S-CPICH Code Nr field.

Remote command:
`[SENSe:]CDPower:UCPich:ANT<antenna>[:STATe]` on page 145

S-CPICH Code Nr ← Antenna1 / Antenna2
If a user-defined CPICH definition is to be used, enter the code of the CPICH based on the spreading factor 256. Possible values are 0 to 255.

Remote command:
`[SENSe:]CDPower:UCPich:ANT<antenna>:CODE` on page 144

S-CPICH Antenna Pattern
Defines the pattern used for evaluation.

Remote command:
`[SENSe:]CDPower:UCPich:ANT<antenna>:PATTern` on page 144

5.1.8 Channel Detection

Access: "Overview" > "Channel Detection"

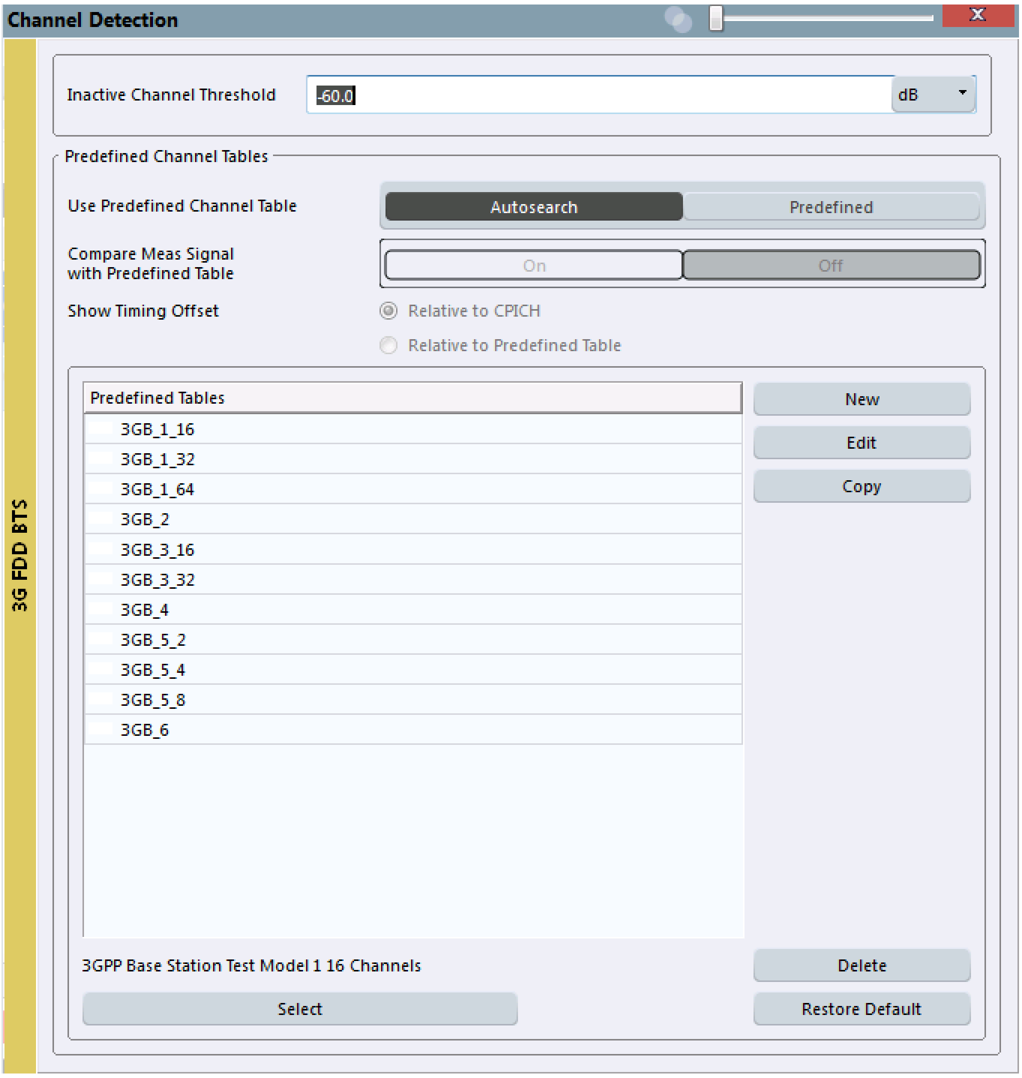
or: "Meas Setup" > "Channel Detection"

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

5.1.8.1 General Channel Detection Settings

Access: "Overview" > "Channel Detection"

or: "Meas Setup" > "Channel Detection"



Inactive Channel Threshold (BTS measurements only)

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

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

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

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle[:STATe]` on page 149
UE measurements:
`CONFigure:WCDPower:MS:CTABle[:STATe]` on page 151

Comparing the Measurement Signal with the Predefined Channel Table
If enabled, the 3GPP FDD application compares the measured signal to the predefined channel tables. In the result summary, only the differences to the predefined table settings are displayed.

Remote command:
`CONFigure:WCDPower[:BTS]:CTABle:COMPare` on page 147

Timing Offset Reference
Defines the reference for the timing offset of the displayed measured signal.

"Relative to CPICH" The measured timing offset is shown in relation to the CPICH.

"Relative to Predefined Table" If the predefined table contains timing offsets, the delta between the defined and measured offsets are displayed in the evaluations.

Remote command:
`CONFigure:WCDPower[:BTS]:CTABle:TOFFset` on page 148

5.1.8.2 Channel Table Management

Access: "Overview" > "Channel Detection"

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.

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:CATalog?` on page 149
UE measurements:
`CONFigure:WCDPower:MS:CTABle:CATalog?` on page 152

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:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:SELect` on page 151
UE measurements:
`CONFigure:WCDPower:MS:CTABle:SELect` on page 153

Creating a New Table

Creates a new channel table. See chapter 5.1.8.4, "Channel Details (BTS Measurements)", on page 76.

For step-by-step instructions on creating a new channel table, see "To define or edit a channel table" on page 98.

Editing a Table

You can edit existing channel table definitions. The details of the selected channel are displayed in the "Channel Table" dialog box. See chapter 5.1.8.4, "Channel Details (BTS Measurements)", on page 76.

Copying a Table

Copies an existing channel table definition. The details of the selected channel are displayed in the "Channel Table" dialog box. See chapter 5.1.8.4, "Channel Details (BTS Measurements)", on page 76.

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:COPY` on page 150
UE measurements:
`CONFigure:WCDPower:MS:CTABle:COPY` on page 152

Deleting a Table

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

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:DELete` on page 151
UE measurements:
`CONFigure:WCDPower:MS:CTABle:DELete` on page 152

Restoring Default Tables

Restores the predefined channel tables delivered with the software.

5.1.8.3 Channel Table Settings and Functions

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

or: "Meas Setup" > "Channel Detection" > "New"/"Copy"/"Edit"

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

Name

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

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:NAME` on page 153
UE measurements:
`CONFigure:WCDPower:MS:CTABle:NAME` on page 154

Comment

Optional description of the channel table.

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:COMMent` on page 154
UE measurements:
`CONFigure:WCDPower:MS:CTABle:COMMent` on page 154

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:
BTS measurements:
`CONFigure:WCDPower[:BTS]:MEASurement` on page 118
UE measurements:
`CONFigure:WCDPower:MS:MEASurement` on page 118

Sorting the Table

Sorts the channel table entries.

Cancelling Configuration

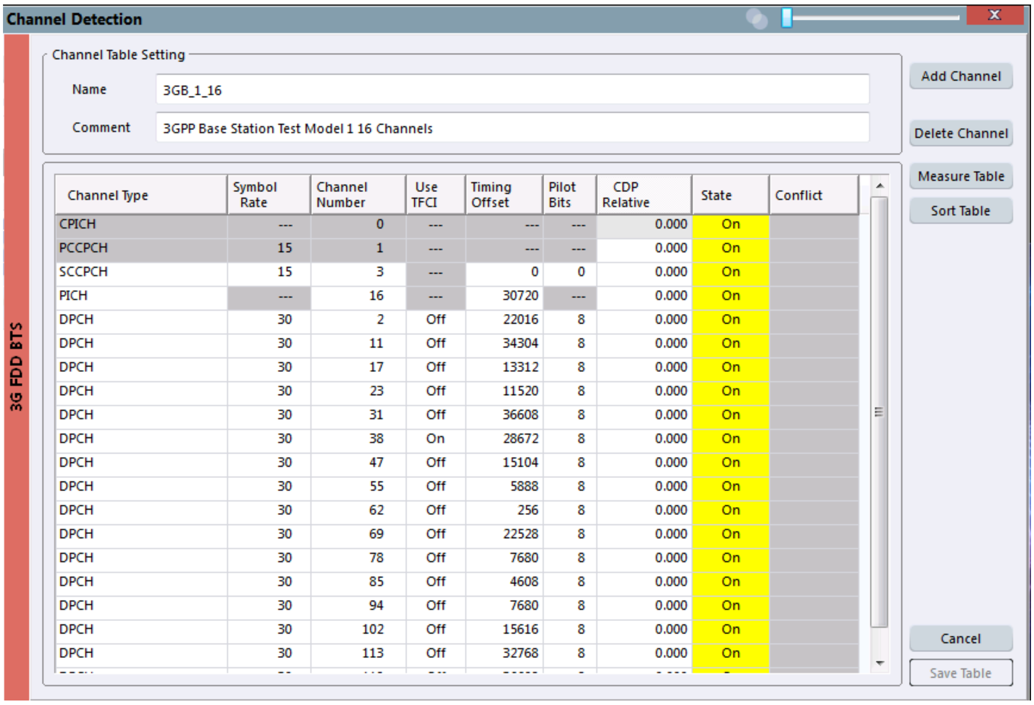
Closes the "Channel Table" dialog box without saving the changes.

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

5.1.8.4 Channel Details (BTS Measurements)

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

or: "Meas Setup" > "Channel Detection" > "New"/"Copy"/"Edit"



Channel Type
Type of channel. For a list of possible channel types see chapter 4.2, "BTS Channel Types", on page 35.

Remote command:
BTS measurements:
`CONFigure:WCDPower[:BTS]:CTABle:DATA` on page 155
UE measurements:
`CONFigure:WCDPower:MS:CTABle:DATA` on page 156

Symbol Rate
Symbol rate at which the channel is transmitted.

Channel Number (Ch. SF)
Number of channel spreading code (0 to [spreading factor-1])

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

Use TFCI
Indicates whether the slot format and data rate are determined by the Transport Format Combination Indicator(TFCI).

Remote command:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155

Timing Offset
Defines a timing offset in relation to the CPICH channel. During evaluation, the detected timing offset can be compared to this setting; only the delta is displayed (see "Timing Offset Reference" on page 73).

Remote command:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155

Pilot Bits
Number of pilot bits of the channel (only valid for the control channel DPCCH)

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

CDP Relative
Code domain power (relative to the total power of the signal)

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

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

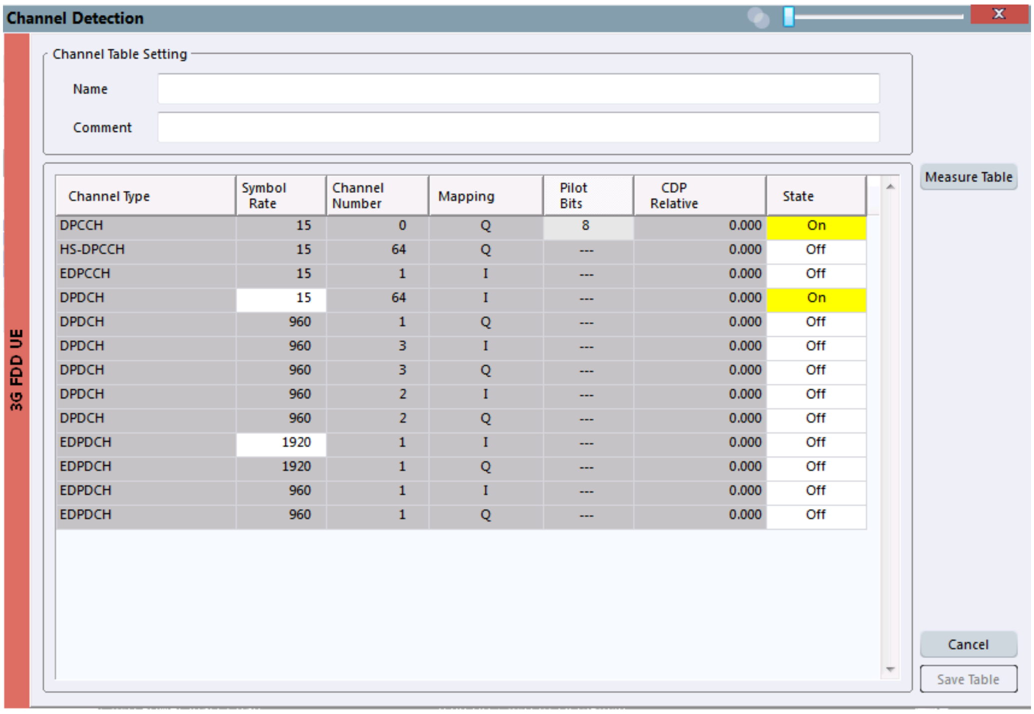
Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

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

5.1.8.5 Channel Details (UE Measurements)

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

or: "Meas Setup" > "Channel Detection" > "New"/"Copy"/"Edit"



Channel Type

Type of channel. For a list of possible channel types see chapter 4.2, "BTS Channel Types", on page 35.

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

Symbol Rate

Symbol rate at which the channel is transmitted.

Channel Number (Ch. SF)

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

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

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.

Pilot Bits

Number of pilot bits of the channel (only valid for the control channel DPCCH)

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

CDP Relative

Code domain power (relative to the total power of the signal)

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

Status

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

Remote command:
BTS measurements:
CONFigure:WCDPower[:BTS]:CTABle:DATA on page 155
UE measurements:
CONFigure:WCDPower:MS:CTABle:DATA on page 156

5.1.9 Automatic Settings

Access: "Auto Set" toolbar

Some settings can be adjusted by the R&S VSE 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.

Adjusting all Determinable Settings Automatically (Auto All)

Activates all automatic adjustment functions for the current measurement settings.

This includes:

- "Setting the Reference Level Automatically (Auto Level)" on page 61
- "Autosearch for Scrambling Code" on page 51
- "Auto Scale All" on page 81

Remote command:
[SENSe:]ADJust:ALL on page 159

Setting the Reference Level Automatically (Auto Level)

The instrument in use automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized. This function is not available on all supported instruments.

Remote command:
[SENSe:]ADJust:LEVel on page 161

Autosearch for Scrambling Code

Starts a search on the measured signal for all scrambling codes. The scrambling code that leads to the highest signal power is chosen as the new scrambling code.

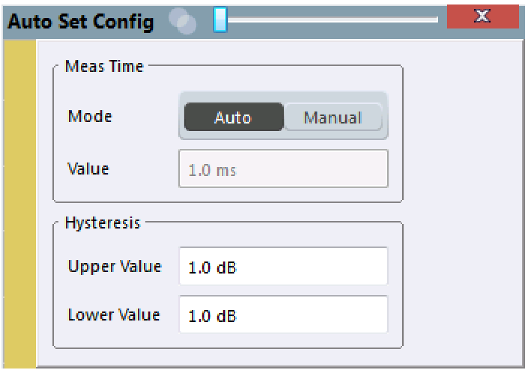
Searching requires that the correct center frequency and level are set. The scrambling code search can automatically determine the primary scrambling code number. The secondary scrambling code number is expected as 0. Alternative scrambling codes can not be detected. Therefore the range for detection is 0x0000 – 0x1FF0h, where the last digit is always 0.

Remote command:
[SENSe:]CDPower:LCODe:SEARch[:IMMediate]? on page 121

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.

Auto Settings Configuration
For some automatic settings, additional parameters can be configured. The "Auto Set Config" dialog box is available when you select the icon from the "Auto Set" toolbar.



Automatic Measurement Time Mode and Value ← Auto Settings Configuration
To determine the optimal reference level automatically, a level measurement is performed on the instrument in use. You can define whether the duration of this measurement is determined automatically or manually.

To define the duration manually, enter a value in seconds.

Remote command:
`[SENSe:]ADJust:CONFigure:DURation:MODE` on page 160
`[SENSe:]ADJust:CONFigure:DURation` on page 159

Upper Level Hysteresis ← Auto Settings Configuration
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier (if available) of the instrument in use 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.

Remote command:
`[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer` on page 160

Lower Level Hysteresis ← Auto Settings Configuration

When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier (if available) of the instrument in use 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.

Remote command:
`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 160

5.1.10 Zoom Functions

Access: "Zoom" icons in 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 205
`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 205

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 206
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 205

Restore Original Display

Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Remote command:
single zoom:
DISPlay[:WINDow<n>]:ZOOM:STATe on page 205
multiple zoom:
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe on page 206 (for each multiple zoom window)

Deactivating Zoom (Selection mode)
Deactivates any zoom mode.

Selecting a point in the display no longer invokes a zoom, but selects an object.

Remote command:
single zoom:
DISPlay[:WINDow<n>]:ZOOM:STATe on page 205
multiple zoom:
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe on page 206 (for each multiple zoom window)

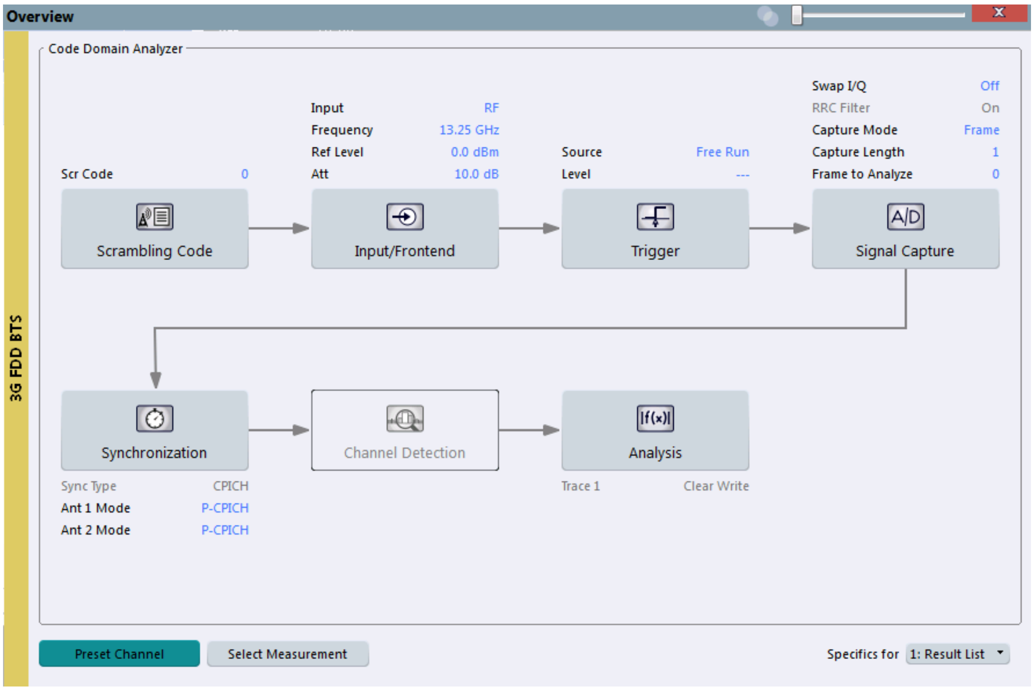
5.2 Time Alignment Error Measurements

Access: "Overview" > "Select Measurement" >

5.2.1 Configuration Overview

Access: "Meas Setup" > "Overview"

For Time Alignment Error measurements, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):



1. "Select Measurement"
   See chapter 3, "Measurements and Result Display", on page 11
2. "Scrambling Code"
   See chapter 5.1.2.2, "BTS Scrambling Code", on page 50
3. "Input/ Frontend"
   See chapter 5.1.3, "Data Input and Output Settings", on page 53
4. (Optionally:) "Trigger"
   chapter 5.1.5, "Trigger Settings", on page 65
5. "Signal Capture"
   See chapter 5.1.6, "Signal Capture (Data Acquisition)", on page 68
6. "Synchronization"
   See chapter 5.1.7, "Synchronization (BTS Measurements Only)", on page 70
7. "Analysis"
   See chapter 6, "Analysis", on page 85
8. "Display Configuration"
   See chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14 and "Evaluation Methods" on page 30

All settings required for Time Alignment Error measurements are identical to those described for Code Domain Analysis (see chapter 5.1, "Code Domain Analysis", on page 46).

6 Analysis

Access: "Overview" > "Analysis"

General result analysis settings concerning the evaluation range, trace, markers, etc. can be configured

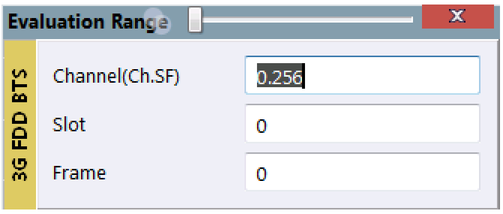
The remote commands required to perform these tasks are described in chapter 10.9, "Analysis", on page 195.

6.1 Evaluation Range

Access: "Overview" > "Analysis" > "Evaluation Range"

or: "Meas Setup" > "Evaluation Range"

The evaluation range defines which channel, slot or frame is evaluated in the result display.



Channel
Selects a channel for the following evaluations:
- Code Domain Power
- Power vs Slot
- Symbol Constellation
- Symbol EVM

Enter a channel number and spreading factor, separated by a decimal point.

The specified channel is selected and marked in red, if active. If no spreading factor is specified, the code on the basis of the spreading factor 512 is marked. For unused channels, the code resulting from the conversion is marked.

Example: Enter *5.128*

Channel 5 is marked at spreading factor 128 (30 ksps) if the channel is active, otherwise code 20 at spreading factor 512.

Remote command:
`[SENSe:]CDPower:CODE` on page 161

Slot
Selects the slot for evaluation. This affects the following evaluations (see also chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14):

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

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

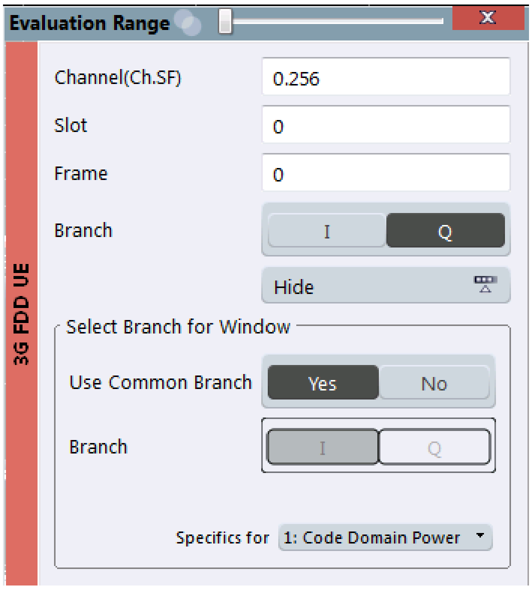
Frame To Analyze
Defines the frame to be analyzed and displayed.

Remote command:
`[SENSe:]CDPower:FRAMe[:VALue]` on page 161

Branch (UE measurements only)
Switches between the evaluation of the I and the Q branch in UE measurements.

Remote command:
`CALCulate<n>:CDPower:Mapping` on page 162

Details ← Branch (UE measurements only)
By default, the same branch is used for all evaluations. However, you can select a different branch for individual windows. These settings are only available in the detailed dialog box, which is displayed when you select the "Details" button in the "Evaluation Range" dialog box.



To hide the detailed dialog box for individual windows, select the "Hide" button.

Selecting a Different Branch for a Window ← Branch (UE measurements only)
By default, the same (common) branch is used by all windows, namely the one specified by the Branch (UE measurements only) setting.

In order to evaluate a different branch for an individual window, toggle the "Use Common Branch" setting to "No". Select the window from the list of active windows under "Specifics for", then select the "Branch".

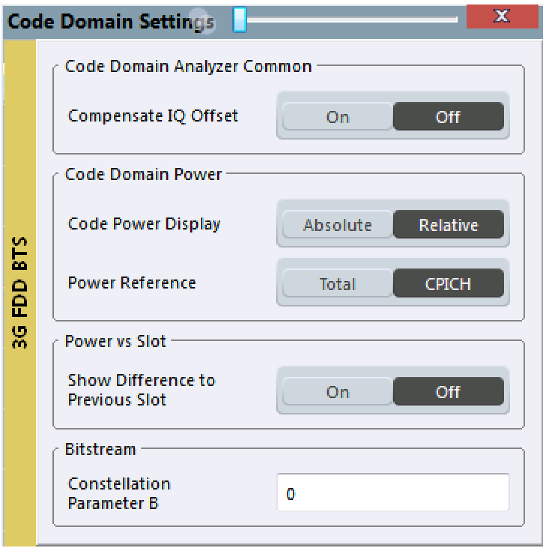
Remote command:
`CALCulate<n>:CDPower:Mapping` on page 162

6.2 Code Domain Analysis Settings (BTS Measurements)

Access: "Overview" > "Analysis" > "Code Domain Settings"

or: "Meas Setup" > "Code Domain Settings"

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



Compensate IQ Offset

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

Remote command:

`[SENSe:]CDPower:NORMalize` on page 163

Code Power Display

For Code Domain Power evaluation:

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

"TOT" Relative to the total signal power

"CPICH" Relative to the power of the CPICH

Remote command:

`[SENSe:]CDPower:PDISplay` on page 164

`[SENSe:]CDPower:PREFerence` on page 164

Show Difference to Previous Slot

For Power vs. Slot evaluation:

If enabled, the slot power difference between the current slot and the previous slot is displayed in the "Power vs. Slot" evaluation.

Remote command:

`[SENSe:]CDPower:PDIFf` on page 164

Constellation Parameter B
For Bitstream evaluation:

Defines the constellation parameter B. According to 3GPP specification, the mapping of 16QAM symbols to an assigned bitstream depends on the constellation parameter B. This parameter can be adjusted to decide which bit mapping should be used for bit-stream evaluation.

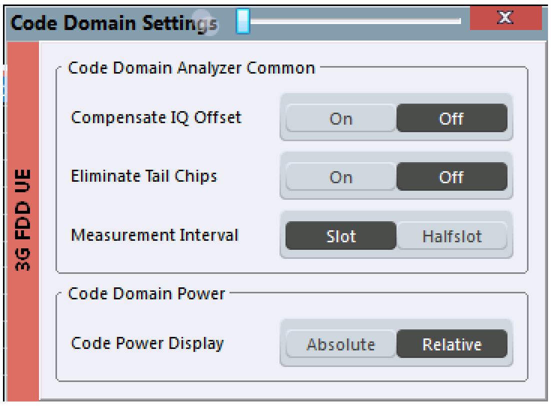
Remote command:
`[SENSe:]CDPower:CPB` on page 163

6.3 Code Domain Analysis Settings (UE Measurements)

Access: "Overview" > "Analysis" > "Code Domain Settings"

or: "Meas Setup" > "Code Domain Settings"

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



Measurement Interval
Switches between the analysis of a half slot or a full slot.

Both measurement intervals are influenced by the settings of Eliminate Tail Chips: If "Eliminate Tail Chips" is set to "On", 96 chips at both ends of the measurement interval are not taken into account for analysis.

"Slot" The length of each analysis interval is 2560 chips, corresponding to one time slot of the 3GPP signal. The time reference for the start of slot 0 is the start of a 3GPP radio frame.

"Halfslot" The length of each analysis interval is reduced to 1280 chips, corresponding to half of one time slot of the 3GPP signal.

Remote command:
`[SENSe:]CDPower:HSLot` on page 166

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 163

Eliminate Tail Chips

Selects the length of the measurement interval for calculation of error vector magnitude (EVM) in accordance with 3GPP specification Release 5.

"On" Changes of power are expected. Therefore an EVM measurement interval of one slot minus 25 µs at each end of the burst (3904 chips) is considered.

"Off" Changes of power are not expected. Therefore an EVM measurement interval of one slot (4096 chips) is considered. (Default settings)

Remote command:
[SENSe:]CDPower:ETCHips on page 165

Code Power Display

For "Code Domain Power" evaluation:

Defines whether the absolute power or the power relative to the total signal is displayed.

"Absolute" Absolute power levels

"Relative" Relative to the total signal power

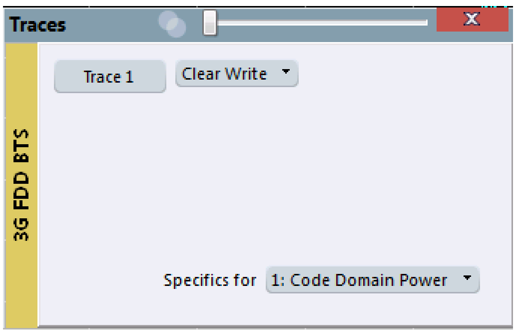
Remote command:
[SENSe:]CDPower:PDISplay on page 164

6.4 Traces

Access: "Overview" > "Analysis" > "Trace"

or: "Trace" > "Trace"

The trace settings determine how the measured data is analyzed and displayed on the screen.



In CDA evaluations, only one trace can be active in each diagram at any time.

Window-specific configuration

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

Trace Mode

Defines the update mode for subsequent traces.

"Clear Write" Overwrite mode: the trace is overwritten by each measurement. This is the default setting.

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

"Average" The average is formed over several measurements.

"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 195

6.5 Markers

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

or: "Marker"

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

Markers in Code Domain Analysis measurements

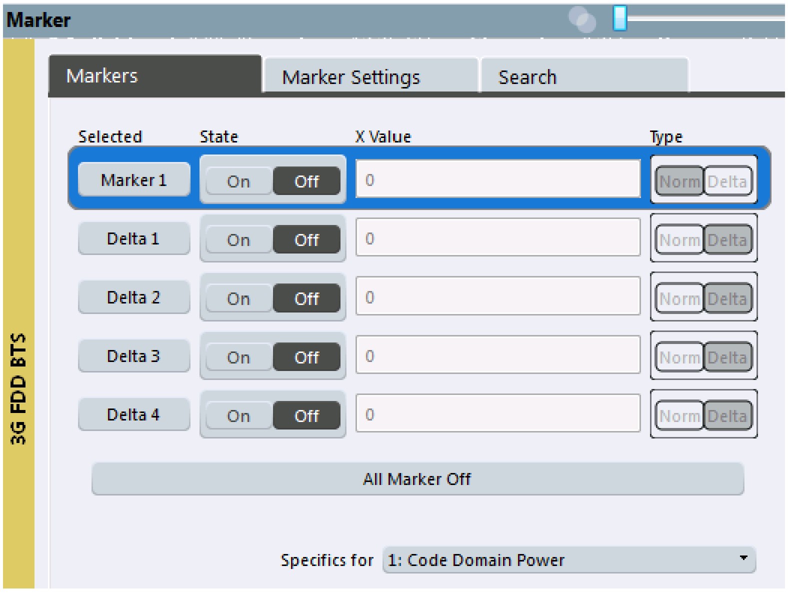
In Code Domain Analysis measurements, the markers are set to individual symbols, codes, slots or channels, depending on the result display. Thus you can use the markers to identify individual codes, for example.

6.5.1 Individual Marker Settings

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

or: "Marker" > "Marker"

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



Place New Marker

Activates the next currently unused marker and sets it to the peak value of the current trace in the current window.

Marker 1/ Delta 1/ Delta 2/.../Delta 4

When you select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker > Select Marker" menu, the marker is activated and an edit dialog box is displayed to enter the marker position ("X-value").

To deactivate a marker, select the marker name in the marker selection list in the tool-bar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off".

Marker 1 is always the default reference marker for relative measurements. If activa-ted, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Several markers can be configured very easily using the "Marker" dialog box, see chapter 6.5, "Markers", on page 91.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 197
CALCulate<n>:MARKer<m>:X on page 197
CALCulate<n>:MARKer<m>:Y? on page 197
CALCulate<n>:DELTamarker<m>[:STATe] on page 198
CALCulate<n>:DELTamarker<m>:X on page 198
CALCulate<n>:DELTamarker<m>:X:RELative? on page 199
CALCulate<n>:DELTamarker<m>:Y? on page 199

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 197
CALCulate<n>:DELTamarker<m>[:STATe] on page 198

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 198
CALCulate<n>:MARKer<m>:X on page 197

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 197
CALCulate<n>:DELTamarker<m>[:STATe] on page 198

All Markers Off

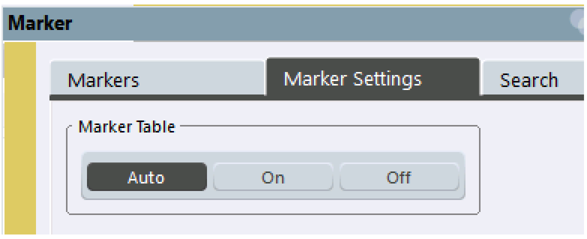
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 196

6.5.2 General Marker Settings

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

or: "Marker" > "Marker" > "Marker Settings" tab



Marker Table Display
Defines how the marker information is displayed.

"On"	Displays the marker information in a table in a separate area beneath the diagram.
"Off"	Displays the marker information within the diagram area.
"Auto"	(Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

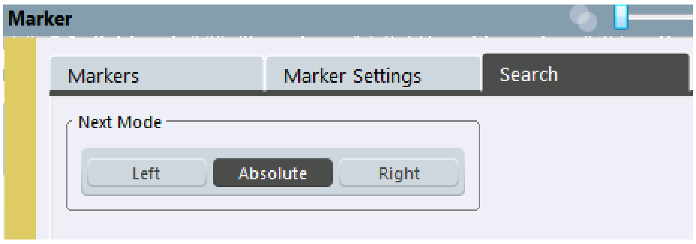
Remote command:
`DISPlay:MTABle` on page 200

6.5.3 Marker Search Settings

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

Access: "Marker" > "Search"

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.



Search Mode for Next Peak

Selects the search mode for the next peak search.

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

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

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

Remote command:
chapter 10.9.2.3, "Positioning the Marker", on page 200

6.5.4 Marker Positioning Functions

Access: "Marker" toolbar

The following functions set the currently selected marker to the result of a peak search.

Markers in Code Domain Analysis measurements

In Code Domain Analysis measurements, the markers are set to individual symbols, codes, slots or channels, depending on the result display. Thus you can use the markers to identify individual codes, for example.

Search Next Peak

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

Remote command:
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 201
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 201
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 201
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 203
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 203
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 203

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 202
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 202
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 202
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 204
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 204
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 204

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 201
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 203

Search Minimum

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

Remote command:
CALCulate<n>:MARKer<m>:MINimum[:PEAK] on page 202
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 204

Marker To CPICH

Sets the marker to the CPICH channel.

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

Marker To PCCPCH

Sets the marker to the PCCPCH channel.

Remote command:
CALCulate<n>:MARKer<m>:FUNCtion:PCCPch on page 201

7 How to Perform Measurements in 3GPP FDD Applications

The following step-by-step instructions demonstrate how to perform measurements with the 3GPP FDD applications.

To perform Code Domain Analysis

1. Open a new channel or replace an existing one and select the "3GPP FDD" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a 3GPP FDD measurement.
3. Select the "Signal Description" button and configure the expected input signal and used scrambling code.
4. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Signal Capture" button and define the acquisition parameters for the input signal.
7. If necessary, select the "Synchronization" button and change the channel synchronization settings.
8. Select the "Channel Detection" button and define how the individual channels are detected within the input signal. If necessary, define a channel table as described in "To define or edit a channel table" on page 98.
9. Select the "Add Window" icon from the toolbar to add further result displays for the 3GPP FDD channel.
10. Select "Meas Setup > Overview" to display the "Overview".
11. Select the "Analysis" button in the "Overview" to configure how the data is evaluated in the individual result displays.
    - Select the channel, slot or frame 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.
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
12. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the "Capture" function to stop the continuous measurement mode and start a defined number of measurements.

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 "Meas Setup" menu, select "Channel Detection".
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:
      - Symbol rate
      - Channel number
      - Whether TFCI is used
      - Timing offset, if applicable
      - Number of pilot bits (for DPCCH only)
      - The channel's code domain power (relative to the total signal power)
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 determine the Time Alignment Error

1. Open a new channel or replace an existing one and select the "3GPP FDD" application.
2. From the "Meas Setup" menu, select "Synchronization". Configure the location of the S-CPICH for antenna 2 and select the "Antenna Pattern".

3. Select the Time Alignment Error measurement:
   a) From the "Meas Setup" menu, select "Select Measurement".
   b) In the "Select Measurement" dialog box, select the "Time Alignment Error" button.

   The Time Alignment Error is calculated and displayed immediately.

8 Measurement Examples

Some practical examples for basic 3GPP°FDD Base station tests are provided here. They describe how operating and measurement errors can be avoided using correct presettings. The measurements are performed with R&S VSE equipped with option R&S VSE-K72.

It is assumed an instrument is connected and configured for input to the R&S VSE software.

(See the R&S VSE Base Software User Manual).

Key settings are shown as examples to avoid measurement errors. Following the correct setting, the effect of an incorrect setting is shown.

The measurements are performed using the following instruments and accessories:

- The R&S VSE with option R&S VSE-K72: 3GPP FDD measurements
- An R&S FSW Signal and Spectrum Analyzer
- The Vector Signal Generator R&S SMW200A with option R&S SMW-K42: digital standard 3GPP FDD (requires options R&S SMW-B10, R&S SMW-B13 and R&S SMW-B103)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

The following measurements are described:

8.1 Measurement 1: Measuring the Relative Code Domain Power

A code domain power measurement on one of the channel configurations is shown in the following. Basic parameters of CDP analysis are changed to demonstrate the effects of values that are not adapted to the input signal.

Test setup

1. Connect the RF A output of the R&S SMW200A to the RF input of the R&S FSW (coaxial cable with N connectors).
2. Connect the reference input (REF INPUT) on the rear panel of the R&S FSW to the reference output (REF OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).

Settings on the R&S SMW200A

1. PRESET
2. "Freq. A" = *2.1175 GHz*
3. "Level"= *0 dBm*
4. "Baseband A > CDMA Standards > 3GPP FDD"
5. "General" tab: "Link Direction > DOWN/FORWARD"
6. "Basestations" tab: "Test Setups/Models > Test_Model_1_16_channels"
7. "Basestations" tab: "Select Basestation > BS 1 > ON"
8. "General" tab: "3GPP FDD > STATE > ON"
9. "RF A": "On"

Settings in the R&S VSE

1. "File > Preset > All"
2. "Measurement Group Setup": "Replace Channel > 3GPP FDD BTS"
3. "Input and Output > Amplitude": "Reference level"= *10 dBm*
4. "Input and Output > Frequency": "Center frequency" = *2.1175 GHz*
5. "Input and Output > Scale": "Auto Scale Once"

Result

Window 1 shows the Code Domain Power of the signal.

Window 2 shows the Result Summary, i.e. the numeric results of the CDP measurement.

Fig. 8-1: Measurement Example 1: Measuring the Relative Code Domain Power

8.1.1 Synchronizing the Reference Frequencies

The synchronization of the reference oscillators both of the DUT and the R&S FSW strongly reduces the measured frequency error.

Test setup

► Connect the reference input (REF INPUT (1...20 MHZ)) on the rear panel of the R&S FSW to the reference output (REF OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).

Settings on the R&S SMW200A

The settings on the R&S SMW200A remain the same.

Settings in the R&S VSE

In addition to the settings of the basic test, activate the use of an external reference:

► "Instruments > Info & Settings > Reference": "Reference Frequency Input = External Reference 10 MHz"

The displayed carrier frequency error should be < 10 Hz.

8.1.2 Behaviour with Deviating Center Frequency

In the following, the behaviour of the DUT and the R&S FSW with an incorrect center frequency setting is shown.

1. Tune the center frequency of the signal generator in 0.5 kHz steps.
2. Watch the measurement results in the R&S VSE:
   - Up to 5 kHz, a frequency error causes no apparent difference in measurement accuracy of the code domain power measurement.
   - Above a frequency error of 5 kHz, the probability of an impaired synchronization increases. With continuous measurements, at times all channels are displayed in blue with almost the same level.
   - Above a frequency error of approx. 7 kHz, a CDP measurement cannot be performed. The R&S VSE displays all possible codes in blue with a similar level.

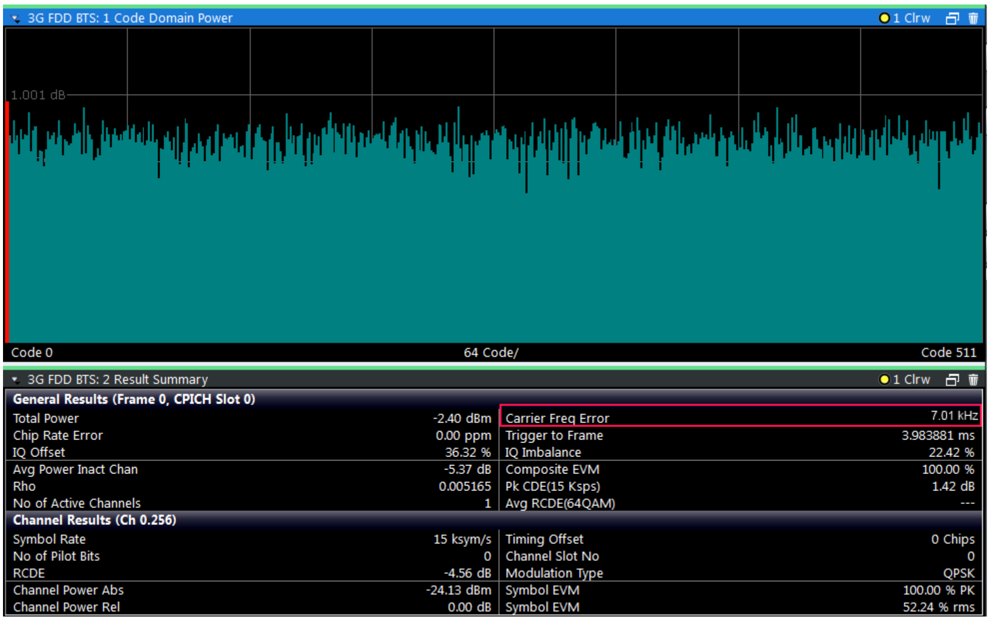


Fig. 8-2: Measurement Example 1: Measuring the Relative Code Domain Power with Incorrect Center Frequency

3. Reset the frequency to *2.1175 GHz* both on the R&S SMW200A and in the R&S VSE software.

8.1.3 Behaviour with Incorrect Scrambling Code

A valid CDP measurement can be carried out only if the scrambling code set in the R&S VSE is identical to that of the transmitted signal.

Settings on the R&S SMW200A

- "Basestationss" tab > BS 1 > "Common" tab: "Scrambling Code (hex)" = *0000*

Settings in the R&S VSE

- "Meas Setup > Scrambling Code" = *0001*

Result

The CDP display shows all possible codes with approximately the same level.

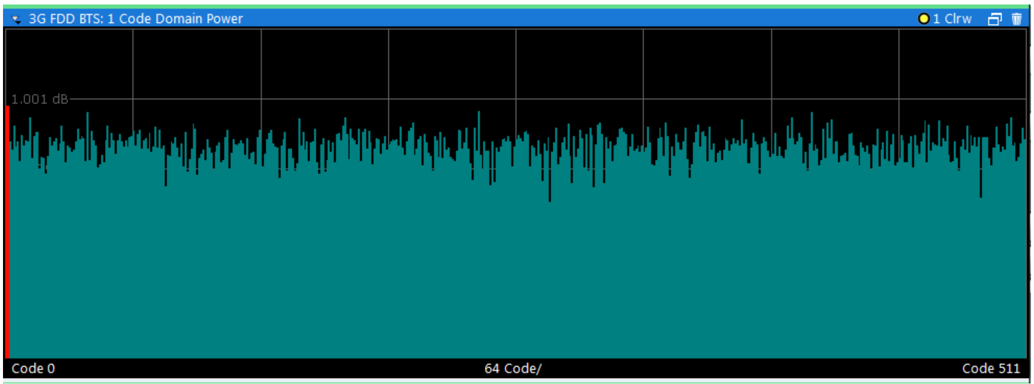


Fig. 8-3: Measurement Example 1: Measuring the Relative Code Domain Power with Incorrect Scrambling Code

8.2 Measurement 2: Triggered Measurement of Relative Code Domain Power

If the code domain power measurement is performed without external triggering, a section of approximately 20 ms of the test signal is recorded at an arbitrary moment to detect the start of a 3GPP FDD BTS frame in this section. Depending on the position of the frame start, the required computing time can be quite long. Applying an external (frame) trigger can reduce the computing time.

Test setup

1. Connect the RF A output of the R&S SMW200A 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 OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output USER 1 of the R&S SMW200A.

Settings on the R&S SMW200A

1. PRESET
2. "Freq. A" = *2.1175 GHz*
3. "Level"= *0 dBm*

4. "Baseband A > CDMA Standards > 3GPP FDD"
5. "General" tab: "Link Direction > DOWN/FORWARD"
6. "Basestations" tab: "Test Setups/Models > Test_Model_1_16_channels"
7. "Basestations" tab: "Select Basestation > BS 1 > ON"
8. "General" tab: "3GPP FDD > STATE > ON"
9. "RF A": "On"

Settings in the R&S VSE

1. "File > Preset > All"
2. "Measurement Group Setup": "Replace Channel > 3GPP FDD BTS"
3. "Input and Output > Amplitude": "Reference level"= *10 dBm*
4. "Input and Output > Frequency": "Center frequency" = *2.1175 GHz*
5. "Meas Setup > Scrambling Code" = *0000*
6. "Input and Output > Trigger": "Trigger Source: External Trigger 1"
7. "Input and Output > Scale": "Auto Scale Once"

Results

The following is displayed:

- Window 1: Code Domain Power of signal
- Window 2: Result Summery, including the "Trigger to Frame", i.e. offset between trigger event and start of 3GPP FDD BTS frame

Fig. 8-4: Measurement Example 2: Triggered Measurement of Relative Code Domain Power

The repetition rate of the measurement increases considerably compared to the repetition rate of a measurement without an external trigger.

Trigger Offset

A delay of the trigger event referenced to the start of the 3GPP FDD BTS frame can be compensated by modifying the trigger offset.

► Setting in the R&S VSE:
"Input and Output > Trigger""Trigger Offset" = *100 µs*

The "Trigger to Frame" parameter in the Result Summary (Window 2) changes: "Trigger to Frame" = -100 µs

8.3 Measurement 3: Measuring the Composite EVM

The 3GPP specification defines the composite EVM measurement as the average square deviation of the total signal.

An ideal reference signal is generated from the demodulated data. The test signal and the reference signal are compared with each other. The square deviation yields the composite EVM.

Test setup

1. Connect the RF A output of the R&S SMW200A 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 OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output USER 1 of the R&S SMW200A.

Settings on the R&S SMW200A

1. PRESET
2. "Freq. A" = *2.1175 GHz*
3. "Level"= *0 dBm*
4. "Baseband A > CDMA Standards > 3GPP FDD"
5. "General" tab: "Link Direction > DOWN/FORWARD"
6. "Basestations" tab: "Test Setups/Models > Test_Model_1_16_channels"
7. "Basestations" tab: "Select Basestation > BS 1 > ON"
8. "General" tab: "3GPP FDD > STATE > ON"
9. "RF A": "On"

Settings in the R&S VSE

1. "File > Preset > All"
2. "Measurement Group Setup": "Replace Channel > 3GPP FDD BTS"
3. "Input and Output > Amplitude": "Reference level"= *10 dBm*
4. "Input and Output > Frequency": "Center frequency" = *2.1175 GHz*
5. "Meas Setup > Scrambling Code" = *0000*
6. "Input and Output > Trigger": "Trigger Source: External Trigger 1"
7. Replace the Result Summary display by a Composite EVM display:
   a) Select the "Delete" icon from the Result Summary window title bar.
   b) Select the "Add Window" icon from the toolbar.
   c) Select the "Composite EVM" result display.
8. "Input and Output > Scale": "Auto Scale Once"

Results

The following is displayed:

- Window 1: Code Domain Power of signal
- Window 2: Composite EVM (EVM for total signal)

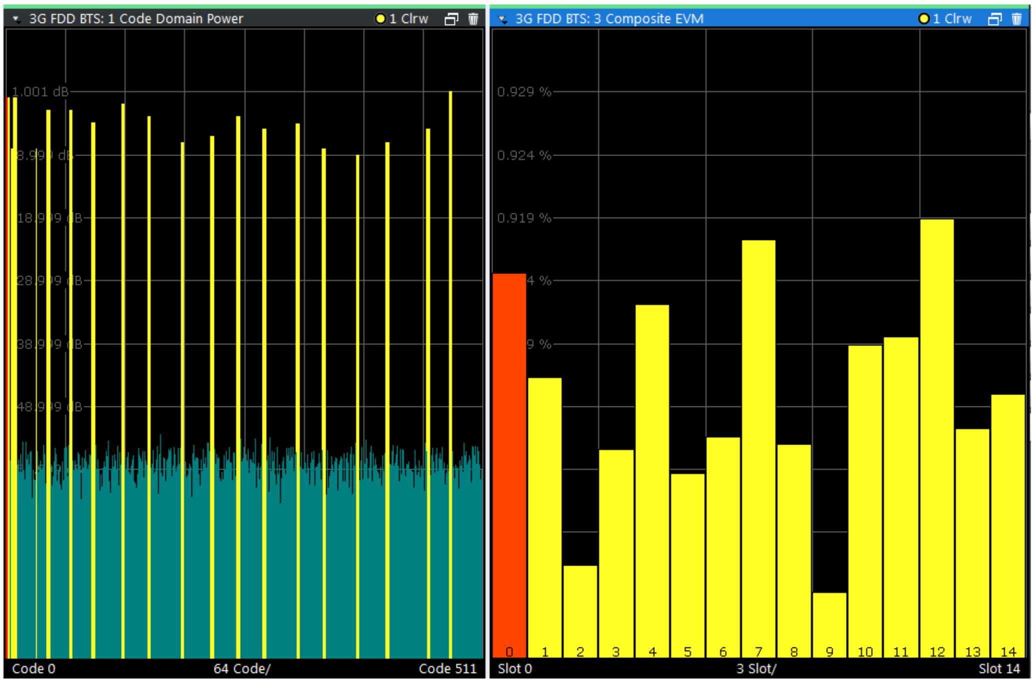


Fig. 8-5: Measurement Example 3: Measuring the Composite EVM

8.4 Measurement 4: Determining the Peak Code Domain Error

The peak code domain error measurement is defined in the 3GPP specification for FDD signals.

An ideal reference signal is generated from the demodulated data. The test signal and the reference signal are compared with each other. The difference of the two signals is projected onto the classes of the different spreading factors. The peak code domain error measurement is obtained by summing up the symbols of each difference signal slot and searching for the maximum error code.

Test setup

1. Connect the RF A output of the R&S SMW200A 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 OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output USER 1 of the R&S SMW200A.

Settings on the R&S SMW200A

1. PRESET

2. "Freq. A" = *2.1175 GHz*
3. "Level"= *0 dBm*
4. "Baseband A > CDMA Standards > 3GPP FDD"
5. "General" tab: "Link Direction > DOWN/FORWARD"
6. "Basestations" tab: "Test Setups/Models > Test_Model_1_16_channels"
7. "Basestations" tab: "Select Basestation > BS 1 > ON"
8. "General" tab: "3GPP FDD > STATE > ON"
9. "RF A": "On"

Settings in the R&S VSE

1. "File > Preset > All"
2. "Measurement Group Setup": "Replace Channel > 3GPP FDD BTS"
3. "Input and Output > Amplitude": "Reference level"= *0 dBm*
4. "Input and Output > Frequency": "Center frequency" = *2.1175 GHz*
5. "Meas Setup > Scrambling Code" = *0000*
6. "Input and Output > Trigger": "Trigger Source: External Trigger 1"
7. Replace the Composite EVM display by a Peak Code Domain Error display:
   a) Select the "Change window" icon from the Composite EVM window title bar.
   b) Select the "Peak Code Domain Error" result display.
8. "Input and Output > Scale": "Auto Scale Once"

Results

The following is displayed:

- Window 1: Code Domain Power of signal
- Window 2: Peak Code Domain Error (projection of error onto the class with spreading factor 256)

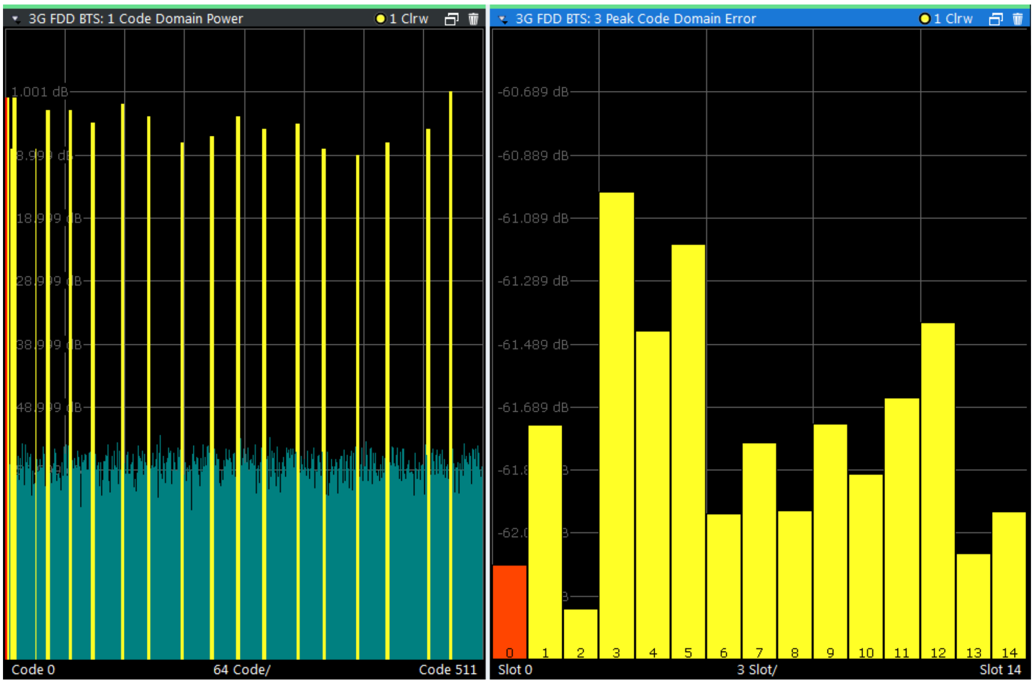


Fig. 8-6: Measurement Example 4: Determining the Peak Code Domain Error

9 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 frequency.
- Check the reference level.
- Check the scrambling code.
- When using an external trigger, check whether an external trigger is being sent to the instrument in use.

9.1 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 device-specific error messages for the 3GPP FDD applications 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, scrambling code, Invert Q values are set incorrectly, or the input signal is invalid.
Sync OK	This message is displayed if synchronization is possible.
Incorrect pilot symbols	This message is displayed if one or more of the received pilot symbols are not equal to the specified pilot symbols of the 3GPP standard. Possible causes are: • Incorrectly sent pilot symbols in the received frame. • Low signal to noise ratio (SNR) of the W-CDMA signal. • One or more code channels have a significantly lower power level compared to the total power. The incorrect pilots are detected in these channels because of low channel SNR. • One or more channels are sent with high power ramping. In slots with low relative power to total power, the pilot symbols might be detected incorrectly (check the signal quality by using the symbol constellation display

10 Remote Commands for 3GPP FDD Measurements

The following commands are required to perform measurements in R&S VSE 3GPP FDD Measurements applications in a remote environment.

It is assumed that the R&S VSE has already been set up for remote control in a network as described in the R&S VSE Base Software User Manual.

General R&S VSE Remote Commands

The application-independent remote commands for general tasks on the R&S VSE are also available for 3GPP FDD measurements and are described in the R&S VSE User Manual. In particular, this comprises the following functionality:

- Controlling instruments and capturing data
- Managing Settings and Results
- Setting Up the Instrument
- Using the Status Register

Channel-specific commands

Apart from a few general commands on the R&S VSE, most commands refer to the currently active channel. Thus, always remember to activate a 3GPP FDD channel before starting a remote program for a 3GPP FDD measurement.

After a short introduction, the tasks specific to the 3GPP FDD application are described here:

10.1 Introduction

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

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

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

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

Remote command examples

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

10.1.1 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 VSE 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.

10.1.2 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`.

10.1.3 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.

10.1.4 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.

10.1.5 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`.

10.1.6 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.

10.1.6.1 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.

10.1.6.2 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`

10.1.6.3 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 10.1.2, "Long and Short Form", on page 114.

Querying text parameters

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

Example:

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

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

10.1.6.4 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'`

10.1.6.5 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.

10.2 Common Suffixes

In 3GPP FDD applications, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<n>	1..x	Window
<t>	1	Trace
<m>	1..4	Marker

10.3 Activating 3GPP FDD Measurements

3GPP FDD measurements require a special application in the R&S VSE. The common commands for configuring and controlling measurement channels, as well as blocks and sequences, are also used in the R&S VSE 3GPP FDD Measurements application.

They are described in the R&S VSE Base Software User Manual.

10.4 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 Display", on page 11.

CONFigure:WCDPower[:BTS]:MEASurement <Type>

This command selects the type of 3GPP FDD BTS base station tests.

Parameters:

<Type>

WCDPower
Code domain power measurement. This selection has the same effect as command `INSTrument:SELect BWCD`

TAERror
Time Alignment Error measurement

*RST: WCDPower

Example: `CONF:WCDP:MEAS TAE`

Mode: BTS application only

Manual operation: See "Result List" on page 30
See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 75

CONFigure:WCDPower:MS:MEASurement <Type>

This command selects the 3GPP FDD UE user equipment tests.

Parameters:

<Type>

WCDPower
Code domain power measurement. This selection has the same effect as command `INSTrument:SELect MWCD`

*RST: WCDPower

Example: `CONF:WCDP:MS:MEAS TAE`

Mode: UE application only

Manual operation: See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 75

10.5 Restoring the Default Configuration (Preset)

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default software 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 48

10.6 Configuring Code Domain Analysis and Time Alignment Error Measurements

The following commands are required to configure Code Domain Analysis and Time Alignment Error measurements.

10.6.1 Signal Description

The signal description provides information on the expected input signal.

10.6.1.1 BTS Signal Description

The following commands describe the input signal in BTS measurements.

[SENSe:]CDPower:ANTenna <Mode>

This command activates or deactivates the antenna diversity mode and selects the antenna to be used.

Parameters:

<Mode> OFF | 1 | 2

*RST: OFF

Example: `CDP:ANT 1`

Mode: BTS application only

Manual operation: See "Antenna Diversity" on page 50
See "Antenna Number" on page 50
See "Antenna1 / Antenna2" on page 71

[SENSe:]CDPower:HSDPamode <State>

This command defines whether the HS-DPCCH channel is searched or not.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The high speed channels can be detected. A detection of the modulation type (QPSK /16QAM) is done instead of a detection of pilot symbols.

OFF | 0
The high speed channel can not be detected. A detection of pilot symbols is done instead a detection of the modulation type (QPSK /16QAM)

*RST: 1

Example: `SENS:CDP:HSDP OFF`

Manual operation: See "HSDPA/UPA" on page 49

[SENSe:]CDPower:LCODe:SEARch[:IMMediate]?

This command automatically searches for the scrambling codes that lead to the highest signal power. The code with the highest power is stored as the new scrambling code for further measurements.

Searching requires that the correct center frequency and level are set. The scrambling code search can automatically determine the primary scrambling code number. The secondary scrambling code number is expected as 0. Alternative scrambling codes can not be detected. Therefore the range for detection is 0x0000 – 0x1FF0h, where the last digit is always 0.

If the search is successful (PASS), a code was found and can be queried using `[SENSe:]CDPower:LCODe:SEARch:LIST?`.

Parameters:

<Status>
: **PASSed**
Scrambling code(s) found.
FAILed
No scrambling code found.

Example: `SENS:CDP:LCOD:SEAR?`
Searches the scrambling code that leads to the highest signal power and returns the status of the search.

Usage: Query only

Mode: BTS application only

Manual operation: See "Autosearch for Scrambling Code" on page 51

[SENSe:]CDPower:LCODe:SEARch:LIST?

This command returns the automatic search sequence (see `[SENSe:]CDPower:LCODe:SEARch[:IMMediate]?` on page 121) as a comma-separated list of results for each detected scrambling code.

Return values:

<Code1>
: Scrambling code in decimal format.
Range: 16 * n, with n = 0...511

<Code2>
: Scrambling code in hexadecimal format.
Range: 0x0000h – 0x1FF0h, where the last digit is always 0

<CPICHPower>
: Highest power value for the corresponding scrambling code.

Example: `SENS:CDP:LCOD:SEAR:LIST?`
Result:
`16,0x10,-18.04,32,0x20,-22.87,48,0x30,-27.62,64,0x40,-29.46`
(Explanation in table below)

Usage: Query only

Mode: BTS application only

Manual operation: See "Scrambling Codes" on page 51

Table 10-1: Description of query results in example:

Code (dec)	Code(hex)	CPICH power (dBm)
16	0x10	-18.04
32	0x20	-22.87
48	0x30	-27.62
64	0x40	-29.46

[SENSe:]CDPower:MIMO <State>

Activates or deactivates single antenna MIMO measurement mode.

Channels that have modulation type MIMO-QPSK or MIMO-16QAM are only recognized as active channels if this setting is `ON`.

For details see "MIMO" on page 50.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SENS:CDP:MIMO ON`

Mode: BTS application only

Manual operation: See "MIMO" on page 50

[SENSe:]CDPower:PCONtrol <Position>

This command determines the power control measurement position. An enhanced channel search is used to consider the properties of compressed mode channels.

Parameters:

<Position> SLOT | PILot

SLOT
The slot power is averaged from the beginning of the slot to the end of the slot.

PILot
The slot power is averaged from the beginning of the pilot symbols of the previous slot to the beginning of the pilot symbols of the current slot.

*RST: PILot

Example: `SENS:CDP:PCON SLOT`
Switch to power averaging from slot start to the end of the slot.
An enhanced channel search is used to consider the properties of compressed mode channels.
`SENS:CDP:PCON PIL`
Switch to power averaging from the pilot symbols of the previous slot number to the start of the pilots of the displayed slot number.
The channel search only considers standard channels.

Mode: BTS application only

Manual operation: See "Compressed Mode" on page 50

10.6.1.2 BTS Scrambling Code

The scrambling code identifies the base station transmitting the signal in BTS measurements.

[SENSe:]CDPower:LCODe:DVALue <ScramblingCode>

This command defines the scrambling code in decimal format.

Parameters:
<ScramblingCode> <numeric value>
*RST: 0

Example: `SENS:CDP:LCOD:DVAL 3`
Defines the scrambling code in decimal format.

Manual operation: See "Scrambling Code" on page 51
See "Format Hex/Dec" on page 51
See "Format" on page 53

[SENSe:]CDPower:LCODe[:VALue] <ScramblingCode>

This command defines the scrambling code in hexadecimal format.

Parameters:
<ScramblingCode> Range: #H0 to #H1fff
*RST: #H0

Example: `SENS:CDP:LCOD #H2`
Defines the scrambling code in hexadecimal format.

Manual operation: See "Format Hex/Dec" on page 51
See "Scrambling Code" on page 52

10.6.1.3 UE Signal Description

The following commands describe the input signal in UE measurements.

Useful commands for describing UE signals described elsewhere:

- `[SENSe:]CDPower:LCODe[:VALue]` on page 123
- `[SENSe:]CDPower:HSDPamode` on page 120

Remote commands exclusive to describing UE signals:

[SENSe:]CDPower:LCODe:TYPE <Type>

This command switches between long and short scrambling code.

Parameters:

<Type> LONG | SHORt

*RST: LONG

Example: `CDP:LCOD:TYPE SHOR`

Mode: UE application only

Manual operation: See "Type" on page 53

[SENSe:]CDPower:QPSK <State>

If enabled, it is assumed that the signal uses QPSK modulation only. Thus, no synchronization is required and the measurement can be performed with optimized settings and speed.

Parameters:

<State> ON | OFF

*RST: OFF

Mode: BTS application only

Manual operation: See "QPSK Modulation Only" on page 53

[SENSe:]CDPower:SFACtor <SpreadingFactor>

This command defines the spreading factor. The spreading factor is only significant for Peak Code Domain Error evaluation.

Parameters:

<SpreadingFactor> 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512

*RST: 512

Example: `SENS:CDP:SFACtor 16`

10.6.2 Configuring the Data Input and Output

10.6.2.1 RF Input

INPut:ATTenuation:PROTection[:STATe] <State>

This command turns the availability of attenuation levels of 10 dB or less on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:ATT:PROT ON`

Manual operation: See "10 dB Minimum Attenuation" on page 56

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**

AC coupling

DC

DC coupling

*RST: AC

Example: `INP:COUP DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 54

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 instrument in use in order to measure the harmonics for a DUT, for example.

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

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

Parameters:

<State> ON | OFF
*RST: OFF

Example: `INP:FILT:HPAS ON`
Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 55

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 55.

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

Manual operation: See "YIG-Preselector" on page 55

INPut:IMPedance <Impedance>

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

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:

<Impedance> 50 | 75
*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 55

INPut:PRESelection:SET <Mode>

This command selects the preselector mode.

The command is available with the optional preselector.

Parameters:

<Mode>

NARRow
Performs a measurement by automatically applying all available combinations of low and high pass filters consecutively. These combinations all have a narrow bandwidth.

WIDE
Performs a measurement by automatically applying all available bandpass filters consecutively. The bandpass filters have a wide bandwidth.

Manual operation: See "Preselector Mode" on page 56

INPut:PRESelection[:STATe] <State>

This command turns the preselector on and off.

Manual operation: See "Preselector State" on page 55

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 VSE.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file

*RST: RF

Manual operation: See "Input Type" on page 54

INPut:TYPE <Input>

The command selects the signal source.

Parameters:

<Input>

INPUT1
Selects RF input 1.

INPUT2
Selects RF input 2.

*RST: INPUT1

Example:

```
INP:TYPE INPUT1
```

Selects RF input 1.

Manual operation: See "Input Selection" on page 56

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce <Type>

Selects an instrument or a file as the source of input provided to the channel.

Parameters:

<Type> FILE | DEVice | NONE

FILE
A loaded file is used for input.

DEVice
A configured device provides input for the measurement

NONE
No input source defined.

Manual operation: See "Input Type" on page 54

10.6.2.2 Configuring the Outputs

Configuring trigger input/output is described in chapter 10.6.4.2, "Configuring the Trigger Output", on page 139.

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the instrument in use on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 58

10.6.3 Frontend Configuration

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

10.6.3.1 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 64

[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 129.

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 64

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

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

In time domain (zero span) measurements, the center frequency is coupled to the RBW.

Parameters:

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

Example: `FREQ:CENT:STEP:AUTO ON`
Activates the coupling of the step size to the span.

[SENSe:]FREQuency: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 65.

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 65

10.6.3.2 Amplitude Settings

The following commands are required to configure the amplitude settings in a remote environment.

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 125
- `INPut:IMPedance` on page 126
- `[SENSe:]ADJust:LEVel` on page 161

Remote commands exclusive to amplitude settings:

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

Automatic scaling of the y-axis is performed once, then switched off again (for all traces, <t> is irrelevant).

Usage: SCPI confirmed

Manual operation: See "Auto Scale Once" on page 63

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

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

The suffix <t> is irrelevant.

Parameters:

<Value> <numeric value>

*RST: depends on the result display

The unit and range depend on the result display.

Example:

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Y-Maximum, Y-Minimum" on page 63

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

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

The suffix <t> is irrelevant.

Parameters:

<Value> <numeric value>

*RST: depends on the result display

The unit and range depend on the result display.

Example:

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Y-Maximum, Y-Minimum" on page 63

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

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

The suffix <t> is irrelevant.

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division
(For example 10 dB in the Code Domain Power result display.)

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level (for all traces, <t> is irrelevant).

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 60

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

This command defines a reference level offset (for all traces, <t> is irrelevant).

Parameters:

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

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

Manual operation: See "Shifting the Display (Offset)" on page 60

INPut:GAIN:STATe <State>

This command turns the preamplifier on the instrument in use on and off. It requires the additional preamplifiier hardware option on the connected instrument.

Depending on the instrument in use, the preamplification is defined by `INPut:GAIN[:VALue]`.

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

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

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 62

INPut:GAIN[:VALue] <Gain>

This command selects the gain level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 132).

The command requires the additional preamplifier hardware option.

Parameters:
<Gain> 15 dB | 30 dB
The availability of gain levels depends on the model of the instrument in use.
*RST: OFF

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

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 62

10.6.3.3 Configuring the Attenuation

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:
<Attenuation> Range: see 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 61

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 VSE determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

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 61

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 134).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

This command requires the electronic attenuation hardware option.

Parameters:

<Attenuation> attenuation in dB

Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual operation: See "Using Electronic Attenuation" on page 61

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

This command requires the electronic attenuation hardware option.

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

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 61

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

This command requires the electronic attenuation hardware option.

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" on page 61

10.6.4 Configuring Triggered Measurements

The following commands are required to configure a triggered measurement in a remote environment.

The tasks for manual operation are described inchapter 5.1.5, "Trigger Settings", on page 65

Note that the availability of trigger settings depends on the instrument in use.

The `*OPC` command should be used after commands that retrieve data so that subsequent commands to change the selected trigger source are held off until after the sweep is completed and the data has been returned.

10.6.4.1 Configuring the Triggering Conditions

The following commands are required to configure a triggered measurement.

Note that the availability of trigger sources depends on the instrument in use.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

Parameters:

<DropoutTime> Dropout time of the trigger.

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

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

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

Parameters:

<Offset> *RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 66

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example:

`TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

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.

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on 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 66

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -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]:SLOPe <Type>

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 67

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note that the availability of trigger sources depends on the instrument in use.

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

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding TRIGGER INPUT/OUTPUT connector on the instrument in use, or the oscilloscope's corresponding input channel.
For details on the connectors see the instrument's Getting Started manual.

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)

IFPower
Second intermediate frequency
(For frequency and time domain measurements only.)

MAGNitude
For (offline) input from a file, rather than an instrument. Triggers on a specified signal level.

*RST: IMMediate

Example:
`TRIG:SOUR EXT`
Selects the external trigger input as source of the trigger signal

Manual operation:
See "Trigger Source" on page 66
See "Free Run" on page 66
See "External Trigger<X>" on page 66

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval> 2.0 ms to 5000

Range: 2 ms to 5000 s
*RST: 1.0 s

Example:
`TRIG:SOUR TIME`
Selects the time trigger input for triggering.
`TRIG:TIME:RINT 50`
The measurement starts every 50 s.

10.6.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors on the instrument in use.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:
<port>

Parameters:
<Direction>

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 58

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.

Parameters:
<Level>

HIGH
TTL signal.

LOW
0 V

*RST: LOW

Manual operation: See "Trigger 2/3" on page 58
See "Level" on page 59

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.

Parameters:

<OutputType>

DEVice
Sends a trigger signal when the R&S VSE 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 58

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.

Usage: Event

Manual operation: See "Send Trigger" on page 59

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.

Parameters:
<Length> Pulse length in seconds.

Manual operation: See "Pulse Length" on page 59

10.6.5 Signal Capturing

The following commands are required to configure how much and how data is captured from the input signal.

Useful commands for configuring data acquisition described elsewhere:

- `[SENSe:]CDPower:FRAMe[:VALue]` on page 161

Remote commands exclusive to signal capturing:

[SENSe:]CDPower:BASE <BaseValue>

This command defines the base of the CDP analysis.

Parameters:

<BaseValue> SLOT | FRAMe

SLOT
Only one slot of the signal is analyzed.

FRAMe
The complete 3GPP frame is analyzed.

*RST: FRAMe

Example: `CDP:BASE SLOT`

Manual operation: See "Capture Mode" on page 69

[SENSe:]CDPower:FILTer[:STATe] <State>

This command selects if a root raised cosine (RRC) receiver filter is used or not. This feature is useful if the RRC filter is implemented in the device under test (DUT).

Parameters:

<State>

ON | 1
If an unfiltered signal is received (normal case), the RRC filter should be used to get a correct signal demodulation.

OFF | 0
If a filtered signal is received, the RRC filter should not be used to get a correct signal demodulation. This is the case if the DUT filters the signal.

*RST: 1

Example: `SENS:CDP:FILT:STAT OFF`

Manual operation: See "RRC Filter State" on page 69

[SENSe:]CDPower:IQLength <CaptureLength>

This command specifies the number of frames that are captured by one sweep.

Parameters:

<CaptureLength> Range: 1 to 100
*RST: 1

Example: `SENS:CDP:IQLength 3`

Manual operation: See "Capture Length (Frames)" on page 69

[SENSe:]CDPower:QINVert <State>

This command inverts the Q-branch of the signal.

Parameters:

ON | OFF *RST: OFF

Example: `CDP:QINV ON`
Activates inversion of Q-branch

Manual operation: See "Invert Q" on page 69

[SENSe:]CDPower:SBANd <NORMal | INVers>

This command is used to swap the left and right sideband.

Parameters:

<NORMal | INVers> *RST: NORM

Example: `CDP:SBAN INV`
Switches the right and left sideband.

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

This command defines the number of measurements that the application uses to average traces.

In case of continuous measurement mode, the application calculates the moving average over the average count.

In case of single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> When you set a capture count of 0 or 1, the R&S VSE performs one single measurement in single measurement mode.
In continuous measurement mode, if the capture count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

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

Usage: SCPI confirmed

Manual operation: See "Capture / Average Count" on page 69

10.6.6 Synchronization

For BTS tests, the individual channels in the input signal need to be synchronized to detect timing offsets in the slot spacings. These commands are described here. they are only available in the 3GPP FDD BTS application

Useful commands for synchronization described elsewhere:

- [SENSe:]CDPower:ANTenna on page 120

Remote commands exclusive to synchronization:

[SENSe:]CDPower:UCPich:ANT<antenna>:CODE <CodeNumber>

This command sets the code number of the user defined CPICH used for signal analysis.

Note: this command is equivalent to the command [SENSe:]CDPower:UCPich:CODE on page 211 for antenna 1.

Suffix:

<antenna>	1 | 2 Antenna to be configured	

Parameters:

<CodeNumber>	Range:	0 to 225
	*RST:	0

Example: `SENS:CDP:UCP:ANT2:CODE 10`

Mode: BTS application only

Manual operation: See "S-CPICH Code Nr" on page 71

[SENSe:]CDPower:UCPich:ANT<antenna>:PATTern <Pattern>

This command defines which pattern is used for signal analysis for the user-defined CPICH (see [SENSe:]CDPower:UCPich:ANT<antenna>[:STATe] on page 145).

Note: this command is equivalent to the command [SENSe:]CDPower:UCPich:PATTern on page 211 for antenna 1.

Suffix:

<antenna>	1 | 2 Antenna to be configured

Parameters:

<Pattern> 1 | 2

1
fixed usage of "Pattern 1" according to standard

2
fixed usage of "Pattern 2" according to standard

*RST: 2

Example: `SENS:CDP:UCP:ANT2:PATT 1`

Mode: BTS application only

Manual operation: See "S-CPICH Antenna Pattern" on page 71

[SENSe:]CDPower:UCPich:ANT<antenna>[:STATe] <State>

Defines whether the common pilot channel (CPICH) is defined by a user-defined position instead of its default position.

Note: this command is equivalent to the command `[SENSe:]CDPower:UCPich[:STATe]` on page 212 for antenna 1.

Suffix:

<antenna> 1 | 2
Antenna to be configured

Parameters:

<State>

0
Standard configuration (CPICH is always on channel 0)

1
User-defined configuration, position defined using `[SENSe:]CDPower:UCPich:ANT<antenna>:CODE` on page 144.

*RST: 0

Example: `SENS:CDP:CPIC:ANT2:STAT 1`

Mode: BTS application only

Manual operation: See "CPICH Mode" on page 71

[SENSe:]CDPower:STYPe <Type>

This command selects the type of synchronization.

Parameters:
<Type> CPICh | SCHannel

CPICh
Synchronization is carried out to CPICH. For this type of synchronization, the CPICH must be available in the input signal.

SCHannel
Synchronization is carried out without CPICh. This type of synchronization is required for test model 4 without CPICH.

*RST: CPICh

Example: `SENS:CDP:STYP SCH`

Mode: BTS application only

Manual operation: See "Synchronization Type" on page 70

10.6.7 Channel Detection

The channel detection settings determine which channels are found in the input signal. The commands for working with channel tables are described here.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, the following abbreviations and assignments to a numeric value are used:

Table 10-2: BTS channel types and their assignment to a numeric parameter value

Param.	Channel type	Description
0	DPCH	**D**edicated **P**hysical **Ch**annel of a standard frame
1	PICH	**P**aging **I**ndication **Ch**annel
2	CPICH	**C**ommon **Pi**lot **Ch**annel
3	PSCH	**P**rimary **S**ynchronization **Ch**annel
4	SSCH	**S**econdary **S**ynchronization **Ch**annel
5	PCCPCH	**P**rimary **C**ommon **C**ontrol **P**hysical **Ch**annel
6	SCCPCH	**S**econdary **C**ommon **C**ontrol **P**hysical **Ch**annel
7	HS_SCCH	HSDPA: **H**igh **S**peed **S**hared **C**ontrol **Ch**annel
8	HS_PDSCH	HSDPA: **H**igh **S**peed **P**hysical **D**ownlink **S**hared **Ch**annel
9	CHAN	Channel without any pilot symbols (QPSK modulated)
10	CPRSD	Dedicated Physical Channel in **compr**e**s**se**d** mode
11	CPR-TPC	Dedicated Physical Channel in **compr**essed mode **TPC** symbols are sent in the first slot of the gap.
12	CPR-SF/2	Dedicated Physical Channel in **compr**essed mode using half spreading factor (**SF/2**).

Param.	Channel type	Description
13	CPR-SF/2-TPC	Dedicated Physical Channel in **compr**ess**e**d mode using half spreading factor (**SF/2**). **TPC** symbols are sent in the first slot of the gap.
14	EHICH-ERGCH	HSUPA: **E**nhanced **H**ARQ Hybrid Acknowledgement **I**ndicator **Ch**annel HSUPA: **E**nhanced **R**elative **G**rant **Ch**annel
15	EAGCH	E-AGCH: **E**nhanced **A**bsolute **G**rant **Ch**annel
16	SCPICH	**S**econdary **C**ommon **Pi**lot **Ch**annel

Table 10-3: UE channel types and their assignment to a numeric parameter value

Param.	Channel type	Description
0	DPDCH	Dedicated Physical Data Channel
1	DPCCH	Dedicated Physical Control Channel
2	HS-DPCCH	High-Speed Dedicated Physical Control Channel
3	E-DPCCH	Enhanced Dedicated Physical Control Channel
4	E_DPDCH	Enhanced Dedicated Physical Data Channel

10.6.7.1 General Channel Detection

The following commands configure how channels are detected in general.

Useful commands for general channel detection described elsewhere:

- `CONFigure:WCDPower[:BTS]:CTABle[:STATe]` on page 149
- `CONFigure:WCDPower[:BTS]:CTABle:SELect` on page 151

Remote commands exclusive to general channel detection:

CONFigure:WCDPower[:BTS]:CTABle:COMPare <State>

This command switches between normal predefined mode and predefined channel table compare mode.

In the compare mode a predefined channel table model can be compared with the measurement in respect to power, pilot length and timing offset of the active channels.

Comparision is a submode of predefined channel table measurement. It only influences the measurement if the "Channel Search Mode" is set to *Predefined* (see `CONFigure:WCDPower[:BTS]:CTABle[:STATe]` on page 149). If the compare mode is selected, the power values, pilot lengths and timing offsets are measured and are compared with the values from the predefined channel table. The "Timing Offset" setting is disabled in this case. The differences between the measured and the predefined values are visualized in the corresponding columns of the "CHANNEL TABLE" evaluation (see "Channel Table" on page 15). The following columns are displayed in the channel table:

- **PilotL** is the substraction of PilotLengthMeasured - PilotLengthPredefined
- **PwrRel** is the substraction of PowerRelMeasured - PowerRelPredefined
- **T Offs** is the substraction of TimingOffsetMeasured - TimingOffsetPredefined

For non-active channels dashes are shown.

Parameters:

<State> ON | OFF

ON
predefined channel table compare mode

OFF
normal predefined mode

*RST: OFF

Example: `CONF:WCDP:CTAB:COMP ON`

Mode: BTS application only

Manual operation: See "Comparing the Measurement Signal with the Predefined Channel Table" on page 73

CONFigure:WCDPower[:BTS]:CTABle:TOFFset <Mode>

This command specifies whether the timing offset and pilot length are measured or if the values are taken from the predefined table.

Parameters:

<Mode> PRED | MEAS

PRED
The timing offset and pilot length values from the predefined table are used.

MEAS
The timing offset and the pilot length are measured by the application. The channel configuration is specified via the predefined channel table.

Example: `CONF:WCDP:CTAB:TOFF MEAS`

Mode: BTS application only

Manual operation: See "Timing Offset Reference" on page 73

[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: `SENS:CDP:ICTR -100`

Mode: BTS application only

Manual operation: See "Inactive Channel Threshold (BTS measurements only)" on page 72

10.6.7.2 Managing Channel Tables

CONFigure:WCDPower[: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:WCDPower[:BTS]:CTABle:SELect` on page 151.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Example: `CONF:WCDP:CTAB ON`

Mode: BTS application only

Manual operation: See "Using Predefined Channel Tables" on page 72

CONFigure:WCDPower[:BTS]:CTABle:CATalog?

This command reads out the names of all channel tables stored in the software. 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:WCDP: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

Mode: BTS application only

Manual operation: See "Predefined Tables" on page 73

Table 10-4: Description of query results in example:

Value	Description
52853	Total size of all channel table files: 52583 bytes
2634403840	Free memory on hard disk: 2.6 Gbytes
3GB_1_16.XML	Channel table 1: `3GB_1_16.XML`
3469	File size for channel table 1: 3469 bytes
3GB_1_32.XML	Channel table 2: `3GB_1_32.XML`
5853	File size for channel table 2: 5853 bytes
3GB_1_64.XML	Channel table 3: `3GB_1_64.XML`
10712	File size for channel table 3: 10712 bytes
...	Channel table x: ...

CONFigure:WCDPower[:BTS]:CTABle:COPY <FileName>

This command copies one channel table onto another one. The channel table to be copied is selected with command `CONFigure:WCDPower[:BTS]:CTABle:NAME` on page 153.

The name of the channel table may contain a maximum of 8 characters.

Parameters:

<FileName> name of the new channel table

Example: `CONF:WCDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be copied.
`CONF:WCDP:CTAB:COPY 'CTAB_2'`
Copies channel table 'NEW_TAB' to 'CTAB_2'.

Usage: Event

Mode: BTS application only

Manual operation: See "Copying a Table" on page 74

CONFigure:WCDPower[:BTS]:CTABle:DELete

This command deletes the selected channel table. The channel table to be deleted is selected with the command `CONFigure:WCDPower[:BTS]:CTABle:NAME` on page 153.

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

Mode: BTS application only

Manual operation: See "Deleting a Table" on page 74

CONFigure:WCDPower[:BTS]:CTABle:SELect <FileName>

This command selects a predefined channel table file for comparison during channel detection. Before using this command, the "RECENT" channel table must be switched on first with the command `CONFigure:WCDPower[:BTS]:CTABle[:STATe]` on page 149.

Parameters:
<FileName> *RST: RECENT

Example: `CONF:WCDP:CTAB ON`
Switches the channel table on.
`CONF:WCDP:CTAB:SEL 'CTAB_1'`
Selects the predefined channel table 'CTAB_1'.

Mode: BTS application only

Manual operation: See "Selecting a Table" on page 74

CONFigure:WCDPower:MS: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:WCDPower:MS:CTABle:SELect` on page 153.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CONF:WCDP:CTAB ON`

Mode: UE application only

Manual operation: See "Using Predefined Channel Tables" on page 72

CONFigure:WCDPower:MS:CTABle:CATalog?

This command reads out the names of all channel tables stored in the software. 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)

Usage: Query only

Mode: UE application only

Manual operation: See "Predefined Tables" on page 73

CONFigure:WCDPower:MS:CTABle:COPY <FileName>

This command copies one channel table onto another one. The channel table to be copied is selected with command `CONFigure:WCDPower:MS:CTABle:NAME` on page 154.

The name of the channel table may contain a maximum of 8 characters.

Parameters:

<FileName> Name of the new channel table

Example: `CONF:WCDP:MS:CTAB:NAME 'NEW_TAB'`
Defines the channel table name to be copied.
`CONF:WCDP:MS:CTAB:COPY 'CTAB_2'`
Copies channel table 'NEW_TAB' to 'CTAB_2'.

Mode: UE application only

Manual operation: See "Copying a Table" on page 74

CONFigure:WCDPower:MS:CTABle:DELete

This command deletes the selected channel table. The channel table to be deleted is selected with the command `CONFigure:WCDPower:MS:CTABle:NAME` on page 154.

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

Mode: UE application only

Manual operation: See "Deleting a Table" on page 74

CONFigure:WCDPower:MS:CTABle:SELect <FileName>

This command selects a predefined channel table file for comparison during channel detection. Before using this command, the "RECENT" channel table must be switched on first with the command `CONFigure:WCDPower:MS:CTABle[:STATe]` on page 151.

Parameters:
<FileName> *RST: RECENT

Example: `CONF:WCDP:MS:CTABl ON`
Switches the channel table on.
`CONF:WCDP:CTAB:MS:SEL 'CTAB_1'`
Selects the predefined channel table 'CTAB_1'.

Mode: UE application only

Manual operation: See "Selecting a Table" on page 74

10.6.7.3 Configuring Channel Tables

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

Remote commands exclusive to configuring channel tables:

CONFigure:WCDPower[: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> <file name>
*RST: RECENT

Example: `CONF:WCDP:CTAB:NAME 'NEW_TAB'`

Mode: BTS application only

Manual operation: See "Name" on page 75

CONFigure:WCDPower[: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:WCDPower[:BTS]:CTABle:NAME` on page 153. The values of the table are defined with command `CONFigure:WCDPower[:BTS]:CTABle:DATA` on page 155.

Parameters:
<Comment>

Example:
`CONF:WCDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name.
`CONF:WCDP:CTAB:COMM 'Comment for table 1'`
Defines a comment for the table.
`CONF:WCDP: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.

Mode: BTS application only

Manual operation: See "Comment" on page 75

CONFigure:WCDPower:MS:CTABle:NAME <FileName>

This command creates a new channel table file or selects an existing channel table in order to copy or delete it.

Parameters:

<FileName>	<file name>	
	*RST:	RECENT

Example: `CONF:WCDP:CTAB:NAME 'NEW_TAB'`

Mode: UE application only

Manual operation: See "Name" on page 75

CONFigure:WCDPower:MS: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:WCDPower:MS:CTABle:NAME` on page 154. The values of the table are defined with command `CONFigure:WCDPower:MS:CTABle:DATA` on page 156.

Parameters:
<Comment>

Example: `CONF:WCDP:MS:CTAB:NAME 'NEW_TAB'`
Defines the channel table name.
`CONF:WCDP:MS:CTAB:COMM 'Comment for table 1'`
Defines a comment for the table.

Mode: UE application only

Manual operation: See "Comment" on page 75

10.6.7.4 Configuring Channel Details (BTS Measurements)

The following commands are used to configure individual channels in a predefined channel table in BTS measurements.

CONFigure:WCDPower[:BTS]:CTABle:DATA <CodeClass>, <CodeNumber>, <UseTFCI>, <TimingOffset>, <PilotLength>, <ChannelType>, <Status>, <CDP>

This command defines or queries the values of the selected channel table. Each line of the table consists of 8 values.

Channels PICH, CPICH and PCCPCH may only be defined once. If channel CPICH or PCCPCH is missing in the command, it is automatically added at the end of the table.

Prior to this command, the name of the channel table has to be defined with the command `CONFigure:WCDPower[:BTS]:CTABle:NAME` on page 153.

Parameters:

<CodeClass> Range: 2 to 9

<CodeNumber> Range: 0 to 511

<UseTFCI> 0 | 1

0
not used

1
used

<TimingOffset> Step width: 256; for code class 9: 512
Range: 0 to 38400

<PilotLength> code class 9: 4
code class 8: 2,4, 8
code class 7: 4, 8
code class 5/6: 8
code class 2/3/4: 16

<ChannelType> For the assignment of channel types to parameters see table 10-2.

<Status> **0**
not active

1
active

<CDP> for queries: CDP relative to total signal power; for settings: CDP absolute or relative

Example: `CONF:WCDP:CTAB:NAME 'NEW_TAB'`
Defines the channel table name.
`CONF:WCDP: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`

Mode: BTS application only

Manual operation: See "Channel Type" on page 76
See "Channel Number (Ch. SF)" on page 77
See "Use TFCI" on page 77
See "Timing Offset" on page 77
See "Pilot Bits" on page 77
See "CDP Relative" on page 77
See "Status" on page 78

10.6.7.5 Configuring Channel Details (UE Measurements)

The following commands are used to configure individual channels in a predefined channel table in UE measurements.

CONFigure:WCDPower:MS:CTABle:DATA <CodeClass>,<NoActChan>,<PilotLength>

This command defines the values of the selected channel table.

The Channel DPCCH may only be defined once. If channel DPCCH is missing in the command data, it is automatically added at the end of the table. Prior to this command, the name of the channel table has to be defined with the command `CONFigure:WCDPower:MS:CTABle:NAME` on page 154.

Setting parameters:

<CodeClass> Code class of channel 1. I-mapped
Range: 2 to 9

<NoActChan> Number of active channels
Range: 1 to 7

<PilotLength> pilot length of channel DPCCH

Return values:

<CodeClass>	Code class of channel 1. I-mapped Range: 2 to 9
<NoActChan>	Number of active channels Range: 1 to 7
<PilotLength>	pilot length of channel DPCCH
<CDP1>	Measured relative code domain power values of channel 1
<CDP2>	Measured relative code domain power values of channel 2
<CDP3>	Measured relative code domain power values of channel 3
<CDP4>	Measured relative code domain power values of channel 4
<CDP5>	Measured relative code domain power values of channel 5
<CDP6>	Measured relative code domain power values of channel 6

Example:

```
CONF:WCDP:MS:CTAB:DATA 8,0,0,5,1,0.00,
4,1,1,0,1,0.00, 4,1,0,0,1,0.00
```

The following channels are defined: DPCCH and two data channels with 960 ksps.

Mode: UE application only

Manual operation:
See "Channel Type" on page 76
See "Channel Number (Ch. SF)" on page 77
See "Pilot Bits" on page 77
See "CDP Relative" on page 77
See "Status" on page 78

CONFigure:WCDPower:MS:CTABle:DATA:HSDPcch <State>

This command activates or deactivates the HS-DPCCH entry in a predefined channel table.

Parameters:

<State> *RST: ON

Example:

```
CONF:WCDP:MS:CTAB:DATA:HSDP ON
```

Mode: UE application only

CONFigure:WCDPower:MS:CTABle:EDATa <CodeClass>, <NoActChan>

This command defines the values for an E-DPCCH channel in the selected channel table. The channel table must be selected using the command `CONFigure:WCDPower:MS:CTABle:NAME` on page 154.

Setting parameters:

<CodeClass> Code class of channel

Range: 2 to 9

<NoActChan>	Number of active channels Range: 0 to 4

Return values:

<CodeClass>	Code class of channel Range: 2 to 9
<NoActChan>	Number of active channels Range: 0 to 4
<ECDP1>	Measured relative code domain power values of channel 1
<ECDP2>	Measured relative code domain power values of channel 2
<ECDP3>	Measured relative code domain power values of channel 3
<ECDP4>	Measured relative code domain power values of channel 4
Example:	`CONF:WCDP:MS:CTAB:EDAT 8,3`
Mode:	UE application only

CONFigure:WCDPower:MS:CTABle:EDATa:EDPCc <State>

This command activates or deactivates the E-DPCCH entry in a predefined channel table.

Parameters:

<State>	*RST: OFF
Example:	`CONF:WCDP:MS:CTAB:EDAT:EDPC ON`
Mode:	UE application only

10.6.8 Automatic Settings

Useful commands for adjusting settings automatically described elsewhere:

- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE` on page 131
- `[SENSe:]CDPower:LCODe:SEARch[:IMMediate]?` on page 121

Remote commands exclusive to adjusting settings automatically:

CONFigure:WCDPower[:BTS]:ASCale[:STATe] <State>

Activate this command if multiple carriers are used. In this case, the autoscaling function automatically changes the level settings if the center frequency is changed to another carrier.

Parameters:

<State> ON | OFF

*RST: ON

Example: `CONF:WCDP:ASC:STAT ON`

Mode: BTS application only

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

Activate this command if multiple carriers are used. In this case, the adjust reference level procedure ensures that the settings of RF attenuation and reference level are optimally adjusted for measuring a multicarrier signal.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CONF:WCDP:MCAR:STAT ON`

Mode: BTS application only

[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
- Scrambling code
- Scaling

Example: `ADJ:ALL`

Usage: Event

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 80

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S VSE 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 "Automatic Measurement Time Mode and Value" on page 81

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command selects the way the R&S VSE determines the length of the measurement .

Parameters:

<Mode>

AUTO
The R&S VSE determines the measurement length automatically according to the current input data.

MANual
The R&S VSE uses the measurement length defined by [SENSe:]ADJust:CONFigure:DURation on page 159.

*RST: AUTO

Manual operation: See "Automatic Measurement Time Mode and Value" on page 81

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

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 82

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

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 81

[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 VSE 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 61

10.6.9 Evaluation Range

The evaluation range defines which data is evaluated in the result display.

[SENSe:]CDPower:CODE <CodeNumber>

This command sets the code number. The code number refers to code class 9 (spreading factor 512).

Parameters:

<CodeNumber> <numeric value>

*RST: 0

Example: `SENS:CDP:CODE 30`

Manual operation: See "Channel" on page 85

[SENSe:]CDPower:FRAMe[:VALue] <Frame>

This command defines the frame to be analyzed within the captured data.

Parameters:

<Frame> <numeric value>

Range: [0 ... CAPTURE_LENGTH – 1]
*RST: 1

Example: `CDP:FRAM:VAL 1`

Manual operation: See "Frame To Analyze" on page 69

[SENSe:]CDPower:SLOT <SlotNumber>

This command selects the (CPICH) slot number to be evaluated.

Parameters:

<SlotNumber> <numeric value>

*RST: 0

Example: `SENS:CDP:SLOT 3`

Manual operation: See "Slot" on page 86

[SENSe:]CDPower:MAPPing <SignalBranch>

This command switches between I and Q branches of the signal for all evaluations (if not specified otherwise using `CALCulate<n>:CDPower:Mapping` on page 162).

Parameters:

<SignalBranch> I | Q

*RST: Q

Example: `CDP:MAPP Q`

Mode: UE application only

CALCulate<n>:CDPower:Mapping <SignalBranch>

This command adjusts the mapping for the evaluations Code Domain Power and Code Domain Error Power in a specific window.

Parameters:

<SignalBranch> I | Q | AUTO

I
The I-branch of the signal will be used for evaluation

Q
The Q-branch of the signal will be used for evaluation

AUTO
The branch selected by the `[SENSe:]CDPower:MAPPing` command will be used for evaluation.

*RST: AUTO

Example: `CALC:CDP:MAPPING AUTO`

Mode: UE application only

Manual operation: See "Branch (UE measurements only)" on page 86
See "Selecting a Different Branch for a Window" on page 87

10.6.10 Code Domain Analysis Settings (BTS Measurements)

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

CALCulate:MARKer<m>:FUNCtion:ZOOM <State>

If marker zoom is activated, the number of channels displayed on the screen in the code domain power and code domain error power result diagram is reduced to 64.

The currently selected marker defines the center of the displayed range.

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

Example: `CALC:MARK:FUNC:ZOOM ON`

[SENSe:]CDPower:CPB <Value>

This command selects the constellation parameter B. According to 3GPP specification, the mapping of 16QAM symbols to an assigned bit pattern depends on the constellation parameter B.

Parameters:
<Value> <numeric value>
*RST: 0

Example: `SENS:CDP:CDP 1`

Manual operation: See "Constellation Parameter B" on page 89

[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 88

[SENSe:]CDPower:PDISplay <Mode>

This command switches between showing the absolute or relative power.

This parameter only affects the Code Domain Power evaluation.

Parameters:
<Mode> ABS | REL

ABSolute
Absolute power levels

RELative
Power levels relative to total signal power or (BTS application only) CPICH channel power (see `[SENSe:]CDPower:PREFerence` on page 164)

*RST: ABS

Example: `SENS:CDP:PDIS ABS`

Manual operation: See "Code Power Display" on page 88
See "Code Power Display" on page 90

[SENSe:]CDPower:PDIFf <State>

This command defines which slot power difference is displayed in the Power vs Slot evaluation.

Parameters:
<State> ON | OFF

ON
The slot power difference to the previous slot is displayed.

OFF
The current slot power of each slot is displayed.

*RST: OFF

Example: `SENS:CDP:PDIF ON`

Mode: BTS application only

Manual operation: See "Show Difference to Previous Slot" on page 88

[SENSe:]CDPower:PREFerence <Mode>

This command defines the reference for the relative CDP measurement values.

Parameters:

<Mode> TOTal | CPICh

TOTal
Total signal power

CPICh
CPICH channel power

*RST: TOTal

Example: `SENS:CDP:PREF CPIC`

Mode: BTS application only

Manual operation: See "Code Power Display" on page 88

10.6.11 Code Domain Analysis Settings (UE Measurements)

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

Useful commands for Code Domain Analysis described elsewhere:

- `CALCulate:MARKer<m>:FUNCtion:ZOOM` on page 163
- `[SENSe:]CDPower:NORMalize` on page 163
- `[SENSe:]CDPower:PDISplay` on page 164

Remote commands exclusive to Code Domain Analysis in UE Measurements:

[SENSe:]CDPower:ETCHips <State>

This command selects length of the measurement interval for calculation of error vector magnitude (EVM). In accordance with 3GPP specification Release 5, the EVM measurement interval is one slot (4096 chips) minus 25 μs (3904 chips) at each end of the burst if power changes are expected. If no power changes are expected, the evaluation length is one slot (4096 chips).

Parameters:

<State>

ON
Changes of power are expected. Therefore an EVM measurement interval of one slot minus 25 μs (3904 chips) is considered.

OFF
Changes of power are not expected. Therefore an EVM measurement interval of one slot (4096 chips) is considered

*RST: OFF

Example: `SENS:CDP:ETCH ON`

Manual operation: See "Eliminate Tail Chips" on page 90

[SENSe:]CDPower:HSLot <State>

This command switches between the analysis of half slots and full slots.

Parameters:
<State> ON | OFF

ON
30 (half) slots are evaluated

OFF
15 (full) slots are evaluated

*RST: OFF

Example: `SENS:CDP:HSL ON`

Mode: UE application only

Manual operation: See "Measurement Interval" on page 89

10.7 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

10.7.1 Global Layout Commands

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in chapter 10.7.2, "Working with Windows in the Display", on page 170 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]?
<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

This command adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the LAYout:GLOBal:REPLace[:WINDow] command.

Parameters:

<ExChanName> string

Name of an existing channel

<ExWinName> string

Name of the existing window within the <ExChanName> channel 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:GLOBal:IDENtify[:WINDow]? query.

<Direction> LEFT | RIGHt | ABOVe | BELow | TAB

Direction the new window is added relative to the existing window.

TAB
The new window is added as a new tab in the specified existing window.

<NewChanName> string

Name of the channel for which a new window is to be added.

<NewWinType> string

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:

```
LAYout:GLOBal:ADD:WINDow? 'IQ Analyzer','1',RIGH,'IQ Analyzer2','FREQ'
```

Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage: Query only

Table 10-5: <WindowType> parameter values for 3GPP FDD application

Parameter value	Window type
BITStream	Bitstream
CCONst	Composite Constellation
CDPower	Code Domain Power
CDEPower	Code Domain Error Power
CEVM	Composite EVM
CTABle	Channel Table
EVMChip	EVM vs Chip
FESLot	Frequency Error vs Slot

Parameter value	Window type
MECHip	Magnitude Error vs Chip
MTABle	Marker table
PCDerror	Peak Code Domain Error
PDSLot	Phase Discontinuity vs Slot
PECHip	Phase Error vs Chip
PSLot	Power vs Slot
PSYMbol	Power vs Symbol
RSUMmary	Result Summary
SCONst	Symbol Constellation
SEVM	Symbol EVM
SMERror	Symbol Magnitude Error
SPERror	Symbol Phase Error

LAYout:GLOBal:CATalog[:WINDow]?

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

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<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:GLOB:CAT?`
Result:
`IQ Analyzer: '1',1,'2',2`
`Analog Demod: '1',1,'4',4`
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

This command queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example: `LAYout:GLOBal:IDENtify? 'IQ Analyzer','Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>,<WindowName>

This command removes a window from the display.

Parameters:

<ChannelName> String containing the name of the channel.

<WindowName> String containing the name of the window.

Usage: Event

LAYout:GLOBal:REPLace[:WINDow] <ExChannelName>,<WindowName>,<NewChannelName>,<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:GLOBal:ADD[:WINDow]?` command.

Parameters:

<ExChannelName> String containing the name of the channel in which a window is to be replaced. The channel name is displayed as the tab label for the measurement channel.

<WindowName> String containing the name of the existing window.
To determine the name and index of all active windows, use the `LAYout:GLOBal:CATalog[:WINDow]?` query.

<NewChannelName> String containing the name of the channel for which a new window will be created.

<WindowType> Type of result display you want to use in the existing window.
Note that the window type must be valid for the specified channel (<NewChannelName>).
See `LAYout:ADD[:WINDow]?` on page 171 for a list of available window types.

Example:

```
LAY:GLOB:REPL:WIND 'IQ Analyzer','1',
'AnalogDemod',MTAB
```

Replaces the I/Q Analyzer result display in window 1 by a marker table for the AnalogDemod channel.

10.7.2 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*.

To configure the layout of windows across measurement channels, use the chapter 10.7.1, "Global Layout Commands", on page 166.

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

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

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',BEL,'XPOW:CDP:ABSolute'`
Adds a Code Domain Power display below window 1.

Usage: Query only

Manual operation: See "Bitstream" on page 15
See "Channel Table" on page 15
See "Code Domain Power" on page 17
See "Code Domain Error Power" on page 18
See "Composite Constellation" on page 18
See "Composite EVM" on page 19
See "EVM vs Chip" on page 20
See "Frequency Error vs Slot" on page 21
See "Mag Error vs Chip" on page 22
See "Marker Table" on page 22
See "Peak Code Domain Error" on page 23
See "Phase Discontinuity vs Slot" on page 24
See "Phase Error vs Chip" on page 24
See "Power vs Slot" on page 26
See "Power vs Symbol" on page 26
See "Result Summary" on page 27
See "Symbol Constellation" on page 27
See "Symbol EVM" on page 28
See "Symbol Magnitude Error" on page 29
See "Symbol Phase Error" on page 29

Table 10-6: <WindowType> parameter values for 3GPP FDD application

Parameter value	Window type
BITStream	Bitstream
CCONst	Composite Constellation
CDPower	Code Domain Power
CDEPower	Code Domain Error Power
CEVM	Composite EVM
CTABle	Channel Table
EVMChip	EVM vs Chip
FESLot	Frequency Error vs Slot
MECHip	Magnitude Error vs Chip
MTABle	Marker table
PCDerror	Peak Code Domain Error
PDSLot	Phase Discontinuity vs Slot
PECHip	Phase Error vs Chip
PSLot	Power vs Slot
PSYMbol	Power vs Symbol
RSUMmary	Result Summary
SCONst	Symbol Constellation
SEVM	Symbol EVM

Parameter value	Window type
SMERror	Symbol Magnitude Error
SPERror	Symbol Phase Error

LAYout:CATalog[:WINDow]?

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

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all measurement channels use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different measurement channel use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

To remove a window for a different measurement channel use the `LAYout:GLOBal:REMove[:WINDow]` command.

Parameters:

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

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 171 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

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 171 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

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

Return values:

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

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

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

To remove a window in a different measurement channel use the `LAYout:GLOBal:REMove[:WINDow]` command.

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

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

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

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 171 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

10.7.3 General Window Commands

The following commands are required to work with windows, independently of the application.

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

DISPlay[:WINDow<n>]:SELect

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

This window is then the active window.

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

Usage: Setting only

10.8 Retrieving Results

The following commands are required to retrieve the results from a 3GPP FDD 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 table 10-2.

Specific commands:

10.8.1 Retrieving Calculated Measurement Results

The following commands describe how to retrieve the calculated results from the CDA and Time Alignment Error measurements.

CALCulate<n>:MARKer<m>:FUNCtion:TAERror:RESult? <ResultType>

This command queries the result of a time alignment measurement (see chapter 3.2, "Time Alignment Error Measurements", on page 30).

Query parameters:

<ResultType> **TAERror**
Returns the time offset between the two antenna signals in chips.

Example: `CALC:MARK:FUNC:TAER:RES? TAER`

Usage: Query only

Mode: BTS application only

Manual operation: See "Result List" on page 30

CALCulate<n>:MARKer<m>:FUNCtion:WCDPower[:BTS]:RESult?
<Measurement>

This command queries the measured and calculated results of the 3GPP FDD BTS code domain power measurement.

Query parameters:

<Measurement> The parameter specifies the required evaluation method.

ACHannels
Number of active channels

ARCDerror
relative code domain error averaged over all channels with modulation type 64QAM

CDPabsolute
code domain power absolute

CDPRelative
code domain power relative

CERRor
chip rate error

CHANnel
channel number

CSLot
channel slot number

EVMPeak
error vector magnitude peak

EVMRms
error vector magnitude RMS

FERRor
frequency error in Hz

IOFFset
imaginary part of the I/Q offset

IQIMbalance
I/Q imbalance

IQOFfset
I/Q offset

MACCuracy
composite EVM

MPIC
average power of inactive channels

MTYPe
modulation type:
2 – QPSK
4 – 16 QAM
5 – 64 QAM
15 – NONE

PCDerror
peak code domain error

PSYMbol
number of pilot bits

PTOTal

total power

QOFFset
real part of the I/Q offset

RCDerror
relative code domain error

RHO
rho value for every slot

SRATe
symbol rate

TFRame
trigger to frame

TOFFset
timing offset

Example: `CALC:MARK:FUNC:WCDP:RES? PTOT`

Usage: Query only

Mode: BTS application only

Manual operation: See "Code Domain Power" on page 17
See "Result Summary" on page 27

CALCulate<n>:MARKer<m>:FUNCtion:WCDPower:MS:RESult? <Measurement>

This command queries the measured and calculated results of the 3GPP FDD UE code domain power measurement.

Query parameters:

<Measurement> The parameter specifies the required evaluation method.

ACHannels
Number of active channels

CDPabsolute
code domain power absolute

CDPRelative
code domain power relative

CERRor
chip rate error

CHANnel
channel number

CMAPping
Channel branch

CSLot
channel slot number

EVMPeak
error vector magnitude peak

EVMRms
error vector magnitude RMS

FERRor
frequency error in Hz

IQIMbalance
I/Q imbalance

IQOFfset
I/Q offset

MACCuracy
composite EVM

MPIC
average power of the inactive codes for the selected slot

MTYPe
modulation type:
BPSK-I: 0
BPSK-Q: 1
4PAM-I: 6
4PAM-Q: 7
NONE: 15

PCDerror
peak code domain error

PSYMbol
Number of pilot bits

PTOTal
total power

RHO

rho value for every slot

SRATe
symbol rate

TFRame
trigger to frame

TOFFset
timing offset

Example: `CALC:MARK:FUNC:WCDP:MS:RES? PTOT`

Usage: Query only

Mode: UE application only

Manual operation: See "Code Domain Power" on page 17

10.8.2 Measurement Results for TRACe<n>[:DATA]? TRACE<n>

The evaluation method selected by the `LAY:ADD:WIND` command also affects the results of the trace data query (`TRACe<n>[:DATA]? TRACE<n>`, see `TRACe<n>[:DATA]?` on page 188).

Details on the returned trace data depending on the evaluation method are provided here.

For details on the graphical results of these evaluation methods, see chapter 3, "Measurements and Result Display", on page 11.

10.8.2.1 Code Domain Power

When the trace data for this evaluation is queried, 5 values are transmitted for each channel:

- the code class
- the channel number
- the absolute level
- the relative level
- the timing offset

For details on these parameters see TRACe<n>[:DATA]? on page 188.

10.8.2.2 Channel Table

When the trace data for this evaluation is queried, 5 values are transmitted for each channel:

- the class
- the channel number
- the absolute level
- the relative level
- the timing offset

For details on these parameters see TRACe<n>[:DATA]? on page 188.

Example:

The following example shows the results of a query for three channels with the following configuration:

Channel	Spreading factor	Channel number	Timing offset
1st	512	7	0
2nd	4	1	256 chips
3rd	128	255	2560 chips

This yields the following result:

9, 7, -40, -20, 0, 2, 1, -40, -20, 256, 7, 255, -40, -20, 2560

The channel order is the same as in the CDP diagram, i.e. it depends on their position in the code domain of spreading factor 512.

10.8.2.3 Code Domain Error Power

When the trace data for this evaluation is queried, 4 values are transmitted for each channel with code class 9:

code class	Highest code class of a downlink signal, always set to 9 (CC9)
code number	Code number of the evaluated CC9 channel [0...511]

CDEP	Code domain error power value of the CC9 channel in [dB]
channel flag	Indicates whether the CC9 channel belongs to an assigned code channel: 0b00-0d0: CC9 is inactive. 0b01-0d1: CC9 channel belongs to an active code channel. 0b11-0d3: CC9 channel belongs to an active code channel; sent pilot symbols are incorrect

The channels are sorted by code number.

10.8.2.4 Power vs Slot

When the trace data for this evaluation is queried, 16 pairs of slots (slot number of CPICH) and level values are transferred:

<slot number>, <level value in dB> (for 16 slots)

10.8.2.5 Result Summary

When the trace data for this evaluation is queried, the results of the result summary are output in the following order:

<composite EVM [%]>,

<peak CDE [dB]>,

<carr freq error [Hz]>,

<chip rate error [ppm]>,

<total power [dB]>,

<trg to frame [µs]>,

<EVM peak channel [%]>,

<EVM mean channel [%]>,

<code class>,

<channel number>,

<power abs. channel [dB]>,

<power rel. channel [dB], referenced to CPICH or total power>,

<timing offset [chips]>,

<I/Q offset [%]>,

<I/Q imbalance [%]>

10.8.2.6 Composite EVM (RMS)

When the trace data for this evaluation is queried, 15 pairs of slots (slot number of CPICH) and level values are transferred:

<slot number>, <level value in %> (for 15 slots)

10.8.2.7 Peak Code Domain Error

When the trace data for this evaluation is queried, 15 pairs of slots (slot number of CPICH) and level values are transferred:

<slot number>, <level value in dB> (for 15 slots)

10.8.2.8 Composite Constellation

When the trace data for this evaluation is queried, the real and the imaginary branches of the chip constellation at the selected slot are transferred:

<Re1>, <Im1>, <Re2>, <Im2>, ..., <Re2560>, <Im2560>

The values are normalized to the square root of the average power at the selected slot.

10.8.2.9 Power vs Symbol

When the trace data for this evaluation is queried, the power of each symbol at the selected slot is transferred. The values indicate the difference to the reference power in dB. The number of the symbols depends on the spreading factor of the selected channel:

$NOFSymbols=10*2^{(8-CodeClass)}$

10.8.2.10 Symbol Constellation

When the trace data for this evaluation is queried, the real and the imaginary branches are transferred:

$<Re_0>, <Im_0>, <Re_1>, <Im_1>, ..., <Re_n>, <Im_n>$

The number of level values depends on the spreading factor:

Spreading factor	Number of level values
512	5
256	10
128	20
64	40
32	80
16	160
8	320
4	640

10.8.2.11 Symbol EVM

When the trace data for this evaluation is queried, the real and the imaginary branches are transferred:

<Re_0>, <Im_0>, <Re_1>, <Im_1>, ..., <Re_n>, <Im_n>

The number of level values depends on the spreading factor:

Spreading factor	Number of level values
512	5
256	10
128	20
64	40
32	80
16	160
8	320
4	640

10.8.2.12 Bitstream

When the trace data for this evaluation is queried, the bit stream of one slot is transferred. Each symbol contains two consecutive bits in the case of a QPSK modulated slot and 4 consecutive bits in the case of a 16QAM modulated slot. 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".

The values and number of the bits are as follows (without HS-DPCCH channels, see [SENSe:]CDPower:HSDPamode on page 120) :

Table 10-7: Bit values and numbers without HS-DPCCH channels

Unit	[]
Value range	{0, 1, 6, 9} 0 - Low state of a transmitted bit 1 - High state of a transmitted bit 6 - Bit of a symbol of a suppressed slot of a DPCH in Compressed Mode (DPCH-CPRSD) 9 - Bit of a suppressed symbol of a DPCH (e.g. TFCI off)
Bits per slot	$N_{BitPerSymb} = 2$
Number of symbols	$N_{Symb} = 10*2^{(8\text{-Code Class})}$
Number of bits	$N_{Bit} = N_{Symb} * N_{BitPerSymb}$
Format	Bit_{00}, Bit_{01}, Bit_{10}, Bit_{11}, Bit_{20}, Bit_{21},.... , $Bit_{NSymb\ 0}$, $Bit_{NSymb\ 1}$

The values and number of the bits including HS-DPCCH channels (see [SENSe:]CDPower:HSDPamode on page 120) are as follows:

Table 10-8: Bit values and numbers including HS-DPCCH channels

Unit	[]
Value range	{0, 1, 6, 7, 8, 9} 0 - Low state of a transmitted bit 1 - High state of a transmitted bit 6 - Bit of a symbol of a suppressed slot of a DPCH in Compressed Mode (DPCH-CPRSD) 7 - Bit of a switched-off symbol of an HS-PDSCH channel 8 - Fill value for unused bits of a lower order modulation symbol in a frame containing higher order modulation 9 - Bit of a suppressed symbol of a DPCH (e.g. TFCI off)
Bits per symbol	$N_{BitPerSymb} = \{2, 4, 6\}$
Symbols per slot	$N_{Symb\_Slot} = 10*2^{(8\text{-Code Class})}$
Symbols per frame	$N_{Symb\_Frame} = 15*N_{Symb\_Slot} = 150*2^{(8\text{-Code Class})}$
Number of bits	$N_{Bit} = N_{Symb\_Frame} * N_{BitPerSymb\_MAX}$
Format (16QAM)	$Bit_{00}, Bit_{01}, Bit_{02}, Bit_{03}, Bit_{10}, Bit_{11}, Bit_{12}, Bit_{13}$,.... ... , $Bit_{NSymb\_Frame\ 0}, Bit_{NSymb\_Frame\ 1}, Bit_{NSymb\_Frame\ 2},$ $Bit_{NSymb\_Frame\ 3}$
Format (64QAM)	$Bit_{00}, Bit_{01}, Bit_{02}, Bit_{03}, Bit_{04}, Bit_{05}, Bit_{10}, Bit_{11}, Bit_{12}, Bit_{13}, Bit_{14}, Bit_{15}$, ..., $Bit_{NSymb\_Frame\ 0}, Bit_{NSymb\_Frame\ 1}, Bit_{NSymb\_Frame\ 2}, Bit_{NSymb\_Frame\ 3}, Bit_{NSymb\_Frame\ 4}, Bit_{NSymb\_Frame\ 5}$

10.8.2.13 Frequency Error vs Slot

When the trace data for this evaluation is queried, 15 pairs of slot (slot number of CPICH) and values are transferred:

<slot number>, <value in Hz>

10.8.2.14 Phase Discontinuity vs Slot

When the trace data for this evaluation is queried, 15 pairs of slot (slot number of CPICH) and values are transferred:

<slot number>, <value in deg>

10.8.2.15 EVM vs Chip

When the trace data for this evaluation is queried, a list of vector error values of all chips at the selected slot 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 slot.

10.8.2.16 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.

10.8.2.17 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.

10.8.2.18 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*$2^{(8\text{-CodeClass})}$

10.8.2.19 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*$2^{(8\text{-CodeClass})}$

10.8.3 Retrieving Trace Results

The following commands describe how to retrieve the trace data from the CDA and Time Alignment Error measurements. Note that for these measurements, only 1 trace per window can be configured.

- `FORMat[:DATA]`
- `TRACe<n>[:DATA]?` on page 188
- TRACe<n>[:DATA]? TRACE1
- TRACe<n>[:DATA]? ABITstream
- TRACe<n>[:DATA]? ATRace1
- TRACe<n>[:DATA]? CTABle

- TRACe<n>[:DATA]? CWCDp
- TRACe<n>[:DATA]? FINal1
- TRACe<n>[:DATA]? PWCDp
- TRACe<n>[:DATA]? TPVSlot

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S VSE to the controlling computer.

Note that the command has no effect for data that you send to the R&S VSE. The R&S VSE 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".
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]? <MeasMode>

This command queries the trace data from the measurement. Depending on the selected measurement mode, the results vary. For a detailed description of the results, see the individual commands.

Query parameters:

<MeasMode> ATRACE1 | ABITstream1 | CTABLe | CEVM | CWCDp | FINAL1 | LIST | PWCDp | TPVSlot | TRACE1
The data type defines which type of trace data is read.

Example: `TRAC:DATA? ATRACE`

Usage: Query only

TRACe<n>[:DATA]? TRACE1

This command returns the trace data. Depending on the evaluation, the trace data format varies.

The channels are output in a comma-separated list in ascending order sorted by code number, i.e. in the same sequence they are displayed on screen.

For details see chapter 10.8.2, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 181.

Return values:

<CodeClass>	**2 … 9** Code class of the channel
<ChannelNo>	**0 … 511** Code number of the channel
<AbsLevel>	**dBm** Absolute level of the code channel at the selected channel slot.
<RelLevel>	**%** Relative level of the code channel at the selected channel slot referenced to CPICH or total power.
<TimingOffset>	**0 … 38400 [chips]** Timing offset of the code channel to the CPICH frame start. The value is measured in chips. The step width is 256 chips in the case of code class 2 to 8, and 512 chips in the case of code class 9.

Example: `TRAC2:DATA? TRACE1`
Returns the trace data from trace 1 in window 2.

Usage: Query only

Manual operation:
See "Code Domain Error Power" on page 18
See "Composite Constellation" on page 18
See "Composite EVM" on page 19
See "EVM vs Chip" on page 20
See "Mag Error vs Chip" on page 22
See "Peak Code Domain Error" on page 23
See "Phase Discontinuity vs Slot" on page 24
See "Phase Error vs Chip" on page 24
See "Power vs Symbol" on page 26
See "Result Summary" on page 27
See "Symbol Constellation" on page 27
See "Symbol EVM" on page 28
See "Symbol Magnitude Error" on page 29
See "Symbol Phase Error" on page 29

TRACe<n>[:DATA]? ABITstream

This command returns the bit streams of all 15 slots one after the other. The output format may be REAL, UINT or ASCII. The number of bits of a 16QAM-modulated channel is twice that of a QPSK-modulated channel, the number of bits of a 64QAM-modulated channel is three times that of a QPSK-modulated channel.

This query is only available if the evaluation for the corresponding window is set to "Bitstream" using the `LAY:ADD:WIND "XTIM:CDP:BSTReam"` command (see `LAYout:ADD[:WINDow]?` on page 171).

The output format is identical to that of the `TRAC:DATA? TRAC` command for an activated Bitstream evaluation (see chapter 10.8.2, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 181). The only difference is the number of symbols which are evaluated. The `ABITstream` parameter evaluates all symbols of one entire frame (vs. only one slot for `TRAC:DATA? TRAC`).

The values 7 and 8 are only used in case of a varying modulation type of an HS-PDSCH channel. In this case the number of bits per symbol (`NBitPerSymb`) varies, as well. However, the length of the transmitted bit vector (NBit) depends only on the maximum number of bits per symbol in that frame. Thus, if the modulation type changes throughout the frame this will not influence the number of bits being transmitted (see examples below).

Example:

`LAY:REPL 2,"XTIM:CDP:BSTReam"`
Sets the evaluation for window 2 to bit stream.
`TRAC2:DATA? ABITstream`
Returns the bit streams of all 15 slots in window 2, one after the other.

Usage: Query only

Manual operation: See "Bitstream" on page 15

Examples for bits 7 and 8 for changing modulation types

Example 1:

Some slots of the frame are 64QAM modulated, other are 16QAM and QPSK modulated and some are switched OFF (NONE). If one or more slots of the frame are 64QAM modulated, six bits per symbol are transmitted and if the highest modulation order is 16QAM, four bits per symbol are transmitted. In any slot of the frame with lower order modulation, the first two or four of the four or six bits are marked by the number 8 and the last bits represent the transmitted symbol. If no power is transmitted in a slot, four or six entries per symbol of value 7 are transmitted.

Example 2:

Some slots of the frame are QPSK modulated and some are switched OFF. If one or more slots of the frame are QPSK modulated and no slot is 16QAM modulated, 2 bits per symbol are transmitted. If no power is transmitted in a slot, 2 entries per symbol of value 7 are transmitted.

Example 3:

Some slots of a DPCH are suppressed because of compressed mode transmission. The bits of the suppressed slots are marked by the digit '6'. In this case, always 2 bits per symbol are transmitted.

TRACe<n>[:DATA]? ATRace1

This command returns a list of absolute Frequency Error vs Slot values for all 16 slots (based on CPICH slots). In contrast to the `TRACE1` parameter return value, absolute values are returned.

Return values:

<SlotNumber> Slot number

<FreqError> Absolute frequency error

Default unit: Hz

Example: `TRAC2:DATA? ATR`
Returns a list of absolute frequency errors for all slots in window 2.

Usage: Query only

Mode: BTS application only

Manual operation: See "Frequency Error vs Slot" on page 21

TRACe<n>[:DATA]? CTABle

This command returns the pilot length and the channel state (active, inactive) in addition to the values returned for `TRACE<t>`.

This command is only available for Code Domain Power or Channel Table evaluations (see chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14).

Return values:

<CodeClass> **2 … 9**
Code class of the channel

<ChannelNo> **0 … 511**
Code number of the channel

<AbsLevel> **dBm**
Absolute level of the code channel at the selected channel slot.

<RelLevel> **%**
Relative level of the code channel at the selected channel slot referenced to CPICH or total power.

<TimingOffset> **0 … 38400 [chips]**
Timing offset of the code channel to the CPICH frame start. The value is measured in chips. The step width is 256 chips in the case of code class 2 to 8, and 512 chips in the case of code class 9.

<PilotLength> The length of the pilot symbols. According to the 3GPP standard, the pilot length range depends on the code class.

Range: 0,2,4,8,16
Default unit: symbols

<ActiveFlag> 0 | 1

Flag to indicate whether a channel is active (1) or not (0)

Example: `TRAC:DATA? CTABle`
Returns a list of channel information, including the pilot length and channel state.

Usage: Query only

Manual operation: See "Channel Table" on page 15
See "Code Domain Power" on page 17

TRACe<n>[:DATA]? CWCDp

This command returns additional results to the values returned for `TRACE<t>`.

The result is a comma-separated list with 10 values for each channel; the channels are output in ascending order sorted by code number, i.e. in the same sequence they are displayed on screen.

This command is only available for Code Domain Power or Channel Table evaluations (see chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14).

Return values:

<CodeClass> **2 … 9**
Code class of the channel

<ChannelNo> **0 … 511**
Code number of the channel

<AbsLevel> **dBm**
Absolute level of the code channel at the selected channel slot.

<RelLevel> **%**
Relative level of the code channel at the selected channel slot referenced to CPICH or total power.

<TimingOffset> **0 … 38400 [chips]**
Timing offset of the code channel to the CPICH frame start. The value is measured in chips. The step width is 256 chips in the case of code class 2 to 8, and 512 chips in the case of code class 9.

<PilotLength> The length of the pilot symbols. According to the 3GPP standard, the pilot length range depends on the code class.
Range: 0,2,4,8,16
Default unit: symbols

<ActiveFlag> 0 | 1
Flag to indicate whether a channel is active (1) or not (0)

<ChannelType> Channel type. For details see table 10-2.
Range: 0 … 16

<ModType> Modulation type of the code channel at the selected channel slot

2
QPSK

4
16 QAM

15
NONE
There is no power in the selected channel slot (slot is switched OFF).

Range: 2,4,15

<Reserved> for future use

Example: `TRAC:DATA? CWCDp`
Returns a list of channel information for each channel in ascending order.

Usage: Query only

Manual operation: See "Channel Table" on page 15
See "Code Domain Power" on page 17

TRACe<n>[:DATA]? FINal1

This command returns the peak list. For each peak the following results are given:

Return values:

<Freq> Peak frequency

<Level> Peak level

<DeltaLevel> Delta between current peak level and next higher peak level

Example: `TRAC2:DATA? FINal1`
Returns a list of peak values.

Usage: Query only

Mode: BTS application only

TRACe<n>[:DATA]? PWCDp

This command returns the pilot length in addition to the values returned for "TRACE<t>".

This command is only available for Code Domain Power or Channel Table evaluations (see chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 14).

Return values:

<CodeClass> **2 … 9**
Code class of the channel

<ChannelNo> **0 … 511**
Code number of the channel

<AbsLevel> **dBm**
Absolute level of the code channel at the selected channel slot.

<RelLevel> **%**
Relative level of the code channel at the selected channel slot referenced to CPICH or total power.

<TimingOffset> **0 … 38400 [chips]**
Timing offset of the code channel to the CPICH frame start. The value is measured in chips. The step width is 256 chips in the case of code class 2 to 8, and 512 chips in the case of code class 9.

<PilotLength> 0,2,4,8,16
The length of the pilot symbols. According to the 3GPP standard, the pilot length range depends on the code class.
Default unit: symbols

Example: `TRAC:DATA? PWCDp`
Returns a list of channel information, including the pilot length.

Usage: Query only

Mode: BTS application only

Manual operation: See "Channel Table" on page 15
See "Code Domain Power" on page 17

TRACe<n>[:DATA]? TPVSlot

This command returns a comma-separated list of absolute Power vs Slot results for all 16 slots. In contrast to the `TRACE<t>` parameter result, absolute values are returned.

Return values:

<SlotNumber> **0...15**
CPICH slot number

<Level> **dBm**
Slot level value

Example: `CALC2:FEED 'XTIM:CDP:PVSLot:ABSolute'`
Sets the evaluation for window 2 to POWER VS SLOT.
`TRAC2:DATA? TPVSlot`
Returns a list of absolute frequency errors for all slots in window 2.

Usage: Query only

Manual operation: See "Power vs Slot" on page 26

10.9 Analysis

The following commands define general result analysis settings concerning the traces and markers.

10.9.1 Traces

The trace settings determine how the measured data is analyzed and displayed on the screen. In 3GPP FDD 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.

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 VSE 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 VSE 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 91

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

10.9.2 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. In 3GPP FDD applications, only 4 markers per window can be configured for Code Domain Analysis.

10.9.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

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

Usage: Event

Manual operation: See "All Markers Off" on page 94

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 "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92
See "Marker State" on page 93
See "Marker Type" on page 93

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 22
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92
See "X-value" on page 93

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

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 "Marker Table" on page 22
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92

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 "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92
See "Marker State" on page 93
See "Marker Type" on page 93

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

(<m> is irrelevant)

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

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.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

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

Manual operation: See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92
See "X-value" on page 93

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.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

Manual operation: See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

The unit depends on the application of the command.

Return values:

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

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

Manual operation: See "Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92

10.9.2.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 94

10.9.2.3 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:FUNCtion:CPICh

This command sets the marker to channel 0.

This command is only available in Code Domain Power and Code Domain Error Power evaluations.

Example: `CALC:MARK:FUNC:CPIC`

Manual operation: See "Marker To CPICH" on page 96

CALCulate<n>:MARKer<m>:FUNCtion:PCCPch

This command sets the marker to the position of the PCCPCH.

This command is only available in code domain power and code domain error power evaluations.

Example: `CALC:MARK:FUNC:PCCP`

Manual operation: See "Marker To PCCPCH" on page 96

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 Next Peak" on page 95

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

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Next Peak" on page 95

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 96

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 Next Peak" on page 95

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 Next Minimum" on page 96

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

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 96

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 96

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 Next Minimum" on page 96

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:FUNCtion:CPICh

This command sets the delta marker to channel 0.

This command is only available in Code Domain Power and Code Domain Error Power evaluations.

Example: `CALC:DELT2:FUNC:CPIC`

CALCulate<n>:DELTamarker<m>:FUNCtion:PCCPch

This command sets the delta marker to the position of the PCCPCH.

This command is only available in code domain power and code domain error power evaluations.

Example: `CALC:DELT2:FUNC:PCCP`

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 Next Peak" on page 95

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

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Next Peak" on page 95

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 96

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 Next Peak" on page 95

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 Next Minimum" on page 96

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

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

Usage: Event

Manual operation: See "Search Next Minimum" on page 96

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 96

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 Next Minimum" on page 96

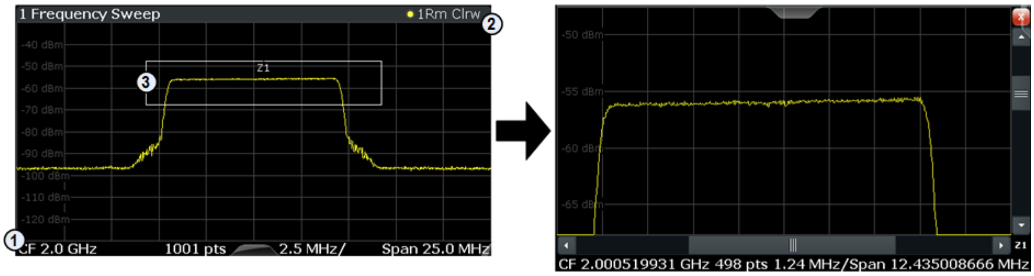
10.9.3 Zooming into the Display

10.9.3.1 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 82

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.

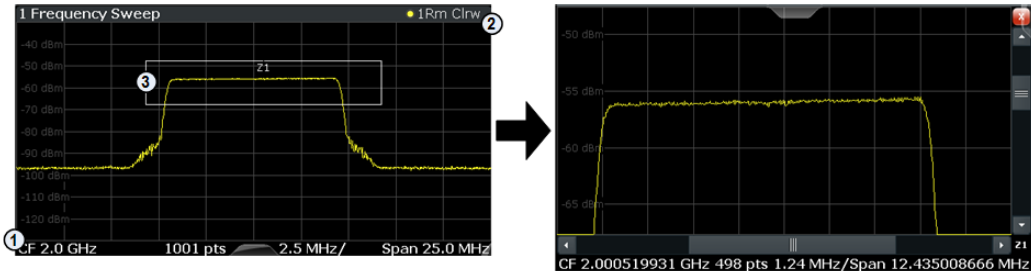
Manual operation: See "Single Zoom" on page 82
See "Restore Original Display" on page 82
See " Deactivating Zoom (Selection mode)" on page 83

10.9.3.2 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 82

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 82
See "Restore Original Display" on page 82
See " Deactivating Zoom (Selection mode)" on page 83

10.10 Querying the Status Registers

The following commands are required for the status reporting system specific to the 3GPP FDD applications. In addition, the 3GPP FDD applications also use the standard status registers of the R&S VSE (depending on the measurement type).

For details on the common R&S VSE status registers refer to the description of remote control basics in the R&S VSE User Manual.

*RST does not influence the status registers.

The `STATus:QUEStionable:SYNC` register contains application-specific information about synchronization errors or errors during pilot symbol detection.

Table 10-9: Status error bits in STATus:QUEStionable:SYNC register for 3GPP FDD applications

Bit	Definition
0	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 scrambling code ● Incorrectly set values for Q-INVERT or SIDE BAND INVERT ● Invalid signal at input ● Antenna 1 synchronization is not possible (Time Alignment Error measurements, 3GPP FDD BTS only)
2	For Time Alignment Error measurements (3GPP FDD BTS only): bit is set if antenna 2 synchronization is not possible; Otherwise: not used.
3 to 4	Not used.
5	Incorrect Pilot Symbol This bit is set when one or more of the received pilot symbols are not equal to the specified pilot symbols of the 3GPP standard. Possible reasons: ● Incorrectly sent pilot symbols in the received frame. ● Low signal to noise ratio (SNR) of the W-CDMA signal. ● One or more code channels has a significantly lower power level compared to the total power. The incorrect pilots are detected in these channels because of low channel SNR. ● One or more channels are sent with high power ramping. In slots with low relative power to total power, the pilot symbols might be detected incorrectly (check the signal quality by using the symbol constellation display).
6 to 14	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.

10.11 Commands for Compatibility

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see chapter 10.7.2, "Working with Windows in the Display", on page 170).

Parameters:

<Evaluation> Type of evaluation you want to display.
See the table below for available parameter values.

Example:

`INST:SEL BWCD`
Activates 3GPP FDD BTS mode.
`CALC:FEED CDP`
Selects the display of the code domain power.

Table 10-10: <Evaluation> parameter values for 3GPP FDD applications

String Parameter	Enum Parameter	Evaluation
'XTIM:CDP:BSTReam'	BITStream	Bitstream
'XTIM:CDP:COMP:CONStel-lation'	CCONst	Composite Constellation
'XPOW:CDEPower'	CDEPower	Code Domain Error Power
'XPOW:CDP' 'XPOW:CDP:ABSolute'	CDPower	Code Domain Power (absolute scaling)
'XPOW:CDP:RATio'	CDPower	Code Domain Power (relative scaling) ***)**
'XTIM:CDP:MACCuracy'	CEVM	Composite EVM
'XTIM:CDP:ERR:CTABle'	CTABle	Channel Table
'XTIMe:CDP:CHIP:EVM'	EVMChip	EVM vs Chip
'XTIM:CDP:FVSLot'	FESLot	Frequency Error vs Slot
'XTIMe:CDP:CHIP:MAGNi-tude'	MECHip	Magnitude Error vs Chip
'XTIM:CDP:ERR:PCDomain'	PCDerror	Peak Code Domain Error
'XTIM:CDPower:PSVSlot'	PDSLot	Phase Discontinuity vs Slot
'XTIMe:CDPower:CHIP:PHA Se'	PECHip	Phase Error vs Chip
'XTIM:CDP:PVSLot' 'XTIM:CDP:PVSLot:ABSolute'	PSLot	Power vs Slot (absolute scaling)
'XTIM:CDP:PVSLot:RATio'	PSLot	Power vs Slot (relative scaling)***)**
'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
'XTIMe:CDPower:SYM-Bol:EVM:MAGNitude'	SMERror	Symbol Magnitude Error
'XTIMe:CDPower:SYM-Bol:EVM:PHASe'	SPERror	Symbol Phase Error
***)** Use [SENS:]CDP:PDIS ABS | REL subsequently to change the scaling		

[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 VSE 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 VSE programs use `[SENSe:]ADJust:LEVel` on page 161.

[SENSe:]CDPower:PRESet

This command resets the 3GPP FDD 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 compatibility reasons only. For new R&S VSE programs use `SYSTem:PRESet:CHANnel[:EXECute]` on page 119.

Usage: Event

[SENSe:]CDPower:UCPich:CODE <CodeNumber>

This command sets the code number of the user defined CPICH used for signal analysis.

This command only applies to antenna 1.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]CDPower:UCPich:ANT<antenna>:CODE` on page 144 for new remote control programs.

Parameters:

<CodeNumber> Range: 0 to 225
*RST: 0

Example: `SENS:CDP:UCP:CODE 10`

Mode: BTS application only

[SENSe:]CDPower:UCPich:PATTern <Pattern>

This command defines which pattern is used for signal analysis for the user-defined CPICH (see `[SENSe:]CDPower:UCPich[:STATe]` on page 212).

This command only applies to antenna 1.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]CDPower:UCPich:ANT<antenna>[:STATe]` on page 145 for new remote control programs.

Parameters:

<Pattern>

1
fixed usage of "Pattern 1" according to standard

2
fixed usage of "Pattern 2" according to standard

*RST: 2

Example: `SENS:CDP:UCP:PATT 1`

Mode: BTS application only

[SENSe:]CDPower:UCPich[:STATe] <State>

Defines whether the common pilot channel (CPICH) is defined by a user-defined position instead of its default position.

If enabled, the user-defined position must be defined using `[SENSe:]CDPower:UCPich:CODE` on page 211.

This command only applies to antenna 1.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]CDPower:UCPich:ANT<antenna>:CODE` on page 144 for new remote control programs.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SENS:CDP:UCP ON`

Mode: BTS application only

10.12 Programming Examples (R&S VSE-K72)

The following programming examples are based on the measurement examples described in chapter 8, "Measurement Examples", on page 100 for manual operation.

The measurements are performed using the following devices and accessories:

- The R&S VSE with option R&S VSE-K72: 3GPP FDD measurements
- An R&S FSW Signal and Spectrum Analyzer
- A Vector Signal Generator R&S SMW200A with option R&S SMW-K42: digital standard 3GPP FDD (requires options R&S SMW-B10, R&S SMW-B13 and R&S SMW-B103)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

Prerequisites in the R&S VSE software

It is assumed an R&S FSW named 'MyFSW' is connected and configured for input to the R&S VSE software.

(See the R&S VSE Base Software User Manual).

Only the commands required to control the R&S VSE-K72 application and the analyzer are provided, not the signal generator.

Test setup

1. Connect the RF A output of the R&S SMW200A to the input of the R&S VSE.

2. Connect the reference input (REF INPUT) on the rear panel of the R&S VSE to the reference input (REF OUT) on the rear panel of the R&S SMW200A (coaxial cable with BNC connectors).
3. Connect the external trigger input of the R&S VSE (TRIGGER INPUT) to the external trigger output of the R&S SMW200A (TRIGOUT1 of PAR DATA).

Settings on the R&S SMW200A

Setting	value
Preset	
Frequency	2.1175 GHz
Level	0 dBm
Digital standard	3GPP FDD
Link direction	DOWN/FORWARD
Test model	Test_Model_1_16_channels
Base station	BS 1
Digital standard - State	ON
Scrambling code	0000

The following measurements are described:

10.12.1 Measurement 1: Measuring the Relative Code Domain Power

```
*RST
//Reset the instrument
INST:CRE:REPL 'IQ Analyzer',BWCD,'BTSMeasurement'
//Replace the default channel by a 3GPP FDD BTS channel named "BTSMeasurement"
DISP:TRAC:Y:SCAL:RLEV 10
//Set the reference level to 10 dBm
FREQ:CENT 2.1175 GHz
//Set the center Frequency to 2.1175 GHz
DISP:TRAC:Y:SCAL:AUTO ONCE
//Optimize the scaling of the y-axis for the current measurement
INIT:CONT OFF
//Stops continuous sweep
SWE:COUN 100
//Set the number of sweeps to be performed to 100
INIT;*WAI
//Start a new measurement with 100 sweeps and wait for the end
```

```
CALC:MARK:FUNC:WCDP:BTS:RES? CDPR
//Retrieve the relative code domain power
//Result: 0 [dB]
TRAC:DATA? TRACE1
//Retrieve the trace data of the code domain power measurement
//Result: +8.000000000,+0.000000000,-4.319848537,-3.011176586,+0.000000000,
//+2.000000000,+1.000000000,-4.318360806,-3.009688854,+1.000000000,
//+8.000000000,+0.000000000,-7.348078156E+001,-7.217211151E+001,+1.000000000,
// [...]

----------Synchronizing the Reference Frequencies-------------------------

//Select the external Frequency from the REF INPUT 1..20 MHZ connector as a reference
DEV:EXTR:SOUR 'MyFSW',E10


//Query the carrier Frequency error
//Result: 0.1 [Hz]

---------Behaviour with Incorrect Scrambling Code------------------------

CDP:LCOD:DVAL 0001
//Change the scrambling code on the analyzer to 0001 (default is 0000)
TRAC:DATA? TRACE1
//Retrieve the trace data of the code domain power measurement
//Result: 1.000000000,+8.000000000,+7.700000000E+001,-2.991873932E+001,-2.861357307E+001,
//+0.000000000,+8.000000000,+7.800000000E+001,-2.892916107E+001,-2.762399483E+001,
//+1.000000000,+8.000000000,+7.800000000E+001,-2.856664085E+001,-2.726147461E+001,
// [...]
```

Table 10-11: Trace results for Relative Code Domain Power measurement (correct scrambling code)

Code class	Channel no.	Abs. power level [dBm]	Rel. power level [%]	Timing offset [chips]
+8.000000000	+0.000000000	-4.319848537	-3.011176586	+0.000000000
+2.000000000	+1.000000000	-4.318360806	-3.009688854	+1.000000000
+8.000000000	+0.000000000	-7.348078156E +001	-7.217211151E +001	+1.000000000
...	...			

Table 10-12: Trace results for Relative Code Domain Power measurement (incorrect scrambling code)

Code class	Channel no.	Abs. power level [dBm]	Rel. power level [%]	Timing offset [chips]
1.000000000	+8.000000000	+7.700000000E +001	-2.991873932E +001	-2.861357307E +001
+0.000000000	+8.000000000	+7.800000000E +001	-2.892916107E +001	-2.762399483E +001

Code class	Channel no.	Abs. power level [dBm]	Rel. power level [%]	Timing offset [chips]
+1.000000000	+8.000000000	+7.800000000E +001	-2.856664085E +001	-2.726147461E +001
...	...			

10.12.2 Measurement 2: Triggered Measurement of Relative Code Domain Power

```
*RST
//Reset the instrument
INST:CRE:REPL 'IQ Analyzer',BWCD,'BTSMeasurement'
//Replace the default channel by a 3GPP FDD BTS channel named "BTSMeasurement"
DISP:TRAC:Y:SCAL:RLEV 10
//Set the reference level to 10 dBm
FREQ:CENT 2.1175 GHz
//Set the center Frequency to 2.1175 GHz
CDP:LCOD:DVAL 0000
//Change the scrambling code on the analyzer to 0000
TRIG:SOUR EXT
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
DISP:TRAC:Y:SCAL:AUTO ONCE
//Optimize the scaling of the y-axis for the current measurement
INIT:CONT OFF
//Stops continuous sweep
SWE:COUN 100
//Set the number of sweeps to be performed to 100
INIT;*WAI
//Start a new measurement with 100 sweeps and wait for the end
CALC:MARK:FUNC:WCDP:BTS:RES? TFR
//Retrieve the trigger to frame (the offset between trigger event and
// start of first captured frame)
//Result: 0.00599987013 [ms]

------- Compensating a delay of the trigger event to the first captured frame -------

TRIG:HOLD 100 us
//Change the trigger offset to 100 us (=trigger to frame value)
CALC:MARK:FUNC:WCDP:BTS:RES? TFR
//Retrieve the trigger to frame value
//Result: 0.00599987013 [ms]
```

10.12.3 Measurement 3: Measuring the Composite EVM

```
*RST
//Reset the instrument
```

```
INST:CRE:REPL 'IQ Analyzer',BWCD,'BTSMeasurement'
//Replace the default channel by a 3GPP FDD BTS channel named "BTSMeasurement"
DISP:TRAC:Y:SCAL:RLEV 10
//Set the reference level to 10 dBm
FREQ:CENT 2.1175 GHz
//Set the center Frequency to 2.1175 GHz
TRIG:SOUR EXT
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
LAY:REPL '2','XTIM:CDP:MACC'
//Replace the second measurement window (Result Summary) by Composite EVM evaluation
DISP:WIND2:TRAC:Y:SCAL:AUTO ONCE
//Optimize the scaling of the y-axis for the Composite EVM measurement
INIT:CONT OFF
//Stops continuous sweep
SWE:COUN 100
//Set the number of sweeps to be performed to 100
INIT;*WAI
//Start a new measurement with 100 sweeps and wait for the end
TRAC2:DATA? TRACE1
//Retrieve the trace data of the composite EVM measurement
//Result: +0.000000000,+5.876136422E-001,
//+1.000000000,+5.916179419E-001,
//+2.000000000,+5.949081182E-001,
//[...]
```

Table 10-13: Trace results for Composite EVM measurement

(CPICH) Slot number	EVM
0	+5.876136422E-001
1	+5.916179419E-001
2	+5.949081182E-001
...	...

10.12.4 Measurement 4: Determining the Peak Code Domain Error

```
*RST
//Reset the instrument
INST:CRE:REPL 'IQ Analyzer',BWCD,'BTSMeasurement'
//Replace the default channel by a 3GPP FDD BTS channel named "BTSMeasurement"
DISP:TRAC:Y:SCAL:RLEV 10
//Set the reference level to 10 dBm
FREQ:CENT 2.1175 GHz
//Set the center Frequency to 2.1175 GHz
TRIG:SOUR EXT
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
LAY:REPL '2','XTIM:CDP:ERR:PCD'
```

```
//Replace the second measurement window (Result Summary) by the
//Peak Code Domain Error evaluation
DISP:WIND2:TRAC:Y:SCAL:AUTO ONCE
//Optimize the scaling of the y-axis for the Composite EVM measurement
INIT:CONT OFF
//Stops continuous sweep
SWE:COUN 100
//Set the number of sweeps to be performed to 100
INIT;*WAI
//Start a new measurement with 100 sweeps and wait for the end
TRAC2:DATA? TRACE1
//Retrieve the trace data of the Peak Code Domain Error measurement
//Result: +0.000000000,-6.730751038E+001,
//+1.000000000,-6.687619019E+001,
//+2.000000000,-6.728615570E+001,
// [...]
```

Table 10-14: Trace results for Peak Code Domain Error measurement

Slot number	Peak Error
0	-6.730751038E+001
1	-6.687619019E+001
2	-6.728615570E+001
...	...

A Reference

A.1 Menu Reference

Most functions in the R&S VSE are available from the menus.

A.1.1 Common R&S VSE Menus

The following menus provide **basic functions for all applications**:

A.1.1.1 File Menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE User Manual.

Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> New Measurement Channel	-	Inserts a new channel in the selected group
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.

Menu item	Correspond-ing icon in toolbar	Description
> Delete Current Mea-surement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE soft-ware
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instru-ments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Selected Channel	-	Restores the default software configuration for an individual channel
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE software
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE software

A.1.1.2 Window Menu

The "Window" menu allows you to hide or show individual windows.

Menu item	Correspond-ing icon in toolbar	Description
Player...	-	Displays the "Player" tool window to recall I/Q data recordings
Instrument Setup...	-	Displays the "Instruments" window to configure input instruments

Menu item	Correspond-ing icon in toolbar	Description
Measurement Group Setup...	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measurement channel
Channel Infos >	-	Displays the channel bar with global channel information for the selected meausrement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated
Configure Selected Result Window	-	Displays the "Window Configuration" dialog box to configure result-specific settings

A.1.1.3 Help Menu

The "Help" menu provides access to help, support and licensing functions.

Menu item	Correspond-ing icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Attempts to create an email with the default mail program (if available) to the Rohde & Schwarz support address for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.1.2 3GP FDD Measurements Menus

The following menus are only available if a 3GP FDD measurement channel is selected.

A.1.2.1 Input & Output Menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table 1-1: "Input & Output" menu items for 3GP FDD Measurements

Menu item	Description
Amplitude	chapter 5.1.4.1, "Amplitude Settings", on page 59
Scale	chapter 5.1.4.2, "Y-Axis Scaling", on page 62
Frequency	chapter 5.1.4.3, "Frequency Settings", on page 63
Trigger	chapter 5.1.5, "Trigger Settings", on page 65
Input Source	chapter 5.1.3.1, "Input Source Settings", on page 53
Output	chapter 5.1.3.2, "Output Settings", on page 57

A.1.2.2 Meas Setup Menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table 1-2: "Meas Setup" menu items for 3GP FDD Measurements

Menu item	Description
Select Measurement	chapter 3, "Measurements and Result Display", on page 11
Capture	"Capture / Average Count" on page 69
Signal Description	chapter 5.1.2, "Signal Description", on page 48
Scrambling Code	chapter 5.1.2.2, "BTS Scrambling Code", on page 50
Signal Capture	chapter 5.1.6, "Signal Capture (Data Acquisition)", on page 68
Sync	chapter 5.1.7, "Synchronization (BTS Measurements Only)", on page 70
Channel Detection	chapter 5.1.8, "Channel Detection", on page 71
Code Domain Settings	chapter 6.2, "Code Domain Analysis Settings (BTS Measurements)", on page 87
Evaluation Range	chapter 6.1, "Evaluation Range", on page 85
Overview	chapter 5.1.1, "Configuration Overview", on page 47

A.1.2.3 Trace Menu

The "Trace" menu provides access to trace-specific functions.

See chapter 6.4, "Traces", on page 90

This menu is application-specific.

Table 1-3: "Trace" menu items for 3GP FDD Measurements

Menu item	Description
Clear Write Max Hold Min Hold Average View	Defines the trace mode, see "Trace Mode" on page 91
Trace ...	Opens the "Traces" configuration dialog box, see chapter 6.4, "Traces", on page 90

A.1.2.4 Marker Menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table 1-4: "Marker" menu items for 3GP FDD Measurements

Menu item	Correspond-ing icon in toolbar	Description
Select marker <x>	M1	" M1 Marker 1/ Delta 1/ Delta 2/.../Delta 4" on page 92
All Markers Off		"All Markers Off" on page 94
CPICH	-	"Marker To CPICH" on page 96
PCCPCH	-	"Marker To PCCPCH" on page 96
Marker...		chapter 6.5.1, "Individual Marker Settings", on page 92
Search	-	chapter 6.5.3, "Marker Search Settings", on page 94

A.1.2.5 Limits Menu

The "Limits" menu does not contain any functions for 3GP FDD measurements.

A.2 Reference of Toolbar Functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-5: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel

"Control" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-6: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement

Icon	Description
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement mode for next capture
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-7: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
?	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-8: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
1:1	Zoom off: displays the diagram in its original size

Table 1-9: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
M1	Select marker

Icon	Description
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table 1-10: Functions in the "AutoSet" toolbar

Icon	Description
	Auto level
	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)

Icon	Description
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

List of Remote Commands (3GPP FDD)

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