R&S®FSW-K76/K77
TD-SCDMA Measurements Options
User Manual

ROHDE&SCHWARZ

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

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

The following firmware options are described:

- R&S FSW-K76 (1313.1445.02)
- R&S FSW-K77 (1313.1451.02)

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.

The following abbreviations are used throughout this manual: R&S®FSW is abbreviated as R&S FSW. "R&S FSW-K76 and R&S FSW-K77" are abbreviated as R&S FSW-K76/-K77.

Contents

1 Preface

1.1 About this Manual

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

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

- **Welcome to the TD-SCDMA Measurements Application**
  Introduction to and getting familiar with the application

- **Measurements and Result Displays**
  Details on supported measurements and their result types

- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement

- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command

- **I/Q Data Import and Export**
  Description of general functions to import and export raw I/Q (measurement) data

- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup

- **How to Perform Measurements in TD-SCDMA Applications**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods

- **Measurement Examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately

- **Remote Commands for TD-SCDMA Measurements**
  Remote commands required to configure and perform TD-SCDMA measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FSW User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes

- **List of remote commands**
  Alphabetical list of all remote commands described in the manual

- **Index**

1.2   Documentation Overview

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

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

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

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

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

Getting Started

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

Online Help

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

User Manuals and Online Manual

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

- **Base unit** manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the **Getting Started** manual.

- **Software option** manuals
  Describe the specific functions of the option. Basic information on operating the R&S FSW is not included.

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

Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS).

Instrument Security Procedures

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

Data Sheet and Brochures

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

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

Release Notes

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

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

Application Notes, Application Cards, White Papers, etc.

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

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

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.

Convention	Description
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3.2 Conventions for Procedure Descriptions

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

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

1.3.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters.

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

2 Welcome to the TD-SCDMA Applications

The TD-SCDMA applications add functionality to the R&S FSW to perform code domain analysis or power measurements according to the TD-SCDMA standard.

R&S FSW-K76 performs **B**ase **T**ransceiver **S**tation (**BTS**) measurements (for downlink signals).

R&S FSW-K77 performs **U**ser **E**quipment (UE) measurements (for uplink signals).

In particular, the TD-SCDMA applications feature:

- Code domain analysis, providing results like code domain power, EVM, peak code domain error etc.
- Various power measurements
- Spectrum Emission Mask measurements
- Statistical (CCDF) evaluation

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 Spectrum application and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage (http://www2.rohde-schwarz.com/product/FSW.html).

Installation

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

2.1 Starting the TD-SCDMA Application

The TD-SCDMA measurements require a special application on the R&S FSW.

To activate the TD-SCDMA applications

1. Select the MODE key.

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

2. Select the "TD-SCDMA BTS" or "TD-SCDMA UE" item.
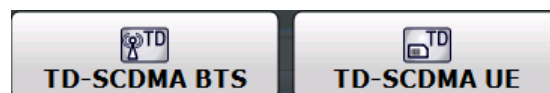
    The R&S FSW opens a new measurement channel for the TD-SCDMA application.

A Code Domain Analysis measurement is started immediately with the default settings. It can be configured in the TD-SCDMA "Overview" dialog box, which is displayed when

you select the "Overview" softkey from any menu (see Chapter 6.2.1, "Configuration Overview", on page 51).

Multiple Measurement Channels and Sequencer Function

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

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

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

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

2.2 Understanding the Display Information

The following figure shows a measurement diagram during a TD-SCDMA 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 TD-SCDMA UE measurements.)
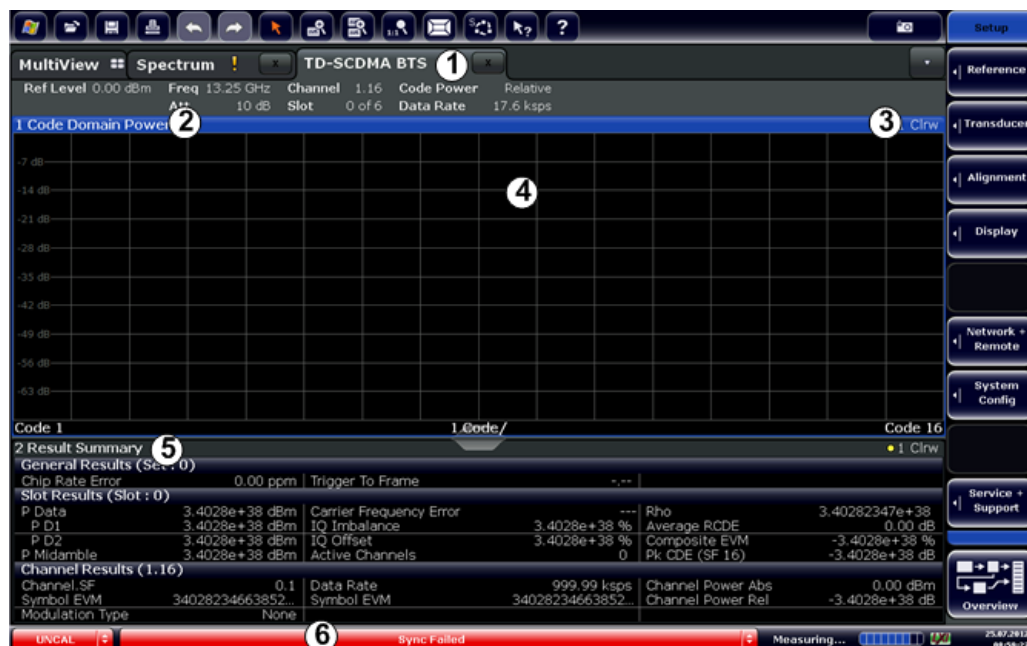
1   = Channel bar for firmware and measurement settings
2+3 = Window title bar with diagram-specific (trace) information
4   = Diagram area
5   = Diagram footer with diagram-specific information
6   = Instrument status bar with error messages, progress bar and date/time display

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MSRA operating mode

In MSRA operating mode, additional tabs and elements are available. A colored background of the screen behind the measurement channel tabs indicates that you are in MSRA operating mode.

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

Channel bar information

In TD-SCDMA applications, when performing Code Domain Analysis, the R&S FSW screen display deviates from the Spectrum application. For Frequency and time domain measurements, the familiar settings are displayed (see the R&S FSW Getting Started manual).

Table 2-1: Hardware settings displayed in the channel bar in TD-SCDMA 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)
Slot	Slot of the (CPICH) channel
Code Power	Power result mode: • Absolute • Relative to total power of the data parts of the signal
Symbol Rate	Symbol rate of the current channel

Window title bar information

For each diagram, the header provides the following information:

Figure 2-1: Window title bar information in TD-SCDMA applications

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

Diagram footer information

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

- Start slot/symbol/code
- slot/symbol/code per division
- Stop slot/symbol/code

Status bar information

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

3 Measurements and Result Display

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

Evaluation methods

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

Evaluation range

You can restrict evaluation to a specific channel, frame or slot, depending on the evaluation method. See Chapter 7.1, "Evaluation Range", on page 108.

3.1 Code Domain Analysis

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

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

A signal section containing at least two TD-SCDMA subframes is recorded for analysis and then searched through to find the start of the first subframe. If a subframe start is found in the signal, the code domain power analysis is performed for the selected slot. The different evaluations are calculated from the captured I/Q data set. Therefore it is not necessary to start a new measurement to change the evaluation.

The TD-SCDMA applications provide the peak code domain error measurement and composite EVM specified by the TD-SCDMA 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 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 (data parts only). By default, the power relative to the total signal is displayed.

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

Remote command:

`CONF:CDP[:BTS]:MEAS CDP,` see `CONFigure:CDPower:MEASurement`
on page 134

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 slot and channel (code) 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 individually.

Table 3-1: General and slot-specific code domain power results in the Result Summary

Parameter	Description
Chip Rate Error	The chip rate error in ppm. A large chip rate error results in symbol errors and, therefore, in possible synchronization errors for code domain measurements. This measurement result is also valid if the application could not synchronize to the TD-SCDMA signal.
Trigger to Frame	The time difference between the beginning of the recorded signal section to the start of the first slot. For triggered measurements, this difference is identical with the time difference of frame trigger (+ trigger offset) and the start of the first slot. If synchronization of the analyzer and input signal fails, the value of "Trigger to Frame" is not significant. For non-triggered measurements, no result is available.
P Data	Average power of the slot's data parts (total and for each data part)
P Midamble	Power of the slot's midamble
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 slot (see also "Synchronization fails" on page 118)
IQ Offset	DC offset of the signal in the selected slot in %
IQ Imbalance	I/Q imbalance of signals in the selected slot in %
Active Channels	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.
RHO	Quality parameter RHO for each slot. According to the TD-SCDMA standard, Rho is the normalized, correlated power between the measured and the ideally generated reference signal.

Parameter	Description
Average RCDE	Average Relative Code Domain Error over all channels. The Average RCDE is calculated according to release 8 of the standard.
Composite EVM	The error vector magnitude (EVM) over the total signal in the selected slot. The EVM is the root of the ratio of the mean error power to the power of an ideally generated reference signal. See also "Composite EVM" on page 21
Pk CDE (15 ksps)	The Peak Code Domain Error projects the difference between the measured signal and the ideal reference signal onto the spreading factor in the selected slot (see "Peak Code Domain Error" on page 23). The symbol rate, from which the spreading factor can be determined, is indicated in brackets.

DwPTS/UpPTS parameters

Optionally, the following parameters determined for the "Downlink Pilot Time Slot" (DwPTS) or the "Uplink Pilot Time Slot" (UpPTS, see also Chapter 4.2, "Frames, Subframes and Slots", on page 39) can be displayed in the Result Summary.

- "Subframe Number": Subframe the slot belongs to
- "DwPTS/UpPTS Active": Indicates whether DwPTS/UpPTS slot is active
- "DwPTS/UpPTS Power": Power in the DwPTS/UpPTS slot
- "DwPTS/UpPTS Rho": RHO for the DwPTS/UpPTS slot
- "DwPTS/UpPTS EVM(RMS)": EVM (RMS) for the DwPTS/UpPTS slot
- "DwPTS/UpPTS EVM(Peak)": EVM (Peak) for the DwPTS/UpPTS slot

The channel-specific results are displayed in the Result Summary, the Channel Table, or both.

Table 3-2: Channel-specific code domain power results

Parameter	Description
Channel Type	Detected type of channel (see Table 4-4)
Ch.SF	Channel number including the spreading factor (in the form <Channel>.<SF>).
SymRate[ksps]	Symbol rate at which the data in the channel is transmitted (in ksps)
Symbol EVM	RMS and peak EVM values per symbol (see "Symbol EVM" on page 27)
Mod	Modulation type (QPSK, 8PSK, 16QAM or 64QAM)
Power [dBm]	Channel power, absolute
Power [dB]	Channel power, relative to total power of the data parts of the signal

Parameter	Description
MA.shift	Midamble shift
	For channels, this is the shift of the associated midamble if a common or default mid-amble assignment is detected (see Chapter 4.4, "Data Fields and Midambles", on page 44)
ΔMid1/2	The power offset between the midamble and the sum power of its channels in data part 1 or 2, respectively.
	The TD-SCDMA specifications require that the midamble and its channels must have the same power. These parameters show if a common or default midamble assign-ment is detected (see Chapter 4.4, "Data Fields and Midambles", on page 44).

3.1.2 Evaluation Methods for Code Domain Analysis

Access: "Overview" > "Display Config"

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

The selected evaluation also affects the results of the trace data query (see Chapter 10.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 203).

Bitstream
The Bitstream evaluation displays the demodulated bits of a selected channel for a given slot.

Figure 3-1: Bitstream display for TD-SCDMA BTS measurements

Depending on the spreading factor (symbol rate) of the channel, a slot can contain a minimum of 44 and a maximum of 704 symbols. Depending on the modulation type, a symbol consists of 2 to 6 bits (see Table 4-8).

TIP: Select a specific symbol using the **MKR key** while the display is focused. If you enter a number, the marker jumps to the selected symbol, which is highlighted by a blue circle.

Remote command:
`LAY:ADD? '1',RIGH, BITS`, see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]?` on page 200

Channel Table
The Channel Table evaluation displays the detected channels and the results of the code domain power measurement. The measurement evaluates the total signal over the selected slot. The Channel Table can contain a maximum of 16 entries, which corresponds to the 16 codes that can be assigned for a spreading factor of 16.

The sort order of the table is configurable (see "Channel Table Sort Order" on page 110). It can be sorted:

- By code number, starting with midambles, then control channels, then data channels
  By midamble, where all channels are listed below the midamble they belong to

Figure 3-2: Channel Table display for TD-SCDMA BTS measurements

By default, only active channels are included in the display; to include inactive channels, see "Channel Table Configuration" on page 18. Inactive channels are marked with dashes in the "Channel Type", "SymRate" and "Modulation" columns.
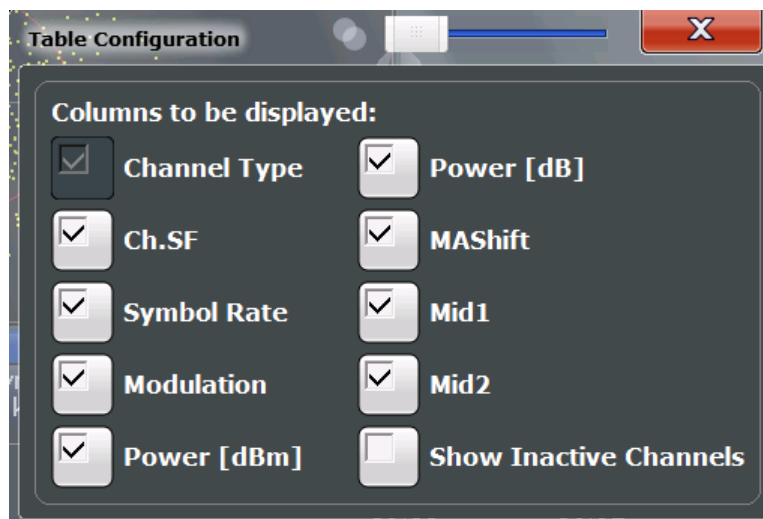
For details on the displayed results, see Table 3-2.

Remote command:
LAY:ADD? '1',RIGH, CTABle, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? on page 200

Channel Table Configuration ← Channel Table
You can configure which parameters are displayed in the Channel Table by selecting
the table 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. To display all channels, including the
inactive ones, enable the "Show Inactive Channels" option.

For details on the displayed results , see Table 3-2.

Code Domain Power
The Code Domain Power evaluation shows the power of all possible codes in the
selected slot in the total signal. Channel detection is based on a power threshold (see
Chapter 4.3, "Channels and Codes", on page 41). Thus, it is important that all codes
have a similar power level (no more than 1.5 dB difference to the average power in the
slot). Thus, the scaling of the code domain power is relative to the average power of
the data parts in the specified slot in the total signal by default. The x-axis shows the
possible codes from 0 to the highest spreading factor. Due to the circumstance that the
power is regulated from slot to slot, the result power can differ between different slots.
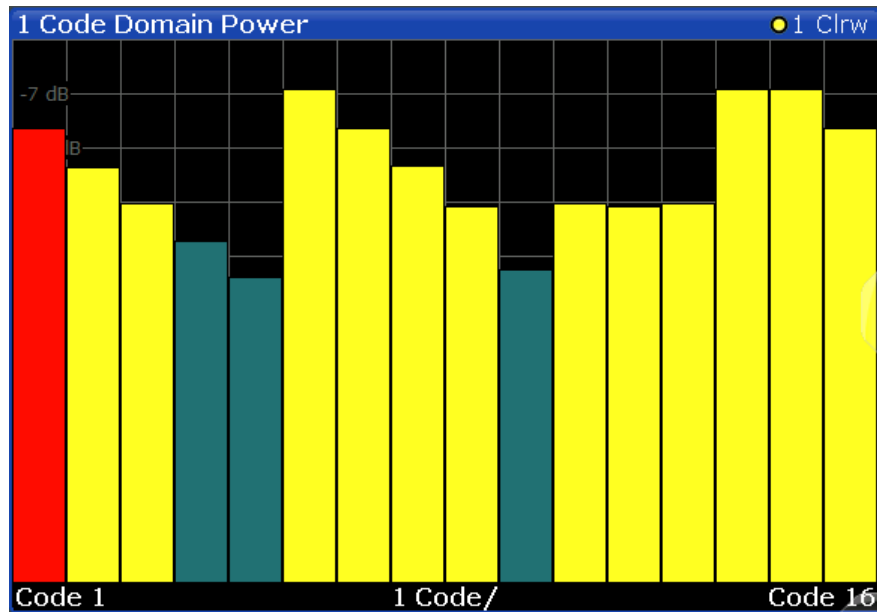
The codes are displayed using the following colors:
- **Yellow**: detected channels
- **Red**: selected channel (if a channel is made up of more than one code, all codes that belong to the channel are red)
- **Green**: no channel detected

Remote command:

`LAY:ADD? '1',RIGH, CDPower`, see `LAYout:ADD[:WINDow]?` on page 184

`CALC:MARK:FUNC:CDP:RES? CDP`, see `CALCulate<n>:MARKer:FUNCtion:CDPower:RESult?` on page 196

`TRACe<n>[:DATA]?` on page 200

Code Domain Error Power

The Code Domain Error Power is the difference in power between the measured and an ideally generated reference signal. The number of codes corresponds to the spreading factor. The y-axis shows the error power for each code. Since it is an error power (as opposed to the measured power), both active and inactive channels can be analyzed at a glance.
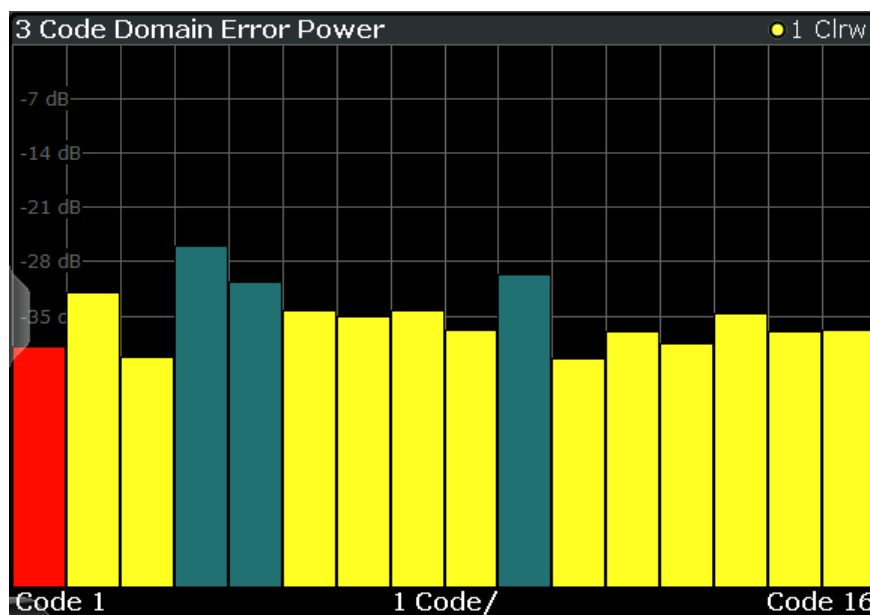
Figure 3-3: Code Domain Error Power Display for TD-SCDMA BTS measurements

The codes are displayed using the following colors:
- **Yellow**: detected channels
- **Red**: selected channel (if a channel is made up of more than one code, all codes that belong to the channel are red)
- **Green**: no channel detected

Remote command:
`LAY:ADD? '1',RIGH, CDEPower,` see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]?` on page 200

Composite Constellation
In the Composite Constellation result display, the constellation points of the 864 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.

Note: The red circle indicates the value "1"
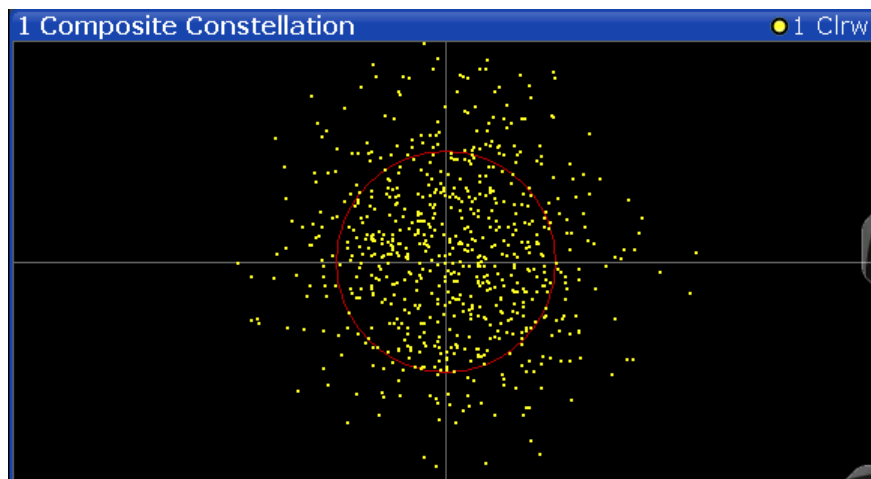
Figure 3-4: Composite Constellation display for TD-SCDMA BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, CCONst,` see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]?` on page 200

Composite EVM

The Composite EVM evaluation determines the error vector magnitude (EVM) over the total signal. The EVM is the root of the ratio of the mean error power to the power of an ideally generated reference signal. To calculate the mean error power, the root mean square average of the real and imaginary parts of the signal is used. The EVM is shown in %. This evaluation is useful to determine the modulation accuracy.

Figure 3-5: Composite EVM display for TD-SCDMA BTS measurements

The result display shows the composite EVM values per slot.

The slots are displayed according to the detected channels using the following colors:
- **Yellow**: active channel
- **Red**: selected channel (if a channel is made up of more than one code, all codes that belong to the channel are red)

- **None**: no active channels

Only the channels detected as being active are used to generate the ideal reference signal. Due to low power, for example, a channel may not be detected as being active. In this case, the difference between the test signal and the reference signal - and therefore the composite EVM - is very large.

Distortions also occur if unassigned codes are wrongly given the status of "active channel". To obtain reliable measurement results, select an adequate channel threshold.

Remote command:
LAY:ADD? '1',RIGH, CEVM, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? on page 200

Mag Error vs Chip

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

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

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

Where:

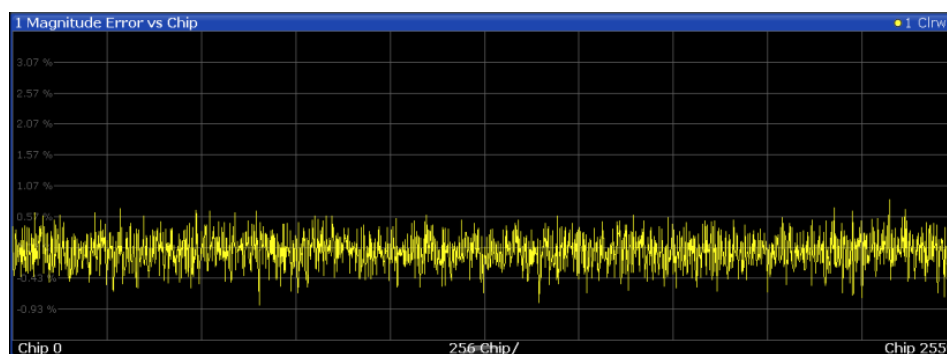|	
MAG_k	Magnitude error of chip number k
s_k	Complex chip value of received signal
x_k	Complex chip value of reference signal
k	Index number of the evaluated chip
N	Number of chips at each CPICH slot
n	Index number for mean power calculation of reference signal

Figure 3-6: Magnitude Error vs Chip display for TD-SCDMA BTS measurements

Remote command:
LAY:ADD? '1',RIGH, MECHip, see LAYout:ADD[:WINDow]? on page 184
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 115).

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

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

Remote command:
LAY:ADD? '1',RIGH, MTAB, see LAYout:ADD[:WINDow]? on page 184
Results:
CALCulate<n>:MARKer<m>:X on page 215
CALCulate<n>:MARKer<m>:Y? on page 212

Peak Code Domain Error

The Peak Code Domain Error is defined as the maximum value for the Code Domain Error for all codes.

In line with the TD-SCDMA specifications, the error is calculated:

- Between the measurement signal and the ideal reference signal
- For a given slot
- For each *active* code
- For any of the supported spreading codes

For inactive slots (containing no active channels), no results are available as no reference power is available.
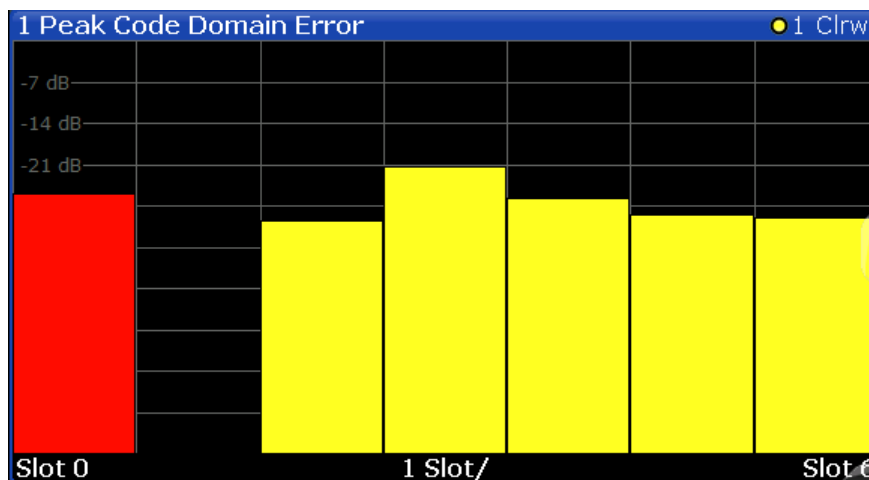

Figure 3-7: Peak Code Domain Error display for TD-SCDMA BTS measurements

The result display shows the peak error values per slot.

The slots are displayed according to the detected channels using the following colors:
- **Yellow**: active channel
- **Red**: selected channel (if a channel is made up of more than one code, all codes that belong to the channel are red)
- **None**: no active channels

Only the channels detected as being active are used to generate the ideal reference signal. If a channel is not detected as being active, e.g. due to low power, the difference between the test signal and the reference signal is too large. The result display therefore shows a peak code domain error that is too high for all slots.

Distortions also occur if unassigned codes are wrongly given the status of "active channel". To obtain reliable measurement results, select an adequate channel threshold.

Remote command:
LAY:ADD? '1',RIGH, PCDerror, see LAYout:ADD[:WINDow]? on page 184

TRACe<n>[:DATA]? on page 200

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

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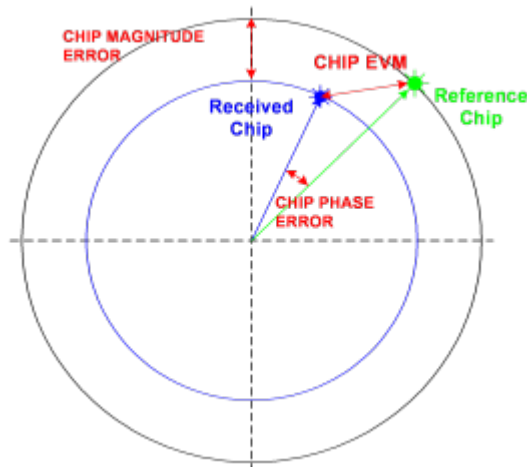

Figure 3-8: Calculating the magnitude, phase and vector error per chip
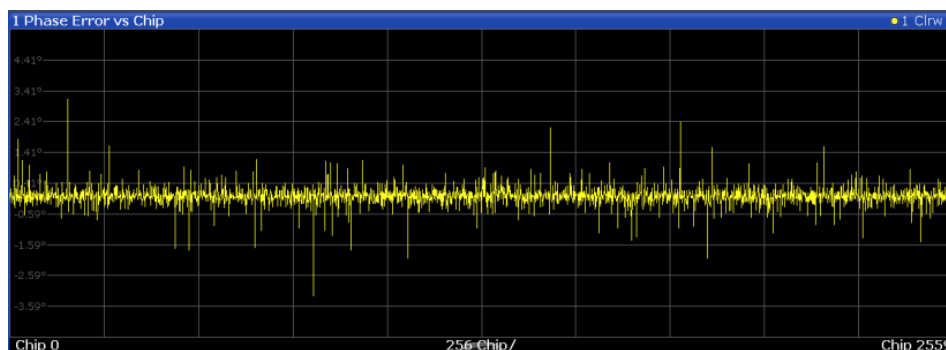
- $PHI_k = \varphi(s_k) - \varphi(x_k) \quad | \quad N = 2560 \quad | \quad k \in [0 \ldots (N-1)]$

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 184
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 data parts of the signal. The measurement evaluates a single channel over all slots.

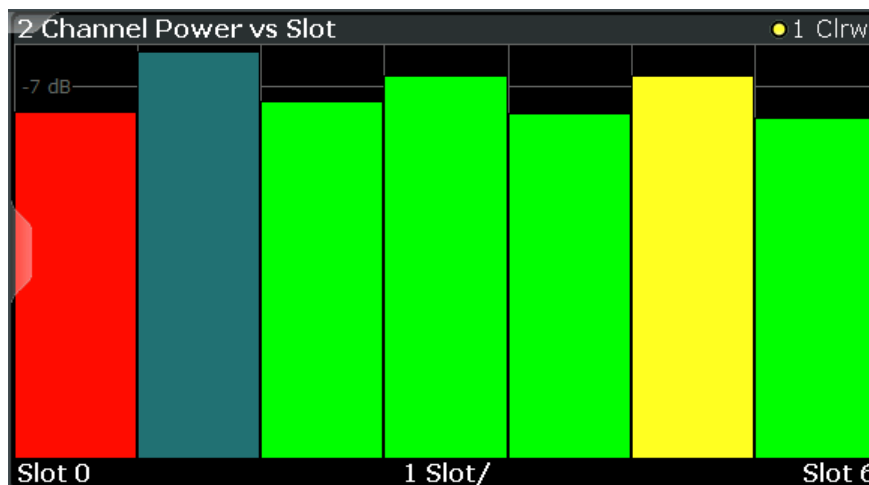*Figure 3-9: Power vs Slot Display for TD-SCDMA BTS measurements*

The slots are displayed according to the detected channels using the following colors:
- **Yellow**: active channel
- **Green**: channel with alias power (power results from channels with a different code class)
- **Cyan**: inactive channel
- **Red**: selected channel (if a channel is made up of more than one code, all codes that belong to the channel are red)

Remote command:
`LAY:ADD? '1',RIGH, PSLot,` see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]?` on page 200

Power vs Symbol

The Power vs Symbol evaluation shows the power measured for each symbol in the selected channel and the selected slot. The power is not averaged here.
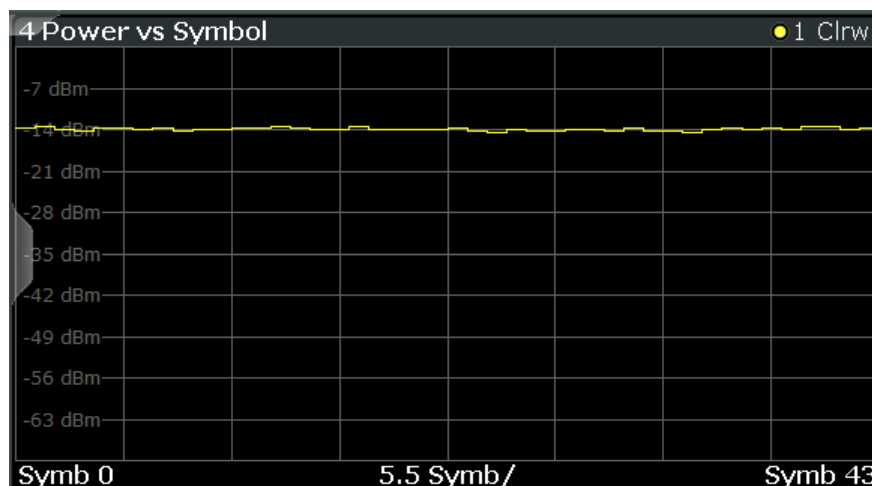
Figure 3-10: Power vs Symbol display for TD-SCDMA BTS measurements

Depending on the spreading factor (symbol rate) of the channel, a slot can contain a minimum of 44 and a maximum of 704 symbols (see Table 4-8).

Remote command:
`LAY:ADD? '1',RIGH, PSYMbol,` see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]?` on page 200

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 14.

Figure 3-11: Result Summary display for TD-SCDMA BTS measurements

Note: DwPTS and UpPTS parameters.
Optionally, the parameters determined for the "Downlink Pilot Time Slot" (DwPTS) or "Uplink Pilot Time Slot" (UpPTS, see also Chapter 4.2, "Frames, Subframes and Slots", on page 39) can be displayed in the Result Summary (see "Show DwPTS Results (BTS mode)" on page 111).

Remote command:
LAY:ADD? '1',RIGH, RSUMmary, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? on page 200
CALCulate<n>:MARKer:FUNCtion:CDPower:RESult? on page 196

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

Note: The red circle indicates the value "1"
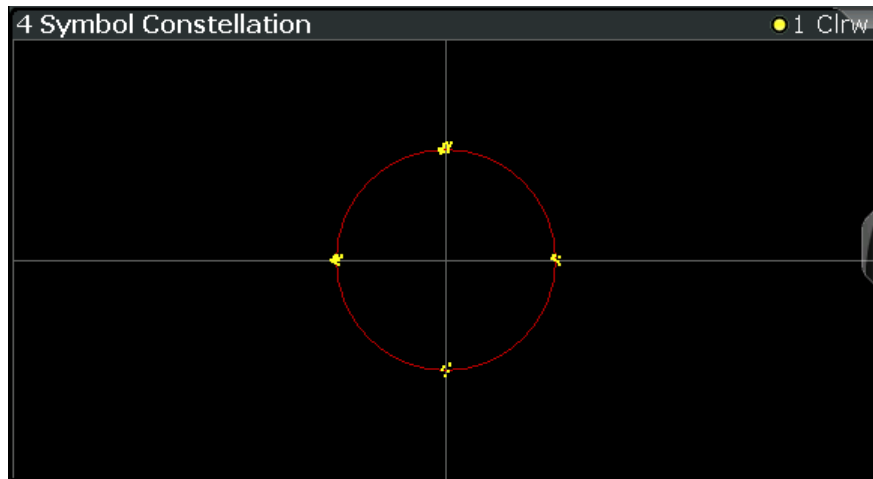
Figure 3-12: Symbol Constellation display for TD-SCDMA BTS measurements

Remote command:
LAY:ADD? '1',RIGH, SCONst, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? on page 200

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 depends on the symbol
rate (or spreading factor) of the channel (see Table 4-8).

Figure 3-13: Symbol EVM display for TD-SCDMA BTS measurements

Remote command:
LAY:ADD? '1',RIGH, SEVM, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? on page 200

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

Figure 3-14: Symbol Magnitude Error display for TD-SCDMA BTS measurements

Remote command:
LAY:ADD? '1',RIGH, SMERror, see LAYout:ADD[:WINDow]? on page 184
TRACe<n>[:DATA]? TRACE<1...4>

Symbol Phase Error

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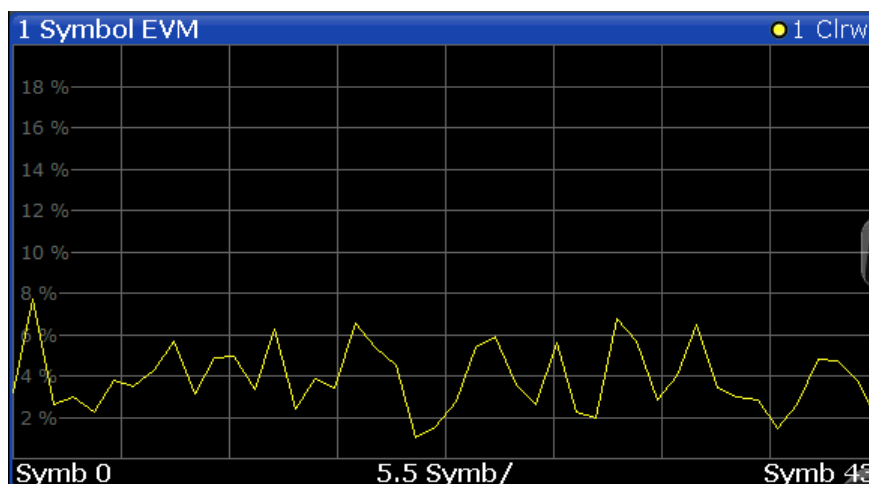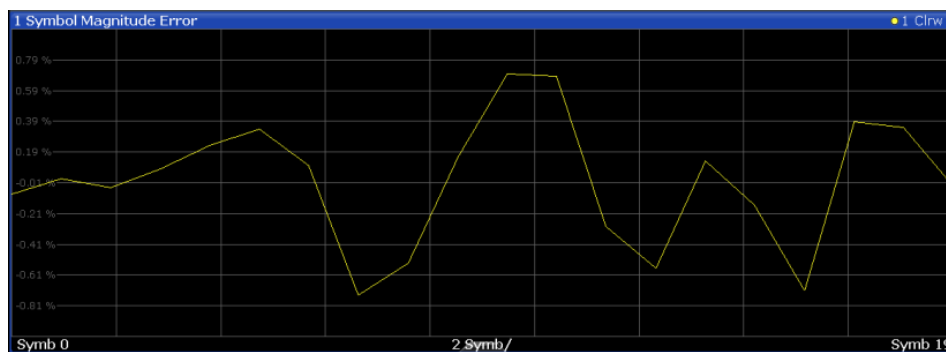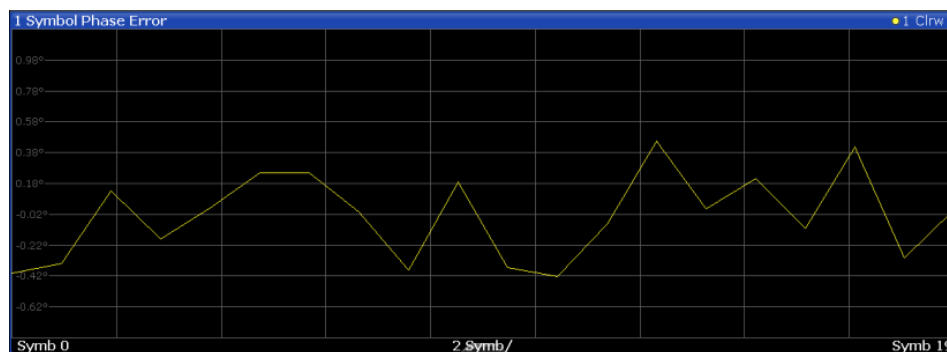

Figure 3-15: Symbol Phase Error display for TD-SCDMA BTS measurements

Remote command:
`LAY:ADD? '1',RIGH, SPERror,` see `LAYout:ADD[:WINDow]?` on page 184
`TRACe<n>[:DATA]? TRACE<1...4>`

3.1.3 CDA Measurements in MSRA Operating Mode

The TD-SCDMA BTS application can also be used to analyze data in MSRA operating mode.

In MSRA operating mode, only the MSRA Master actually captures data; the MSRA applications receive an extract of the captured data for analysis, referred to as the **application data**. The application data range is indicated in the MSRA Master by vertical blue lines.

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

In the TD-SCDMA BTS application, the analysis interval is automatically determined. It depends on the selected channel/ slot/ frame to analyze, which is defined for the evaluation range, and on the result display. The currently used analysis interval (in seconds, related to capture buffer start) is indicated in the window header for each result display.

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

3.2 Frequency and Time Domain Measurements

Access: "Overview" > "Select Measurement"

In addition to the Code Domain Analysis measurements, the TD-SCDMA applications also provide some frequency and time domain measurements as defined in the TD-SCDMA standard. Frequency and time domain measurements are identical to the corresponding measurements in the base unit, but configured according to the requirements of the TD-SCDMA standard.

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

MSRA operating mode

Frequency and time domain measurements are not available in MSRA operating mode.

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

3.2.1 Measurement Types and Results in the Frequency and Time Domain

Access: "Overview" > Select Measurement

The TD-SCDMA applications provide the following frequency and time domain measurements:

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

The Power vs Time measurement checks the signal power in the time domain against a transmission power mask defined by the TD-SCDMA specification (*"transmit ON/OFF power time mask"*). This measurement is meant to ensure that each burst remains within a tight power range, i.e. rises and falls very quickly.

For **downlink** measurements, the power in the slots reserved for the uplink transmission must quickly fall to the low value. It must then quickly rise to high again in the slots for downlink transmission. Thus, the slots of interest in downlink Power vs Time measurements are **slot 1** to the slot indicated by the *Switching Point*, in which the **OFF** power is checked.

Figure 3-16: Power vs Time diagram for TD-SCDMA BTS application

In the TD-SCDMA **UE application**, it is assumed that only one uplink device is checked during one measurement. Furthermore, it is assumed that each uplink device uses only a single slot for transmission. Thus, for uplink measurements, only one slot is checked against the transmit mask. Since the TD-SCDMA UE application has no information which slot is being used, it assumes the first slot in which a burst is detected to be slot 1, the first slot for uplink transmission. In this slot, the power must quickly rise to the high value, and quickly fall back to low at the end. Thus, the slot of interest in **uplink** Power vs Time measurements is **slot 1**, which cannot be changed, and in which the **ON** power is checked.
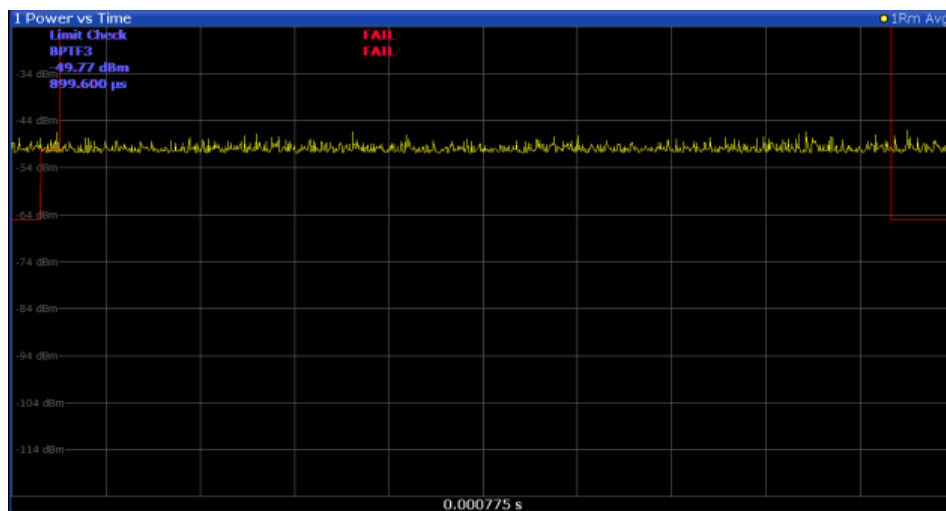
Figure 3-17: Power vs Time diagram for TD-SCDMA UE application

To perform the power check, the TD-SCDMA application must synchronize the transmit mask to the current signal, as the mask is defined relative to a slot start.

The application measures the power in the defined number of subframes in the time domain and calculates the average power in the slots of interest. It then compares the averaged power of the signal against the mask for allowed transmission power.

The mask consists of four defined intervals:

- Before the burst
- During fall time
- During the low time

- During the rise time

Note: For UE measurements, the ON power is checked, thus the mask is defined for the following intervals:
- Before the burst
- During the rise time
- During the high time
- During fall time

As a result, the power vs time trace is displayed. The result of the limit check (Pass/Fail) is also indicated in the diagram.

The numeric results are provided in the List Evaluation result display (see "List Evaluation" on page 37).

For details, see Chapter 6.3.1, "Power vs Time", on page 98.

Remote command:
CONF:CDP[:BTS]:MEAS PVT, see CONFigure:CDPower:MEASurement on page 134
Querying results:
TRAC:DATA? TRACE1, see TRACe<n>[:DATA]? on page 200
CALCulate<n>:LIMit<k>:FAIL? on page 209
CONFigure:CDPower[:BTS]:PVTime:LIST:RESult? on page 198

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

The Power measurement determines the TD-SCDMA signal channel power. The R&S FSW measures the signal power in a single channel with a bandwidth of 1.2288 MHz. The results are based on the root mean square.
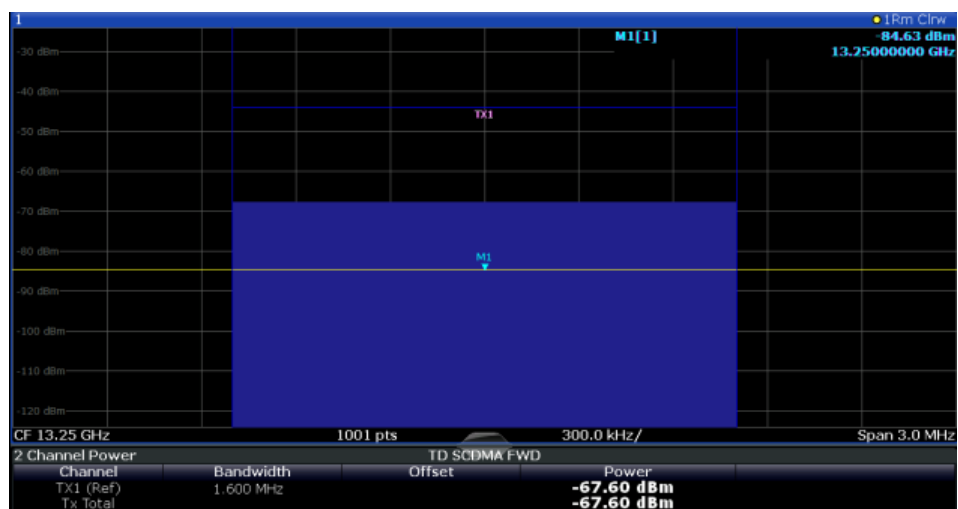
Figure 3-18: Signal channel power measurement in TD-SCDMA BTS application

For details, see Chapter 6.3.2, "Signal Channel Power Measurements", on page 101.

Remote command:

CONF:CDP[:BTS]:MEAS POW, see CONFigure:CDPower:MEASurement on page 134

Querying results: CALC:MARK:FUNC:POW:RES? CPOW, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210

CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210

Channel Power ACLR

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

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

The measurement range can be adapted to a slot range of the current TD-SCDMA signal.

The R&S FSW measures the channel power and the relative power of the adjacent channels and of the alternate channels. The results are displayed below the diagram.
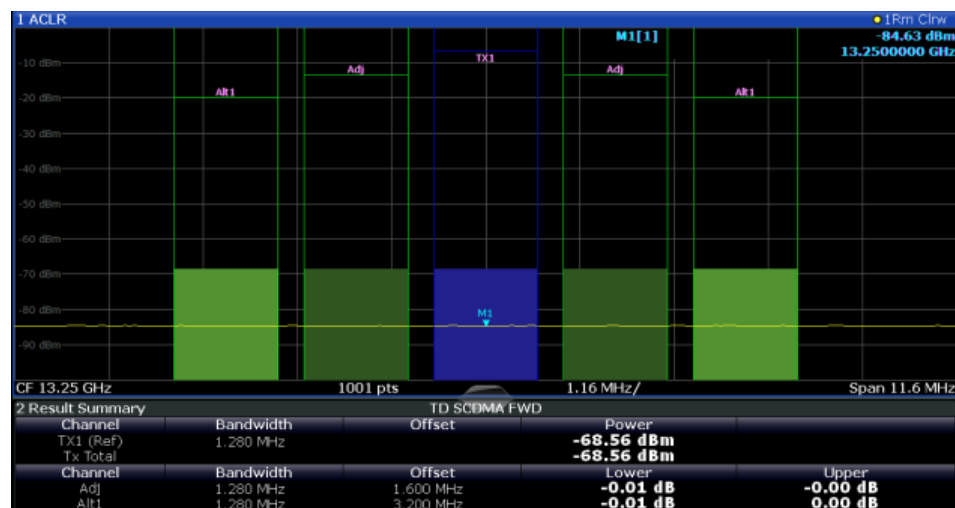
Figure 3-19: ACLR measurement in TD-SCDMA BTS application

For details, see Chapter 6.3.3, "Channel Power (ACLR) Measurements", on page 102.

Remote command:

CONF:CDP[:BTS]:MEAS ACLR, see CONFigure:CDPower:MEASurement on page 134

Querying results:

CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210

CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210

Spectrum Emission Mask

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

The Spectrum Emission Mask measurement determines the power of the TD-SCDMA signal in defined offsets from the carrier and compares the power values with a spectral mask specified by TD-SCDMA.

For details, see Chapter 6.3.4, "Spectrum Emission Mask", on page 103.

Figure 3-20: SEM measurement results for TD-SCDMA BTS measurement

Remote command:
CONF:CDP[:BTS]:MEAS ESP, see CONFigure:CDPower:MEASurement on page 134
Querying results:
CALC:MARK:FUNC:POW:RES? CPOW, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210
CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? on page 210
CALCulate<n>:LIMit<k>:FAIL? on page 209

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

The Occupied Bandwidth measurement determines the bandwidth that the signal occupies.

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

The occupied bandwidth (Occ BW) and the frequency markers are displayed in the marker table.
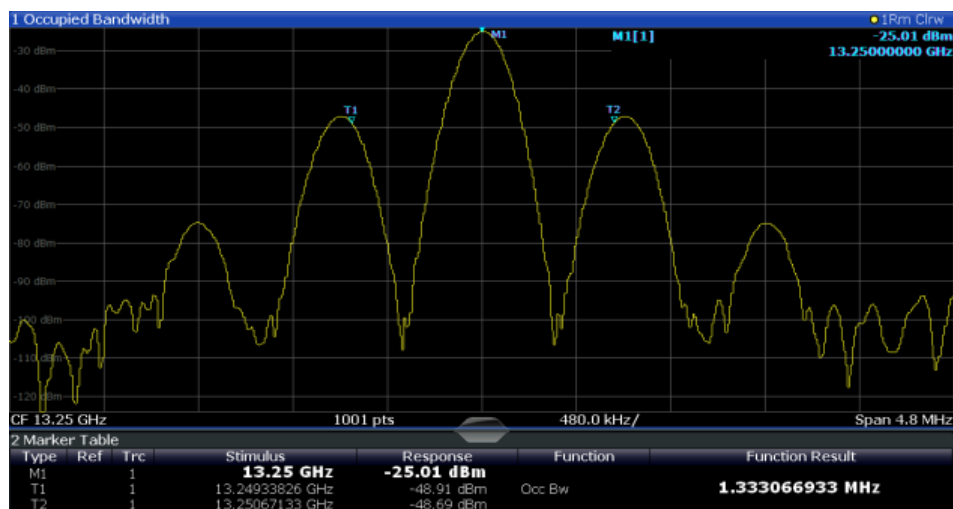
Figure 3-21: Occupied bandwidth measurement in TD-SCDMA BTS application

For details, see Chapter 6.3.5, "Occupied Bandwidth", on page 104.

Remote command:
CONF:CDP[:BTS]:MEAS OBAN, see CONFigure:CDPower:MEASurement
on page 134
Querying results:
CALC:MARK:FUNC:POW:RES? OBW, see CALCulate<n>:MARKer<m>:FUNCtion:
POWer<sb>:RESult? on page 210

CALC:MARK:FUNC:POW:RES? ACP, see CALCulate<n>:MARKer<m>:FUNCtion:
POWer<sb>:RESult? on page 210

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

The CCDF measurement determines the distribution of the signal amplitudes (comple-
mentary cumulative distribution function). The CCDF and the Crest factor are dis-
played. For the purposes of this measurement, a signal section of user-definable
length is recorded continuously in the zero span, and the distribution of the signal
amplitudes is evaluated.
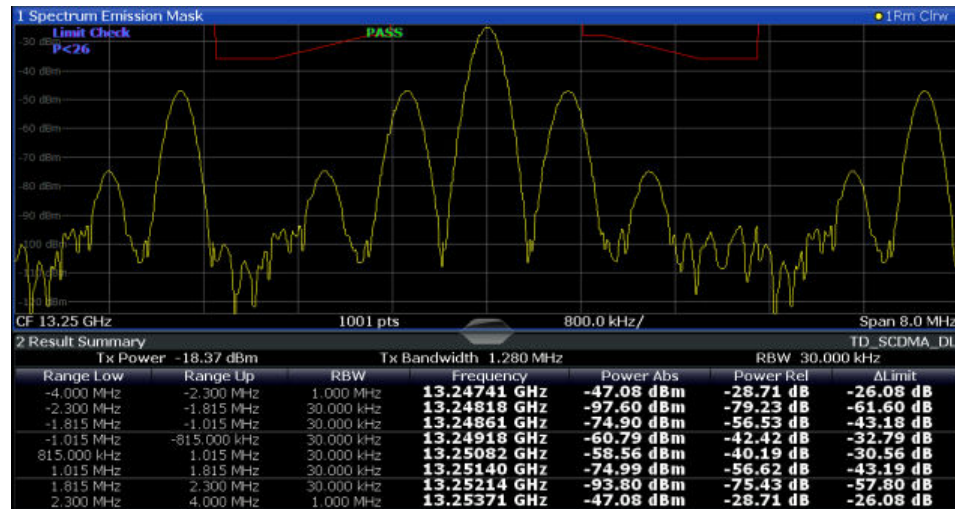
For details, see Chapter 6.3.6, "CCDF", on page 106.
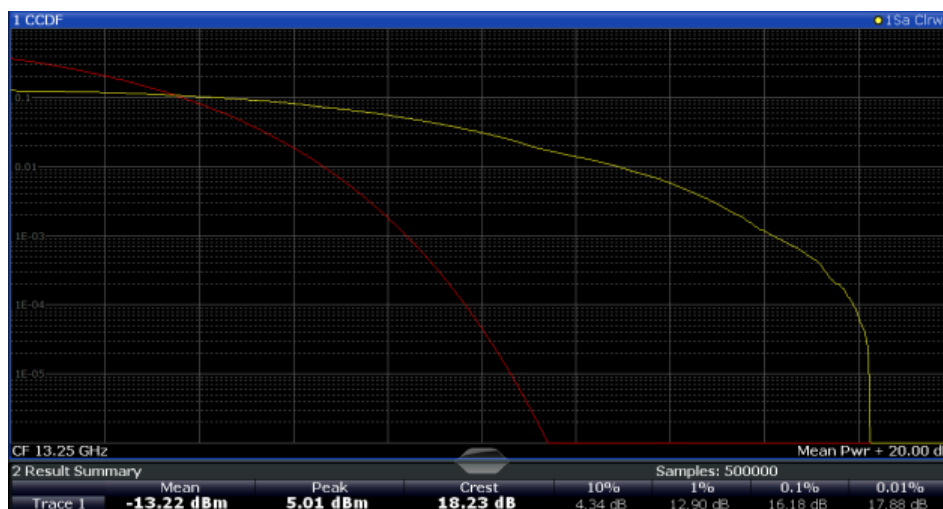
Figure 3-22: CCDF measurement results for TD-SCDMA BTS measurements

Remote command:
CONF:CDP[:BTS]:MEAS CCDF, see CONFigure:CDPower:MEASurement
on page 134
Querying results:
CALCulate<n>:STATistics:RESult<t>? on page 212

3.2.2 Evaluation Methods for Frequency and Time Measurements

Access: "Overview" > "Display Config"

The evaluation methods for frequency and time domain measurements are identical to those in the Spectrum application.

Diagram
Displays a basic level vs. frequency or level vs. time diagram of the measured data to evaluate the results graphically. This is the default evaluation method. Which data is displayed in the diagram depends on the "Trace" settings. Scaling for the y-axis can be configured.
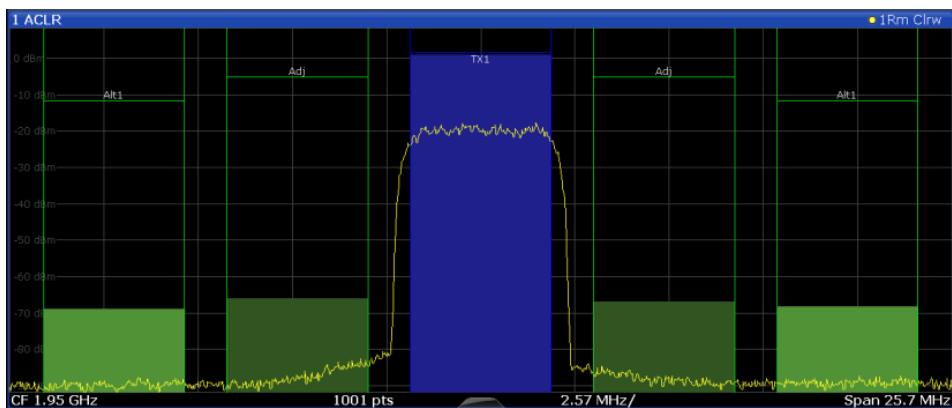
Remote command:
`LAY:ADD? '1',RIGH, DIAG,` see `LAYout:ADD[:WINDow]?` on page 184

List Evaluation

The list evaluation provides the numerical results for the **Power vs Time** measurement.

The List Evaluation displays the following information:

Column	Description
Start / Stop	Start and stop time of the individual time intervals of the Emission Envelope Mask (in ns)
Avg	Average power measured in mask interval
Max	Maximum power measured in mask interval
Time @ MaxPower	The exact point in time when the maximum power occurred

For details, see Chapter 6.3.1, "Power vs Time", on page 98.

Remote command:
`LAY:ADD? '1',RIGH, LEV,` see `LAYout:ADD[:WINDow]?` on page 184

Result Summary

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

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

Remote command:
LAY:ADD? '1',RIGH, RSUM, see LAYout:ADD[:WINDow]? on page 184

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 115).

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

4 Marker Table

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

Remote command:
LAY:ADD? '1',RIGH, MTAB, see LAYout:ADD[:WINDow]? on page 184
Results:
CALCulate<n>:MARKer<m>:X on page 215
CALCulate<n>:MARKer<m>:Y? on page 212

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

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

2 Marker Peak List

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

Remote command:
LAY:ADD? '1',RIGH, PEAK, see LAYout:ADD[:WINDow]? on page 184
Results:
CALCulate<n>:MARKer<m>:X on page 215
CALCulate<n>:MARKer<m>:Y? on page 212

4 Measurement Basics

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

4.1 Short Introduction to TD-SCDMA

Many communication standards, such as WCDMA or cdma2000, distribute the data from different users to different frequencies within a specific band (FDD mode). As opposed to these standards, TD-SCDMA distributes the data in *time* (TDD mode). Furthermore, the mentioned FDD-based standards require two distinct frequency bands for uplink (to the base station) and downlink (from the base station) communication. Whereas TD-SCDMA can adjust the number of time slots (and thus the data rate) used for downlink or uplink dynamically, according to the current traffic requirements. The available time slots can be distributed flexibly either to several users, or to a single user requiring a higher data rate. This is a benefit especially when transmitting Internet data, as usually more data is downloaded than uploaded.

Distributing the data in time also means the TD-SCDMA standard can use the same carrier frequency for both uplink and downlink.

4.2 Frames, Subframes and Slots

The structure of a typical TD-SCDMA signal is shown in Figure 4-1.

A TD-SCDMA signal is divided into *frames* with a length of 10 ms each. The frames are further divided into two *subframes*, with a length of 5 ms each. For the physical communication layer, mostly the subframes are of interest.

Each subframe consists of seven *slots*, named TS0 to TS6. Furthermore, a "Downlink Pilot Time Slot" (DwPTS) and an "Uplink Pilot Time Slot" (UpPTS), which are required to transmit synchronization codes. Between the two synchronization areas, a guard period of 75 μs is inserted. Each slot has a length of 0.675 ms.

The first slot (TS0) of a subframe is always reserved for downlink, the second slot (TS1) is always reserved for uplink. The *switching point* indicates the time after which subsequent slots are available for downlink again. The system is informed about the current location of the switching point by higher layers.
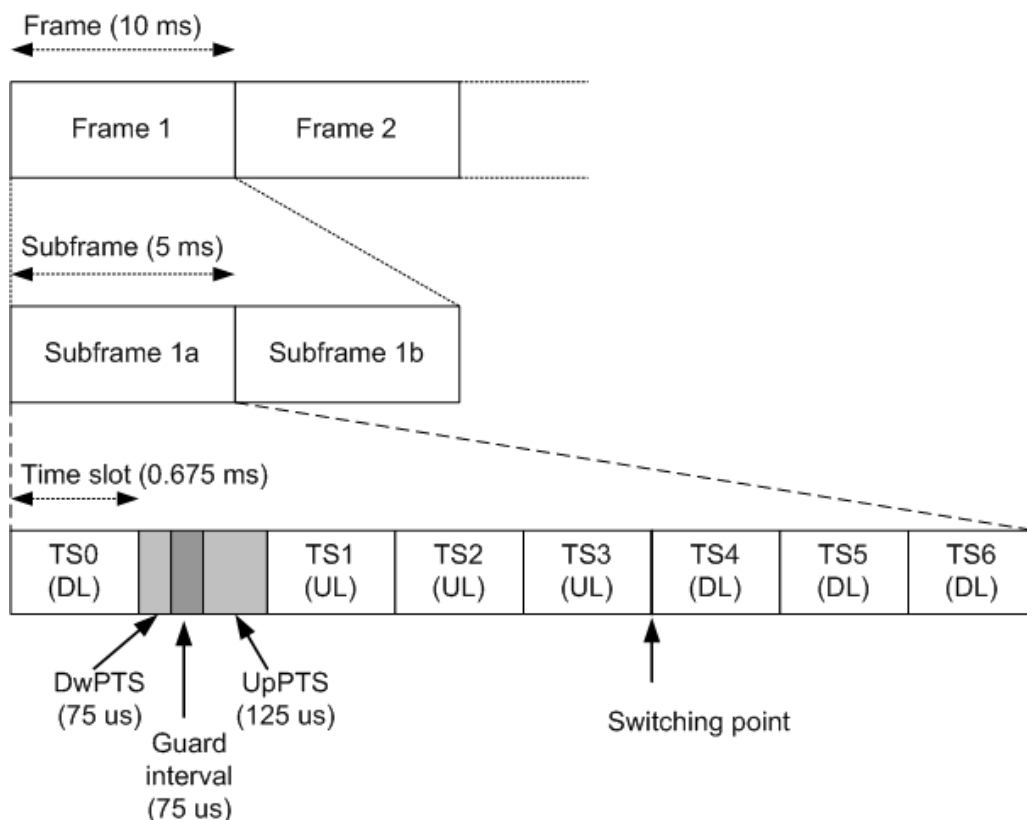
Figure 4-1: TD-SCDMA signal structure

Synchronization

The individual channels in the input signal must be synchronized to detect timing offsets in the slot spacings. To do so, either slot 0 (BTS mode) or slot 1 (UE mode), or the "Downlink Pilot Time Slot" (DwPTS) or "Uplink Pilot Time Slot" (UpPTS) can be used.

In UE mode, if the UpPTS is used for synchronization, you must define the SYNC-UL code to be used. This code depends on the used scrambling code as indicated in the following table.

Table 4-1: Possible SYNC-UL codes depending on scrambling code

Code Group	Scrambling Code	Sync -UL Code
Group 1	0 to 3	0 to 7
Group 2	4 to 7	8 to 15
...	...	...
Group 32	124 to 127	248 to 255

4.3 Channels and Codes

Within each time slot, up to 16 code channels can be transmitted. Each channel is spread over one to 16 codes (also referred to as *channelization codes*), depending on the code class of the channel. The code class specifies the spreading factor of the channel and thus the number of possible channels per slot.

Table 4-2: Relationship between code class, channels and spreading factor

Code class	Spreading factor = No. channels per slot
0	1
1	2
2	4
3	8
4	16

Chips

The user data is spread to code channels across the available bandwidth using the spreading factor before transmission. The spread bits are referred to as *chips*. Each slot consists of 864 chips. The chips are transferred at a rate of 1.28 Megachips per second (Mcps).

Active and inactive codes/slots

During code domain analysis, the power in the selected slot in the captured subframes is measured to detect active channels. If the total power in the slot does not exceed a threshold, the slot is considered to be inactive. Otherwise, the slot is analyzed to detect channels.

To do so, the data in the slot is unscrambled according to the defined scrambling code and carrier (= center) frequency. Then, all possible spreading sequences are applied to the unscrambled data, defining the individual channels. Each despread channel whose power exceeds the channel threshold is considered to be active. The reference signal is then generated according to the active channels only.

If the power threshold for inactive channels is not set correctly, power from supposedly inactive channels contributes to the peak code domain error, leading to false results.

To determine the correct threshold, the Code Domain Power evaluation is a useful instrument (see "Code Domain Power" on page 18).

4.3.1 Special Channels

To control the data transmission between the sender and the receiver, specific symbols must be included in the transmitted data. This data is included in special data channels defined by the 3GPP standard which use fixed codes in the code domain. Thus, the receiver can easily them.

Table 4-3: Special channels in TD-SCDMA signals

Name	Description	Slot No.	Spreading factor (SF)	Code No. (1...SF)
P-CCPCH1	**P**rimary **c**ommon **c**ontrol **p**hysical **ch**annel 1	0	16	1
P-CCPCH2	**P**rimary **c**ommon **c**ontrol **p**hysical **ch**annel 2	0	16	2

Other special control channels do not have a fixed code, but are identified by higher layers.

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

The detected type of the channel is indicated in the Channel Table evaluation according to the following assignment:

Table 4-4: Available channel types in TD-SCDMA signals

No.	Channel type
0	Inactive
1	Midamble
2	DPCH (user data)

4.3.2 Channel Characteristics

The spreading factor used by a channel determines the data rate. Based on a sub-frame length of 5 ms, the bits per slot can be calculated.

The modulation used to transmit the user data determines how many bits are required for each symbol, and thus the maximum number of symbols per slot. Thus, the symbol rate depends on the used modulation and the data rate. The following tables show the relationships:

Table 4-5: Number of symbols per slot depending on spreading factor

Spreading factor	Number of symbols
16	44
8	88
4	176
2	352
1	704

Table 4-6: Number of bits per symbol depending on modulation

Modulation	Number of bits per symbol
QPSK	2
8PSK	3
16QAM	4
64QAM	6

Table 4-7: Number of bits per slot depending on modulation and spreading factor

SF	Modulation			
	QPSK	8PSK	16QAM	64QAM
	Number of bits			
16	88	132	176	264
8	176	264	352	528
4	352	528	704	1056
2	704	1056	1408	2112
1	1408	2112	2816	4224

Table 4-8: Channel parameters and their dependencies

Spread-ing Fac-tor	Sym-bols / Slot	QPSK		8PSK		16QAM		64QAM	
		Bits per Slot	ksps	Bits per slot	ksps	Bits per slot	ksps	Bits per slot	ksps
1	704	1408	281.6	2112	422.4	2816	563.2	4224	844.8
2	352	704	140.8	1056	211.2	1408	281.6	2112	422.4
4	176	352	70.4	528	105.6	704	140.8	1056	211.2
8	88	176	35.2	264	52.8	352	70.4	528	105.6
16	44	88	17.6	132	26.4	176	35.2	264	52.8

Channel notation

Channels are generally indicated by their channel number and spreading factor (in the form <Channel>.<SF>).

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.

The specified channel is selected and marked in red in the corresponding result displays, if active. If no spreading factor is specified, the spreading factor 16 is assumed. For inactive (unused) channels, the code based on the spreading factor 16 is highlighted.

Example: Enter *4.8*

Channel 4 is marked at spreading factor 8 (35.2 ksps) if the channel is active, other-wise code 7 at spreading factor 16.

4.4 Data Fields and Midambles

Each slot consists of 864 chips, of which 704 are used to transmit data. The data is divided into two data fields with 352 chips each. The *midamble* (consisting of the remaining 144 chips) is located between the two data fields. A guard period of 16 chips completes the slot.
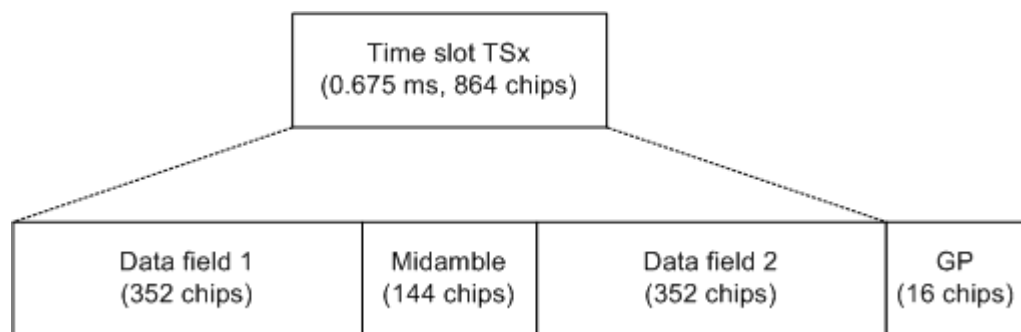

Figure 4-2: TD-SCDMA slot structure

Midamble shifts

The midamble is a known symbol sequence which can be used to synchronize the signal in the slot, and to distinguish the data from individual users in a single slot. Different users can be distinguished by their different time shifts of the same basic midamble sequence. For each midamble shift, the known symbol sequence is rotated cyclically by a defined number of chips. The maximum number of possible *midamble shifts* defines the maximum number of possible users in a single slot.

Each user is thus identified by a particular time slot and a particular code on a particu-lar carrier frequency.

Midamble assignment

A midamble is assigned to each code channel by the transmission side. Different meth-ods of assigning midambles to code channels are available.

- **Default midamble assignment**
  Specific midambles are assigned to each channelization code according to a stan-dard-specific rule
- **User-specific midamble assignment**
  Each code channel is assigned an individual midamble code; higher communica-tion layers must determine which midamble belongs to which channelization code
- **Common midamble assignment**
  All code channels share a common midamble

The midamble to be inserted between the data fields in a slot is generated by superimposing the individual midambles of the codes.

The TD-SCDMA specifications require that the power of the midamble and the power of the data fields for a single slot must be identical. When using the default midamble assignment, this means that each individual midamble is transmitted with the same power as its assigned channelization code. For common midamble assignment, this means the (single) midamble is transmitted with the same power as the data fields. For user-specific assignment, the individual midambles are not known at this stage.

The parameters ΔMid1/2 in the Channel Table results show the power offset of the midamble to the data fields 1 or 2 for each channel (see Table 3-2).

4.5 CDA Measurements in MSRA Operating Mode

The TD-SCDMA BTS application can also be used to analyze data in MSRA operating mode.

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

Data coverage for each active application

Generally, if a signal contains multiple data channels for multiple standards, separate applications are used to analyze each data channel. Thus, it is of interest to know which application is analyzing which data channel. The MSRA Master display indicates the data covered by each application, restricted to the channel bandwidth used by the corresponding standard (for TD-SCDMA: 1.6 MHz), by vertical blue lines labeled with the application name.

Analysis interval

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

In the TD-SCDMA BTS application, the analysis interval is determined automatically. It depends on the selected channel/ slot / set to analyze, which is defined for the evaluation range, and on the result display. The analysis interval cannot be edited directly in the TD-SCDMA BTS application, but is changed automatically when you change the evaluation range.

Analysis line

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

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

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

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

5 I/Q Data Import and Export

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

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

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

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

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

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

Export only in MSRA mode

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

5.1 Import/Export Functions

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

These functions are only available if no measurement is running.

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

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

Import
Access: "Save/Recall" > Import

Provides functions to import data.

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

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

Remote command:
MMEMory:LOAD:IQ:STATe on page 223

Export
Access: "Save/Recall" > Export

Opens a submenu to configure data export.

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

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

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

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

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

Remote command:
MMEMory:STORe<n>:IQ:STATe on page 224
MMEMory:STORe<n>:IQ:COMMent on page 223

6 Configuration

The TD-SCDMA applications provide several different measurements for signals according to the TD-SCDMA application. The main and default measurement is Code Domain Analysis. In addition to the code domain power measurements specified by the TD-SCDMA standard, the TD-SCDMA options offer measurements with predefined settings in the frequency and time domain, e.g. channel power or power vs time measurements.

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

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

Selecting the measurement type

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

► To select a different measurement type, do one of the following:

- Select the "Overview" softkey. In the "Overview", select the "Select Measurement" button. Select the required measurement.
- Press the MEAS key. In the "Select Measurement" dialog box, select the required measurement.

6.1 Result Display Configuration

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

- Select the ▦ "SmartGrid" icon from the toolbar.
- Select the "Display" button in the "Overview".
- Press the MEAS key.
- Select the "Display Config" softkey in any TD-SCDMA menu.

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

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

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

6.2 Code Domain Analysis

Access: MODE > "TD-SCDMA BTS"/"TD-SCDMA UE"

TD-SCDMA measurements require special applications on the R&S FSW.

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

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

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

When you activate a TD-SCDMA application, Code Domain Analysis of the input signal is started automatically with the default configuration. The "Code Domain Analyzer" menu is displayed and provides access to the most important configuration functions.

The "Span", "Bandwidth", "Lines", and "Marker Functions" menus are not available for Code Domain Analysis in TD-SCDMA applications.

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

Importing and Exporting I/Q Data

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

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

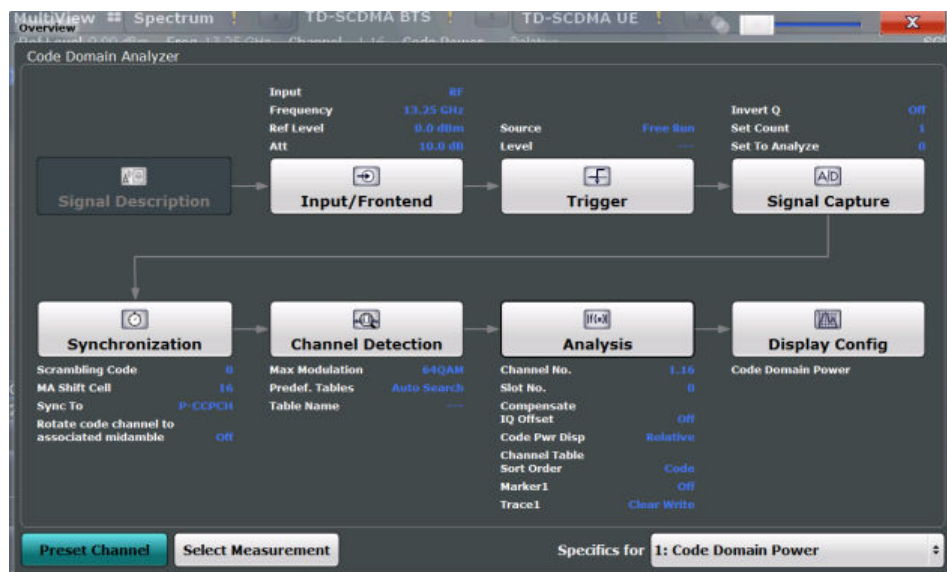For details on importing and exporting I/Q data, see the R&S FSW User Manual.

6.2.1   Configuration Overview

Access: all menus

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

In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire measurement channel from input over processing to 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 frequency and time domain measurements, see Chapter 6.3, "Frequency and Time Domain Measurements", on page 98.

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

The "Signal Description" button indicated in the "Overview" is not required for TD-SCDMA measurements.

1. "Select Measurement"
   See Chapter 3, "Measurements and Result Display", on page 13

2. "Input/ Frontend"
   See Chapter 6.2.2, "Data Input and Output Settings", on page 53

3. (Optionally:) "Trigger"
   See Chapter 6.2.4, "Trigger Settings", on page 77

4. "Signal Capture"
   See Chapter 6.2.5, "Signal Capture (Data Acquisition)", on page 83

5. "Synchronization"
   See Chapter 6.2.7, "Synchronization", on page 85

6. "Channel Detection"

See Chapter 6.2.8, "Channel Detection", on page 88

7. "Analysis"
   See Chapter 7, "Analysis", on page 108

8. "Display Configuration"
   See Chapter 6.1, "Result Display Configuration", on page 49

To configure settings

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

Preset Channel

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

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

Remote command:
SYSTem:PRESet:CHANnel[:EXECute] on page 133

Select Measurement

Selects a different measurement to be performed.

See Chapter 3, "Measurements and Result Display", on page 13.

Specifics for

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

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

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

6.2.2   Data Input and Output Settings

Access: INPUT / OUTPUT

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

6.2.2.1 Input Source Settings

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

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

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

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

Radio Frequency Input

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

Radio Frequency State
Activates input from the RF INPUT connector.

Remote command:
INPut:SELect on page 138

Input Coupling

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

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

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

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

Remote command:
INPut:COUPling on page 136

Impedance

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

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

This value also affects the unit conversion (see "Reference Level" on page 70).

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

Remote command:
INPut:IMPedance on page 137

Direct Path

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

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

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

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

"Off"   The analog mixer path is always used.

Remote command:
INPut:DPATh on page 136

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

This function requires an additional hardware option.

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

Remote command:
INPut:FILTer:HPASs[:STATe] on page 137

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

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

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

Remote command:
INPut:FILTer:YIG[:STATe] on page 137

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

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

Remote command:
INPut:CONNector on page 135

Digital I/Q Input Settings

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

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

These settings are only available if the Digital Baseband Interface option is installed on
the R&S FSW.
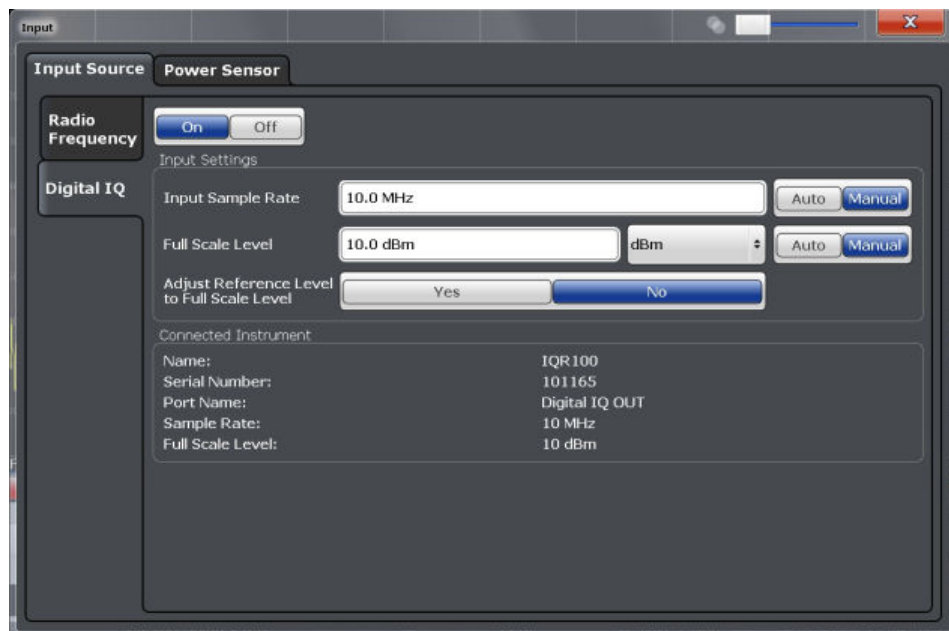
For more information, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Digital I/Q Input State

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

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

Remote command:
INPut:SELect on page 138

Input Sample Rate

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

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

The allowed range is from 100 Hz to 10 GHz.

Remote command:
INPut:DIQ:SRATe on page 141
INPut:DIQ:SRATe:AUTO on page 142

Full Scale Level

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

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

Remote command:
INPut:DIQ:RANGe[:UPPer] on page 141
INPut:DIQ:RANGe[:UPPer]:UNIT on page 141
INPut:DIQ:RANGe[:UPPer]:AUTO on page 140

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

Remote command:
INPut:DIQ:RANGe:COUPling on page 141

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

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

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

Remote command:
INPut:DIQ:CDEVice on page 139

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

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

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

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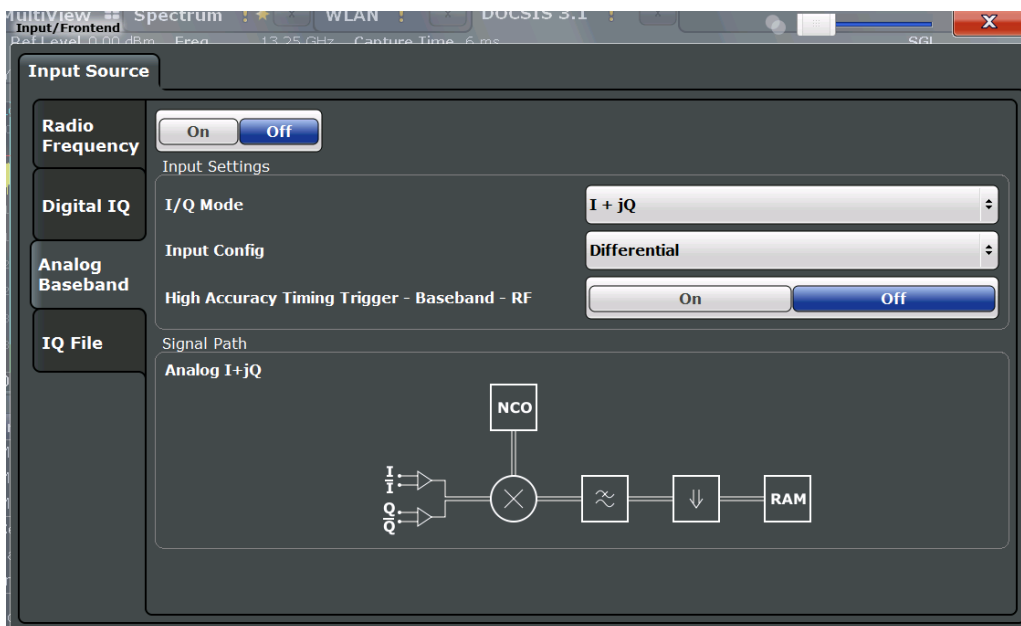
Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.
If you select the "File > Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available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

Analog Baseband Input Settings

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

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

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

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

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

Remote command:
INPut:SELect on page 138

I/Q Mode
Defines the format of the input signal.

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

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

"I Only / Low IF I"

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

"Q Only / Low IF Q"

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

Remote command:
INPut:IQ:TYPE on page 145

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

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

"Single Ended"   I, Q data only

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

Remote command:
INPut:IQ:BALanced[:STATe] on page 144

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

Note: Prerequisites for previous models of R&S FSW.
For R&S FSW models with a serial number lower than 103000, special prerequisites
and restrictions apply for high accuracy timing:
● To obtain this high timing precision, trigger port 1 and port 2 must be connected via
  the Cable for High Accuracy Timing (order number 1325.3777.00).
● As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be
  used to trigger a measurement.
● Trigger port 2 is configured as output if the high accuracy timing option is active.
  Make sure not to activate this option if you use trigger port 2 in your measurement
  setup.

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

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

Remote command:
CALibration:AIQ:HATiming[:STATe] on page 145

Center Frequency

Defines the center frequency for analog baseband input.

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

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

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

Probe Settings

Probes are configured in a separate tab on the "Input" dialog box which is displayed when you select the INPUT/OUTPUT key and then "Input Source Config".
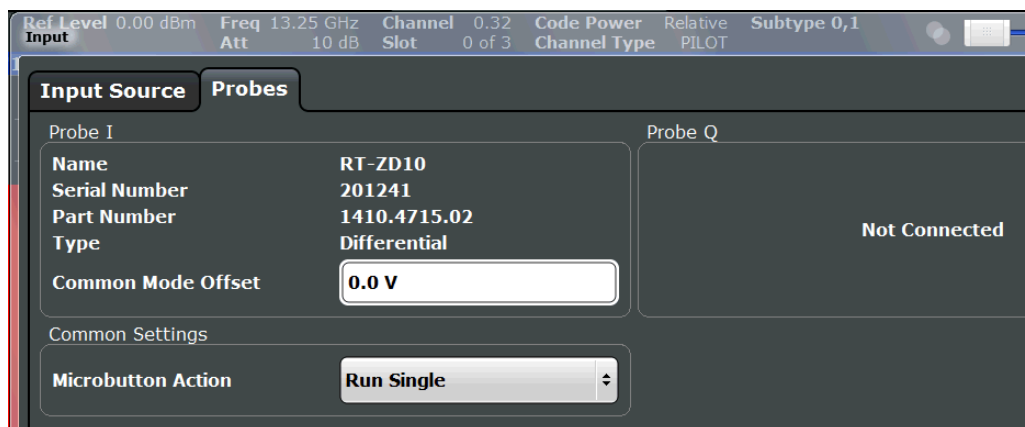
For each possible probe connector (Baseband Input I, Baseband Input Q), the detected type of probe, if any, is displayed. The following information is provided for each connected probe:

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

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

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

Common Mode Offset

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

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

Remote command:
[SENSe:]PROBe<p>:SETup:CMOFfset on page 146

Microbutton Action

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

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

"Run single"   Starts one data acquisition.

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

Remote command:
[SENSe:]PROBe<p>:SETup:MODE on page 147

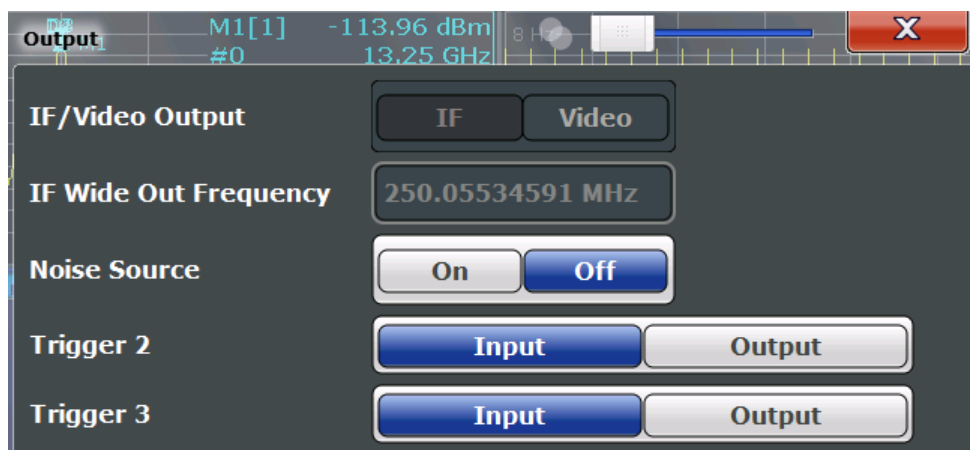### 6.2.2.2 Output Settings

Access: INPUT/OUTPUT > "Output"

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

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

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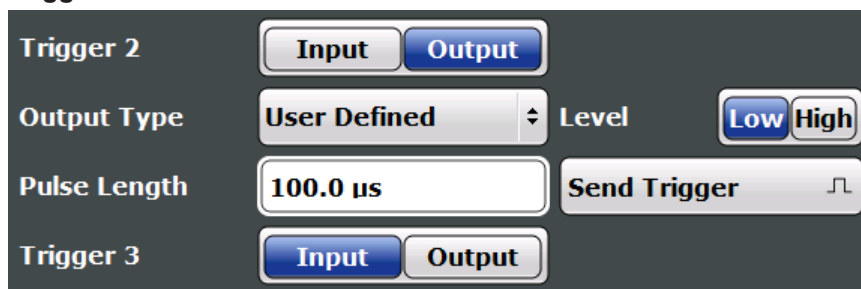
Noise Source

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

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

Remote command:
DIAGnostic:SERVice:NSOurce on page 149

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

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

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

Remote command:
OUTPut:TRIGger<port>:DIRection on page 162

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

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

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

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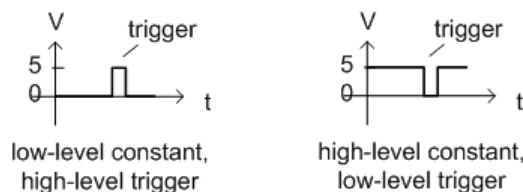   In this case, further parameters are available for the output signal.

Remote command:
OUTPut:TRIGger<port>:OTYPe on page 163

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

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

low-level constant,
high-level trigger

high-level constant,
low-level trigger

Remote command:
OUTPut:TRIGger<port>:LEVel on page 162

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

Remote command:
OUTPut:TRIGger<port>:PULSe:LENGth on page 163

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

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

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

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 163

6.2.2.3 Digital I/Q Output Settings

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

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

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

> Digital I/Q output is available with bandwidth extension option R&S FSW-B500/ -B512, but not with R&S FSW-B512R (Real-Time).
>
> However, see the note regarding digital I/Q output and the R&S FSW-B500/ -B512 option in the R&S FSW I/Q Analyzer and I/Q Input User Manual.
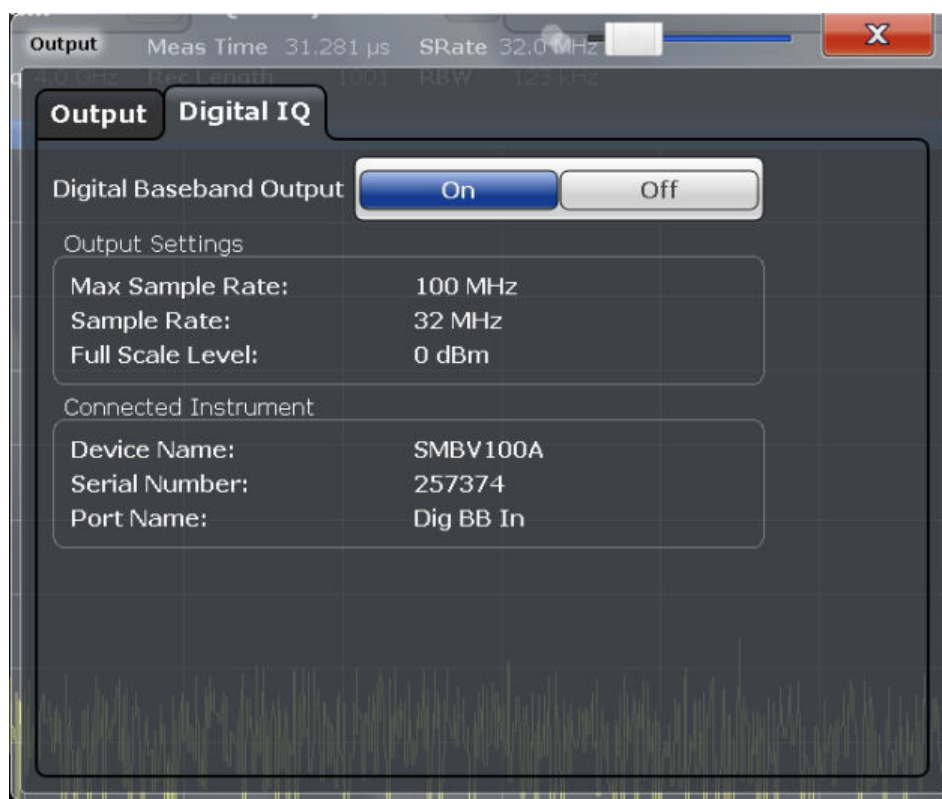
For details on digital I/Q output, see the R&S FSW I/Q Analyzer User Manual.

Digital Baseband Output

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

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

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

Remote command:
OUTPut:DIQ on page 142

Output Settings Information

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

The following information is displayed:

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

Remote command:
OUTPut:DIQ:CDEVice? on page 142

Connected Instrument

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

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

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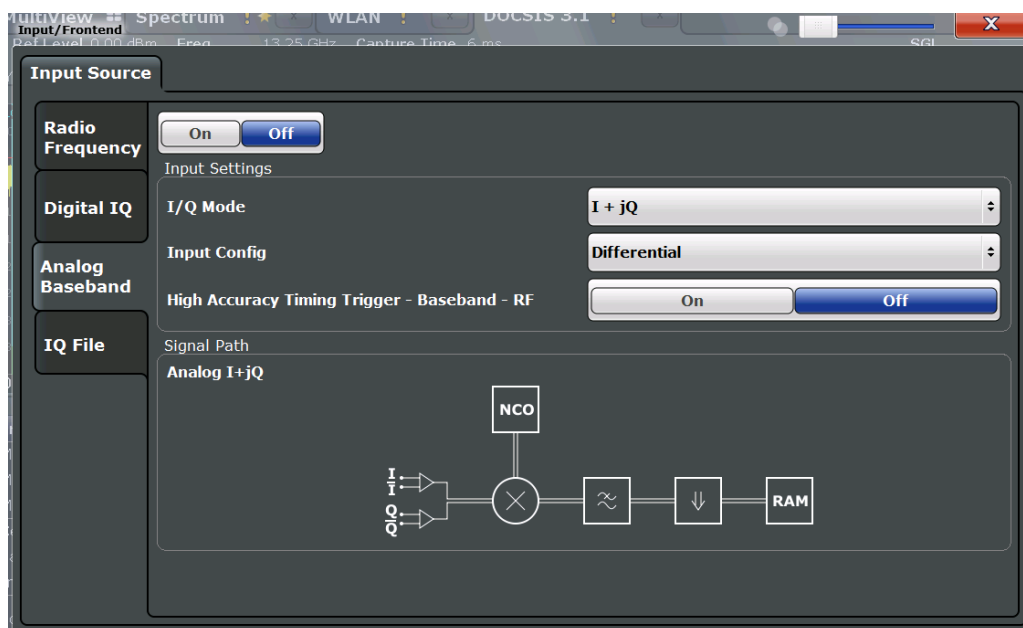- Used port

Remote command:
OUTPut:DIQ:CDEVice? on page 142

6.2.2.4 Analog Baseband Input Settings

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

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

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

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

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

Remote command:
INPut:SELect on page 138

I/Q Mode
Defines the format of the input signal.

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

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

"I Only / Low IF I"

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

"Q Only / Low IF Q"

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

Remote command:
INPut:IQ:TYPE on page 145

Input Configuration

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

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

"Single Ended"   I, Q data only

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

Remote command:
INPut:IQ:BALanced[:STATe] on page 144

High Accuracy Timing Trigger - Baseband - RF

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

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

● To obtain this high timing precision, trigger port 1 and port 2 must be connected via the Cable for High Accuracy Timing (order number 1325.3777.00).
● As trigger port 1 and port 2 are connected via the cable, only trigger port 3 can be used to trigger a measurement.
● Trigger port 2 is configured as output if the high accuracy timing option is active. Make sure not to activate this option if you use trigger port 2 in your measurement setup.
● When you first enable this setting, you are prompted to connect the cable for high accuracy timing to trigger ports 1 and 2. If you cancel this prompt, the setting remains disabled. As soon as you confirm this prompt, the cable must be in place - the firmware does not check the connection. (In remote operation, the setting is activated without a prompt.)

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

Remote command:
CALibration:AIQ:HATiming[:STATe] on page 145

Center Frequency

Defines the center frequency for analog baseband input.

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

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

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

6.2.3 Frontend Settings

Access: "Overview" > "Input / Frontend"

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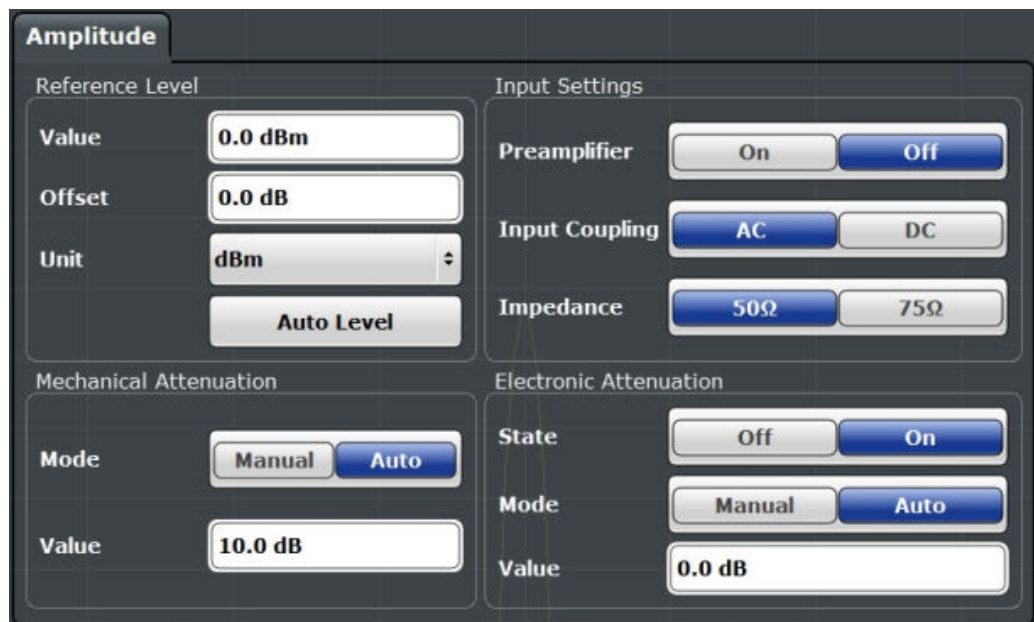
6.2.3.1 Amplitude Settings

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

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

Amplitude settings for input from the optional Analog Baseband interface are described in Chapter 6.2.3.2, "Amplitude Settings for Analog Baseband Input", on page 73.

Reference Level

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

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

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

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 153

Shifting the Display (Offset) ← Reference Level

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

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

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

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet on page 153

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

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

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 97).

Remote command:
[SENSe:]ADJust:LEVel on page 177

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

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

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

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

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

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

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

Remote command:

INPut:ATTenuation on page 155

INPut:ATTenuation:AUTO on page 156

Using Electronic Attenuation

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

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

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

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) > 13.6 GHz.

In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation can be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

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

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

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

Remote command:

INPut:EATT:STATe on page 157

INPut:EATT:AUTO on page 157

INPut:EATT on page 156

Input Settings

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

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

Preamplifier ← Input Settings

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

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

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

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

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

"Off"   Deactivates the preamplifier.

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

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

Remote command:
INPut:GAIN:STATe on page 154
INPut:GAIN[:VALue] on page 155

6.2.3.2 Amplitude Settings for Analog Baseband Input

Access: "Overview" > "Amplitude"

The following settings and functions are available to define amplitude settings for input via the optional Analog Baseband Interface in the applications that support it.
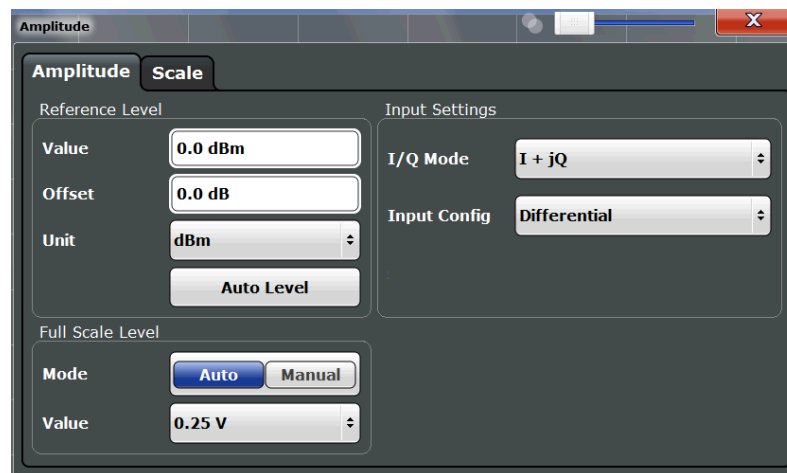
The input settings provided here are identical to those in the "Input Source" > "Analog Baseband" tab, see "Analog Baseband Input Settings" on page 58.

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

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

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

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel on page 153

Shifting the Display (Offset) ← **Reference Level**
Defines an arithmetic level offset. This offset is added to the measured level. In some result displays, the scaling of the y-axis is changed accordingly.

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

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

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet on page 153

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

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

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 97).

Remote command:
[SENSe:]ADJust:LEVel on page 177

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

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

For manual input, the following values can be selected:

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

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

For details on probes, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.
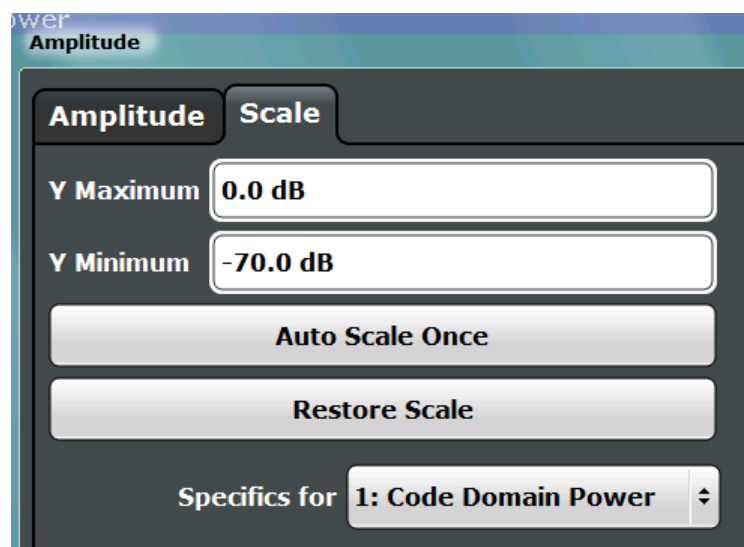
Remote command:
INPut:IQ:FULLscale:AUTO on page 144
INPut:IQ:FULLscale[:LEVel] on page 144

6.2.3.3 Y-Axis Scaling

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

Or: AMPT > "Scale Config"

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

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

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum on page 152
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum on page 152

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.
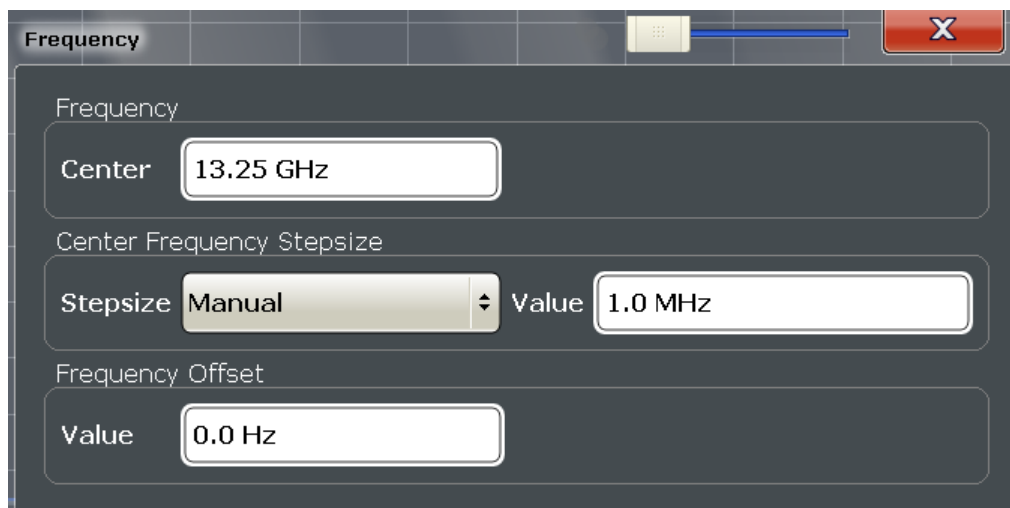
Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE on page 152

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

6.2.3.4 Frequency Settings

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

Center frequency
Defines the center frequency of the signal in Hertz.

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

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

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

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

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

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

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

This setting is available for frequency and time domain measurements.

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

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

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

Frequency Offset

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

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

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

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

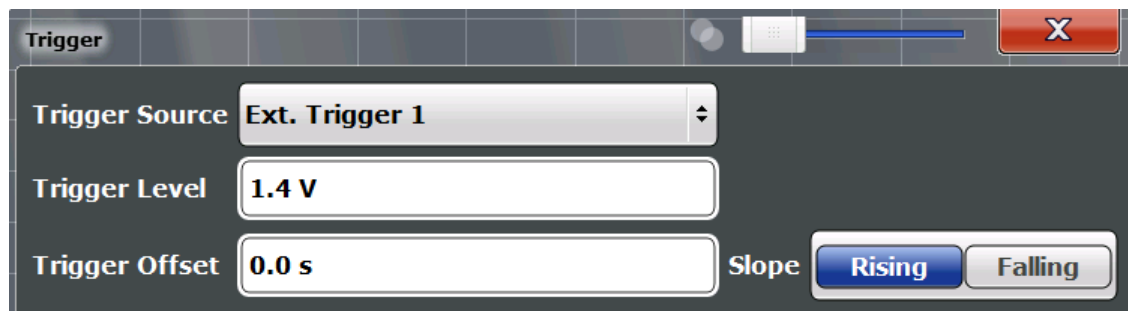**Note:** In MSRA mode, this function is only available for the MSRA Master.
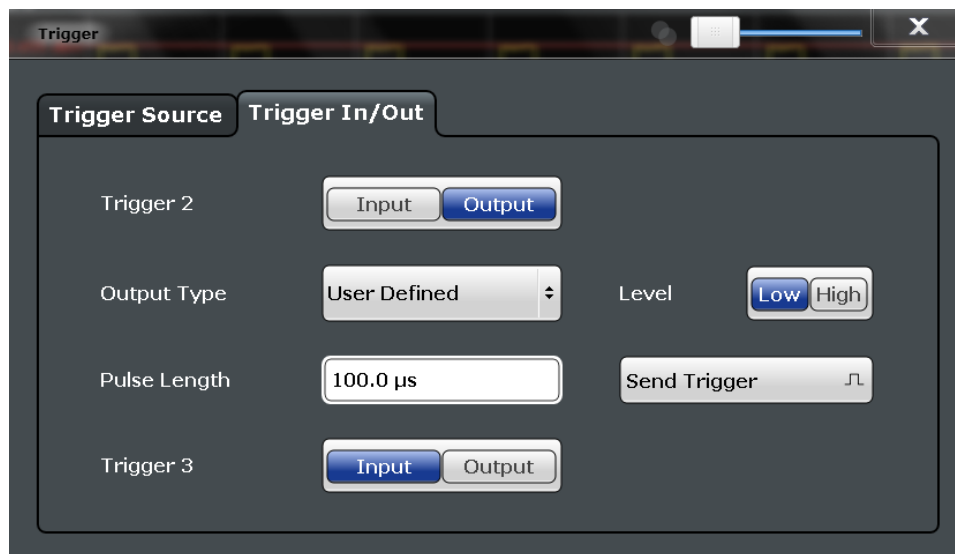
Remote command:
[SENSe:]FREQuency:OFFSet on page 151

6.2.4 Trigger Settings

Access: "Overview" > "Trigger"

Trigger settings determine when the input signal is measured.

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

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

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

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

Remote command:
TRIGger[:SEQuence]:SOURce on page 160

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

Remote command:
TRIG:SOUR IMM, see TRIGger[:SEQuence]:SOURce on page 160

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

(See "Trigger Level" on page 80).

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

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

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

"External Trigger 2"
> Trigger signal from the TRIGGER 2 INPUT / OUTPUT connector.
> Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 63).

"External Trigger 3"
> Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector on the rear panel.
> Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 63).

Remote command:
TRIG:SOUR EXT, TRIG:SOUR EXT2
TRIG:SOUR EXT3
See TRIGger[:SEQuence]:SOURce on page 160

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

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

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

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

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

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

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

Remote command:
TRIG:SOUR GP0, see TRIGger[:SEQuence]:SOURce on page 160

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

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

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

This trigger source is only available for RF input.

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

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

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

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

Remote command:
TRIG:SOUR IFP, see TRIGger[:SEQuence]:SOURce on page 160

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

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

Remote command:
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 160
For analog baseband or digital baseband input only:
TRIGger[:SEQuence]:LEVel:BBPower on page 159

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

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

Remote command:
TRIGger[:SEQuence]:HOLDoff[:TIME] on page 158

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

Remote command:
TRIGger[:SEQuence]:SLOPe on page 160

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

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

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

Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 159

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

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

Remote command:
TRIGger[:SEQuence]:IFPower:HOLDoff on page 159

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

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

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

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

Remote command:
[SENSe:]MSRA:CAPTure:OFFSet on page 226

Trigger 2/3

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

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

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

(Trigger 1 is INPUT only.)

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

"Input"	The signal at the connector is used as an external trigger source by the R&S FSW. Trigger input parameters are available in the "Trigger" dialog box.
"Output"	The R&S FSW sends a trigger signal to the output connector to be used by connected devices. Further trigger parameters are available for the connector.

Remote command:
OUTPut:TRIGger<port>:DIRection on page 162

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

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

Remote command:
OUTPut:TRIGger<port>:OTYPe on page 163

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

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

low-level constant,   high-level constant,
high-level trigger   low-level trigger

Remote command:
OUTPut:TRIGger<port>:LEVel on page 162

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

Remote command:
OUTPut:TRIGger<port>:PULSe:LENGth on page 163

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

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

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

Remote command:
OUTPut:TRIGger<port>:PULSe:IMMediate on page 163

6.2.5 Signal Capture (Data Acquisition)

Access: "Overview" > "Signal Capture"

How much and how data is captured from the input signal are defined in the "Signal Capture" settings.
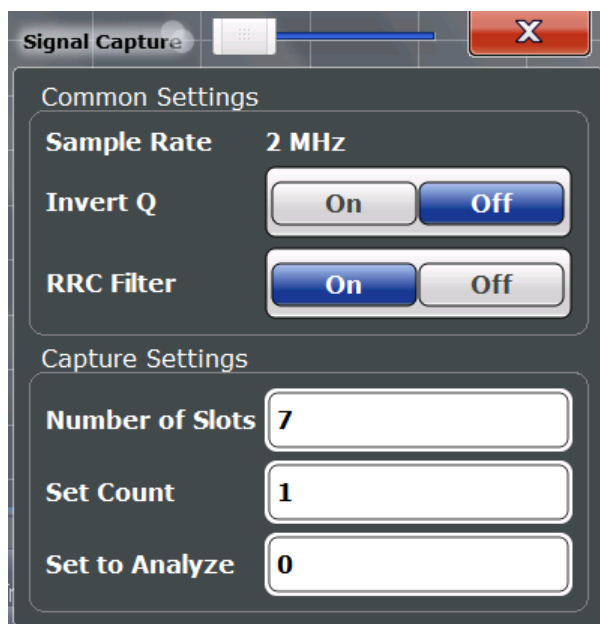
> ℹ **MSRA operating mode**
>
> In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition settings for the TD-SCDMA BTS application in MSRA mode define the **application data extract**. See Chapter 6.2.6, "Application Data (MSRA) ", on page 85.
>
> For details on the MSRA operating mode, see the R&S FSW MSRA User Manual.

Sample Rate

The sample rate is always 2 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 165

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 164

Set Count
Defines the number of consecutive sets to be captured and stored in the instrument's I/Q memory. One set consists of 63 slots. The R&S FSW can capture from 1 to 4500 sets.

Remote command:
[SENSe:]CDPower:SET:COUNt on page 165

Set to Analyze
Selects a specific set for further analysis. The value range depends on the Set Count and is between 0 and [Set Count-1].

Remote command:
[SENSe:]CDPower:SET on page 178

Number of Slots to Capture
Defines the number of slots to capture.

Note: if the Set Count is larger than 1, the number of slots to capture is automatically set to the maximum of 64.

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

6.2.6 Application Data (MSRA)

For the TD-SCDMA BTS application in MSRA operating mode, the application data range is defined by the same settings used to define the signal capturing in Signal and Spectrum Analyzer mode (see Chapter 6.2.5, "Signal Capture (Data Acquisition)", on page 83.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the analysis interval for the TD-SCDMA BTS measurement (see "Capture Offset" on page 81).

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

For details, see Chapter 4.5, "CDA Measurements in MSRA Operating Mode", on page 45.

6.2.7 Synchronization

Access: "Overview" > "Synchronization"

The individual channels in the input signal need to be synchronized to detect timing off-sets in the slot spacings. These settings are described here.
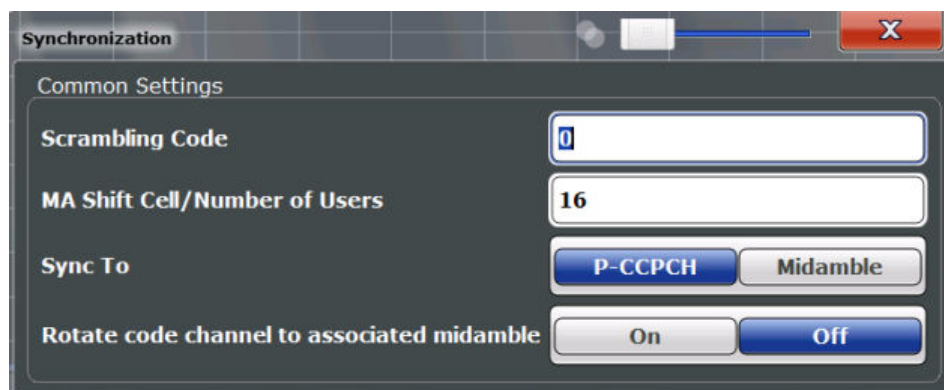
Scrambling Code
Sets the Scrambling Code of the base station. Possible values are between 0 and 127 and have to be entered as decimals.

Remote command:
[SENSe:]CDPower:SCODe on page 166

SYNC-UL Code (UE only)
Defines the code used for synchronization on the UpPTS (see "Time Reference (UE mode)" on page 87).

Remote command:
[SENSe:]CDPower:SULC on page 168

MA Shift Cell / Number of Users
Sets the maximum number of usable midamble shifts (= number of users) on the base station. Possible values are in the range from 2 to 16 in steps of 2 midamble shifts.

If you use a predefined channel table, this value is replaced by that of the channel table.

For details see Chapter 4.4, "Data Fields and Midambles", on page 44.

Remote command:
[SENSe:]CDPower:MSHift on page 166

Time Reference (BTS mode)
Defines which slot is used as a time reference for synchronization.

"DwPTS"   Uses the Downlink Pilot Time Slot (DwPTS) as a time reference (see also Chapter 4.2, "Frames, Subframes and Slots", on page 39)

"Slot 0"   Uses slot 0 as a time reference.

Remote command:
[SENSe:]CDPower:TREF on page 168

Time Reference (UE mode)
Defines which slot is used as a time reference for synchronization.

"UpPTS"   Uses the Uplink Pilot Time Slot (UpPTS) as a time reference (see
                  also Chapter 4.2, "Frames, Subframes and Slots", on page 39)

"Slot 1"   Uses slot 1 as a time reference.

Remote command:
[SENSe:]CDPower:TREF on page 168

Sync To
Defines the phase reference. For a successful synchronization, the selected slot must
contain at least one data channel with sufficient power.

(Not available for Power vs Time measurements.)

"P-CCPCH"   **(BTS application only)**
                  By default, the R&S FSW TD-SCDMA BTS application determines
                  the phase reference for all downlink data slots from the downlink pilot
                  channel (P-CCPCH) in slot 0. For some measurements like beam-
                  forming or repeater measurements, it might be necessary to apply dif-
                  ferent phase offsets to each time slot. In these timeslots, using the P-
                  CCPCH as phase reference leads to rotated constellation diagrams
                  and poor EVM results.

"Code Chan-   **(UE application only)**
nel"   The R&S FSW TD-SCDMA UE determines the phase reference from
                  the channel of the selected slot. This is useful when synchronization
                  fails in poor SNR environments.
                  For channel synchronization, at least one of the channels must be
                  QPSK or 8PSK modulated.

"Midamble"   The R&S FSW TD-SCDMA application determines the phase refer-
                  ence from the midamble of the selected slot. With this method, the
                  data slots can be phase rotated to each other and a degradation of
                  the EVM results can be avoided.

Remote command:
[SENSe:]CDPower:STSLot on page 166
UE application: [SENSe:]CDPower:STSLot:MODE on page 167

Rotate code channel to associated midamble
(Not available for Power vs Time measurements.)

By default, the R&S FSWTD-SCDMA application determines one phase reference for
all midambles and channels of a data slot. If this option is enabled, phase rotations
between the channels are allowed. Each channel gets its own phase reference from
the associated midamble according to section AA.2 of the standard document 3GPP
TS 25.221. If the associated midamble is missing, the common phase reference is
used for this channel.

Remote command:
[SENSe:]CDPower:STSLot:ROTate on page 168

6.2.8 Channel Detection

Access: "Overview" > "Channel Detection"

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

6.2.8.1 General Channel Detection Settings

Access: "Overview" > "Channel Detection"
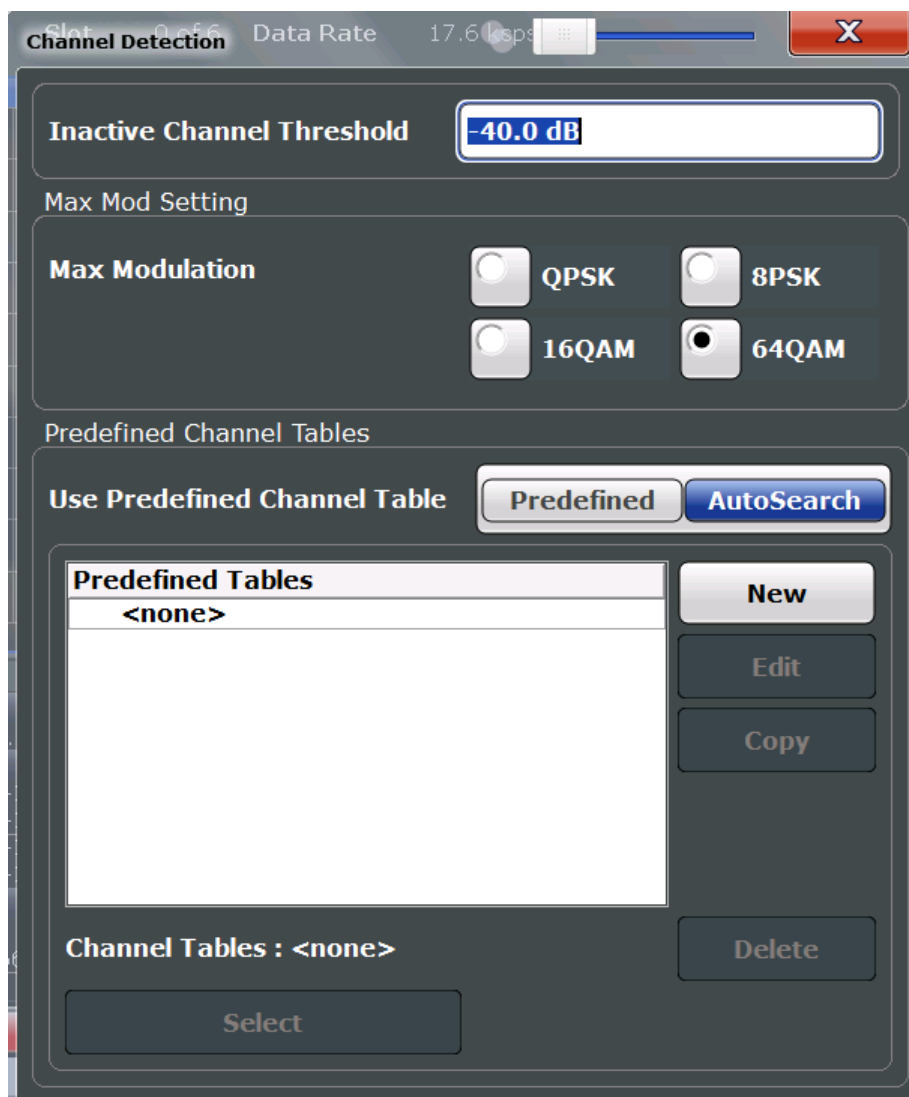
Figure 6-1: Channel detection configuration for TD-SCDMA BTS application

Inactive Channel Threshold

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

Remote command:
[SENSe:]CDPower:ICTReshold on page 169

Max Modulation

Defines the highest modulation to be considered in the automatic channel search. In low SNR environments, it may be necessary to limit the channel search to lower modulations than 64QAM. The following types are available:

- QPSK
- 8PSK
- 16QAM
- 64QAM

Remote command:
[SENSe:]CDPower:MMAX on page 169

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.

"Autosearch"   Detects channels automatically based on the active predefined channel table.

Remote command:
CONFigure:CDPower:CTABle[:STATe] on page 171

6.2.8.2 Channel Table Management

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

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

Remote command:
BTS measurements:
CONFigure:CDPower:CTABle:CATalog? on page 170

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

Remote command:
CONFigure:CDPower:CTABle:SELect on page 171

Creating a New Table
Creates a new channel table. See Chapter 6.2.8.4, "Channel Details", on page 93.

For step-by-step instructions on creating a new channel table, see "To define or edit a channel table" on page 120.

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 6.2.8.4, "Channel Details", on page 93.

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 6.2.8.4, "Channel Details", on page 93.

Remote command:
CONFigure:CDPower:CTABle:COPY on page 171

Deleting a Table

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

Remote command:
CONFigure:CDPower:CTABle:DELete on page 171

6.2.8.3 Channel Table Settings and Functions

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

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

Name

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

Remote command:
CONFigure:CDPower:CTABle:NAME on page 172

Comment

Optional description of the channel table.

Remote command:
CONFigure:CDPower:CTABle:COMMent on page 172

MA Shifts Cell

Defines the maximum number of midamble shifts (i.e. the maximum number of users) in a single cell for channel detection using the predefined table.

This value replaces the global value defined by "MA Shift Cell / Number of Users" on page 86.

For details, see Chapter 4.4, "Data Fields and Midambles", on page 44.

Remote command:
CONFigure:CDPower:CTABle:MSHift on page 174

Adding a Channel

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

Deleting a Channel

Deletes the currently selected channel from the table.

Creating a New Channel Table from the Measured Signal (Measure Table)

Creates a completely new channel table according to the current measurement data.

Remote command:
CONFigure:CDPower:MEASurement on page 134

Sorting the Table by Midamble
(BTS application only):

Sorting by midamble means that after each midamble, the corresponding code is listed. The R&S FSW automatically distinguishes between common and default midamble assignment. The assignment of code to midamble is specified in the TD-SCDMA standard.

If neither a common, nor a default midamble assignment is found, sorting is in code order.

For details, see Chapter 4.4, "Data Fields and Midambles", on page 44.

Sorting the Table by Code

The midambles are sorted according to their midamble shifts. Active and inactive channels are projected to a spreading factor of 16 and sorted according to their code numbers.

Selecting the Slot to Evaluate

The application analyzes a single slot over the total signal to detect channels. Which slot to analyze is defined here.

The values in the "Channel Detection" settings and in the "Evaluation Range" settings are identical.
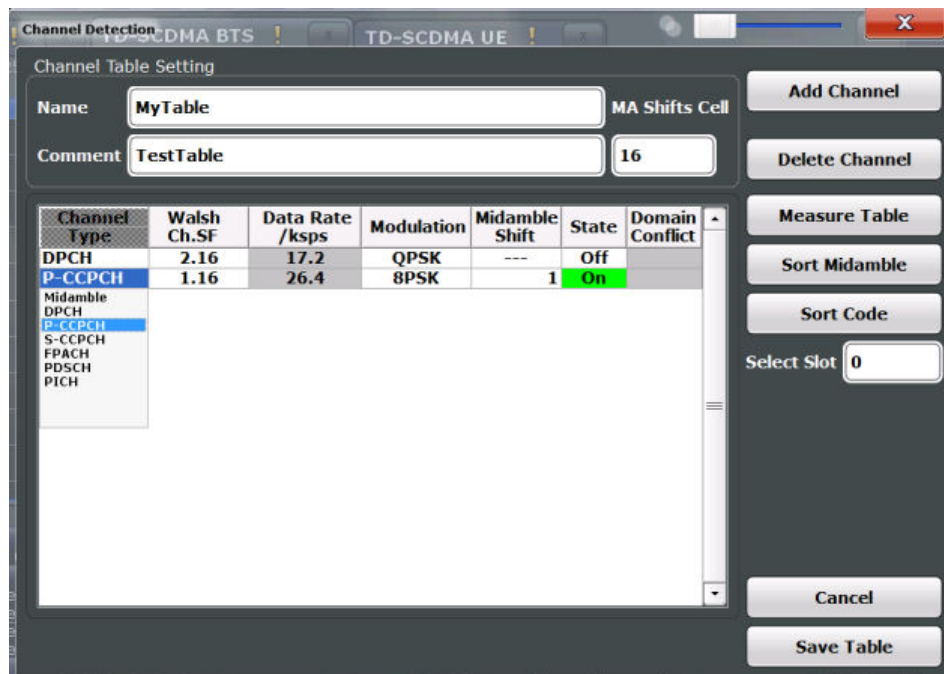
Cancelling Configuration

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.

6.2.8.4 Channel Details

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

To edit channel settings, select the corresponding cell in the table and enter the new value. Gray cells are read-only and cannot be edited.

Channel Type

Type of channel. For a list of possible channel types, see Chapter 4.3.1, "Special Channels", on page 41.

Remote command:
CONFigure:CDPower:CTABle:DATA on page 173

Channel Number (Ch. SF)

Channel number, defined by code and spreading factor

Remote command:
CONFigure:CDPower:CTABle:DATA on page 173

Symbol Rate

Symbol rate at which the channel is transmitted.

(Read-only; for reference purposes)

For an overview of possible symbol rates depending on the modulation type and other parameters, see Table 4-8.

Modulation
The modulation type.

For an overview of possible modulation types and other parameters, see Table 4-8.

Midamble Shift
For channels, this is the shift of the associated midamble if a common or default mid-amble assignment is detected.

For details, see Chapter 4.4, "Data Fields and Midambles", on page 44.

Remote command:
CONFigure:CDPower:CTABle:MSHift on page 174

State
Indicates the channel state. Codes that are not assigned are marked as inactive channels (OFF).

Remote command:
CONFigure:CDPower:CTABle:DATA on page 173

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

6.2.9   Sweep Settings

Access: SWEEP

The sweep settings define how the data is measured.

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

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel. However, the sweep mode only takes effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.

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

Remote command:
INITiate<n>:CONTinuous on page 192

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

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

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

Remote command:
INITiate<n>[:IMMediate] on page 192

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

Remote command:
INITiate<n>:CONMeas on page 191

Refresh (MSRA only)
This function is only available if the Sequencer is deactivated and only for **MSRA slave applications**.

The data in the capture buffer is re-evaluated by the currently active slave application only. The results for any other slave applications remain unchanged.

This is useful, for example, after evaluation changes have been made or if a new sweep was performed from another slave application; in this case, only that slave application is updated automatically after data acquisition.

Note: To update all active slave applications at once, use the "Refresh all" function in the "Sequencer" menu.

Remote command:
INITiate<n>:REFResh on page 226

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

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

Remote command:
[SENSe:]SWEep:COUNt on page 174

6.2.10 Automatic Settings

Access: AUTO SET

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

> **MSRA operating mode**
>
> In MSRA operating mode, the following automatic settings are not available, as they require a new data acquisition. However, TD-SCDMA applications cannot acquire data in MSRA operating mode.

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

This includes:

- Auto Level
- "Auto Scale All" on page 97

Note: MSRA operating modes. In MSRA operating mode, this function is only available for the MSRA Master, not the applications.

Remote command:
[SENSe:]ADJust:ALL on page 175

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

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

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

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 97).

Remote command:
[SENSe:]ADJust:LEVel on page 177

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

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

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

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

Remote command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 176

Changing the Automatic Measurement Time (Meastime Manual)
This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.

Remote command:
[SENSe:]ADJust:CONFigure:DURation:MODE on page 176
[SENSe:]ADJust:CONFigure:DURation on page 176

Upper Level Hysteresis
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer on page 177

Lower Level Hysteresis
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer on page 176

6.3 Frequency and Time Domain Measurements

Access: "Overview" > "Select Measurement"

When you activate a TD-SCDMA application, Code Domain Analysis of the input signal is started automatically. However, the TD-SCDMA applications also provide various frequency and time domain measurement types.

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

For details refer to "General Measurement Configuration" in the R&S FSW User Manual.

The measurement-specific settings for the following measurements are available in the "Analysis" dialog box (via the "Overview").

6.3.1 Power vs Time

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

The Power vs Time measurement checks the signal power against a transmission power mask defined by the TD-SCDMA specification.

6.3.1.1 Default Settings for PvT Measurements

By default, the following settings are used for a Power vs Time measurement in the TD-SCDMA BTS application:

Parameter	Default Value
Span	Zero Span
Sweep Time	2.4 ms
RBW	1.28 MHz
VBW	10 MHz

Parameter	Default Value
Trace Mode	Average
Switching point **(BTS application only):**	3
Number of subframes	100

6.3.1.2 PvT Configuration Overview

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

> The "Signal Description", "Signal Capture" and "Channel Detection" buttons indicated in the "Overview" are not available for TD-SCDMA Power vs Time measurements.

1. "Select Measurement"
   See Chapter 3, "Measurements and Result Display", on page 13

2. "Input/ Frontend"
   See Chapter 6.2.2, "Data Input and Output Settings", on page 53

3. (Optionally:) "Trigger"
   See Chapter 6.2.4, "Trigger Settings", on page 77

4. "Synchronization"
   See Chapter 6.2.7, "Synchronization", on page 85

5. "Analysis"
   See Chapter 7, "Analysis", on page 108

6. "Display Configuration"
   See Chapter 6.1, "Result Display Configuration", on page 49

> The "Span", "Lines", and "Marker Functions" menus are not available for Power vs Time measurements in TD-SCDMA applications.

To configure settings

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

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

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

Remote command:
SYSTem:PRESet:CHANnel[:EXECute] on page 133

Select Measurement

Selects a different measurement to be performed.

See

Specifics for

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

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

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

6.3.1.3 PvT Measurement Settings

The following settings and functions are specific to the Power vs Time measurement in the TD-SCDMA applications. They are available from the "Power vs Time" menu, which is displayed when you press the MEAS CONFIG key.

Switching Point
(BTS application only):

The switching point defines the border between uplink slots and downlink slots and is between 1 and 6.

In downlink Power vs Time measurements, the slots of interest are defined as the range from **slot 1** to the slot indicated by the "Switching Point".

In the TD-SCDMA **UE application**, the slot of interest is **slot 1**, which cannot be changed. Thus, the switching point is irrelevant.

Remote command:
CONFigure:CDPower[:BTS]:PVTime:SPOint on page 181

Start Meas

Starts measuring the power for the defined number of subframes (same effect as pressing the RUN SINGLE key).

Remote command:
INIT:CONT OFF, see INITiate<n>:CONTinuous on page 192
INITiate<n>[:IMMediate] on page 192

No of Subframes

Defines the number of subframes that the R&S FSW includes in the measurement. The results of the Power vs Time measurement are based on the average of the number of the subframes. This setting is identical to the "Sweep / Average Count" on page 95.

Remote command:
CONFigure:CDPower[:BTS]:PVTime:SFRames on page 181

Adapting the Measurement to the Current Signal

You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):

Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:ACHannel:SLOT:STARt on page 182
[SENSe:]POWer:ACHannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal

Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:ACHannel:AUTO:LTIMe on page 181

6.3.2 Signal Channel Power Measurements

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

The Power measurement determines the TD-SCDMA signal channel power in a single channel with a bandwidth of 1.2288 MHz.

In order to determine the signal power, the TD-SCDMA application performs a Channel Power measurement as in the Spectrum application with the following settings:

Table 6-2: Predefined settings for TD-SCDMA Signal Channel Power measurements

Standard	TD SCDMA FWD (**UE**: TD SCDMA REV)
Number of adjacent channels	0
Frequency span	3 MHz
Measurement bandwidth	1.6 MHz

The main measurement menus and the configuration "Overview" for the RF measurements are identical to the Spectrum application. However, an additional function is provided to adapt the Power measurement to the current TD-SCDMA signal.

Adapting the Measurement to the Current Signal

You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):

Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:ACHannel:SLOT:STARt on page 182
[SENSe:]POWer:ACHannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal

Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:ACHannel:AUTO:LTIMe on page 181

6.3.3 Channel Power (ACLR) Measurements

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

Channel Power ACLR measurements are performed as in the Spectrum application with the following predefined settings according to TD-SCDMA specifications (adjacent channel leakage ratio).

Table 6-3: Predefined settings for TD-SCDMA ACLR Channel Power measurements

Standard	TD SCDMA FWD (**UE**: TD SCDMA REV)
Number of adjacent channels	2

For further details about the ACLR measurements refer to "Measuring Channel Power and Adjacent-Channel Power" in the R&S FSW User Manual.

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

● Reference level and reference level offset

● RBW, VBW

● Sweep time

● Span

● Number of adjacent channels

● Fast ACLR mode

The main measurement menus and the configuration "Overview" for the RF measurements are identical to the Spectrum application. However, an additional function is provided to adapt the ACLR measurement to the current TD-SCDMA signal.

Adapting the Measurement to the Current Signal
You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):

Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:ACHannel:SLOT:STARt on page 182
[SENSe:]POWer:ACHannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal
Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:ACHannel:AUTO:LTIMe on page 181

6.3.4 Spectrum Emission Mask

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

The Spectrum Emission Mask measurement determines the power of the TD-SCDMA signal in defined offsets from the carrier and compares the power values with a spectral mask specified by TD-SCDMA.

For further details about the Spectrum Emission Mask measurements refer to "Spectrum Emission Mask Measurement" in the R&S FSW User Manual.

The TD-SCDMA applications perform the SEM measurement as in the Spectrum application with the following settings:

Table 6-4: Predefined settings for TD-SCDMA SEM measurements

Span	+/- 4 MHz
Number of ranges	9
Fast SEM	ON
Number of power classes	1

Channel bandwidth	1.28 MHz
Power reference type	Channel power
Detector	RMS

> ℹ️ Changing the RBW and the VBW is restricted due to the definition of the limits by the standard.

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

- Reference level and reference level offset
- Sweep time
- Span

The main measurement menus and the configuration "Overview" for the RF measurements are identical to the Spectrum application. However, an additional function is provided to adapt the SEM measurement to the current TD-SCDMA signal.

Adapting the Measurement to the Current Signal
You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):

Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:ACHannel:SLOT:STARt on page 182
[SENSe:]POWer:ACHannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal
Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:ACHannel:AUTO:LTIMe on page 181

6.3.5 Occupied Bandwidth

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

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

The Occupied Bandwidth measurement is performed as in the Spectrum application with the following predefined settings according to TD-SCDMA specifications:

Table 6-5: Predefined settings for TD-SCDMA OBW measurements

Setting	Default value
% Power Bandwidth	99 %
Channel bandwidth	1.28 MHz
Sweep Time	676 ms
RBW	30 kHz
VBW	300 kHz
Detector	RMS
Trigger	Gated, IF power

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

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

● Reference level and reference level offset

● RBW, VBW

● Sweep time

● Span

The main measurement menus and the configuration "Overview" for the RF measurements are identical to the Spectrum application. However, an additional function is provided to adapt the OBW measurement to the current TD-SCDMA signal.

Adapting the Measurement to the Current Signal
You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):

Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:ACHannel:SLOT:STARt on page 182
[SENSe:]POWer:ACHannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal
Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:AChannel:AUTO:LTIMe on page 181

6.3.6 CCDF

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

The CCDF measurement determines the distribution of the signal amplitudes (complementary cumulative distribution function).

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

Table 6-6: Predefined settings for TD-SCDMA CCDF measurements

CCDF	Active on trace 1
Analysis bandwidth	10 MHz
Number of samples	500000
Detector	Sample

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

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

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

The main measurement menus and the configuration "Overview" for the RF measurements are identical to the Spectrum application. However, an additional function is provided to adapt the CCDF measurement to the current TD-SCDMA signal.

Adapting the Measurement to the Current Signal
You can adapt the measurement range to the current TD-SCDMA signal.

Start Slot / Stop Slot ← Adapting the Measurement to the Current Signal (BTS application only):
Defines the measurement range for **Channel Power** measurements as a range of slots in the current TD-SCDMA signal, e.g. the downlink slots 4 to 6, for a "Switching Point" = 3.

Remote command:
[SENSe:]POWer:AChannel:SLOT:STARt on page 182
[SENSe:]POWer:AChannel:SLOT:STOP on page 182

Auto Level & Time ← Adapting the Measurement to the Current Signal
Automatically adjusts the reference level and the trigger offset to subframe start to their optimum levels for the current signal. This prevents overloading the R&S FSW.

When this function is activated, current measurements are aborted and resumed after the automatic level detection is finished.

Remote command:
[SENSe:]POWer:ACHannel:AUTO:LTIMe on page 181

7 Analysis

Access: "Overview" > "Analysis"

Analysis of RF Measurements

General result analysis settings concerning the trace, markers, lines etc. for RF measurements are almost identical to the analysis functions in the Spectrum application. Only some special marker functions and spectrograms are not available in TD-SCDMA applications.

For details, see the "Common Analysis and Display Functions" chapter in the R&S FSW User Manual.

The remote commands required to perform these tasks are described in Chapter 10.10, "Analysis", on page 213.

7.1 Evaluation Range

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

The evaluation range defines which channel, slot or set is evaluated in the result display.
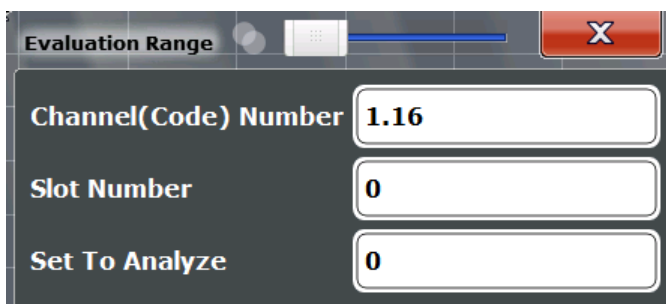
Channel (Code) Number
Selects a channel for the following evaluations:

- Bitstream
- Power vs Slot
- Power vs Symbol
- Result Summary

- Symbol Constellation
- Symbol EVM

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

The specified channel is selected and marked in red in the corresponding result displays, if active. If no spreading factor is specified, the code based on the spreading factor 16 is marked. For unused channels, the code resulting from the conversion is marked.

Example: Enter *4.8*

Channel 4 is marked at spreading factor 8 (35.2 ksps) if the channel is active, otherwise code 7 at spreading factor 16.

Remote command:
[SENSe:]CDPower:CODE on page 178

Slot Number
Selects the slot for evaluation. This affects channel detection as well as the following evaluations (see also Chapter 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 16):

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

Remote command:
[SENSe:]CDPower:SLOT on page 178

Set to Analyze
Selects a specific set for further analysis. The value range depends on the Set Count and is between 0 and [Set Count-1].

Remote command:
[SENSe:]CDPower:SET on page 178

7.2 Code Domain Analysis Settings

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

Some evaluations provide further settings for the results.
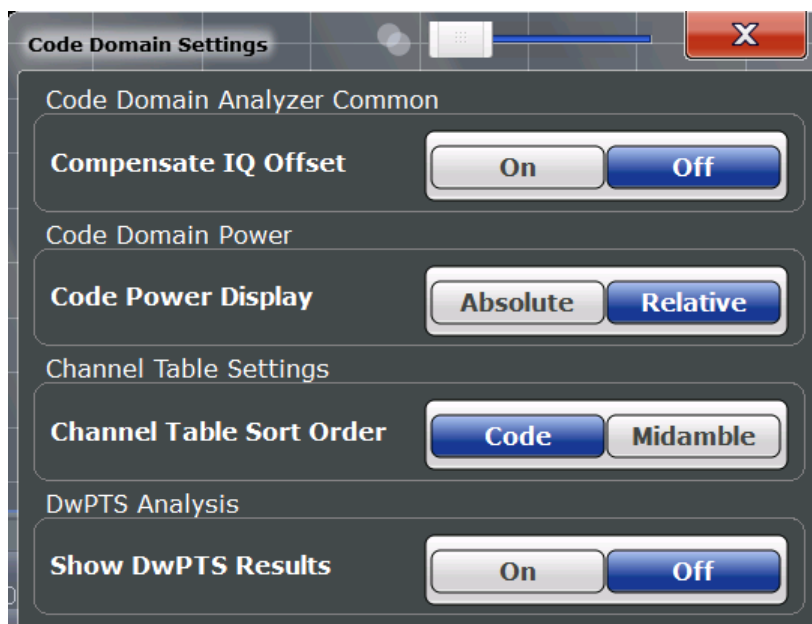
Figure 7-1: Code Domain Settings (BTS mode)

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 179

Code Power Display

For "Code Domain Power" evaluation:

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

Remote command:

[SENSe:]CDPower:PDISplay on page 179

Channel Table Sort Order

You can sort channels in the Channel Table result display in two ways:

"Code Order"   First, all midambles are listed, then all control channels and last all data channels
The midambles are sorted according to their midamble shifts. Active and inactive channels are projected to a spreading factor of 16 and sorted according to their code numbers.

"Midamble Order"	All control and data channels are assigned to the midambles they belong to; the midambles are in ascending order

The TD-SCDMA application automatically distinguishes between common and default midamble allocation. If neither a common nor a default midamble allocation is found, sorting is in code order.
The allocation of code to midamble is specified in the TD-SCDMA standard. (See also Chapter 4.4, "Data Fields and Midambles", on page 44).

Remote command:
CONFigure:CDPower:CTABle:ORDer on page 179

Show DwPTS Results (BTS mode)
Displays additional information on the "Downlink Pilot Time Slot" (DwPTS, see also Chapter 4.2, "Frames, Subframes and Slots", on page 39) in the Result Summary.

Remote command:
[SENSe:]CDPower:PTS on page 180

Show UpPTS Results (UE mode)
Displays additional information on the "Uplink Pilot Time Slot" (UpPTS, see also Chapter 4.2, "Frames, Subframes and Slots", on page 39) in the Result Summary.

Remote command:
[SENSe:]CDPower:PTS on page 180

7.3 Traces

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

Or: TRACE > "Trace Config"

The trace settings determine how the measured data is analyzed and displayed on the screen.
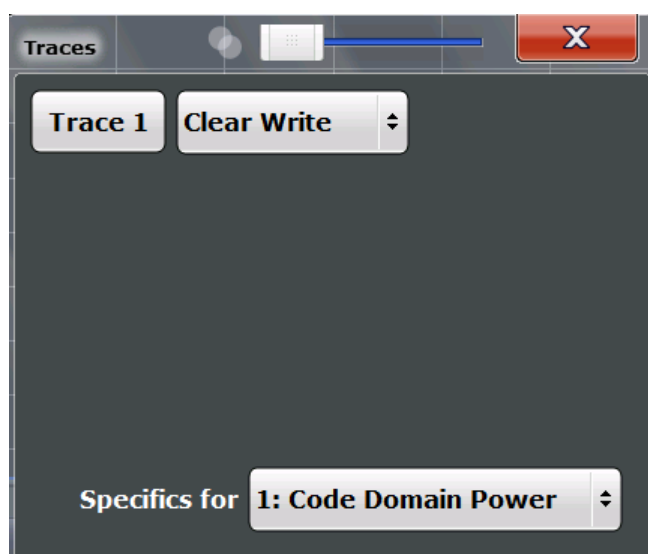
In CDA evaluations, only one trace can be active in each diagram at any time.

Window-specific configuration

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

Trace Mode
Defines the update mode for subsequent traces.

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

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

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

"Average"   The average is formed over several measurements.

"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 213

7.4 Markers

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

Or: MKR

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

Markers in Code Domain Analysis measurements

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

7.4.1 Individual Marker Settings

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

Or: MKR > "Marker Config"

In CDA evaluations, up to four markers can be activated in each diagram at any time.
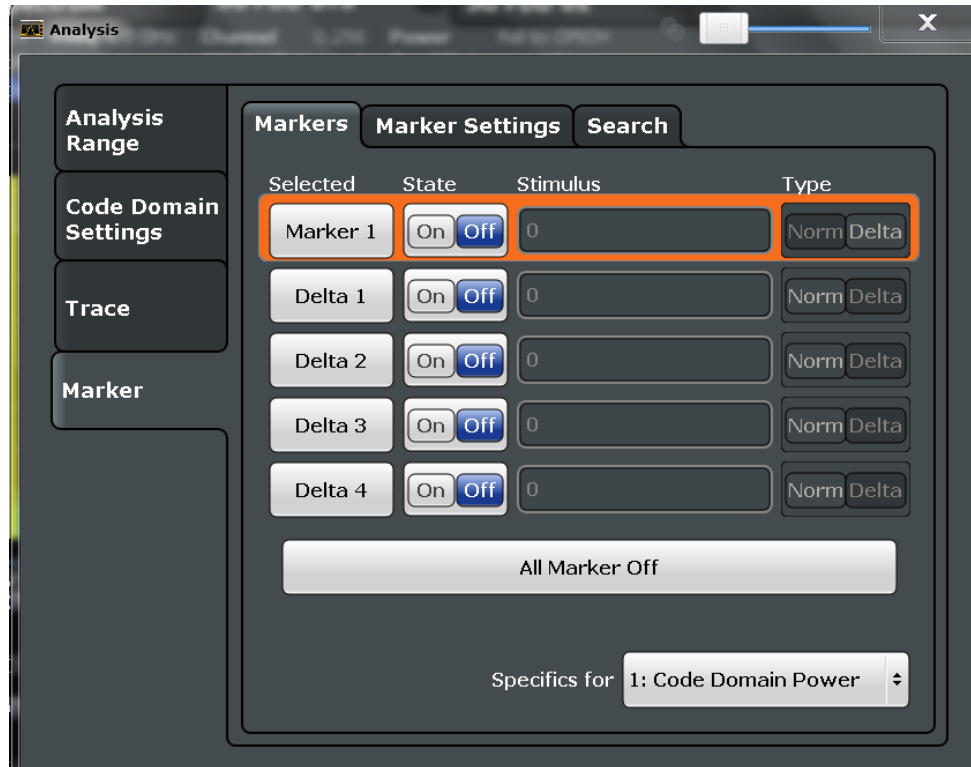
Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

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

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 215
CALCulate<n>:DELTamarker<m>[:STATe] on page 216

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 216
CALCulate<n>:MARKer<m>:X on page 215

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 215
CALCulate<n>:DELTamarker<m>[:STATe] on page 216

All Markers Off

Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 215

7.4.2 General Marker Settings

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

Or: MKR > "Marker Config" > "Marker Settings" tab
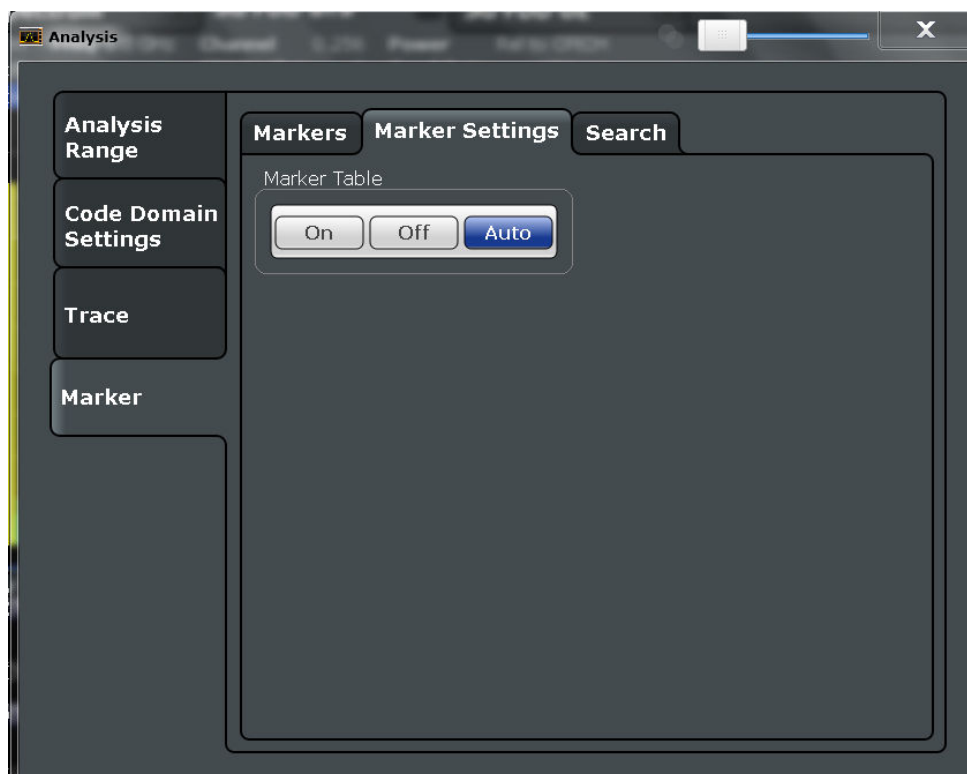
Marker Table Display

Defines how the marker information is displayed.

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

"Off"   Displays the marker information within the diagram area. No separate marker table is displayed.

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

Remote command:
DISPlay:MTABle on page 218

7.4.3 Marker Search Settings

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

Access: MKR -> > "Search Config"

Several functions are available to set the marker to a specific position very quickly and easily. In order to determine the required marker position, searches can be performed. The search results are affected by special settings.
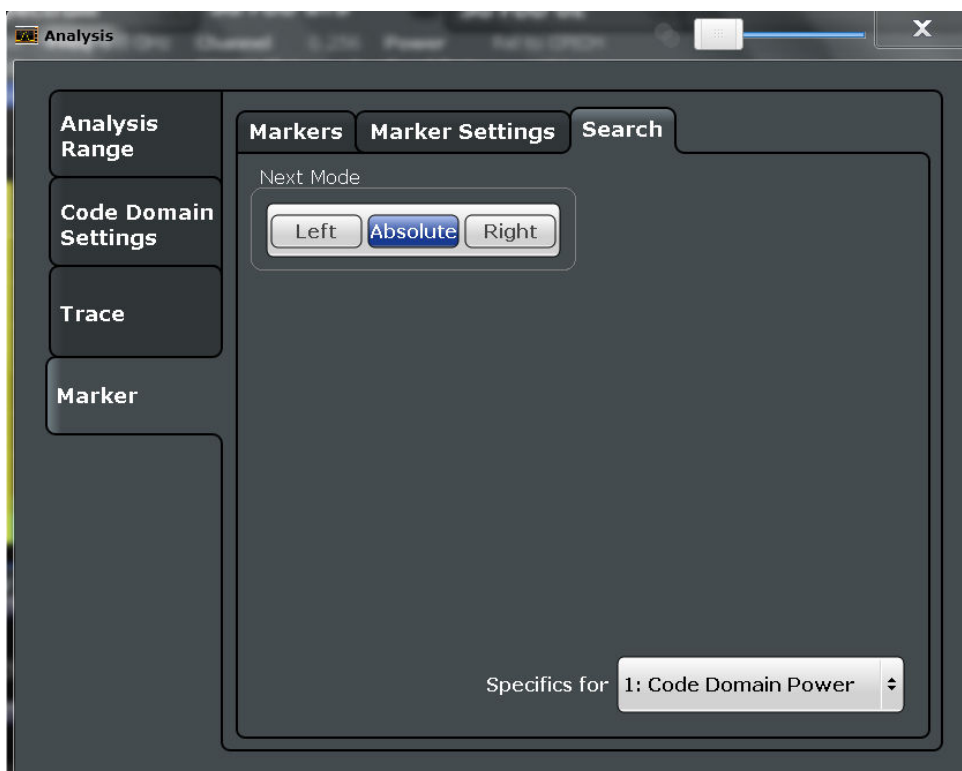
Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left"	Determines the next maximum/minimum to the left of the current peak.
"Absolute"	Determines the next maximum/minimum to either side of the current peak.
"Right"	Determines the next maximum/minimum to the right of the current peak.

Remote command:
Chapter 10.10.2.3, "Positioning the Marker", on page 218

7.4.4 Marker Positioning Functions

Access: MKR ->

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

Markers in Code Domain Analysis measurements

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

Search Next Peak

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

Remote command:

CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 219

CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 219

CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 218

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 221

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 222

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 221

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 220

CALCulate<n>:MARKer<m>:MINimum:LEFT on page 219

CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 220

CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 222

CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 222

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 223

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 219

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 221

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 220

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 222

8 Optimizing and Troubleshooting the Measurement

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

Synchronization fails

- Check the frequency.
- Check the reference level.
- When using an **external trigger,** check whether an external trigger is being sent to the R&S FSW.
- Check the **carrier frequency error** (see Chapter 3.1.1, "Code Domain Parameters", on page 14)
  Frequency differences between the transmitter and receiver of more than 1.0 kHz impair synchronization of the Code Domain Power measurement. If at all possible, the transmitter and the receiver should be synchronized.
- Check the **chip rate error**. A large chip rate error results in symbol errors and, therefore, in possible synchronization errors for code domain measurements.

EVM and Error results are too high

Only the channels detected as being active are used to generate the ideal reference signal. If a channel is not detected as being active, e.g. on account of low power, the difference between the test signal and the reference signal and therefore the (composite) EVM and code domain errors are very large.

Distortions also occur if unassigned codes are wrongly given the status of "active channel". To obtain reliable measurement results, select an adequate **channel threshold**.

8.1 Error Messages

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

A short explanation of the device-specific error messages for the TD-SCDMA 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.

9 How to Perform Measurements in TD-SCDMA Applications

The following step-by-step instructions demonstrate how to perform measurements with the TD-SCDMA applications.

The following tasks are described:

- To perform Code Domain Analysis
- To define or edit a channel table
- To perform a Power vs Time check
- To perform an RF measurement
- To select the application data for MSRA measurements

To perform Code Domain Analysis

1. Press the MODE key and select the "TD-SCDMA BTS" applications for base station tests, or "TD-SCDMA UE" for user equipment tests.

   Code Domain Analysis of the input signal is performed by default.

2. Select the "Overview" softkey to display the "Overview" for Code Domain Analysis.

3. Select the "Input/Frontend" button and then the "Frequency" tab to define the input signal's center frequency.

4. Select the "Amplitude" tab to define the reference level and other settings concerning the expected power levels.

5. Optionally, in the "Overview", 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, i.e. how many sets and slots are to be captured.
   In MSRA mode, define the application data instead, see "To select the application data for MSRA measurements" on page 122.

7. Select the "Synchronization" button and define the channel synchronization settings, i.e. the maximum number of users and the scrambling code to be expected in the input signal.

8. Select the "Channel Detection" button and define how the individual channels are to be detected within the input signal. If necessary, define a channel table as described in "To define or edit a channel table" on page 120.

9. Select the "Display Config" button and select the evaluation methods that are of interest to you.
   Arrange them on the display to suit your preferences.

10. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.

11. Select the "Analysis" button in the "Overview" to configure how the data is evaluated in the individual result displays.

    ● Select the channel, slot and set to be evaluated.
    ● Configure specific settings for the selected evaluation method(s).
    ● Optionally, configure the trace to display the average over a series of measurements. If necessary, increase the "Sweep/Average Count" in the "Sweep Config" dialog box.
    ● Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.

12. Start a new measurement with the defined settings.
    In MSRA mode you may want to stop the continuous measurement mode by the Sequencer and perform a single data acquisition:

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

To define or edit a channel table

Channel tables contain a list of channels to be detected and their specific parameters. You can create user-defined and edit pre-defined channel tables.

1. Select the "Channel Detection" softkey from the main "Code Domain Analyzer" menu to open the "Channel Detection" dialog box.

2. To define a new channel table, select the "New" button next to the "Predefined Tables" list.
   To edit an existing channel table:

   a) Select the existing channel table in the "Predefined Tables" list.
   b) Select the "Edit" button next to the "Predefined Tables" list.

3. In the "Channel Table" dialog box, define a name and, optionally, a comment that describes the channel table. The comment is displayed when you set the focus on the table in the "Predefined Tables" list.

4. Define the maximum number of users ("MA Shifts Cell") to be used for the channel table.

5. 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.

6. 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.

7. 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) Close the dialog box.
   e) Start a new measurement.

To perform a Power vs Time check

The Power vs Time measurement checks the signal power in the time domain against a transmission power mask defined by the TD-SCDMA specification (for details see "Power vs Time" on page 30).

1. Press the MODE key and select the "TD-SCDMA BTS" applications for base station tests, or "TD-SCDMA UE" for user equipment tests.

   Code Domain Analysis of the input signal is performed by default.

2. Switch to the Power vs Time measurement:

   a) Press the MEAS key.
   b) In the "Select Measurement" dialog box, select the "Power vs Time" button.

3. For downlink measurements (BTS application) only:
   Select the "Switching Point" softkey to define the slot which separates the uplink from the downlink data. Only the slots for downlink data are measured and checked against the transmission power mask.
   (For uplink measurements, the application always measures slot 1, thus the switching point is irrelevant.)

4. For downlink measurements (BTS application):
   Select the "Auto Level & Time" softkey to adjust the reference level and the trigger offset to subframe start to their optimum levels for the current signal.
   For uplink measurements, select the "Adapt to Signal" softkey and then the "Auto Level & Time" button to adjust the reference level and the trigger offset to subframe start automatically.

5. Select the "No. of Subframes" softkey to define how many slots are taken into consideration for the Power vs Time results.

6. Optionally, press the TRIGGER key and define a trigger for the measurement, for example an external trigger to start measuring only when a useful signal is transmitted.

7. Select the "Start Meas" softkey or press the RUN SINGLE key to start a new measurement.

   The Power vs Time diagram is displayed, averaged over the defined number of subframes. The result of the limit check against the transmission power mask is also indicated.

8. To display the numerical results, select the "Display Config" softkey and drag the "Evaluation List" result to the display.

To perform an RF measurement

1. Press the MODE key and select the "TD-SCDMA BTS" applications for base station tests, or "TD-SCDMA UE" for user equipment tests.

    Code Domain Analysis of the input signal is performed by default.

2. Select the RF measurement:

    a) Press the MEAS key.
    b) In the "Select Measurement" dialog box, select the required measurement.

    The selected measurement is activated with the default settings for TD-SCDMA mode immediately.

3. If necessary, adapt the settings as described for the individual measurements in the R&S FSW User Manual.

4. Select the "Display Config" button and select the evaluation methods that are of interest to you.
    Arrange them on the display to suit your preferences.

5. Exit the SmartGrid mode and select the "Overview" softkey to display the "Overview" again.

6. Select the "Analysis" button in the "Overview" to make use of the advanced analysis functions in the result displays.

    ● Configure a trace to display the average over a series of sweeps; if necessary, increase the "Sweep Count" in the "Sweep" settings.
    ● Configure markers and delta markers to determine deviations and offsets within the evaluated signal.
    ● Use special marker functions to calculate noise or a peak list.
    ● Configure a limit check to detect excessive deviations.

7. Optionally, export the trace data of the graphical evaluation results to a file.

    a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
    b) Select "Export Trace to ASCII File".
    c) Define a file name and storage location and select "OK".

To select the application data for MSRA measurements

In multi-standard radio analysis you can analyze the data captured by the MSRA Master in the TD-SCDMA BTS application. Assuming you have detected a suspect area of the captured data in another application, you would now like to analyze the same data in the TD-SCDMA BTS application.

1. Select the "Overview" softkey to display the "Overview" for Code Domain Analysis.

2. Select the "Signal Capture" button.

3. Define the application data range as the "Capture Length (Slots)".

4. Define the starting point of the application data as the "Capture offset". The offset is calculated according to the following formula:
    <capture offset> = <starting point for application> - <starting point in capture buffer>

5. The analysis interval is automatically determined according to the selected channel, slot or set to analyze (defined for the evaluation range), depending on the result display. Note that the set/slot/channel is analyzed *within the application data*. If the analysis interval does not yet show the required area of the capture buffer, move through the sets/slots/channels in the evaluation range or correct the application data range.

6. If the Sequencer is off, select the "Refresh" softkey in the "Sweep" menu to update the result displays for the changed application data.

10 Remote Commands for TD-SCDMA Measurements

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

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

In particular, this includes:

● Managing Settings and Results, i.e. storing and loading settings and result data

● Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation

● Using the common status registers

The following topics specific to TD-SCDMA applications are described here:

10.1 Introduction

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

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

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

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

Remote command examples

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

10.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

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

- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSW follow the SCPI syntax rules.

- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.

- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.

- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.

- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

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 126.

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 an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

10.2 Common Suffixes

In the R&S FSW TD-SCDMA Measurements application, the following common suffixes are used in remote commands:

Table 10-1: Common suffixes used in remote commands in the R&S FSW TD-SCDMA Measurements application

Suffix	Value range	Description
<m>	1 to 4 (RF: 1 to 16)	Marker
<n>	1 to 16	Window (**in the currently selected measurement channel**)
<t>	1 (RF: 1 to 6)	Trace
<k>	not applicable	Limit line

10.3 Activating the TD-SCDMA Applications

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

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer2").

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

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

Example: INST:SEL 'IQAnalyzer'
                     INST:CRE:DUPL
                     Duplicates the channel named 'IQAnalyzer' and creates a new
                     measurement channel named 'IQAnalyzer2'.

Usage: Event

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

This command adds an additional measurement channel.

The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType>   Channel type of the new channel.
                       For a list of available channel types see INSTrument:LIST?
                       on page 131.

<ChannelName>   String containing the name of the channel. The channel name is
                       displayed as the tab label for the measurement channel.
                       Note: If the specified name for a new channel already exists, the
                       default name, extended by a sequential number, is used for the
                       new channel (see INSTrument:LIST? on page 131).

Example: INST:CRE IQ, 'IQAnalyzer2'
                     Adds an additional I/Q Analyzer channel named "IQAnalyzer2".

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

This command replaces a measurement channel with another one.

Setting parameters:

<ChannelName1>	String containing the name of the measurement channel you want to replace.
<ChannelType>	Channel type of the new channel. For a list of available channel types see `INSTrument:LIST?` on page 131.
<ChannelName2>	String containing the name of the new channel. Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 131).
Example:	`INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'` Replaces the channel named 'IQAnalyzer2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.
Usage:	Setting only

INSTrument:DELete <ChannelName>

This command deletes a measurement channel.

If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

<ChannelName>	String containing the name of the channel you want to delete. A measurement channel must exist in order to be able delete it.
Example:	`INST:DEL 'IQAnalyzer4'` Deletes the channel with the name 'IQAnalyzer4'.
Usage:	Event

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName>	For each channel, the command returns the channel type and channel name (see tables below). Tip: to change the channel name, use the `INSTrument:REName` command.

Example:	`INST:LIST?`
	Result for 3 measurement channels:
	`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage:	Query only

Table 10-2: Available measurement channel types and default channel names in Signal and Spectrum Analyzer mode

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
802.11ad (R&S FSW-K95)	WIGIG	802.11ad
Amplifier Measurements (R&S FSW-K18)	AMPLifier	Amplifier
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
Avionics (R&S FSW-K15)	AVIonics	Avionics
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
DOCSIS 3.1 (R&S FSW-K192/193)	DOCSis	DOCSIS 3.1
GSM (R&S FSW-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSW-K10x)	LTE	LTE
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
Pulse (R&S FSW-K6)	PULSE	Pulse
Real-Time Spectrum (R&S FSW-B160R/-K160RE)	RTIM	Real-Time Spectrum
Spurious Measurements (R&S FSW-K50)	SPUR	Spurious
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
Transient Analysis (R&S FSW-K60)	TA	Transient Analysis
VSA (R&S FSW-K70)	DDEM	VSA
WLAN (R&S FSW-K91)	WLAN	WLAN

*) the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

<ChannelName1>   String containing the name of the channel you want to rename.

<ChannelName2>   String containing the new channel name.
                     Note that you cannot assign an existing channel name to a new
                     channel; this will cause an error.

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
                     Renames the channel with the name 'IQAnalyzer2' to 'IQAna-
                     lyzer3'.

Usage: Setting only

INSTrument[:SELect] <Mode>

This command activates a new measurement channel with the defined channel type,
or selects an existing measurement channel with the specified name.

Also see

- `INSTrument:CREate[:NEW]` on page 130

Parameters:

<Mode>   **BTDS**
                     TD-SCDMA BTS mode (R&S FSW-K76 option)
                     MTDS
                     TD-SCDMA UE mode (R&S FSW-K77 option)

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

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

Usage: Event

Manual operation: See "Preset Channel" on page 53

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 13.

CONFigure:CDPower:MEASurement <Measurement>

This command selects the measurement type for the TD-SCDMA BTS application.

For details on these measurements see Chapter 3.2, "Frequency and Time Domain Measurements", on page 29.

Parameters:

<Measurement>

ACLR
Adjacent Channel Power

CCDF
Complementary Cumulative Distribution Function

CDPower
Code Domain Power

ESPectrum
Spectrum Emission Mask

OBWidth
Occupied Bandwidth

POWer
Channel Power

PVTime
Power vs Time

*RST: CDPower

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

Manual operation: See "Power vs Time" on page 30
See "Power" on page 32
See "Channel Power ACLR" on page 33
See "Spectrum Emission Mask" on page 33
See "Occupied Bandwidth" on page 34
See "CCDF" on page 35
See "Creating a New Channel Table from the Measured Signal (Measure Table)" on page 92

10.5 Configuring Code Domain Analysis

The following commands are required to configure Code Domain Analysis.

10.5.1　Configuring the Data Input and Output

10.5.1.1　RF Input

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

The command works only if the overload condition has been eliminated first.

Usage:　　　　　Event

INPut:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input. It is not available for the R&S FSW67 or R&S FSW85.

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

Parameters:

<ConnType>   **RF**
                    RF input connector

                    AIQI
                    Analog Baseband I connector

                    *RST: RF

Example: INP:CONN:AIQI
                    Selects input from the analog baseband I connector.

Usage: SCPI confirmed

Manual operation: See "Input Connector" on page 56

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

The command is not available for measurements with the optional Digital Baseband Interface.

Parameters:

<CouplingType>   **AC**
                    AC coupling

                    DC
                    DC coupling

                    *RST: AC

Example: INP:COUP DC

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 55

INPut:DPATh <State>

Enables or disables the use of the direct path for frequencies close to 0 Hz.

Parameters:

<State>   **AUTO | 1**
                    (Default) the direct path is used automatically for frequencies close to 0 Hz.

                    OFF | 0
                    The analog mixer path is always used.

                    *RST: 1

Example: INP:DPAT OFF

Usage: SCPI confirmed

Manual operation: See "Direct Path" on page 55

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

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

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

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

Parameters:

<State>	ON | OFF
	*RST: OFF
Example:	INP:FILT:HPAS ON
	Turns on the filter.
Usage:	SCPI confirmed
Manual operation:	See "High-Pass Filter 1...3 GHz" on page 56

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

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG-preselector described in "YIG-Preselector" on page 56.

Parameters:

<State>	ON | OFF | 0 | 1
	*RST: 1 (0 for I/Q Analyzer, GSM, VSA, Pulse, Amplifier, Transient Analysis, DOCSIS and MC Group Delay measurements)
Example:	INP:FILT:YIG OFF
	Deactivates the YIG-preselector.
Manual operation:	See "YIG-Preselector" on page 56

INPut:IMPedance <Impedance>

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

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

The command is not available for measurements with the optional Digital Baseband Interface.

Parameters:

<Impedance>	50 | 75
	*RST: 50 Ω

Example:	`INP:IMP 75`
Usage:	SCPI confirmed
Manual operation:	See "Impedance" on page 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 FSW.

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

Parameters:

<Source>
RF
Radio Frequency ("RF INPUT" connector)
DIQ
Digital IQ data (only available with optional Digital Baseband Interface
For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.
AIQ
Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)
For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.
*RST: RF

Manual operation: See "Radio Frequency State" on page 54
See "Digital I/Q Input State" on page 57
See "Analog Baseband Input State" on page 59

10.5.1.2 Configuring Digital I/Q Input and Output

Remote commands for the R&S DigIConf software

Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the R&S FSW to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.

All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Example 1:

```
SOURce:EBOX:*RST

SOURce:EBOX:*IDN?
```

Result:

"Rohde&Schwarz,DigIConf,02.05.436 Build 47"

Example 2:

```
SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ
```

Defines the frequency value of the reference clock.

Remote commands exclusive to digital I/Q data input and output

INPut:DIQ:CDEVice

This command queries the current configuration and the status of the digital I/Q input from the optional Digital Baseband Interface.

For details see the section "Interface Status Information" for the optional Digital Baseband Interface in the R&S FSW I/Q Analyzer User Manual.

Return values:

<ConnState>	Defines whether a device is connected or not.
	0 No device is connected.
	1 A device is connected.
<DeviceName>	Device ID of the connected device

<SerialNumber>	Serial number of the connected device
<PortName>	Port name used by the connected device
<SampleRate>	Maximum or currently used sample rate of the connected device in Hz (depends on the used connection protocol version; indicated by <SampleRateType> parameter)
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device.
	Not Started
	Has to be Started
	Started
	Passed
	Failed
	Done
<PRBSTestState>	State of the PRBS test.
	Not Started
	Has to be Started
	Started
	Passed
	Failed
	Done
<SampleRateType>	**0**
	Maximum sample rate is displayed
	1
	Current sample rate is displayed
<FullScaleLevel>	The level (in dBm) that should correspond to an I/Q sample with the magnitude "1" (if transferred from connected device); If not available, 1.#QNAN (not a number) is returned
Example:	INP:DIQ:CDEV? Result: 1,SMW200A,101190,BBMM 1 OUT, 100000000,200000000,Passed,Passed,1,1.#QNAN
Manual operation:	See "Connected Instrument" on page 58

INPut:DIQ:RANGe[:UPPer]:AUTO <State>

If enabled, the digital input full scale level is automatically set to the value provided by the connected device (if available).

This command is only available if the optional Digital Baseband interface is installed.

Parameters:

<State>   ON | OFF

                        *RST: OFF

Manual operation: See "Full Scale Level" on page 57

INPut:DIQ:RANGe:COUPling <State>

If enabled, the reference level for digital input is adjusted to the full scale level automatically if the full scale level changes.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State>   ON | OFF

                        *RST: OFF

Manual operation: See "Adjust Reference Level to Full Scale Level" on page 58

INPut:DIQ:RANGe[:UPPer] <Level>

Defines or queries the "Full Scale Level", i.e. the level that corresponds to an I/Q sample with the magnitude "1".

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level>   <numeric value>

                        Range: 1 µV to 7.071 V
                        *RST: 1 V

Manual operation: See "Full Scale Level" on page 57

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

Defines the unit of the full scale level (see "Full Scale Level" on page 57). The availability of units depends on the measurement application you are using.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<Level>   VOLT | DBM | DBPW | WATT | DBMV | DBUV | DBUA | AMPere

                        *RST: Volt

Manual operation: See "Full Scale Level" on page 57

INPut:DIQ:SRATe <SampleRate>

This command specifies or queries the sample rate of the input signal from the optional Digital Baseband Interface (see "Input Sample Rate" on page 57).

Parameters:

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

Example: INP:DIQ:SRAT 200 MHz

Manual operation: See "Input Sample Rate" on page 57

INPut:DIQ:SRATe:AUTO <State>

If enabled, the sample rate of the digital I/Q input signal is set automatically by the connected device.

This command is only available if the optional Digital Baseband Interface is installed.

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Manual operation: See "Input Sample Rate" on page 57

OUTPut:DIQ <State>

This command turns continuous output of I/Q data to the optional Digital Baseband Interface on and off.

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

If digital baseband output is active, the sample rate is restricted to 100 MHz (200 MHz if enhanced mode is possible; max. 160 MHz bandwidth).

Parameters:

<State>	ON | OFF	
	*RST:	OFF

Example: OUTP:DIQ ON

Manual operation: See "Digital Baseband Output" on page 66

OUTPut:DIQ:CDEVice?

This command queries the current configuration and the status of the digital I/Q data output to the optional Digital Baseband Interface.

Return values:

<ConnState>	Defines whether a device is connected or not.
	0
	No device is connected.
	1
	A device is connected.
<DeviceName>	Device ID of the connected device
<SerialNumber>	Serial number of the connected device

<PortName>	Port name used by the connected device
<NotUsed>	to be ignored
<MaxTransferRate>	Maximum data transfer rate of the connected device in Hz
<ConnProtState>	State of the connection protocol which is used to identify the connected device.
	Not Started
	Has to be Started
	Started
	Passed
	Failed
	Done
<PRBSTestState>	State of the PRBS test.
	Not Started
	Has to be Started
	Started
	Passed
	Failed
	Done
<NotUsed>	to be ignored
<Placeholder>	for future use; currently "0"
Example:	`OUTP:DIQ:CDEV?`
	Result:
	`1,SMW200A,101190,CODER 1 IN,`
	`0,200000000,Passed,Done,0,0`
Usage:	Query only
Manual operation:	See "Output Settings Information" on page 66
	See "Connected Instrument" on page 66

10.5.1.3 Configuring Input via the Optional Analog Baseband Interface

The following commands are required to control the optional Analog Baseband Interface in a remote environment. They are only available if this option is installed.

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

Useful commands for Analog Baseband data described elsewhere:

- `INP:SEL AIQ` (see `INPut:SELect` on page 138)
- `[SENSe:]FREQuency:CENTer` on page 150

Commands for the Analog Baseband calibration signal are described in the R&S FSW User Manual.

Remote commands exclusive to Analog Baseband data input and output

INPut:IQ:BALanced[:STATe] <State>

This command defines whether the input is provided as a differential signal via all 4 Analog Baseband connectors or as a plain I/Q signal via 2 single-ended lines.

Parameters:

<State>	**ON**
	Differential
	OFF
	Single ended
	*RST: ON

Example: `INP:IQ:BAL OFF`

Manual operation: See "Input Configuration" on page 60

INPut:IQ:FULLscale:AUTO <State>

This command defines whether the full scale level (i.e. the maximum input power on the Baseband Input connector) is defined automatically according to the reference level, or manually.

Parameters:

<State>	**ON**
	Automatic definition
	OFF
	Manual definition according to `INPut:IQ:FULLscale[:LEVel]` on page 144
	*RST: ON

Example: `INP:IQ:FULL:AUTO OFF`

Manual operation: See "Full Scale Level Mode / Value" on page 74

INPut:IQ:FULLscale[:LEVel] <PeakVoltage>

This command defines the peak voltage at the Baseband Input connector if the full scale level is set to manual mode (see `INPut:IQ:FULLscale:AUTO` on page 144).

Parameters:

<PeakVoltage>	0.25 V | 0.5 V | 1 V | 2 V
	Peak voltage level at the connector.
	For probes, the possible full scale values are adapted according to the probe's attenuation and maximum allowed power.
	*RST: 1V

Example: INP:IQ:FULL 0.5V

Manual operation: See "Full Scale Level Mode / Value" on page 74

INPut:IQ:TYPE <DataType>

This command defines the format of the input signal.

Parameters:

<DataType>   IQ | I | Q

IQ
The input signal is filtered and resampled to the sample rate of the application.
Two input channels are required for each input signal, one for the in-phase component, and one for the quadrature component.

I
The in-phase component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the in-phase component of the input signal is down-converted first (Low IF I).

Q
The quadrature component of the input signal is filtered and resampled to the sample rate of the application. If the center frequency is not 0, the quadrature component of the input signal is down-converted first (Low IF Q).

*RST: IQ

Example: INP:IQ:TYPE Q

Manual operation: See "I/Q Mode" on page 59

CALibration:AIQ:HATiming[:STATe] <State>

Activates a mode with enhanced timing accuracy between analog baseband, RF and external trigger signals.

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

Parameters:

\<State\>	ON | OFF | 1 | 0

ON \| 1
The high accuracy timing function is switched on.
The cable for high accuracy timing must be connected to trigger ports 1 and 2.

OFF \| 0
The high accuracy timing function is switched off.

*RST: OFF

Example:	CAL:AIQ:HAT:STAT ON
Manual operation:	See "High Accuracy Timing Trigger - Baseband - RF" on page 60

10.5.1.4 Setting up Probes

Probes can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband interface (option R&S FSW-B71) is installed.

[SENSe:]PROBe\<p\>:SETup:CMOFfset \<CMOffset\>

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

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

Suffix:

\<p\>	1 | 2 | 3

Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

\<CMOffset\>	Range: -100E+24 to 100E+24

Increment: 1E-3
*RST: 0
Default unit: V

Manual operation:	See "Common Mode Offset" on page 62

[SENSe:]PROBe<p>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<p>	1 | 2 | 3
	Selects the connector:
	1 = Baseband Input I
	2 = Baseband Input Q
	3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<PartNumber>	Part number in a string.

Usage:	Query only

[SENSe:]PROBe<p>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:

<p>	1 | 2 | 3
	Selects the connector:
	1 = Baseband Input I
	2 = Baseband Input Q
	3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<SerialNo>	Serial number in a string.

Usage:	Query only

[SENSe:]PROBe<p>:SETup:MODE <Mode>

Select the action that is started with the micro button on the probe head.

See also: "Microbutton Action" on page 62.

Suffix:

<p>	1 | 2 | 3
	Selects the connector:
	1 = Baseband Input I
	2 = Baseband Input Q
	3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:

<Mode>   **RSINgle**

Run single: starts one data acquisition.

NOACtion

Nothing is started on pressing the micro button.

*RST: RSINgle

Manual operation: See "Microbutton Action" on page 62

[SENSe:]PROBe<p>:SETup:NAME?

Queries the name of the probe.

Suffix:

<p>   1 | 2 | 3

Selects the connector:

1 = Baseband Input I

2 = Baseband Input Q

3 = RF (currently not supported; use "1" with RF Input Connec-
tor setting "Baseband Input I")

Return values:

<Name>   Name string

Usage: Query only

[SENSe:]PROBe<p>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not
detected). To switch the probe on, i.e. activate input from the connector, use
INP:SEL:AIQ (see INPut:SELect on page 138).

Suffix:

<p>   1 | 2 | 3

Selects the connector:

1 = Baseband Input I

2 = Baseband Input Q

3 = RF (currently not supported; use "1" with RF Input Connec-
tor setting "Baseband Input I")

Return values:

<State>   DETected | NDETected

*RST: NDETected

Usage: Query only

[SENSe:]PROBe<p>:SETup:TYPE?

Queries the type of the probe.

Suffix:

<p>   1 | 2 | 3

                              Selects the connector:

                              1 = Baseband Input I

                              2 = Baseband Input Q

                              3 = RF (currently not supported; use "1" with RF Input Connec-
                              tor setting "Baseband Input I")

Return values:

<Type>   String containing one of the following values:

                              – None (no probe detected)

                              – active differential

                              – active single-ended

Usage: Query only

10.5.1.5 Configuring the Outputs

Configuring trigger input/output is described in Chapter 10.5.3.2, "Configuring the Trigger Output", on page 162.

DIAGnostic:SERVice:NSOurce <State>

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

Suffix:

<n>   Window

Parameters:

<State>   ON | OFF

                              *RST: OFF

Example: DIAG:SERV:NSO ON

Manual operation: See "Noise Source" on page 63

10.5.2 Frontend Configuration

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

10.5.2.1 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 61
See "Center frequency" on page 76

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

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 76

[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.

Note: In MSRA mode, the setting command is only available for the MSRA Master. For MSRA slave applications, only the query command is available.

Parameters:

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

Example:	FREQ:OFFS 1GHZ
Usage:	SCPI confirmed
Manual operation:	See "Frequency Offset" on page 77

10.5.2.2 Amplitude and Scaling Settings

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

Useful commands for amplitude settings described elsewhere:

- INPut:COUPling on page 136
- INPut:IMPedance on page 137
- [SENSe:]ADJust:LEVel on page 177

Remote commands exclusive to amplitude settings:

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

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

Suffix:

<n>	Window
<t>	irrelevant

Usage:	SCPI confirmed
Manual operation:	See "Auto Scale Once" on page 75

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

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

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	<numeric value>
	*RST: depends on the result display
	The unit and range depend on the result display.
Example:	DISP:TRAC:Y:MIN -60
	DISP:TRAC:Y:MAX 0
	Defines the y-axis with a minimum value of -60 and maximum value of 0.
Manual operation:	See "Y-Maximum, Y-Minimum" on page 75

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

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

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	<numeric value>
	*RST: depends on the result display
	The unit and range depend on the result display.

Example: `DISP:TRAC:Y:MIN -60`
`DISP:TRAC:Y:MAX 0`
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Y-Maximum, Y-Minimum" on page 75

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

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

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	numeric value WITHOUT UNIT (unit according to the result display)
	Defines the range per division (total range = 10*<Value>)
	*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division

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

This command defines the reference level (for all traces in all windows).

Suffix:

<n>, <t>	irrelevant

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

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 70

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

This command defines a reference level offset (for all traces in all windows).

Suffix:

<n>, <t>	irrelevant

Parameters:

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

Example:	DISP:TRAC:Y:RLEV:OFFS –10dB
Manual operation:	See "Shifting the Display (Offset)" on page 70

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S FSW adjusts the scaling of the y-axis accordingly.

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Position>	0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.
	*RST: 100 PCT = frequency display; 50 PCT = time display
Example:	DISP:TRAC:Y:RPOS 50PCT
Usage:	SCPI confirmed

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

The command defines the power value assigned to the reference position in the grid (for all traces).

For external generator calibration measurements (requires the optional External Generator Control), this command defines the power offset value assigned to the reference position.

Suffix:

<n>	Window
<t>	irrelevant

Parameters:

<Value>	*RST: 0 dBm, coupled to reference level
Example:	DISP:TRAC:Y:RVAL –20dBm
	Sets the power value assigned to the reference position to -20 dBm

---

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off. It requires the optional preamplifier hardware.

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

Parameters:

<State>	ON | OFF
	*RST: OFF

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

Usage:	SCPI confirmed

Manual operation:	See "Preamplifier" on page 72

INPut:GAIN[:VALue] <Gain>

This command selects the gain if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 154).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain>	15 dB | 30 dB
	The availability of gain levels depends on the model of the R&S FSW.
	R&S FSW8/13: 15dB and 30 dB
	R&S FSW26 or higher: 30 dB
	All other values are rounded to the nearest of these two.
	*RST: OFF

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

Usage:	SCPI confirmed

Manual operation:	See "Preamplifier" on page 72

10.5.2.3 Configuring the Attenuation

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 157).

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

This function is not available if the optional Digital Baseband Interface is active.

Parameters:

<Attenuation>	Range:	see data sheet
	Increment:	5 dB
	*RST:	10 dB (AUTO is set to ON)

Example: INP:ATT 30dB

Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 71

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

This function is not available if the optional Digital Baseband Interface is active.

Parameters:

<State>	ON	OFF	0	1
	*RST: 1

Example: INP:ATT:AUTO ON

Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 71

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 157).

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

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

\<Attenuation\>	attenuation in dB

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

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

Manual operation: See "Using Electronic Attenuation" on page 72

INPut:EATT:AUTO \<State\>

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

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

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

\<State\>   1 | 0 | ON | OFF

1 | ON

0 | OFF

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 72

INPut:EATT:STATe \<State\>

This command turns the electronic attenuator on and off.

This command requires the electronic attenuation hardware option.

It is not available if the optional Digital Baseband Interface is active.

Parameters:

\<State\>   1 | 0 | ON | OFF

1 | ON

0 | OFF

*RST: 0

Example: `INP:EATT:STAT ON`
Switches the electronic attenuator into the signal path.

Manual operation: See "Using Electronic Attenuation" on page 72

10.5.3 Configuring Triggered Measurements

The following commands are required to configure a triggered measurement in a remote environment. The tasks for manual operation are described in Chapter 6.2.4, "Trigger Settings", on page 77.

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

10.5.3.1 Configuring the Triggering Conditions

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

This command defines the holding time before the baseband power trigger event.

The command requires the optional Digital Baseband Interface or the optional Analog Baseband Interface.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 159 command for new remote control programs.

Parameters:

<Period>	Range:	150 ns to 1000 s
	*RST:	150 ns

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

TRIGger[:SEQuence]: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 80

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period>	Range:	0 s to 10 s
	*RST:	0 s

Example:	TRIG:SOUR EXT
	Sets an external trigger source.
	TRIG:IFP:HOLD 200 ns
	Sets the holding time to 200 ns.
Manual operation:	See "Trigger Holdoff" on page 81

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

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis>	Range:	3 dB to 50 dB
	*RST:	3 dB

Example:	TRIG:SOUR IFP
	Sets the IF power trigger source.
	TRIG:IFP:HYST 10DB
	Sets the hysteresis limit value.
Manual operation:	See "Hysteresis" on page 81

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

This command sets the level of the baseband power trigger.

This command is available for the optional Digital Baseband Interface and the optional Analog Baseband Interface.

Parameters:

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

Example:	TRIG:LEV:BBP -30DBM

Manual operation: See "Trigger Level" on page 80

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 80

TRIGger[:SEQuence]:SLOPe <Type>

For external and time domain trigger sources you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:

<Type>   POSitive | NEGative

                    POSitive
                    Triggers when the signal rises to the trigger level (rising edge).

                    NEGative
                    Triggers when the signal drops to the trigger level (falling edge).

                    *RST: POSitive

Example: TRIG:SLOP NEG

Manual operation: See "Slope" on page 81

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency
(Frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface or the optional Analog Baseband Interface.

IFPower
Second intermediate frequency
(For frequency and time domain measurements only.)
Not available for input from the optional Digital Baseband Interface. For input from the optional Analog Baseband Interface, this parameter is interpreted as `BBPower` for compatibility reasons.

BBPower
Baseband power (for digital input via the optional Digital Baseband Interface
Baseband power (for digital input via the optional Digital Baseband Interface or the optional Analog Baseband interface
(UE mode (K77) only)

PSEN
External power sensor
(For frequency and time domain measurements only.)

GP0 | GP1 | GP2 | GP3 | GP4 | GP5
For applications that process I/Q data, such as the I/Q Analyzer or optional applications, and only if the optional Digital Baseband Interface is available.
Defines triggering of the measurement directly via the LVDS connector. The parameter specifies which general purpose bit (0 to 5) will provide the trigger data.
The assignment of the general purpose bits used by the Digital IQ trigger to the LVDS connector pins is provided in "Digital I/Q" on page 79.
*RST: IMMediate

Example: TRIG:SOUR EXT
Selects the external trigger input as source of the trigger signal

Manual operation: See "Trigger Source" on page 78
See "Free Run" on page 78
See "External Trigger 1/2/3" on page 79
See "Digital I/Q" on page 79
See "IF Power" on page 80

10.5.3.2   Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable
TRIGGER INPUT/OUTPUT connectors on the R&S FSW.

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as
well as an output.

Suffix:
<port>   Selects the used trigger port.
2 = trigger port 2 (front panel)
3 = trigger port 3 (rear panel)

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

Manual operation: See "Trigger 2/3" on page 63

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the (TTL compatible) signal generated at the trigger
output.

This command works only if you have selected a user defined output with `OUTPut:
TRIGger<port>:OTYPe`.

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

Parameters:

<Level>	**HIGH**	
	5 V	
	LOW	
	0 V	
	*RST:	LOW

Example:	OUTP:TRIG2:LEV HIGH
Manual operation:	See "Level" on page 64

OUTPut:TRIGger<port>:OTYPe <OutputType>

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

Suffix:

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

Parameters:

<OutputType>	**DEVice**
	Sends a trigger signal when the R&S FSW has triggered internally.
	TARMed
	Sends a trigger signal when the trigger is armed and ready for an external trigger event.
	UDEFined
	Sends a user defined trigger signal. For more information see OUTPut:TRIGger<port>:LEVel.
	*RST: DEVice

Manual operation:	See "Output Type" on page 64

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

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

Usage:	Event
Manual operation:	See "Send Trigger" on page 64

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

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

Suffix:

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

Parameters:

<Length>   Pulse length in seconds.

Example: OUTP:TRIG2:PULS:LENG 0.02

Manual operation: See "Pulse Length" on page 64

10.5.4 Signal Capturing

The following commands are required to configure how much and how data is captured from the input signal.

MSRA operating mode

In MSRA operating mode, only the MSRA Master channel actually captures data from the input signal. The data acquisition settings for the TD-SCDMA application in MSRA mode define the **application data** (see also Chapter 10.12, "Configuring the Slave Application Data Range (MSRA mode only)", on page 224).

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

Useful commands when defining signal capturing described elsewhere:

*   [SENSe:]CDPower:SET on page 178

Remote commands exclusive to defining signal capturing:

[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 84

[SENSe:]CDPower:IQLength <CaptureLength>

This command specifies the number of slots that are captured by one measurement. If more than one set is to be captured (see `[SENSe:]CDPower:SET:COUNt` on page 165), the number of slots is automatically set to the maximum of 64.

Parameters:
<CaptureLength>   Range: 2 to 64
                       *RST: 7

Example: `SENS:CDP:IQLength 3`

Manual operation: See "Number of Slots to Capture" on page 85

[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 84

[SENSe:]CDPower:SET:COUNt <NoOfSets>

This command sets the number of sets to be captured and stored in the instrument's memory.

Refer to "Set Count" on page 85 for more information.

Parameters:
<NoOfSets>   Range: 1 to TDS: 99; CDMA: 490
                     Increment: 1
                     *RST: 1

Example: `CDP:SET:COUN 12`
                     Sets the number of sets to 12.

Mode: TDS

Manual operation: See "Set Count" on page 85

10.5.5 Synchronization

The individual channels in the input signal need to be synchronized to detect timing off-sets in the slot spacings. These commands are described here.

Remote commands exclusive to synchronization:

[SENSe:]CDPower:MSHift <MaxMAShift>

This command sets the maximum number of usable midamble shifts (= number of users) on the base station.

If you use a predefined channel table, this value is replaced by that of the channel table (see `CONFigure:CDPower:CTABle:MSHift` on page 174).

Parameters:

<MaxMAShift>	Range:	2 to 16
	Increment:	2
	*RST:	16

Example: `CDP:MSH 10`
Sets the maximum number of midamble shifts to 10.

Manual operation: See "MA Shift Cell / Number of Users" on page 86

[SENSe:]CDPower:SCODe <numeric value>

This command sets the scrambling code of the base station.

Parameters:

<numeric value>	Range:	0 to 127
	Increment:	1
	*RST:	0

Example: `CDP:SCOD 28`
Sets scrambling code 28.

Manual operation: See "Scrambling Code" on page 86

[SENSe:]CDPower:STSLot <State>

This command selects the phase reference for synchronization (see "Sync To" on page 87).

Parameters:

<State>	ON | OFF

ON

The instrument synchronizes to the midamble of the selected slot.

OFF

BTS application:

The instrument synchronizes to the P-CCPCH in slot 0.

UE application:

The instrument synchronizes to the channel of the selected slot.

*RST: OFF

Example:	`CDP:SLOT 7`

Selects slot number 7.

`CDP:STSL ON`

Activates synchronizing to the midamble of slot 7.

Manual operation:	See "Sync To" on page 87

[SENSe:]CDPower:STSLot:MODE <Mode>

This command selects the phase reference for synchronization (see "Sync To" on page 87).

Parameters:

<Mode>	CODE | MA

CODE

BTS application:

The instrument synchronizes to the P-CCPCH in slot 0.

UE application:

The instrument synchronizes to the channel of the selected slot.

MA

The instrument synchronizes to the midamble of the selected slot.

*RST: MA

Example:	`CDP:STSL:MODE CODE`

Activates channel synchronizing

Mode:	UE only

Manual operation:	See "Sync To" on page 87

[SENSe:]CDPower:STSLot:ROTate <Mode>

By default, the TD-SCDMA application determines one phase reference for all midambles and channels of a data slot. If this function is enabled, phase rotations between the channels are allowed. Each channel gets its own phase reference from the associated midamble according to section AA.2 of the standard document 3GPP TS 25.221. If the associated midamble is missing, the common phase reference is used for this channel.

Parameters:

<Mode>	ON | OFF
	*RST: OFF
Example:	CDP:STSL:ROT ON
	Allows phase rotations between channels.
Manual operation:	See "Rotate code channel to associated midamble" on page 87

[SENSe:]CDPower:SULC <SyncUL>

Defines the code used for synchronization on the UpPTS (see "Time Reference (UE mode)" on page 87).

This command is available for UE mode (K77) only.

Parameters:

<SyncUL>	integer
	For details on available values depending on the scrambling code see Table 4-1.
	Range: 0 to 255
	*RST: 0
Example:	CDP:SULC 28
	Sets the code 28.
Manual operation:	See "SYNC-UL Code (UE only)" on page 86

[SENSe:]CDPower:TREF <numeric value>

Defines which slot is used as a time reference for synchronization.

Parameters:

<numeric value>	**DPTS**
	Uses the Downlink Pilot Time Slot (DwPTS) as a time reference
	UPTS
	Uses the Uplink Pilot Time Slot (UpPTS) as a time reference
	SLOT
	Uses slot 0 (BTS mode) or slot 1 (UE mode) as a time reference
	*RST: SLOT
Example:	CDP:TREF DPTS

Manual operation: See "Time Reference (BTS mode)" on page 86
See "Time Reference (UE mode)" on page 87

10.5.6 Channel Detection

The channel detection settings determine which channels are found in the input signal. The commands required to work with channel tables are described here.

10.5.6.1 General Channel Detection

The following commands configure how channels are detected in general.

Useful commands for general channel detection described elsewhere:

● CONFigure:CDPower:CTABle[:STATe] on page 171

Remote commands exclusive to general channel detection:

[SENSe:]CDPower:ICTReshold <ThresholdLevel>

This command defines the minimum power that a single channel must have compared to the total signal in order to be regarded as an active channel. Channels below the specified threshold are regarded as "inactive".

Parameters:

<ThresholdLevel>   Range: -100 dB to 0 dB
*RST: -40 dB

Example: SENS:CDP:ICTR –100

Manual operation: See "Inactive Channel Threshold " on page 89

[SENSe:]CDPower:MMAX <ModType>

This command defines the highest modulation to be considered in the automatic channel search. In low SNR environments it may be necessary to limit the channel search to lower modulations than 64QAM.

Parameters:

<ModType>   **QPSK**
                            Consider QPSK modulation only

                            PSK8
                            Consider QPSK and 8PSK modulation.

                            QAM16
                            Consider QPSK, 8PSK and 16QAM modulation

                            QAM64
                            Consider QPSK, 8PSK, 16QAM and 64QAM modulation

                            *RST: QAM64

Example: SENS:CDP:MMAX PSK8
                            Assume QPSK and 8PSK modulations only for the automatic
                            channel search

Manual operation: See "Max Modulation" on page 89

10.5.6.2 Managing Channel Tables

CONFigure:CDPower:CTABle:CATalog?

This command queries the names of all the channel tables stored on the instrument for
the current application.

The first two result values are global values for all channel tables, the subsequent val-
ues are listed for each individual table.

The syntax for the return values is: <TotalSize>, <FreeMem>, <FileName>, <FileSize>,
<FileName>, <FileSize>,...,<FileName>, <FileSize>

Parameters:

<TotalSize>   Sum of file sizes of all channel table files (in bytes)

<FreeMem>   Available memory left on hard disk (in bytes)

<FileName>   File name of individual channel table file

<FileSize>   File size of individual channel table file (in bytes)

Example: CONF:CDP:CTAB:CAT?
                            Returns all existing channel tables.

Usage: Query only

Manual operation: See "Predefined Tables" on page 90

CONFigure:CDPower:CTABle:COPY <TargetFileName>

This command copies one channel table to another. Select the channel table you want to copy using the `CONFigure:CDPower:CTABle:NAME` command. The name of the channel table may contain up to eight characters.

Parameters:

<TargetFileName>   <string> = name of the new channel table

Example: `CONF:CDP:CTAB:NAME 'CTAB_1'`
                     Selects channel table 'CTAB_1'.
                     `CONF:CDP:CTAB:COPY 'CTAB_2'`
                     Makes a copy of 'CTAB_1' with the name 'CTAB_2'.

Manual operation: See "Copying a Table" on page 91

CONFigure:CDPower:CTABle:DELete

This command deletes the selected channel table. Select the channel table you want to delete using the `CONFigure:CDPower:CTABle:NAME` command.

Example: `CONF:CDP:CTAB:NAME 'CTAB_1'`
                     Selects channel table 'CTAB_1'
                     `CONF:CDP:CTAB:DEL`
                     Deletes channel table 'CTAB_1'.

Usage: Event

Manual operation: See "Deleting a Table" on page 91

CONFigure:CDPower: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:CDPower:CTABle[:STATe]` on page 171.

Parameters:

<FileName>   *RST: RECENT

Example: `CONF:WCDP:CTAB ON`
                     Switches the channel table on.
                     `CONF:CDP:CTAB:SEL 'CTAB_1'`
                     Selects the predefined channel table 'CTAB_1'.

Manual operation: See "Selecting a Table" on page 90

CONFigure:CDPower:CTABle[:STATe] <State>

This command switches the use of a predefined channel table on or off. When switched on, the measured channel table is stored under the name "RECENT" and is selected for use. After the "RECENT" channel table is switched on, another channel table can be selected with the command `CONFigure:CDPower:CTABle:SELect` on page 171.

Parameters:

<State>	ON | OFF
	*RST: OFF

Example: `CONF:CDP:CTAB ON`

Manual operation: See "Using Predefined Channel Tables" on page 90

10.5.6.3 Configuring Channel Tables

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

Remote commands exclusive to configuring channel tables:

CONFigure:CDPower:CTABle:COMMent <Comment>

This command defines a comment for the channel table selected with `CONFigure:CDPower:CTABle:NAME`.

Parameters:

<Comment>	comment for the channel table

Example: `CONF:CDP:CTAB:NAME 'CTAB_1'`
Selects channel table 'CTAB_1'.
`CONF:CDP:CTAB:COMM 'Comment for CTAB_1'`
Writes a comment for 'CTAB_1'.

Manual operation: See "Comment" on page 91

CONFigure:CDPower:CTABle:NAME <ChannelTable>

This command selects an existing channel table or creates a new one. Use this command to edit the channel table. To use a channel table for a measurement, use the `CONFigure:CDPower:CTABle:SELect` command.

Parameters:

<ChannelTable>	<string> = name of the channel table
	*RST: RECENT

Example: `CONF:CDP:CTAB:NAME 'NEW_TAB'`
Selects channel table for editing. If a channel table with this name does not exist, a new channel table by that name is created.

Manual operation: See "Name" on page 91

CONFigure:CDPower:CTABle:DATA <ChannelType>, <CodeClass>,
    <CodeNumber>, <ModType>, <MAShift>, <ActiveFlag>,<Reserved>,
    <Reserved>

This command defines or queries the parameters of the channel table selected or created with the `CONFigure:CDPower:CTABle:NAME` command.

To define a channel (one row in the channel table), you have to enter eight values in the following order:

<ChannelType>, <CodeClass>, <CodeNumber>, <ModType>, <MAShift>, <ActiveFlag>,<Reserved>, <Reserved>

Return values:

<ChannelType>   0 ... 7

Type of the channel
0 = inactive
1 = midamble
2 = DPCH
3 = P-CCPCH
4 = S-CCPCH
5 = FPACH
6 = PDSCH
7 = PICH
Note that **values 2 to 7** are not distinguished by the application; all these values are mapped to the value 2 (DPCH).

<CodeClass>   **0 … 4**
Code class of the channel. The code class specifies the spreading factor of the channel.
0 = spreading factor 1
1 = spreading factor 2
2 = spreading factor 4
3 = spreading factor 8
4 = spreading factor 16

<CodeNo>   **1 … 16**
Code number of the channel. The number of codes depends on the spreading factor (see Table 4-2).

<ModType>   Modulation type of the channel
0 = invalid (for midamble)
1 = QPSK
2 = 8PSK
3 = 16QAM
4 = 64QAM

<MAShift>   **0 … 38400**
Midamble shift of the channel

<ActiveFlag>   0 | 1

Flag to indicate whether a channel is active (1) or not (0)

<Reserved1>, <Reserved2>	Placeholder values; Currently not used.

Example:	`CONF:CDP:CTAB:NAME 'CTAB_1'`
	Selects or creates channel table 'CTAB_1'
	`CONF:CDP:CTAB:DATA`
	`'2,4,1,1,1,1,0,0,2,4,2,1,1,1,0,0'`
	Defines two data channels with QPSK modulation.

Manual operation:	See "Channel Type" on page 93 See "Channel Number (Ch. SF)" on page 93 See "State" on page 94

CONFigure:CDPower:CTABle:MSHift <MAShift>

This command defines the number of midamble shifts in the channel table.

This value replaces the value defined by `[SENSe:]CDPower:MSHift` on page 166.

Parameters:

<numeric value>	**2 | 4 | 6 | 8 | 10 | 12 | 14 | 16** *RST: 16
Example:	`CONF:CDP:CTAB:MSH 4` Sets the number of midamble shifts to 4.
Manual operation:	See "MA Shifts Cell" on page 92 See "Midamble Shift" on page 94

10.5.7 Sweep Settings

[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.

Suffix:

<n>	Window

Example:	SWE:COUN 64
	Sets the number of measurements to 64.
	INIT:CONT OFF
	Switches to single measurement mode.
	INIT;*WAI
	Starts a measurement and waits for its end.
Usage:	SCPI confirmed
Manual operation:	See "Sweep / Average Count" on page 95

10.5.8 Automatic Settings

MSRA operating mode

In MSRA operating mode, the following commands are not available, as they require a new data acquisition. However, TD-SCDMA applications cannot perform data acquisition in MSRA operating mode.

Useful commands for adjusting settings automatically described elsewhere:

*   DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO ONCE on page 152

Remote commands exclusive to adjusting settings automatically:

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

*   Reference level

Example:	ADJ:ALL
Usage:	Event
Manual operation:	See "Adjusting all Determinable Settings Automatically (Auto All)" on page 96

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 97

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command selects the way the R&S FSW determines the length of the measurement .

Parameters:

<Mode> **AUTO**
The R&S FSW determines the measurement length automatically according to the current input data.
MANual
The R&S FSW uses the measurement length defined by
`[SENSe:]ADJust:CONFigure:DURation` on page 176.

*RST: AUTO

Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 97
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 97

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

When the reference level is adjusted automatically using the `[SENSe:]ADJust: LEVel` on page 177 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>	Range:	0 dB to 200 dB
	*RST:	+1 dB
	Default unit: dB	

Example:	SENS:ADJ:CONF:HYST:LOW 2
	For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation:	See "Lower Level Hysteresis" on page 97

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

When the reference level is adjusted automatically using the [SENSe:]ADJust: LEVel on page 177 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>	Range:	0 dB to 200 dB
	*RST:	+1 dB
	Default unit: dB	

Example:	SENS:ADJ:CONF:HYST:UPP 2

Example:	For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation:	See "Upper Level Hysteresis" on page 97

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example:	ADJ:LEV

Usage:	Event

Manual operation:	See "Setting the Reference Level Automatically (Auto Level)" on page 71

10.5.9 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 spreading factor 16.

Parameters:

<CodeNumber>   <numeric value>

                         *RST: 0

Example: SENS:CDP:CODE 3

Manual operation: See "Channel (Code) Number" on page 108

[SENSe:]CDPower:SET <SetNo>

This command selects a specific set for further analysis. The number of sets to capture has to be defined with the [SENSe:]CDPower:SET command before using this command.

Parameters:

<SetNo>   Range: 0 to SET COUNT -1
                         Increment: 1
                         *RST: 0

Example: CDP:SET:COUN 10
                         Selects the 10th set for further analysis.

Manual operation: See "Set to Analyze" on page 85

[SENSe:]CDPower:SLOT <SlotNumber>

This command selects the slot number to be evaluated. The number of slots to capture has to be defined with the [SENSe:]CDPower:IQLength command before using this command.

Parameters:

<SlotNumber>   <numeric value>

                         Range: 0 to <Number of slots to capture> -1
                         Increment: 1
                         *RST: 0

Example: SENS:CDP:SLOT 3

Manual operation: See "Slot Number" on page 109

10.5.10 Code Domain Analysis Settings

Some evaluations provide further settings for the results.

CONFigure:CDPower:CTABle:ORDer <CODE | MIDamble>

This command selects sorting of the channel table in code order or midamble order.

Parameters:

<CODE | MIDamble>   **CODE**
Channels are sorted in code order.

MIDamble
Channels are sorted in midamble order.

*RST: CODE

Example: CONF:CDP:CTAB:ORD
Sorts the channels in code order.

Manual operation: See "Channel Table Sort Order" on page 110

[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 110

[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 power of the data parts of the signal

*RST: ABS

Example: SENS:CDP:PDIS ABS

Manual operation: See "Code Power Display" on page 110

[SENSe:]CDPower:PTS <State>

If activated, additional information on the DwPTS (BTS mode) or UpPTS (UE mode) is displayed in the Result Summary. (See also Chapter 4.2, "Frames, Subframes and Slots", on page 39.)

This parameter only affects the Code Domain Power evaluation.

Parameters:

<State>	ON | OFF
	ON
	PTS evaluation is activated.
	OFF
	PTS evaluation is disabled.
	*RST: OFF

Example: SENS:CDP:PTS ON

Manual operation: See "Show DwPTS Results (BTS mode)" on page 111
                        See "Show UpPTS Results (UE mode)" on page 111

10.6 Configuring Frequency and Time Domain Measurements

Frequency and time domain measurements are performed in the Spectrum application, with some predefined settings as described in Chapter 6.3, "Frequency and Time Domain Measurements", on page 98.

For details on configuring these RF measurements in a remote environment, see the Remote Commands chapter of the R&S FSW User Manual.

The TD-SCDMA RF measurements must be activated for a TD-SCDMA application, see Chapter 10.3, "Activating the TD-SCDMA Applications", on page 129.

The individual measurements are activated using the CONFigure:CDPower: MEASurement on page 134 command.

Some frequency and time domain measurements require further configuration.

   Analysis for Frequency and Time Domain Measurements

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

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

10.6.1 Configuring Power vs Time Measurements

CONFigure:CDPower[:BTS]:PVTime:SFRames <numeric value>

This command defines the number of subframes to be used for averaging.

Parameters:

<numeric value>	Subframe value.
	*RST: 100
Example:	`CONF:CDP:PVT:SFR 50`
	Sets the number of subframes to 50.
Manual operation:	See "No of Subframes" on page 101

CONFigure:CDPower[:BTS]:PVTime:SPOint <numeric value>

This command defines the switching point between uplink and downlink slots.

Parameters:

<numeric value>	1 to 7
	*RST: 3
Example:	`CONF:CDP:PVT:SPO 7`
	Sets the switching point to 7.
Manual operation:	See "Switching Point" on page 100

[SENSe:]POWer:ACHannel:AUTO:LTIMe

This command automatically adjusts the reference level and the trigger to frame time to their optimum levels. This prevents overloading of the R&S FSW.

Current measurements are aborted when this command is executed and resumed after the automatic level detection is finished.

Usage:	Event
Manual operation:	See "Auto Level & Time" on page 101

10.6.2 Configuring the Slot Range for Frequency Sweeps on Downlink Data

In the BTS application, you can define which slots to analyze, i.e. which slots contain downlink data (depending on the switching point).

[SENSe:]POWer:ACHannel:SLOT:STARt <StartSlot>

Sets the first slot of the measurement.

Parameters:

<StartSlot>	The start slot may not be larger than the stop slot.
	In the UE application, the default value is 1.

	Range:	1 to 7
	*RST:	4

Example:	POW:ACH:SLOT:STAR 2
Manual operation:	See "Start Slot / Stop Slot" on page 101

[SENSe:]POWer:ACHannel:SLOT:STOP <StopSlot>

Sets the last slot of the measurement.

Parameters:

<StopSlot>	The stop slot may not be lower than the start slot.
	In the UE application, stop slots other than 1 require an external trigger. The default value is 1.

	Range:	1 to 7
	*RST:	6

Example:	POW:ACH:SLOT:STOP 5
Manual operation:	See "Start Slot / Stop Slot" on page 101

10.7 Configuring the Result Display

The following commands are required to configure the screen display in a remote environment. The tasks for manual operation are described in Chapter 6.1, "Result Display Configuration", on page 49.

10.7.1 General Window Commands

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

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>　　　　　**SPLit**

Displays the MultiView tab with an overview of all active channels

SINGle

Displays the measurement channel that was previously focused.

*RST:　　　SING

Example:　　　　　DISP:FORM SPL

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*.
To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 187).

Suffix:

<n>　　　　　　　　　Window

Parameters:

<Size>　　　　　　**LARGe**

Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl

Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST:　　　SMALl

Example:　　　　　DISP:WIND2:SIZE LARG

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.

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

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the LAYout:REPLace[:WINDow] command.

Parameters:

<WindowName>   String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the LAYout:CATalog[:WINDow]? query.

<Direction>   LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType>   text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:ADD? '1',LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation: See "Bitstream" on page 16
                          See "Channel Table" on page 17
                          See "Code Domain Power" on page 18
                          See "Code Domain Error Power" on page 19
                          See "Composite Constellation" on page 20
                          See "Composite EVM" on page 21
                          See "Mag Error vs Chip" on page 22
                          See "Marker Table" on page 23
                          See "Peak Code Domain Error" on page 23
                          See "Phase Error vs Chip" on page 24
                          See "Power vs Slot" on page 25
                          See "Power vs Symbol" on page 26
                          See "Result Summary" on page 26
                          See "Symbol Constellation" on page 27
                          See "Symbol EVM" on page 27
                          See "Symbol Magnitude Error" on page 28
                          See "Symbol Phase Error" on page 29
                          See "Diagram" on page 36
                          See "List Evaluation" on page 37
                          See "Result Summary" on page 37
                          See "Marker Peak List" on page 38

Table 10-3: <WindowType> parameter values for TD-SCDMA 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
LEValuation	List evaluation (Power vs. Time)
MECHip	Magnitude Error vs. Chip
MTABle	Marker table
PCDerror	Peak Code Domain Error
PECHip	Phase Error vs. Chip
PSLot	Channel 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:CATalog[:WINDow]?

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

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

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

<WindowIndex>	**numeric value**
	Index of the window.

Example:	LAY:CAT?
	Result:
	'2',2,'1',1
	Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage:	Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName>	String containing the name of a window.

Return values:

<WindowIndex>	Index number of the window.

Example:	LAY:WIND:IDEN? '2'
	Queries the index of the result display named '2'.
	Response:
	2

Usage:	Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

Parameters:

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

Example:	LAY:REM '2'
	Removes the result display in the window named '2'.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName>   String containing the name of the existing window.
                   By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType>   Type of result display you want to use in the existing window. See `LAYout:ADD[:WINDow]?` on page 184 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
                   Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the `DISPlay[:WINDow<n>]:SIZE` on page 183 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.
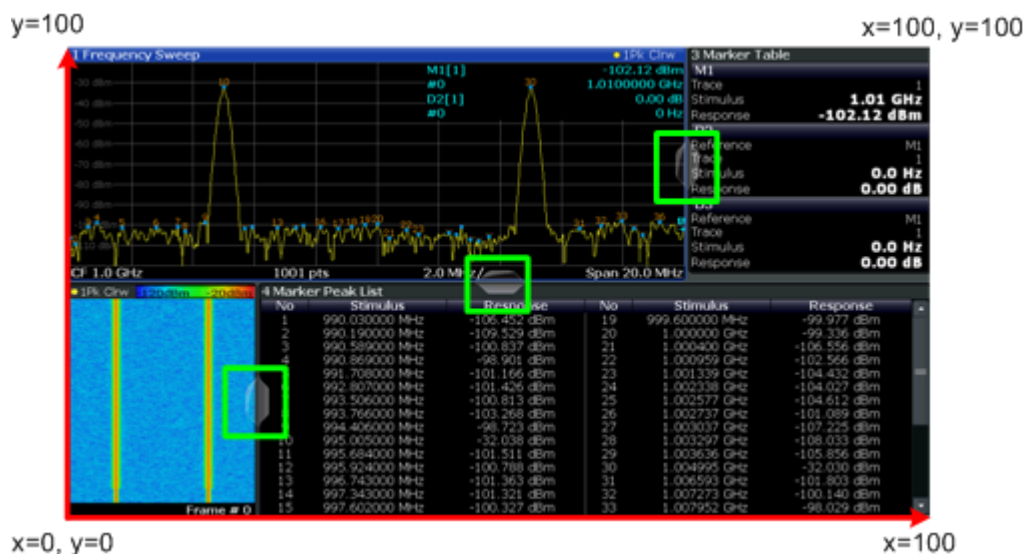
Figure 10-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1>   The index of one window the splitter controls.

<Index2>   The index of a window on the other side of the splitter.

<Position>   New vertical or horizontal position of the splitter as a fraction of
                            the screen area (without channel and status bar and softkey
                            menu).
                            The point of origin (x = 0, y = 0) is in the lower left corner of the
                            screen. The end point (x = 100, y = 100) is in the upper right cor-
                            ner of the screen. (See Figure 10-1.)
                            The direction in which the splitter is moved depends on the
                            screen layout. If the windows are positioned horizontally, the
                            splitter also moves horizontally. If the windows are positioned
                            vertically, the splitter also moves vertically.

                            Range: 0 to 100

Example: LAY:SPL 1,3,50
                            Moves the splitter between window 1 ('Frequency Sweep') and 3
                            ('Marker Table') to the center (50%) of the screen, i.e. in the fig-
                            ure above, to the left.

Example: LAY:SPL 1,4,70
                            Moves the splitter between window 1 ('Frequency Sweep') and 3
                            ('Marker Peak List') towards the top (70%) of the screen.
                            The following commands have the exact same effect, as any
                            combination of windows above and below the splitter moves the
                            splitter vertically.
                            LAY:SPL 3,2,70
                            LAY:SPL 4,1,70
                            LAY:SPL 2,1,70

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n>	Window

Parameters:

<Direction>	LEFT | RIGHt | ABOVe | BELow
<WindowType>	Type of measurement window you want to add. See `LAYout:ADD[:WINDow]?` on page 184 for a list of available window types.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

	`LAY:WIND1:ADD? LEFT,MTAB`
	Result:
	`'2'`
	Adds a new window named '2' with a marker table to the left of window 1.

Usage:

	Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

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

Suffix:

<n>	Window

Return values:

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

Example:

	`LAY:WIND2:IDEN?`
	Queries the name of the result display in window 2.
	Response:
	`'2'`

Usage:

	Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

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

Suffix:

<n>   Window

Example: LAY:WIND2:REM
                            Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

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

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

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:

<n>   Window

Parameters:

<WindowType>   Type of measurement window you want to replace another one with.
                            See `LAYout:ADD[:WINDow]?` on page 184 for a list of available window types.

Example: LAY:WIND2:REPL MTAB
                            Replaces the result display in window 2 with a marker table.

10.8 Starting a Measurement

The measurement is started immediately when a TD-SCDMA application is activated, however, you can stop and start a new measurement any time.

ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

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

To abort a sequence of measurements by the Sequencer, use the `INITiate<n>:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example:	`ABOR;:INIT:IMM` Aborts the current measurement and immediately starts a new one.

Example:	`ABOR;*WAI`
	`INIT:IMM`
	Aborts the current measurement and starts a new one once abortion has been completed.

Usage:	Event SCPI confirmed

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

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

As opposed to `INITiate<n>[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:

<n>	irrelevant

Usage:	Event
Manual operation:	See "Continue Single Sweep" on page 95

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual measurement channel.

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

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

If the measurement mode is changed for a measurement channel while the Sequencer is active (see `INITiate<n>:SEQuencer:IMMediate` on page 193) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:

<n>	irrelevant

Parameters:

<State>	ON | OFF | 0 | 1
	ON | 1
	Continuous measurement
	OFF | 0
	Single measurement
	*RST:　　1
Example:	`INIT:CONT OFF`
	Switches the measurement mode to single measurement.
	`INIT:CONT ON`
	Switches the measurement mode to continuous measurement.
Manual operation:	See "Continuous Sweep/RUN CONT" on page 94
	See "Start Meas" on page 100

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

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

Suffix:

<n>	irrelevant

Usage:	Event

Manual operation:	See "Single Sweep/ RUN SINGLE" on page 95
	See "Start Meas" on page 100

INITiate<n>:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate<n>:SEQuencer:IMMediate` on page 193.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 195.

Suffix:

<n>	irrelevant

Usage:	Event

INITiate<n>:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 195).

Suffix:

<n>	irrelevant

Example:	`SYST:SEQ ON`
	Activates the Sequencer.
	`INIT:SEQ:MODE SING`
	Sets single sequence mode so each active measurement will be performed once.
	`INIT:SEQ:IMM`
	Starts the sequential measurements.

Usage:	Event

INITiate<n>:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 195).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

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

Suffix:

<n>	irrelevant

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate<n>:SEQuencer:REFResh[:ALL]

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only in MSRA mode.

The data in the capture buffer is re-evaluated by all active MSRA slave applications.

Suffix:

<n>	irrelevant

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

Usage: Event

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State>   ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

10.9 Retrieving Results

The following commands are required to retrieve the results from a TD-SCDMA measurement in a remote environment.

When the channel type is required as a parameter by a remote command or provided as a result for a remote query, abbreviations or assignments to a numeric value are used as described in Chapter 10.5.6, "Channel Detection", on page 169.

10.9.1 Retrieving Calculated Measurement Results

The following commands describe how to retrieve the calculated results from the CDA.

CALCulate<n>:MARKer:FUNCtion:CDPower:RESult? <ResultType>

This command queries the results of the code domain measurement. Refer to Chapter 3.1.1, "Code Domain Parameters", on page 14 for a detailed description of all results.

(The suffix <n> is irrelevant.)

Query parameters:

<ResultType>

ACTive
Returns the number of active channels.

ARCD
Returns the Average Relative Code Domain Error.

CDPabsolute
Returns the absolute channel power in dBm.

CDPRelative
Returns the relative channel power in dB.

CHANnel
Returns the current channel number.

CERror
Returns the Chip Rate Error in ppm.

DACTive
Indicates whether DwPTS slot is active (BTS mode only)

DPOWer
Power in the DwPTS slot (BTS mode only)

DRHO
RHO for the DwPTS slot (BTS mode only)

DERM
EVM (RMS) for the DwPTS slot (BTS mode only)

DEPK
EVM (Peak) for the DwPTS slot (BTS mode only)

EVMPeak
Returns the maximum Error Vector Magnitude of the selected channel.

EVMRMS
Returns the average Error Vector Magnitude of the selected channel.

IQIMbalance
Returns the IQ Imbalance in %.

IQOFfset
Returns the IQ Offset in %.

MACCuracy
Returns the Composite EVM in %.

PCDerror
Returns the Peak Code Domain Error dB.

PD1
Returns the power of the slot's data part 1 in dBm.

PD2
Returns the power of the slot's data part 2 in dBm.

PDATa
Returns the average power of the data parts in dBm.

PMIDamble

Returns the power of the midamble in dBm.

RHO
Returns the parameter Rho.

SFACtor
Returns the spreading factor of the channel.

SFRame
Subframe number

SLOT
Returns the currently analyzed slot number.

SRATe
Returns the symbol rate in ksps.
Note that TFRame returns a '9' if the trigger is at Free Run.

TFRame
Returns the Trigger to Frame time in seconds.

UACTive
Indicates whether UpPTS slot is active (UE mode only)

UPOWer
Power in the UpPTS slot (UE mode only)

URHO
RHO for the UpPTS slot (UE mode only)

UERM
EVM (RMS) for the UpPTS slot (UE mode only)

UEPK
EVM (Peak) for the UpPTS slot (UE mode only)

Example:	CALC:MARK:FUNC:CDP:RES? CERR Returns the Chip Rate Error
Usage:	Query only
Manual operation:	See "Code Domain Power" on page 18 See "Result Summary" on page 26

CONFigure:CDPower[:BTS]:PVTime:LIST:RESult?

Queries the list evaluation results for Power vs Time measurements. The results are a comma-separated list containing the following values for each list range:

Return values:

<RangeNo>	consecutive number of list range
<StartTime>	Start time of the individual list range
<StopTime>	Stop time of the individual list range
<AverageDBM>	Average power level in list range in dBm.
<AverageDB>	Average power level in list range in dB.
<MaxDBM>	Maximum power level in list range in dBm.
<MaxDB>	Maximum power level in list range in dB.

<MinDBM>	Minimum power level in list range in dBm.
<MinDB>	Minimum power level in list range in dB.
<LimitCheck>	Result of limit check for the list range. **0** Passed **1** Failed
<Reserved1>	0; currently not used
<Reserved2>	0; currently not used
Usage:	Query only
Manual operation:	See "Power vs Time" on page 30

10.9.2 Retrieving Trace Results

The following commands describe how to retrieve the trace data from the CDA. Note that for these measurements, only 1 trace per window can be configured.

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>	**ASCii** ASCii format, separated by commas. This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be. **REAL,32** 32-bit IEEE 754 floating-point numbers in the "definite length block format". In the Spectrum application, the format setting REAL is used for the binary transmission of trace data. For I/Q data, 8 bytes per sample are returned for this format setting. *RST: ASCII
Example:	FORM REAL,32
Usage:	SCPI confirmed

TRACe<n>[:DATA]? <ResultType>

This command returns the trace data. Depending on the evaluation, the trace data format varies.

The data format depends on `FORMat[:DATA]`.

For details see Chapter 10.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 203.

Query parameters:

<ResultType>　　　　　Selects the type of result to be returned.

　　　　　　　　　　　TRACE1 | ... | TRACE4
　　　　　　　　　　　Returns the trace data for the corresponding trace as a comma-separated list of values. This data consists of some or all of the result parameters described below, depending on the result type.
　　　　　　　　　　　For details see Chapter 10.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 203.

　　　　　　　　　　　LIST
　　　　　　　　　　　For CDA measurements:
　　　　　　　　　　　Returns the results for the DwPTS/UpPTS slot. See Table 10-5.
　　　　　　　　　　　For RF measurements:
　　　　　　　　　　　Returns the results of the peak list evaluation for Spurious Emission and Spectrum Emission Mask measurements.
　　　　　　　　　　　For details see Table 10-4.

Return values:

<AbsLevel> |　　　　　**dBm or %**
<RelLevel>　　　　　　Absolute level of the channel at the selected channel slot
　　　　　　　　　　　or:
　　　　　　　　　　　Relative level of the channel at the selected channel slot referenced to CPICH or total power
　　　　　　　　　　　(Depending on `[SENSe:]CDPower:PDISplay` on page 179)

<ActiveFlag>　　　　　0 | 1
　　　　　　　　　　　Flag to indicate whether a channel is active (1) or not (0)

<CError>　　　　　　　Chip Rate Error in ppm.

<CDPAbsolute>,　　　　Code domain power absolute or relative to total signal power
<CDPRelative>　　　　　(data parts).

<ChannelType>　　　　0 ... 2
　　　　　　　　　　　Type of the channel
　　　　　　　　　　　0 = inactive
　　　　　　　　　　　1 = midamble
　　　　　　　　　　　2 = DPCH

<CodeClass>	**0 … 4** Code class of the channel. The code class specifies the spreading factor of the channel. **0** = spreading factor 1 **1** = spreading factor 2 **2** = spreading factor 4 **3** = spreading factor 8 **4** = spreading factor 16
<CodeNo>	**1 … 16** Code number of the channel. The number of codes depends on the spreading factor (see Table 4-2).
<EVMPeak>	Maximum value of the EVM.
<EVMRMS>	Average value of the EVM.
<FError>	Frequency Error in Hz.
<CIQImbal>	I/Q Imbalance in %.
<IQOffset>	I/Q Offset in %.
<MAccuracy>	Composite EVM in %.
<MAShift>	**0 … 38400** Midamble shift of the channel
<ΔMiD1>, <ΔMiD2>	dB Power offset between: sum power of channels belonging to midamble(k), only data field 1/2 and power of midamble(k)
<ModType>	Modulation type of the channel **0** = invalid (for midamble) **1** = QPSK **2** = 8PSK **3** = 16QAM **4** = 64QAM
<PCDError>	Peak Code Domain Error in dB.
<PD1>, <PD2>	Power of the data parts over all channels in dB.
<PData>	Mean power of both data parts (P1 and P2) over all channels in dBm.
<PMidamble>	Power of the midamble in dB.
<reserved1-4>	Placeholder value; Currently not used.
<RHO>	0 | 1 Rho.
<SF>	1 ... 16 Spreading Factor of the channel.

<Slot>	Slot number. The range depends on the capture length.
<SYMRate>	Symbol rate in kbps.
<TrigFrame>	Trigger to Frame in ms. This value is valid only after successful synchronization to the TD-SCDMA signal. When using the Free Run trigger mode, the command returns a '9'.
<Validity>	**0** = inactive channel **1** = active channel **2** = alias channel. In this case the channel consists of more than one code.
Example:	`TRAC2:DATA? TRACE1` Returns the trace data from trace 1 in window 2.
Usage:	Query only
Manual operation:	See "Bitstream" on page 16 See "Channel Table" on page 17 See "Code Domain Power" on page 18 See "Code Domain Error Power" on page 19 See "Composite Constellation" on page 20 See "Composite EVM" on page 21 See "Mag Error vs Chip" on page 22 See "Peak Code Domain Error" on page 23 See "Phase Error vs Chip" on page 24 See "Power vs Slot" on page 25 See "Power vs Symbol" on page 26 See "Result Summary" on page 26 See "Symbol Constellation" on page 27 See "Symbol EVM" on page 27 See "Symbol Magnitude Error" on page 28 See "Symbol Phase Error" on page 29 See "Power vs Time" on page 30

Table 10-4: Return values for LIST parameter (Spurious / SEM measurements)

For every measurement range you have defined (range 1...n), the command returns eight values in the following order.

<No>,<StartFreq>,<StopFreq>,<RBW>,<PeakFreq>,<PowerAbs>,<PowerRel>,<PowerDelta>,<LimitCheck>,<Unused1>,<Unused2>
- <No>: range number
- <StartFreq>,<StopFreq>: start and stop frequency of the range
- <RBW>: resolution bandwidth
- <PeakFreq>: frequency of the peak in a range
- <PowerAbs>: absolute power of the peak in dBm
- <PowerRel>: power of the peak in relation to the channel power in dBc
- <PowerDelta>: distance from the peak to the limit line in dB, positive values indicate a failed limit check
- <LimitCheck>: state of the limit check (0 = PASS, 1 = FAIL)
- <Unused1>,<Unused2>: reserved (0.0)

Table 10-5: Return values for LIST parameter (DwPTS / UpPTS Results)

For CDA measurements the LIST parameter returns the following results for the Downlink Pilot Time Slot (DwPTS) or Uplink Pilot Time Slot (UpPTS):

<State>,<Power>,<Rho>,<EVM RMS>,<EVM peak>
- <State>: Indicates whether DwPTS/UpPTS slot is active
- <Power>: Power in the DwPTS/UpPTS slot
- <Rho>: RHO for the DwPTS/UpPTS slot
- <EVM RMS>: EVM (RMS) for the DwPTS/UpPTS slot
- <EVM peak>: EVM (Peak) for the DwPTS/UpPTS slot

TRACe<n>[:DATA]:X? <TraceNumber>

This command queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements.

This is especially useful for traces with non-equidistant x-values, e.g. for SEM or Spurious Emissions measurements.

Suffix:

<n>   Window

Query parameters:

<TraceNumber>   Trace number.

                         TRACE1 | ... | TRACE6

Example: `TRAC3:X? TRACE1`

                       Returns the x-values for trace 1 in window 3.

Usage: Query only

10.9.3 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 (see `TRACe<n>[:DATA]?` on page 200).

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 3.1.2, "Evaluation Methods for Code Domain Analysis", on page 16.

10.9.3.1　Bitstream

When the trace data for this evaluation is queried, the bit stream of one slot is transferred. One value is transferred per bit (range 0, 1).

The number of bits depends on the modulation (see Table 4-8).

10.9.3.2　Channel Table

For the Channel Table result display, the command returns 11 values for each channel in the following order:

`<ChannelType>, <CodeClass>, <CodeNo>, <ModType>, <AbsLevel>, <RelLevel>, <MAShift>, <ΔMiD1>, <ΔMiD2>, <reserved1>, <reserved2>`

For details on these parameters see `TRACe<n>[:DATA]?` on page 200.

The output depends on the channel sorting order (see `CONFigure:CDPower: CTABle:ORDer` on page 179).

In **code sorting order**, all midambles are output first, then control channels and last the data channels.

In **midamble sorting order**, each midamble is output with its corresponding control and data channel.

Example:

The following example shows the results of a query for three active channels in common midamble allocation:

- Midamble m(3), -3.0 dBm
- DPCH, 1.16, QPSK, -7.78 dB
- DPCH, 2.8, QPSK, -7.78 dB
- DPCH, 3.4, 8PSK, -7.78 dB

In this example, the command would return the following string:

```
1, 0, 0, 0, -3.0, 0, 3, 0.005, 0.005, 0, 0 2 , 4, 1, 1, -7.78,
-4.78, 3, 0, 0, 0, 0 2 , 3, 2, 1, -7.78, -4.78, 3, 0, 0, 0,
0 2 , 2, 3, 2, -7.78, -4.78, 3, 0, 0, 0, 0 0 , 4, 2, 1, -46.9,
-43.9, 3, 0, 0, 0, 0 0 , 4, 5, 1, -46.9, -43.9, 3, 0, 0, 0,
0 0 , 4, 6, 1, -46.9, -43.9, 3, 0, 0, 0, 0 0 , 4, 7, 1, -46.9,
-43.9, 3, 0, 0, 0, 0 0 , 4, 8, 1, -46.9, -43.9, 3, 0, 0, 0,
0 0 , 4, 13, 1, -46.9, -43.9, 3, 0, 0, 0, 0 0 , 4, 14, 1, -46.9,
-43.9, 3, 0, 0, 0, 0 0 , 4, 15, 1, -46.9, -43.9, 3, 0, 0, 0,
0 0 , 4, 16, 1, -46.9, -43.9, 3, 0, 0, 0, 0
```

10.9.3.3 Code Domain Power / Code Domain Error Power

When the trace data for this evaluation is queried, 4 values are transmitted for each channel:

```
<CodeClass>, <CodeNo>, <Level>, <ActiveFlag>
```

- the code class (<CodeClass>)
- the channel number (<CodeNo>)
- the absolute or relative level (<Level>), depending on `[SENSe:]CDPower: PDISplay` on page 179
- the state of the channel (<ActiveFlag>)

For details on these parameters see `TRACe<n>[:DATA]?` on page 200.

The query returns a maximum of 16 channels. Channels that consist of more than one code are returned as one channel.

Example:

Consider the following configuration (three active channels out of a total of 12):

- DPCH, 1.16, (CC4), -7.0 dB
- DPCH, 2.8, (CC3), -7.3 dB
- DPCH, 3.4, (CC2), -8.0 dB

In this example, the command would return the following string (active channels in **bold**):

```
4, 1, -7.0, 1, 4, 2, -55.1, 0, 3, 2, -7.3, 1, 4, 5, -56.3, 0, 4,
6, -55.8, 0, 4, 7, -57.0, 0, 2, 3, -8.0, 1, 4, 13, -55.8, 0, 4,
14, -56.3, 0, 4, 15, -55.9, 0, 4, 16, -57.3, 0
```

10.9.3.4   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>, ..., <Re864>, <Im864>

The values are normalized to the square root of the average power at the selected slot.

10.9.3.5   Composite EVM (RMS)

For the Composite EVM result display, the command returns two values for each slot in the following order:

<Slot_0>, <MAccuracy_0>, ..., <Slot_n>, <MAccuracy_n>

The number of slots depends on the capture length.

10.9.3.6   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.

10.9.3.7   Peak Code Domain Error

For the Peak Code Domain Error result display, the command returns two values for each slot in the following order:

<Slot_0>, <AbsLevel_0>, ..., <Slot_n>, <AbsLevel_n>

The number of slots depends on the capture length.

10.9.3.8   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.

10.9.3.9   Power vs Slot

For the Power vs Slot result display, the command returns three values for each slot in the following order:

<Slot_0>, <Level_0>, <Validity_0>..., <Slot_n>, <Level_n>, <Validity_n>

In addition to the power level, the source of the power (active, inactive or alias channel) is provided.

Whether the level is provided as an absolute or relative value depends on `[SENSe:]CDPower:PDISplay` on page 179).

10.9.3.10 Power vs Symbol

When the trace data for this evaluation is queried, the absolute power of each symbol at the selected slot is transferred.

The number of symbols depends on the spreading factor (see Table 4-8).

10.9.3.11 Power vs Time

When the trace data for this evaluation is queried, the peak power in the defined slot range for each measured subframe is transferred.

The number of values depends on the number of subframes (see "No of Subframes" on page 101).

10.9.3.12 Result Summary

For the Result Summary, the command returns 25 values for the selected set, slot and channel in the following order:

<Slot>, <PData>, <PD1>, <PD2>, <PMidamble>, <RHO>, <MAccuracy>, <PCDError>, <FError>, <CError>, <TrigFrame>, <IQImbalance>, <IQOffset>, <ActiveFlag>, <SymRate>, <CodeNo>, <SF>, <CDPRelative>, <CDPAbsolute>, <EVMRMS>, <EVMPeak>, <reserved1>, <reserved2>, <reserved3>, <reserved4>

For details on these parameters see `TRACe<n>[:DATA]?` on page 200.

10.9.3.13 Symbol Constellation

For the Symbol Constellation result display, the command returns one value each for the real and imaginary parts of each symbol:

$<Re_0>$, $<Im_0>$, $<Re_1>$, $<Im_1>$, ..., $<Re_n>$, $<Im_n>$

The number of symbols depends on the spreading factor (see Table 4-8).

10.9.3.14 Symbol EVM

For the Symbol EVM result display, the command returns one value for each symbol: <EVMRMS>

The number of symbols depends on the spreading factor (see Table 4-8).

10.9.3.15 Symbol Magnitude Error

When the trace data for this evaluation is queried, the magnitude error in % of each symbol at the selected slot is transferred. The number of the symbols depends on the spreading factor of the selected channel:

$NOFSymbols = 10*2^{(8-CodeClass)}$

10.9.3.16 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:

$NOFSymbols = 10*2^{(8-CodeClass)}$

10.9.4 Exporting Trace Results

RF measurement trace results can be exported to a file.

For more commands concerning data and results storage see the R&S FSW User Manual.

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

Secure User Mode

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

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

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

Suffix:

<n>	Window

Parameters:

<Trace>	Number of the trace to be stored
<FileName>	String containing the path and name of the target file.
Example:	`MMEM:STOR1:TRAC 3,'C:\TEST.ASC'` Stores trace 3 from window 1 in the file `TEST.ASC`.
Usage:	SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>　　　　　**COMMa**

Uses a comma as decimal separator, e.g. *4,05*.

POINt

Uses a point as decimal separator, e.g. *4.05*.

*RST:　　　　*RST has no effect on the decimal separator. Default is POINt.

Example:　　　　`FORM:DEXP:DSEP POIN`

Sets the decimal point as separator.

10.9.5　Retrieving RF Results

The following commands are required to retrieve the results of the TD-SCDMA RF measurements.

See also Chapter 10.9.3, "Measurement Results for TRACe<n>[:DATA]? TRACE<n>", on page 203.

CALCulate<n>:LIMit<k>:FAIL?

This command queries the result of a limit check in the specified window.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 192.

Suffix:

<n>　　　　　　　　　Window

<k>　　　　　　　　　Limit line

Return values:

<Result>　　　　　　**0**

PASS

1

FAIL

Example:　　　　`INIT;*WAI`

Starts a new sweep and waits for its end.

`CALC2:LIM3:FAIL?`

Queries the result of the check for limit line 3 in window 2.

Usage: Query only
                        SCPI confirmed

Manual operation: See "Power vs Time" on page 30
                        See "Spectrum Emission Mask" on page 33

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult? <Measurement>

This command queries the results of power measurements.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also INITiate<n>:CONTinuous on page 192.

Suffix:
<n>, <m>   irrelevant

<sb>   1 | 2 | 3 (4 | 5)
                      Sub block in a Multi-standard radio measurement;
                      MSR ACLR: 1 to 5
                      Multi-SEM: 1 to 3
                      for all other measurements: irrelevant

Query parameters:

<Measurement>   **ACPower | MCACpower**

ACLR measurements (also known as adjacent channel power or multicarrier adjacent channel measurements).

Returns the power for every active transmission and adjacent channel. The order is:

• power of the transmission channels
• power of adjacent channel (lower,upper)
• power of alternate channels (lower,upper)

MSR ACLR results:

For MSR ACLR measurements, the order of the returned results is slightly different:

• power of the transmission channels
• total power of the transmission channels for each sub block
• power of adjacent channels (lower, upper)
• power of alternate channels (lower, upper)
• power of gap channels (lower1, upper1, lower2, upper2)

The unit of the return values depends on the scaling of the y-axis:

• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

GACLr

For MSR ACLR measurements only: returns a list of ACLR values for each gap channel (lower1, upper1, lower2, upper2)

MACM

For MSR ACLR measurements only: returns a list of CACLR values for each gap channel (lower1, upper1, lower2, upper2)

CN

Carrier-to-noise measurements.
Returns the C/N ratio in dB.

CN0

Carrier-to-noise measurements.
Returns the C/N ratio referenced to a 1 Hz bandwidth in dBm/Hz.

CPOWer

Channel power measurements.
Returns the channel power. The unit of the return values depends on the scaling of the y-axis:

• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

For SEM measurements, the return value is the channel power of the reference range (in the specified sub block).

PPOWer

Peak power measurements.
Returns the peak power. The unit of the return values depends on the scaling of the y-axis:

• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

For SEM measurements, the return value is the peak power of the reference range (in the specified sub block).

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

Usage:	Query only
Manual operation:	See "Power" on page 32
	See "Channel Power ACLR" on page 33
	See "Spectrum Emission Mask" on page 33
	See "Occupied Bandwidth" on page 34

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also INITiate<n>:CONTinuous on page 192.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Result>	Result at the marker position.

Example:	INIT:CONT OFF
	Switches to single measurement mode.
	CALC:MARK2 ON
	Switches marker 2.
	INIT;*WAI
	Starts a measurement and waits for the end.
	CALC:MARK2:Y?
	Outputs the measured value of marker 2.
Usage:	Query only
Manual operation:	See "Marker Table" on page 23
	See "Marker Peak List" on page 38

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

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

Suffix:

<n>	irrelevant

<t>		Trace
Parameters:		
<ResultType>		**MEAN**
		Average (=RMS) power in dBm measured during the measurement time.
		PEAK
		Peak power in dBm measured during the measurement time.
		CFACtor
		Determined crest factor (= ratio of peak power to average power) in dB.
		ALL
		Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>
Example:		`CALC:STAT:RES2? ALL`
		Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB
Usage:		Query only
Manual operation:		See "CCDF" on page 35

10.10 Analysis

The following commands define general result analysis settings concerning the traces and markers.

10.10.1 Traces

The trace settings determine how the measured data is analyzed and displayed on the screen. In TD-SCDMA applications, only one trace per window can be configured for Code Domain Analysis.

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNt`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Suffix:

<n>	Window
<t>	Trace

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 112

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

This command turns a trace on and off.

The measurement continues in the background.

Suffix:

<n>	Window
<t>	Trace

Parameters:

<State>	ON	OFF	1	0
	*RST:　　　1 for TRACe1, 0 for TRACe 2 to 6
Example:	DISP:TRAC3 ON
Usage:	SCPI confirmed

10.10.2 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. In TD-SCDMA applications, only 4 markers per window can be configured for Code Domain Analysis.

10.10.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<State>	ON | OFF
	*RST: OFF

Example:	CALC:MARK3 ON
	Switches on marker 3.

Manual operation:	See "Marker State" on page 113
	See "Marker Type" on page 114

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<m>	Marker (query: 1 to 16)
<n>	Window

Parameters:

<Position>	Numeric value that defines the marker position on the x-axis.
	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 23
	See "Marker Peak List" on page 38
	See "X-value" on page 114

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Suffix:

<n>	Window

<m>	Marker

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

Usage:	Event

Manual operation:	See "All Markers Off" on page 114

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:

<n>	Window

<m>	Marker

Parameters:

<State>	ON | OFF
	*RST: OFF

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

Manual operation:	See "Marker State" on page 113
	See "Marker Type" on page 114

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

Suffix:

<n>	Window

<m>	irrelevant

Example:	CALC:DELT:AOFF
	Turns all delta markers off.

Usage:	Event

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<m>	Marker

<n>	Window

Example: CALC:DELT:X?

Outputs the absolute x-value of delta marker 1.

Manual operation: See "X-value" on page 114

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n>   Window

<m>   Marker

Return values:
<Position>   Position of the delta marker in relation to the reference marker.

Example: CALC:DELT3:X:REL?

Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 192.

The unit depends on the application of the command.

Suffix:

<m>   Marker

<n>   Window

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

Example: INIT:CONT OFF

Switches to single sweep mode.

INIT;*WAI

Starts a sweep and waits for its end.

CALC:DELT2 ON

Switches on delta marker 2.

CALC:DELT2:Y?

Outputs measurement value of delta marker 2.

Usage: Query only

10.10.2.2 General Marker Settings

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>   **ON**
                       Turns the marker table on.

                       OFF
                       Turns the marker table off.

                       AUTO
                       Turns the marker table on if 3 or more markers are active.

                       *RST: AUTO

Example: DISP:MTAB ON
                     Activates the marker table.

Manual operation: See "Marker Table Display" on page 115

10.10.2.3 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

Positioning Normal Markers

The following commands position markers on the trace.

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

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage:	Event
Manual operation:	See "Search Next Peak" on page 117

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

This command moves a marker to the next lower peak.

Suffix:

<n>	Window
<m>	Marker

Usage:	Event
Manual operation:	See "Search Next Peak" on page 117

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

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Usage:	Event
Manual operation:	See "Peak Search" on page 117

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

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage:	Event
Manual operation:	See "Search Next Peak" on page 117

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

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

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

This command moves a marker to the next minimum value.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

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

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Minimum" on page 117

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

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

Positioning Delta Markers

The following commands position delta markers on the trace.

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

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

The search includes only measurement values to the left of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 117

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

This command moves a marker to the next higher value.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 117

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

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Peak Search" on page 117

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

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

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Peak" on page 117

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

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

The search includes only measurement values to the right of the current marker position.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

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

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

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

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

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Suffix:

<n>	Window
<m>	Marker

Usage: Event

Manual operation: See "Search Minimum" on page 117

CALCulate\<n>:DELTamarker\<m>:MINimum:RIGHt

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

The search includes only measurement values to the right of the current marker position.

Suffix:

\<n>   Window

\<m>   Marker

Usage: Event

Manual operation: See "Search Next Minimum" on page 117

10.11 Importing and Exporting I/Q Data and Results

For details on importing and exporting I/Q data see Chapter 5, "I/Q Data Import and Export", on page 47.

MMEMory:LOAD:IQ:STATe 1,\<FileName>

This command restores I/Q data from a file.

The file extension is *.iq.tar.

Parameters:
\<FileName>   String containing the path and name of the source file.

Example: `MMEM:LOAD:IQ:STAT 1, 'C:`
                           `\R_S\Instr\user\data.iq.tar'`
                           Loads IQ data from the specified file.

Usage: Setting only

Manual operation: See "I/Q Import" on page 48

MMEMory:STORe\<n>:IQ:COMMent \<Comment>

This command adds a comment to a file that contains I/Q data.

Suffix:
\<n>   irrelevant

Parameters:
\<Comment>   String containing the comment.

Example: MMEM:STOR:IQ:COMM 'Device test 1b'
                        Creates a description for the export file.
                        MMEM:STOR:IQ:STAT 1, 'C:
                        \R_S\Instr\user\data.iq.tar'
                        Stores I/Q data and the comment to the specified file.

Manual operation: See "I/Q Export" on page 48

MMEMory:STORe<n>:IQ:STATe 1, <FileName>

This command writes the captured I/Q data to a file.

The file extension is *.iq.tar. By default, the contents of the file are in 32-bit floating point format.

Secure User Mode

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

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

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

Suffix:
<n>   irrelevant

Parameters:
1

<FileName>   String containing the path and name of the target file.

Example: MMEM:STOR:IQ:STAT 1, 'C:
                        \R_S\Instr\user\data.iq.tar'
                        Stores the captured I/Q data to the specified file.

Manual operation: See "I/Q Export" on page 48

10.12 Configuring the Slave Application Data Range (MSRA mode only)

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

For the TD-SCDMA BTS slave application, the slave application data range is defined by the same commands used to define the signal capture in Signal and Spectrum Analyzer mode (see Chapter 10.5.4, "Signal Capturing", on page 164). Be sure to select the correct measurement channel before executing this command.

In addition, a capture offset can be defined, i.e. an offset from the start of the captured data to the start of the slave application data for the TD-SCDMA BTS measurement.

The **analysis interval** used by the individual result displays cannot be edited, but is determined automatically. However, you can query the currently used analysis interval for a specific window.

The **analysis line** is displayed by default but can be hidden or re-positioned.

Remote commands exclusive to MSRA slave applications

The following commands are only available for MSRA slave application channels:

CALCulate<n>:MSRA:ALINe:SHOW

This command defines whether or not the analysis line is displayed in all time-based windows in all MSRA slave applications and the MSRA Master.

Note: even if the analysis line display is off, the indication whether or not the currently defined line position lies within the analysis interval of the active slave application remains in the window title bars.

Suffix:
<n>   irrelevant

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

CALCulate<n>:MSRA:ALINe[:VALue] <Position>

This command defines the position of the analysis line for all time-based windows in all MSRA slave applications and the MSRA Master.

Suffix:
<n>   irrelevant

Parameters:
<Position>   Position of the analysis line in seconds. The position must lie
                             within the measurement time of the MSRA measurement.
                             Default unit: s

CALCulate<n>:MSRA:WINDow<n>:IVAL?

This command queries the analysis interval for the window specified by the WINDow suffix <n> (the CALC suffix is irrelevant). This command is only available in slave application measurement channels, not the MSRA View or MSRA Master.

Suffix:

<n>	Window

Return values:

<IntStart>	Start value of the analysis interval in seconds
	Default unit: s
<IntStop>	Stop value of the analysis interval in seconds

Usage: Query only

INITiate<n>:REFResh

This function is only available if the Sequencer is deactivated (`SYSTem:SEQuencer SYST:SEQ:OFF`) and only for slave applications in MSRA mode, not the MSRA Master.

The data in the capture buffer is re-evaluated by the currently active slave application only. The results for any other slave applications remain unchanged.

Suffix:

<n>	irrelevant

Example: `SYST:SEQ:OFF`
Deactivates the scheduler
`INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a new data measurement and waits for the end of the sweep.
`INST:SEL 'IQ ANALYZER'`
Selects the IQ Analyzer channel.
`INIT:REFR`
Refreshes the display for the I/Q Analyzer channel.

Usage: Event

Manual operation: See "Refresh (MSRA only)" on page 95

[SENSe:]MSRA:CAPTure:OFFSet <Offset>

This setting is only available for slave applications in MSRA mode, not for the MSRA Master. It has a similar effect as the trigger offset in other measurements.

Parameters:

<Offset>	This parameter defines the time offset between the capture buffer start and the start of the extracted slave application data. The offset must be a positive value, as the slave application can only analyze data that is contained in the capture buffer.
	Range: 0 to <Record length>
	*RST: 0

Manual operation: See "Capture Offset" on page 81

10.13 Status Registers

The following commands are required for the status reporting system specific to the TD-SCDMA applications. In addition, the TD-SCDMA applications also use the standard status registers of the R&S FSW (depending on the measurement type).

For details on the common R&S FSW status registers refer to the description of remote control basics in the R&S FSW User Manual.

For a description of the status registers for the Digital Baseband Interface (R&S FSW-B17), see the R&S FSW I/Q Analyzer User Manual.

*RST does not influence the status registers.

10.13.1 STATus:QUEStionable:SYNC Register

The `STATus:QUEStionable:SYNC` register contains application-specific information about synchronization errors or errors during pilot symbol detection.

Table 10-6: Status error bits in STATus:QUEStionable:SYNC register for TD-SCDMA applications

Bit	Definition
0	Not used.
1	Frame Sync failed This bit is set when synchronization is not possible within the application. Possible reasons: • Invalid frequency • Invalid level • Invalid scrambling code • Invalid max. number of MA shift cell • Invalid values for INVERT Q • Invalid signal at input
2 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.

Suffix:

<n>	Window
<m>	Marker

Query parameters:

<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

Usage:	Query only

STATus:QUEStionable:SYNC:CONDition? <ChannelName>

This command reads out the CONDition section of the status register.

The command does not delete the contents of the EVENt section.

Suffix:

<n>	Window
<m>	Marker

Query parameters:

<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

Usage:	Query only

STATus:QUEStionable:SYNC:ENABle <BitDefinition>, <ChannelName>

This command controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:NTRansition <BitDefinition>,<ChannelName>

This command controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:PTRansition <BitDefinition>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<BitDefinition>	Range: 0 to 65535
<ChannelName>	String containing the name of the channel. The parameter is optional. If you omit it, the command works for the currently active channel.

10.14   Deprecated Commands

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

Note that this command is maintained for compatibility reasons only. Use the LAYout commands for new remote control programs (see Chapter 10.7.2, "Working with Windows in the Display", on page 183).

Parameters:

<Evaluation>　　　　　　Type of evaluation you want to display.
　　　　　　　　　　　　　See the table below for available parameter values.

Example:　　　　　　INST:SEL BTDS
　　　　　　　　　　　　　Activates TD-SCDMA mode.
　　　　　　　　　　　　　CALC:FEED CDP
　　　　　　　　　　　　　Selects the display of the code domain power.

Table 10-7: <Evaluation> parameter values for TD-SCDMA 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
'XTIM:CDP:ERR:PCDomain'	PCDerror	Peak Code Domain Error
'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
) Use [SENS:]CDP:PDIS ABS | REL subsequently to change the scaling		

CONFigure:CDPower[:BTS]:PVTime:LIST[:STATe] <State>

This command hides or shows the list evaluation result display.

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 183).

Parameters:

<State>　　　　　　ON | OFF
　　　　　　　　　　*RST:　　OFF

[SENSe:]CDPower:LEVel:ADJust

This command adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Note that this command is retained for compatibility reasons only. For new R&S FSW programs use [SENSe:]ADJust:LEVel on page 177.

10.15 Programming Examples (TD-SCDMA BTS)

The following programming examples are meant to demonstrate the operation of the R&S FSWTD-SCDMA application in a remote environment. They are performed with an R&S FSW equipped with option R&S FSW-K76. Only the commands required to control the R&S FSW-K76 application are provided, not the signal generator.

The measurements are performed using the following devices and accessories:

- The R&S FSW with Application Firmware R&S FSW-K76: TD-SCDMA BTS
- The Vector Signal Generator R&S SMU with option R&S SMU-B45: digital standard 3GPP (options R&S SMU-B20 and R&S SMU-B11 required)
- 1 coaxial cable, 50Ω, approx. 1 m, N connector
- 1 coaxial cable, 50Ω, approx. 1 m, BNC connector

Test setup

1. Connect the RF output of the R&S SMU to the input of the R&S FSW.

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

3. Connect the external trigger input of the R&S FSW (TRIGGER INPUT) to the external trigger output of the R&S SMU (TRIGOUT1 of PAR DATA).

Settings on the R&S SMU

Setting	Value
Preset	
Frequency	2.1175 GHz
Level	0 dBm
Digital standard	TDSCDMA/3GPP
Link direction	DOWN/FORWARD
Test model	DPCCH_DPDCH960ksps

Setting	Value
User equipment	UE 1
Digital standard - State	ON
Scrambling code	0000

The following measurements are described:

10.15.1 Measurement 1: Measuring the Signal Channel Power

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz
//Select the power measurement
CONF:CDP:MEAS POW

//--------Configuring the measurement ----------------
//Set the slot range to analyze downlink data from slots 3 to 7 (switching point = 2)
SENS:POW:ACH:SLOT:STAR 3
SENS:POW:ACH:SLOT:STOP 7
//Automatically set the reference level and trigger to frame values according
//to measured levels and time.
SENS:POW:ACH:AUTO:LTIM

//----------Performing the measurement ----------------
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI

//-------------Retrieving results ------------------------
//Retrieves the calculated total power value of the signal channel
CALC:MARK:FUNC:POW:RES? CPOW
```

```
//Result: -1.02 [dB]
//Retrieve the trace data of the power measurement
TRAC:DATA? TRACE1
//Result: -1.482287750E+002,-6.440737915E+001,-1.482287750E+002,-1.482287750E+002,
-1.482287750E+002,-6.440737915E+001,-1.482287750E+002,-1.482287750E+002, [...]
```

Table 10-8: Trace results for power measurement

Frequency	Power level
-1.482287750E+002	-6.440737915E+001
-1.482287750E+002	-1.482287750E+002
-1.482287750E+002	-6.440737915E+001
...	...

10.15.2 Measurement 2: Determining the Spectrum Emission Mask

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 0 dBm
DISP:TRAC:Y:SCAL:RLEV 0
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz
//Select the spectrum emission mask measurement
CONF:CDP:MEAS ESP


//--------Configuring the measurement ----------------
//Set the slot range to analyze downlink data from slots 3 to 7 (switching point = 2)
SENS:POW:ACH:SLOT:STAR 3
SENS:POW:ACH:SLOT:STOP 7
//Automatically set the reference level and trigger to frame values according
//to measured levels and time.
SENS:POW:ACH:AUTO:LTIM


//----------Performing the measurement -----------------
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI


//-------------Retrieving results ------------------------
//Retrieves the calculated channel power value of the reference channel
CALC:MARK:FUNC:POW:RES? CPOW
//Result: -36.013 [dBm]
```

```
//Queries the result of the limit check
CALC:LIM:FAIL?
//Result: 0 [passed]
//Retrieves the peak list of the spectrum emission mask measurement
TRAC:DATA? LIST
//Result:
//+1.000000000,-1.275000000E+007,-8.500000000E+006,+1.000000000E+006,+2.108782336E+009,
//-8.057177734E+001,-7.882799530E+001,-2.982799530E+001,+0.000000000,+0.000000000,+0.000000000

//+2.000000000,-8.500000000E+006,-7.500000000E+006,+1.000000000E+006,+2.109000064E+009,
//-8.158547211E+001,-7.984169006E+001,-3.084169006E+001,+0.000000000,+0.000000000,+0.000000000

//+3.000000000,-7.500000000E+006,-3.500000000E+006,+1.000000000E+006,+2.113987200E+009,
//-4.202708435E+001,-4.028330231E+001,-5.270565033,+0.000000000,+0.000000000,+0.000000000,

 [...]
```

Table 10-9: Trace results for Relative Code Domain Power measurement

Range No.	Start freq. [Hz]	Stop freq. [Hz]	RBW [Hz]	Freq. peak power [Hz]	Abs. peak power [dBm]	Rel. peak power [%]	Delta to margin [dB]	Limit check result	-	-	-
1	+1.000000 0000	-1.27500 0000E +007	-8.50000 0000E +006	+1.00000 0000E +006	+2.10878 2336E +009	-8.05717 7734E +001	-7.88279 9530E +001	-2.982 79953 0E +001	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0
2	+2.000000 0000	-8.50000 0000E +006	-7.50000 0000E +006	+1.00000 0000E +006	+2.10900 0064E +009	-8.15854 7211E +001	-7.98416 9006E +001	-3.084 16900 6E +001	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0
3	+3.000000 0000	-7.50000 0000E +006	-3.50000 0000E +006	+1.00000 0000E +006	+2.11398 7200E +009	-4.20270 8435E +001	-4.02833 0231E +001	-5.270 56503 3	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0	+0. 00000 00000 00000 0
...	...										

10.15.3 Measurement 3: Measuring the Relative Code Domain Power

```
//------- Preparing the instrument -----------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
```

```
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 10 dBm
DISP:TRAC:Y:SCAL:RLEV 10
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz
//Optimize the scaling of the y-axis for the current measurementDISP:TRAC:Y:SCAL:AUTO ONCE


//-------Configuring CDA -----------------

//Capture 32 slots in 1 set
SENS:CDP:SET:COUN 1
SENS:CDP:IQL 32
//Invert Q-branch of signal
SENS:CDP:QINV ON
//Base station uses scrambling code 16
SENS:CDP:SCOD 16
//Maximum number of users on base station is 8
SENS:CDP:MSH 8
//Synchronize to phase reference of midamble in slot
SENS:CDP:STSL ON
//Allow for phase rotations between channels.
SENS:CDP:STSL:ROT ON
//Power threshold for active channel is -10 dB compared to total signal
SENS:CDP:ICTR -10
//Automatic channel search for modulation up to 8PSK.
SENS:CDP:MMAX PSK8
CONF:CDP:CTAB OFF


//--------Defining the evaluation range and result displays ----------
//Analyze slot 3 in set 0.SENS:CDP:SET 0
SENS:CDP:SLOT 3
//Set code 3 (for SF 16) as current code.
SENS:CDP:CODE 3
//Define relative power values
SENS:CDP:PDIS REL


//----------Performing the measurement -----------------
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI

//-------- Retrieving results----------
//Retrieve the relative code domain power
CALC:MARK:FUNC:CDP:BTS:RES? CDPR
```

```
//Result: 0 [dB]
//Retrieve the trace data of the code domain power measurement
TRAC:DATA? TRACE1
//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
//ROSC:SOUR EXT10

//Query the carrier frequency error
CALC:MARK:FUNC:CDP:BTS:RES? FERR
//Result: 0.1 [Hz]
```

Table 10-10: Trace results for Relative Code Domain Power measurement

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
...	...			

10.15.4 Measurement 4: Triggered Measurement of Relative Code Domain Power

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 10 dBm
DISP:TRAC:Y:SCAL:RLEV 10
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz


//--------Configuring the measurement ----------------
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
TRIG:SOUR EXT
//Optimize the scaling of the y-axis for the current measurement
DISP:TRAC:Y:SCAL:AUTO ONCE


//----------Performing the measurement -----------------
```

```
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI


//------------Retrieving results ------------------------
//Retrieve the trigger to frame (the offset between trigger event and
// start of first captured frame)
CALC:MARK:FUNC:CDP:BTS:RES? TFR
//Result: 0.00599987013 [ms]


//------- Compensating a delay of the trigger event to the first captured frame -------


//Change the trigger offset to 100 us (=trigger to frame value)
TRIG:HOLD 100 us
//Retrieve the trigger to frame value
CALC:MARK:FUNC:CDP:BTS:RES? TFR
//Result: 0.00599987013 [ms]
```

10.15.5 Measurement 5: Measuring the Composite EVM

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 10 dBm
DISP:TRAC:Y:SCAL:RLEV 10
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz


//--------Configuring the measurement ----------------
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
TRIG:SOUR EXT
//Replace the second measurement window (Result Summary) by Composite EVM evaluation
LAY:REPL '2',CEVM
//Optimize the scaling of the y-axis for the Composite EVM measurement
DISP:WIND2:TRAC:Y:SCAL:AUTO ONCE


//----------Performing the measurement -----------------
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI
```

```
//-------------Retrieving results ------------------------
//Retrieve the trace data of the composite EVM measurementTRAC2:DATA? TRACE1

//Result: +0.000000000,+5.876136422E-001,
//+1.000000000,+5.916179419E-001,
//+2.000000000,+5.949081182E-001,
//[...]
```

Table 10-11: Trace results for Composite EVM measurement

(CPICH) Slot number	EVM
0	+5.876136422E-001
1	+5.916179419E-001
2	+5.949081182E-001
...	...

10.15.6 Measurement 6: Determining the Peak Code Domain Error

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the reference level to 10 dBm
DISP:TRAC:Y:SCAL:RLEV 10
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz


//--------Configuring the measurement ----------------
//Set the trigger source to the external trigger
//(TRIGGER INPUT connector)
TRIG:SOUR EXT
//Replace the second measurement window (Result Summary) by the
//Peak Code Domain Error evaluation
LAY:REPL '2',PCD
//Optimize the scaling of the y-axis for the Composite EVM measurement
DISP:WIND2:TRAC:Y:SCAL:AUTO ONCE


//----------Performing the measurement -----------------
//Stops continuous sweep
INIT:CONT OFF
//Sets the number of sweeps to be performed to 10
SWE:COUN 10
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI


//-------------Retrieving results ------------------------
```

```
//Retrieve the trace data of the Peak Code Domain Error measurement
TRAC2:DATA? TRACE1
//Result: +0.000000000,-6.730751038E+001,
//+1.000000000,-6.687619019E+001,
//+2.000000000,-6.728615570E+001,
// [...]
```

Table 10-12: Trace results for Peak Code Domain Error measurement

Slot number	Peak Error
0	-6.730751038E+001
1	-6.687619019E+001
2	-6.728615570E+001
...	...

10.15.7 Measurement 7: Checking the Power vs Time

This example demonstrates how to check the signal power in the time domain against a transmission power mask defined by the TD-SCDMA specification in a remote environment (for details see "Power vs Time" on page 30).

```
//------- Preparing the instrument ------------
//Reset the instrument
*RST
//Activate a TD-SCDMA BTS measurement channel named "BTSMeasurement"
INST:CRE:NEW BTDS,'BTSMeasurement'
//Set the center frequency to 2.1175 GHz
FREQ:CENT 2.1175 GHz
//Select the power vs time measurement
CONF:CDP:MEAS PVT


//--------Configuring the measurement ----------------
//Set the switching point to 2 to analyze downlink data in slots 3 to 7
CONF:CDP:PVT:SPO 2
//Set the number of subframes to average to 50.
CONF:CDP:PVT:SFR 50
//Automatically set the reference level and trigger to frame values according
//to measured levels and time.
SENS:POW:ACH:AUTO:LTIM
//Add a second measurement window for the list evaluation
LAY:ADD '1',BEL,LEV


//----------Performing the measurement -----------------
//Stops continuous sweep
INIT:CONT OFF
//Start a new measurement with 10 sweeps and wait for the end
INIT;*WAI


//-------------Retrieving results ------------------------
```

```
//Query the result of the limit check for the 50 subframes against the
//transmission power mask
CALC:LIM:FAIL?
//Retrieve the calculated peak power value of the 50 subframes
//CALC:MARK:FUNC:POW:RES? PPOW
//Result: -1.02 [dB]
//Retrieve the trace data of the power vs time measurement
TRAC:DATA? TRACE1
//Result: -1.201362252,-1.173495054,-1.187217355,-1.186594367,-1.171583891,
//-1.188250422,-1.204138160,-1.181404829,-1.186317205,-1.197872400, [...]
```

Table 10-13: Trace results for power vs time measurement

Subframe	Power level
-1.201362252	-1.173495054
-1.187217355	-1.186594367
-1.171583891	-1.188250422
...	...

11 I/Q Data File Format (iq-tar)

I/Q data is packed in a file with the extension `.iq.tar`. An iq-tar file contains I/Q data in binary format together with meta information that describes the nature and the source of data, e.g. the sample rate. The objective of the iq-tar file format is to separate I/Q data from the meta information while still having both inside one file. In addition, the file format allows you to preview the I/Q data in a web browser, and allows you to include user-specific data.

The iq-tar container packs several files into a single `.tar` archive file. Files in `.tar` format can be unpacked using standard archive tools (see http://en.wikipedia.org/wiki/Comparison_of_file_archivers) available for most operating systems. The advantage of `.tar` files is that the archived files inside the `.tar` file are not changed (not compressed) and thus it is possible to read the I/Q data directly within the archive without the need to unpack (untar) the `.tar` file first.

Contained files

An iq-tar file must contain the following files:

- **I/Q parameter XML file**, e.g. `xyz.xml`
  Contains meta information about the I/Q data (e.g. sample rate). The filename can be defined freely, but there must be only one single I/Q parameter XML file inside an iq-tar file.
- **I/Q data binary file**, e.g. `xyz.complex.float32`
  Contains the binary I/Q data of all channels. There must be only one single I/Q data binary file inside an iq-tar file.

Optionally, an iq-tar file can contain the following file:

- **I/Q preview XSLT file**, e.g. `open_IqTar_xml_file_in_web_browser.xslt`
  Contains a stylesheet to display the I/Q parameter XML file and a preview of the I/Q data in a web browser.
  A sample stylesheet is available at http://www.rohde-schwarz.com/file/open_IqTar_xml_file_in_web_browser.xslt.

11.1 I/Q Parameter XML File Specification

The content of the I/Q parameter XML file must comply with the XML schema `RsIqTar.xsd` available at: http://www.rohde-schwarz.com/file/RsIqTar.xsd.

In particular, the order of the XML elements must be respected, i.e. iq-tar uses an "ordered XML schema". For your own implementation of the iq-tar file format make sure to validate your XML file against the given schema.

The following example shows an I/Q parameter XML file. The XML elements and attributes are explained in the following sections.

Sample I/Q parameter XML file: xyz.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="open_IqTar_xml_file_in_web_browser.xslt"?>
<RS_IQ_TAR_FileFormat fileFormatVersion="1"
xsi:noNamespaceSchemaLocation="RsIqTar.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Name>R&S FSW</Name>
  <Comment>Here is a comment</Comment>
  <DateTime>2011-01-24T14:02:49</DateTime>
  <Samples>68751</Samples>
  <Clock unit="Hz">6.5e+006</Clock>
  <Format>complex</Format>
  <DataType>float32</DataType>
  <ScalingFactor unit="V">1</ScalingFactor>
  <NumberOfChannels>1</NumberOfChannels>
<DataFilename>xyz.complex.float32</DataFilename>
<UserData>
  <UserDefinedElement>Example</UserDefinedElement>
</UserData>
  <PreviewData>...</PreviewData>
</RS_IQ_TAR_FileFormat>
```

Element	Description
RS_IQ_TAR_File-Format	The root element of the XML file. It must contain the attribute `fileFormatVersion` that contains the number of the file format definition. Currently, `fileFormatVersion` "2" is used.
Name	Optional: describes the device or application that created the file.
Comment	Optional: contains text that further describes the contents of the file.
DateTime	Contains the date and time of the creation of the file. Its type is `xs:dateTime` (see `RsIqTar.xsd`).
Samples	Contains the number of samples of the I/Q data. For multi-channel signals all channels have the same number of samples. One sample can be: • A complex number represented as a pair of I and Q values • A complex number represented as a pair of magnitude and phase values • A real number represented as a single real value See also `Format` element.
Clock	Contains the clock frequency in Hz, i.e. the sample rate of the I/Q data. A signal generator typically outputs the I/Q data at a rate that equals the clock frequency. If the I/Q data was captured with a signal analyzer, the signal analyzer used the clock frequency as the sample rate. The attribute `unit` must be set to "Hz".
Format	Specifies how the binary data is saved in the I/Q data binary file (see `DataFilename` element). Every sample must be in the same format. The format can be one of the following: • `complex`: Complex number in cartesian format, i.e. I and Q values interleaved. I and Q are unitless • `real`: Real number (unitless) • `polar`: Complex number in polar format, i.e. magnitude (unitless) and phase (rad) values interleaved. Requires `DataType` = `float32` or `float64`

Element	Description
DataType	Specifies the binary format used for samples in the I/Q data binary file (see `DataFilename` element and Chapter 11.2, "I/Q Data Binary File", on page 245). The following data types are allowed: • `int8`: 8 bit signed integer data • `int16`: 16 bit signed integer data • `int32`: 32 bit signed integer data • `float32`: 32 bit floating point data (IEEE 754) • `float64`: 64 bit floating point data (IEEE 754)
ScalingFactor	Optional: describes how the binary data can be transformed into values in the unit Volt. The binary I/Q data itself has no unit. To get an I/Q sample in the unit Volt the saved samples have to be multiplied by the value of the `ScalingFactor`. For polar data only the magnitude value has to be multiplied. For multi-channel signals the `ScalingFactor` must be applied to all channels. The attribute `unit` must be set to "`V`". The `ScalingFactor` must be > 0. If the `ScalingFactor` element is not defined, a value of 1 V is assumed.
NumberOfChannels	Optional: specifies the number of channels, e.g. of a MIMO signal, contained in the I/Q data binary file. For multi-channels, the I/Q samples of the channels are expected to be interleaved within the I/Q data file (see Chapter 11.2, "I/Q Data Binary File", on page 245). If the `NumberOfChannels` element is not defined, one channel is assumed.
DataFilename	Contains the filename of the I/Q data binary file that is part of the iq-tar file. It is recommended that the filename uses the following convention: <xyz>.<Format>.<Channels>ch.<Type> • <xyz> = a valid Windows file name • <Format> = complex, polar or real (see `Format` element) • <Channels> = Number of channels (see `NumberOfChannels` element) • <Type> = float32, float64, int8, int16, int32 or int64 (see `DataType` element) Examples: • xyz.complex.1ch.float32 • xyz.polar.1ch.float64 • xyz.real.1ch.int16 • xyz.complex.16ch.int8
UserData	Optional: contains user, application or device-specific XML data which is not part of the iq-tar specification. This element can be used to store additional information, e.g. the hardware configuration. User data must be valid XML content.
PreviewData	Optional: contains further XML elements that provide a preview of the I/Q data. The preview data is determined by the routine that saves an iq-tar file (e.g. R&S FSW). For the definition of this element refer to the `RsIqTar.xsd` schema. Note that the preview can be only displayed by current web browsers that have JavaScript enabled and if the XSLT stylesheet `open_IqTar_xml_file_in_web_browser.xslt` is available.

Example: ScalingFactor

Data stored as `int16` and a desired full scale voltage of 1 V

`ScalingFactor` = 1 V / maximum int16 value = 1 V / 2^{15} = 3.0517578125e-5 V

Scaling Factor	Numerical value	Numerical value x ScalingFactor
Minimum (negative) int16 value	$-2^{15} = -32768$	-1 V
Maximum (positive) int16 value	$2^{15}-1 = 32767$	0.999969482421875 V

Example: PreviewData in XML

```
<PreviewData>
    <ArrayOfChannel length="1">
      <Channel>
        <PowerVsTime>
          <Min>
            <ArrayOfFloat length="256">
              <float>-134</float>
              <float>-142</float>
              ...
              <float>-140</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-70</float>
              <float>-71</float>
              ...
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </PowerVsTime>
        <Spectrum>
          <Min>
            <ArrayOfFloat length="256">
              <float>-133</float>
              <float>-111</float>
              ...
              <float>-111</float>
            </ArrayOfFloat>
          </Min>
          <Max>
            <ArrayOfFloat length="256">
              <float>-67</float>
              <float>-69</float>
              ...
              <float>-70</float>
              <float>-69</float>
            </ArrayOfFloat>
          </Max>
        </Spectrum>
        <IQ>
          <Histogram width="64" height="64">0123456789...0</Histogram>
        </IQ>
      </Channel>
    </ArrayOfChannel>
  </PreviewData>
```

11.2 I/Q Data Binary File

The I/Q data is saved in binary format according to the format and data type specified in the XML file (see `Format` element and `DataType` element). To allow reading and writing of streamed I/Q data, all data is interleaved, i.e. complex values are interleaved pairs of I and Q values and multi-channel signals contain interleaved (complex) samples for channel 0, channel 1, channel 2 etc. If the `NumberOfChannels` element is not defined, one channel is presumed.

Example: Element order for real data (1 channel)

```
I[0],                           // Real sample 0
I[1],                           // Real sample 1
I[2],                           // Real sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

```
I[0], Q[0],                     // Real and imaginary part of complex sample 0
I[1], Q[1],                     // Real and imaginary part of complex sample 1
I[2], Q[2],                     // Real and imaginary part of complex sample 2
...
```

Example: Element order for complex polar data (1 channel)

```
Mag[0], Phi[0],                 // Magnitude and phase part of complex sample 0
Mag[1], Phi[1],                 // Magnitude and phase part of complex sample 1
Mag[2], Phi[2],                 // Magnitude and phase part of complex sample 2
...
```

Example: Element order for complex cartesian data (3 channels)

Complex data: I[channel no][time index], Q[channel no][time index]

```
I[0][0], Q[0][0],               // Channel 0, Complex sample 0
I[1][0], Q[1][0],               // Channel 1, Complex sample 0
I[2][0], Q[2][0],               // Channel 2, Complex sample 0

I[0][1], Q[0][1],               // Channel 0, Complex sample 1
I[1][1], Q[1][1],               // Channel 1, Complex sample 1
I[2][1], Q[2][1],               // Channel 2, Complex sample 1

I[0][2], Q[0][2],               // Channel 0, Complex sample 2
I[1][2], Q[1][2],               // Channel 1, Complex sample 2
I[2][2], Q[2][2],               // Channel 2, Complex sample 2
...
```

Example: Element order for complex cartesian data (1 channel)

This example demonstrates how to store complex cartesian data in float32 format using MATLAB®.

```
% Save vector of complex cartesian I/Q data, i.e. iqiqiq...
N = 100
iq = randn(1,N)+1j*randn(1,N)
fid = fopen('xyz.complex.float32','w');
for k=1:length(iq)
  fwrite(fid,single(real(iq(k))),'float32');
  fwrite(fid,single(imag(iq(k))),'float32');
end
fclose(fid)
```

List of Remote Commands (TD-SCDMA)

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