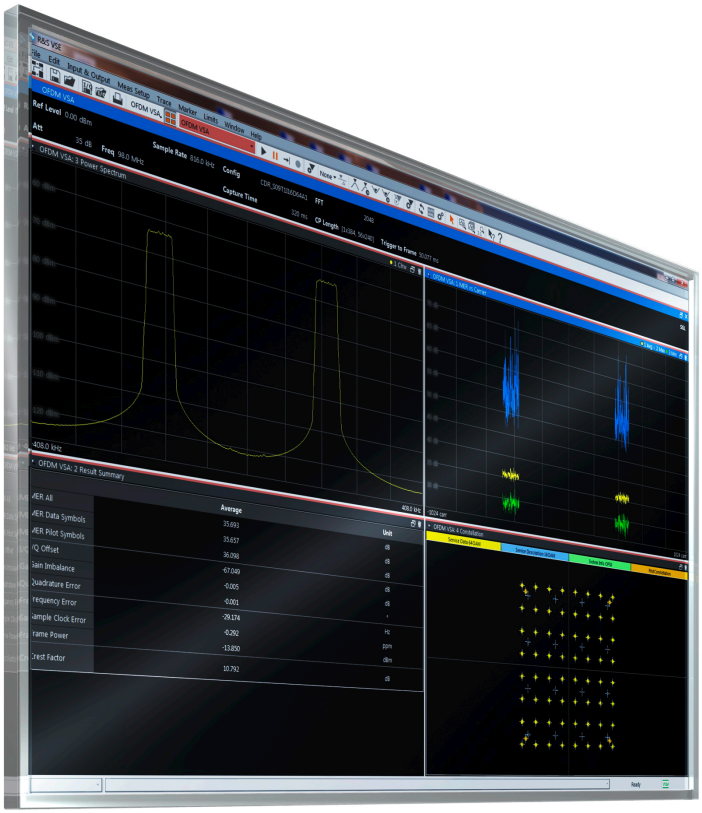
R&S®ETL-K470
CDR Signal Analysis Software
Manual



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Manual

Version 01

ROHDE&SCHWARZ

This manual applies to the following instrument, version 3.51 and later:

- R&S®ETL (2112.0004.13)

The following software options are described:

- R&S®ETL-K470 CDR Signal Analysis Software (1346.8884.02)

The following hardware options are recommended:

- R&S®ETL-B203 RF Preselector (2112.0327.03)

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1346.8926.02 | Version 01 | R&S®ETL-K470

The following abbreviations are used throughout this manual: R&S®ETL-CDR Signal Analysis Software is abbreviated as R&S ETL-CDR software. R&S®VSE is abbreviated as R&S VSE.

Contents

1 Preface

1.1 About this Manual

This R&S ETL CDR software manual provides all the information **specific to the application**. All general software functions and settings common to all applications are described in the R&S VSE base software user manual.

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

- **Welcome to the R&S ETL CDR software**
  Introduction to and getting familiar with the application, installation information
- **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 and analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **How to perform measurements in the R&S ETL CDR software**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Measurement examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Optimizing and troubleshooting the measurement**
  Hints and tips on how to handle errors and optimize the measurement configuration
- **Remote commands for CDR measurements**
  Remote commands required to configure and perform CDR measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks in the software are provided in the R&S VSE base software user manual.)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
  Reference material
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 Welcome to the R&S ETL CDR software

The R&S ETL CDR software performs vector and scalar measurements on convergent digital radio (CDR) signals. To perform the measurements, it converts RF signals into the complex baseband.

The R&S ETL CDR software features:

- Analysis of convergent digital radio (CDR) signals as defined by People's Republic of China, Radio, Film and Television Industry Standard GY/T 268.1-2013
- I/Q-based measurement results such as MER, constellation diagrams, power spectrum

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

The R&S ETL CDR software is based on the R&S VSE Vector Signal Explorer Base Software. Functions that are not discussed in this manual are the same as in the I/Q Analyzer application and are described in the R&S VSE base software user manual.

The latest version is available for download at the product homepage http://www.rohde-schwarz.com/product/VSE.html.

Note, however, that the R&S ETL CDR software does not support the full functionality of the R&S VSE software.

In particular, the following restrictions apply:

- No instruments other than R&S ETL are supported.
- Only a single R&S ETL can be connected.
- Only a single instance of the R&S VSE can be connected to the same R&S ETL at the same time.
- Only the R&S ETL CDR software (OFDM VSA) and the I/Q Analyzer are supported as measurement modes. (Regardless of any other option licenses that may be available on an FS-PC dongle, for example.)

2.1 Introduction to Vector Signal Analysis

The goal of vector signal analysis is to determine the quality of the signal that is transmitted by the device under test (DUT) by comparing it against an ideal signal. The DUT is usually connected with the analyzer via a cable. The key task of the analyzer is to determine the ideal signal. Hence, the analyzer aims to reconstruct the ideal signal from the measured signal that is transmitted by the DUT. This ideal signal is commonly

referred to as the *reference signal*, while the signal from the DUT is called the *measurement signal*.

After extracting the reference signal, the R&S ETL CDR software compares the measurement signal and the reference signal, and the results of this comparison are displayed.

Example:

The most common vector signal analysis measurement is the MER (Modulation Error Ratio) measurement. Here, the complex baseband reference signal is subtracted from the complex baseband measurement signal. The magnitude of this error vector represents the MER value. The MER has the advantage that it "summarizes" all potential errors and distortions in one single value. If the MER value is high, the signal quality of the DUT is high.

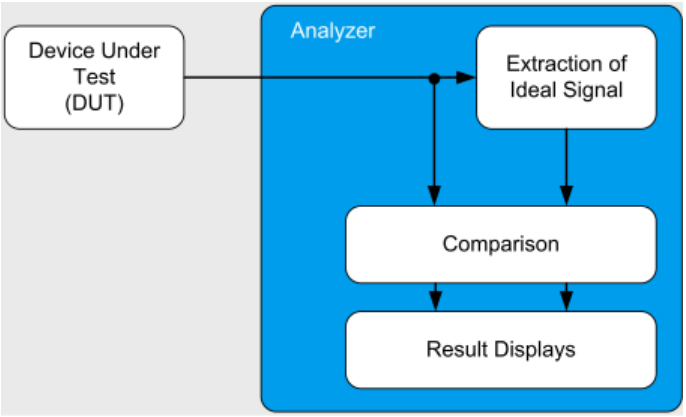


Figure 2-1: Simplified schema of vector signal analysis

2.2 Installing the R&S ETL CDR software

2.2.1 Installing Required Components

The following software components must be installed to run the R&S ETL CDR software successfully:

- Microsoft .NET Framework 4.0
- R&S License Server
- VISA (Virtual Instrument Software Architecture)

The R&S License Server and Microsoft .NET Framework 4.0 are installed automatically during installation of the R&S ETL CDR software.

VISA can be installed directly during installation of the R&S ETL CDR software, or manually, independently of the R&S ETL CDR software installation.

Installing the Microsoft .NET Framework

When you install the R&S ETL CDR software via the provided installation file (see Chapter 2.2.2, "Installing the R&S ETL CDR software", on page 9), the installer automatically checks whether the required Microsoft .NET Framework version is available on the PC. If not, an internet connection to the Microsoft website is established to download the Framework version 4.0 (due to the large file size). Thus, before attempting to install the R&S ETL CDR software, ensure that a strong internet connection is available from the PC, as downloading can take some time. Alternatively, download the Framework 4.0 version from the internet manually before you start the R&S ETL CDR software installation.

Installing VISA

It is also necessary to install VISA (Virtual Instrument Software Architecture) on the PC to access instruments connected via IEEE or LAN bus.

It is recommended that you use the R&S VISA driver. The R&S VISA driver is supplied with the R&S ETL CDR software installation, and can be installed together with the R&S ETL CDR software (see Chapter 2.2.2, "Installing the R&S ETL CDR software", on page 9).

Once the R&S ETL CDR software is installed, a status icon in the status bar indicates whether the VISA installation is available.

2.2.2 Installing the R&S ETL CDR software

The R&S ETL CDR software is based on the R&S VSE base software. To install the R&S ETL CDR software, the R&S VSE software installation package is used. It consists of one file, whose name contains the main version number, e.g. `VSESetup_V1.60.exe`. It is referred to as `VSESetup.exe` throughout this description. Download the file from the Rohde & Schwarz web page at http://www.rohde-schwarz.com/software/VSE.

The R&S ETL CDR software can only be installed on PCs using the 64-bit version of Windows 7 or Windows 10. Installation on an R&S ETL instrument is not supported. It is recommended that you copy the R&S VSE installation file to the hard disk of the PC before you execute it.

To install the R&S ETL CDR software

1. Execute the `VSESetup_XXX.exe` file on the PC.
2. Select the required options to install:
   - Unless you have ensured the required R&S VISA is installed manually before starting the R&S VSE installation on a PC, be sure to keep the "R&S VISA" option selected.
   - "R&S VSE Vector Signal Explorer software"
   - "R&S VSE K96 OFDM signal analysis"

- "Activate R&S ETL-CDR K470"

3. Select "Install".

The installer performs the following actions:

- Checks for the required Microsoft .NET Framework versions on the PC, and if necessary, downloads the required version from the Internet, before installing both versions
- If enabled, installs the R&S VISA software on the PC
- Installs the R&S ETL CDR software including an uninstall tool
- Creates a shortcut on the desktop
- If necessary (the software specifically asks you), sets the required environment variables
  This step can require administrator rights on the PC.

When the installation is complete, the dialog box turns green and all selected options are indicated as "OK".

2.2.3 Deinstalling the R&S ETL CDR software

Access: "Start" > "All Programs" > "Rohde-Schwarz" > "VSE" > [version_number] > "Uninstall VSE"

or: (Windows 7) "Start" > "Control Panel" > "Add or Remove Software"

or: (Windows 10) "Start" > "Settings" > "System" > "Apps & features" > "R&S VSE Signal Analyzer" > "Uninstall".

You can uninstall the R&S VSE itself via the uninstall tool available in the R&S VSE folder, or via the standard Windows "Add or Remove Software" function.

2.3 Starting the R&S ETL CDR software

The R&S ETL CDR software is an application in the R&S VSE software.

Prerequisites for starting the R&S ETL CDR software

Before you start the R&S ETL CDR software, the following prerequisites must be met:

- An Ethernet connection from the PC to an R&S ETL must be established.
- The R&S ETL must have a valid R&S ETL-K470 CDR license and a firmware version 3.51 or later.

The R&S ETL-K470 CDR license is a single license. That means only a single instance of the R&S VSE can be connected to the same R&S ETL at the same time. If a second R&S VSE instance (running on a different PC) attempts to connect to the same R&S ETL, the second R&S VSE instance displays the following message: "ETL connection broken or removed. Shutting down application." The second instance then shuts down automatically after 30 seconds.

To start the R&S ETL CDR software

1. Start the R&S VSE via the Windows "Start Menu" entry or the shortcut on the desktop.
2. Enter the IP address of the connected R&S ETL. If no valid R&S ETL-K470 CDR license is found, the software does not start.

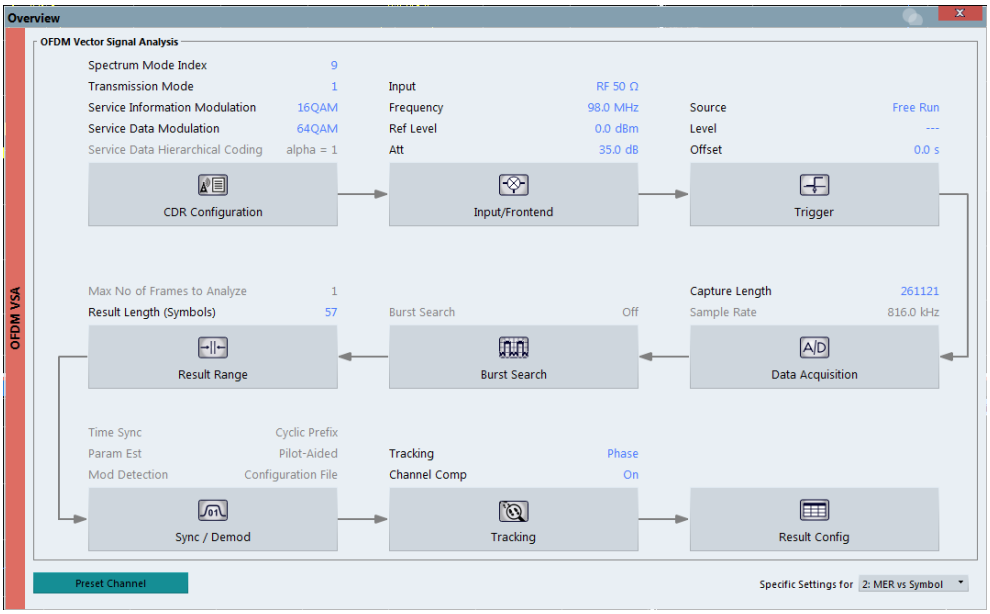
   The R&S VSE software runs in an exclusive CDR mode. CDR mode is designed to analyze CDR signals within the R&S VSE software. The correct channel "OFDM VSA" is started automatically when the software is launched. Additionally, you can start it by creating a measurement channel in CDR mode.

To activate the R&S ETL CDR software

1. Channel

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

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

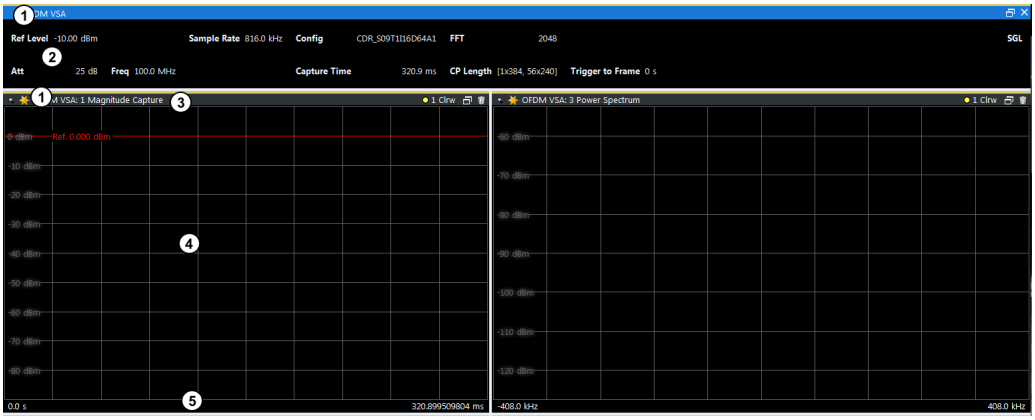


2. Select the "OFDM VSA" item.

The R&S VSE opens a new measurement channel for the R&S ETL CDR software.

2.4 Understanding the Display Information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



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

Channel bar information

In the R&S ETL CDR software, the following settings are shown:

Table 2-1: Information displayed in the channel bar in the R&S ETL CDR software

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Center frequency for the RF signal
Offset	Reference level offset
SRate	Sample Rate (fixed to 816 kHz)
Config	Currently loaded configuration file
Capture Time	How long data was captured in current sweep
FFT	FFT size

CP Length	Cyclic prefix length of the beacon (CP1) and the data body (CP2)
Trigger to Frame	Offset between the trigger event and the start of the CDR subframe

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

Window title bar information

For each diagram, the header provides the following information:

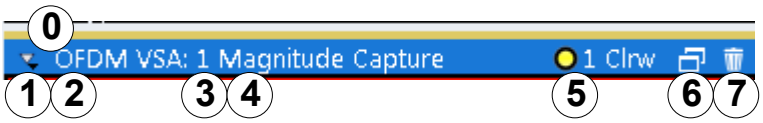


Figure 2-2: Window title bar information in R&S ETL CDR software

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

Diagram area

The diagram area displays the results according to the selected result displays (see Chapter 3.2, "Evaluation Methods for CDR Measurements", on page 15).

Diagram footer information

The diagram footer (beneath the diagram) contains the start and stop symbols or time of the evaluation range.

Status bar information

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

3 CDR Measurement and Results

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

To add further result displays for the CDR channel

► Select the "Add Window" icon from the toolbar, or select the "Window > New Window" menu item.

For details on working with channels and windows, see the "Operating Basics" chapter in the R&S VSE base software user manual.

3.1 CDR Parameters

Several signal parameters are determined during vector signal analysis and displayed in the Result Summary.

For details concerning the calculation of individual parameters, see Chapter C, "Formulae", on page 176.

Table 3-1: CDR parameters

Parameter	Description	SCPI Parameter
MER [dB]	Average Modulation Error Ratio (MER) for all data and all pilot cells of the analyzed frames. The MER is the ratio of the RMS power of the ideal reference signal to the RMS power of the error vector.	`MER[:ALL]`
MER Data Symbols [dB]	Average Modulation Error Ratio of the payload symbols over all data carriers	`MER:DATA`
MER Pilot Symbols [dB]	Average Modulation Error Ratio of the payload symbols over all pilot carriers	`MER:PILot`
I/Q offset [dB]	Transmitter center frequency leakage relative to the total Tx channel power	`IQOFset`
Gain imbalance [dB]	Amplification of the quadrature phase component of the signal relative to the amplification of the in-phase component	`GIMBalance`
Quadrature error [°]	Phase angle between Q-channel and I-channel deviating from the ideal 90 degrees; measure for crosstalk from the Q-branch into the I-branch	`QUADerror`
*) Required to retrieve the parameter result, See `FETCh:SUMM:<parameter>[:AVERage]` on page 141		

Parameter	Description	SCPI Parameter
Frequency Error [Hz]	Frequency error between the signal and the currently defined center frequency The R&S ETL CDR software is designed to compensate carrier offsets of up to ±2 kHz. For higher frequency offsets, you must configure the Maximum Carrier Offset and the filters accordingly (see Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52 and "Filter Settings" on page 50). The absolute frequency error includes the frequency error of the connected R&S ETL and that of the DUT. If possible, the transmitter connected R&S ETL and the DUT should be synchronized (using an external reference). See R&S VSE base software user manual > "Configuring Instruments"	FERRor
Sample Clock Error	Clock error between the signal and the sample clock of the R&S ETL CDR software in parts per million (ppm), i.e. the symbol timing error If possible, the transmitter connected R&S ETL and the DUT should be synchronized (using an external reference). See R&S VSE base software user manual > "Configuring Instruments"	SERRor
Frame Power	Average time domain power of the analyzed subframe	POWer
Crest factor [dB]	The ratio of the peak power to the mean power of the analyzed subframe	CRESt
Trigger to Frame [s]	(Displayed in channel bar only, not included in Result Summary.) The time offset between the trigger event and the start of the first CDR subframe	FETCh:TTFRame?
*) Required to retrieve the parameter result, See FETCh:SUMM:<parameter>[:AVERage] on page 141		

3.2 Evaluation Methods for CDR Measurements

The data that was measured by the R&S ETL CDR software can be evaluated using various different methods without having to start a new measurement. Which results are displayed depends on the selected evaluation.

The CDR measurement provides the following evaluation methods:

Allocation Matrix

The Allocation Matrix display is a graphical representation of the OFDM cell structure defined by the current CDR configuration.

Use markers to get more detailed information on the individual cells.

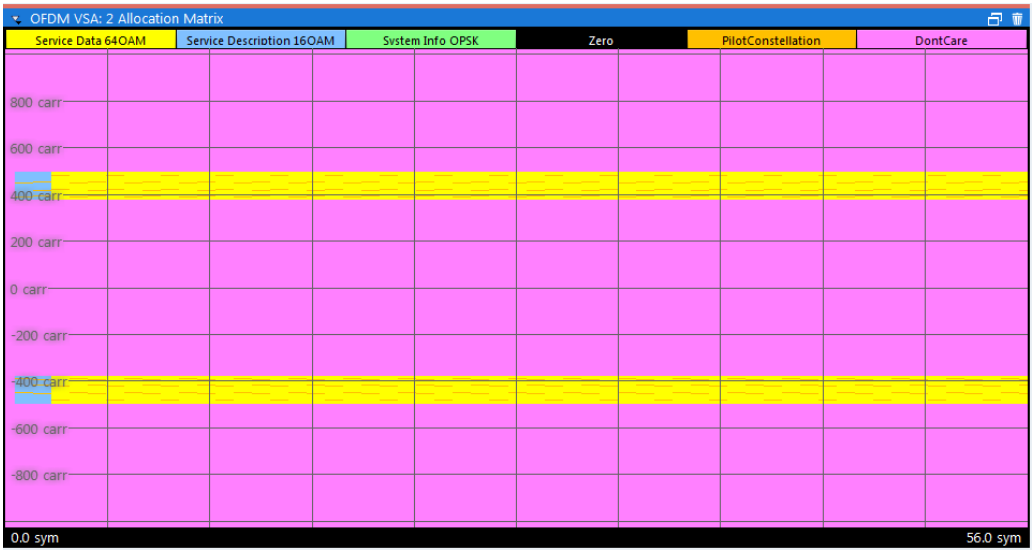


Figure 3-1: Allocation Matrix

The legend for the color coding is displayed at the top of the matrix.

Markers in the Allocation Matrix

Using markers you can detect individual allocation points for a specific symbol or carrier. When you activate a marker in the Allocation Matrix, its position is defined by the symbol and carrier number the point belongs to. The marker result indicates the I and Q values of the point.

See also "Markers in the Constellation diagram and Allocation Matrix" on page 63.

Remote command:
`LAY:ADD? '1',RIGH,AMATrix`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe<n>[:DATA]?` on page 150, see Chapter 7.7.4.1, "Allocation Matrix", on page 155
`TRACe<n>[:DATA]:X?` on page 151
`TRACe<n>[:DATA]:Y?` on page 151
Symbol unit: `UNIT:SAXes` on page 113

CCDF

The CCDF results display shows the probability of an amplitude exceeding the mean power. The x-axis displays power relative to the measured mean power.

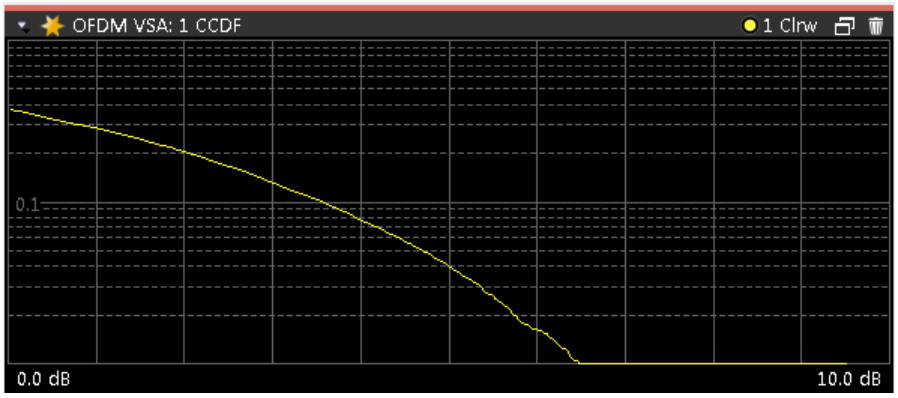


Figure 3-2: CCDF display

Remote command:
`LAY:ADD? '1',RIGH,CCDF`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.2, "CCDF", on page 155
`TRACe<n>[:DATA]:X?` on page 151

Channel Flatness

The Channel Flatness display shows the amplitude of the channel transfer function vs. carrier.

The channel flatness can only be calculated at valid carrier locations. This means that a gap appears between the upper and lower half subband for spectrum mode index 9, 10, 22, and 23.

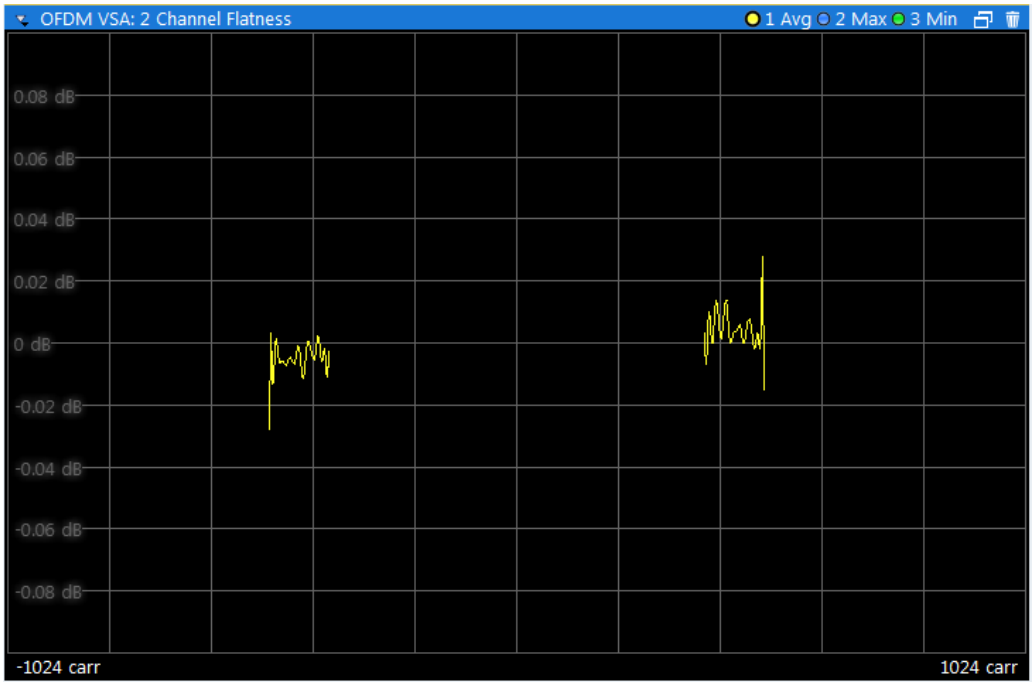


Figure 3-3: Channel Flatness Display

Remote command:
`LAY:ADD? '1',RIGH,CHFL`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.3, "Channel Flatness", on page 155
`TRACe<n>[:DATA]:X?` on page 151
Carrier unit: `UNIT:CAXes` on page 111

Constellation Diagram
The Constellation Diagram shows the inphase and quadrature results for the analyzed input data. The ideal points for the selected cell types are displayed for reference purposes.

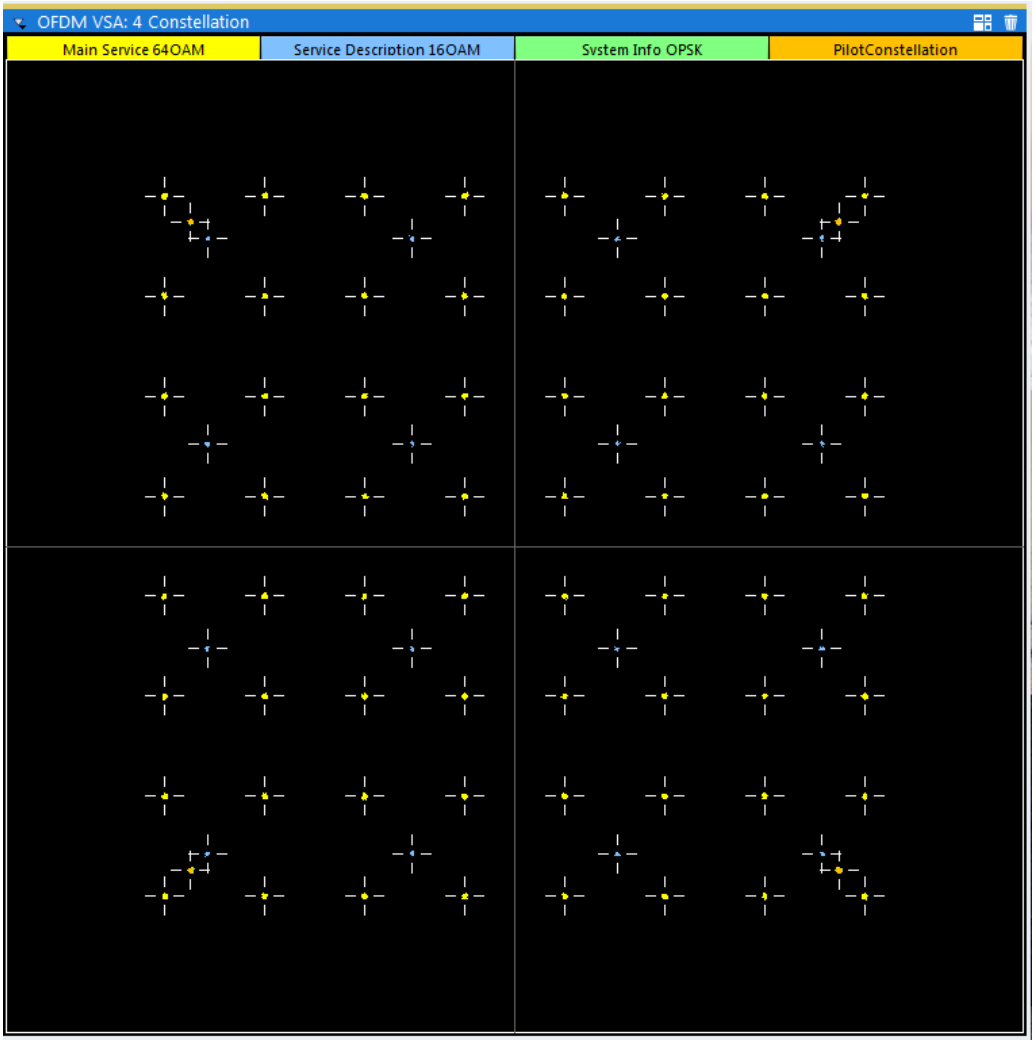


Figure 3-4: Constellation diagram

The legend for the color coding is displayed at the top of the matrix. If you click on one of the codes, only the selected constellation points are displayed. Click again, and all constellation points are displayed again (according to the constellation filter, see Chapter 5.1, "Result Configuration", on page 57).

Markers in the Constellation diagram

Using markers you can detect individual constellation points for a specific symbol or carrier. When you activate a marker in the Constellation diagram, its position is defined by the symbol and carrier number the point belongs to. The marker result indicates the I and Q values of the point.

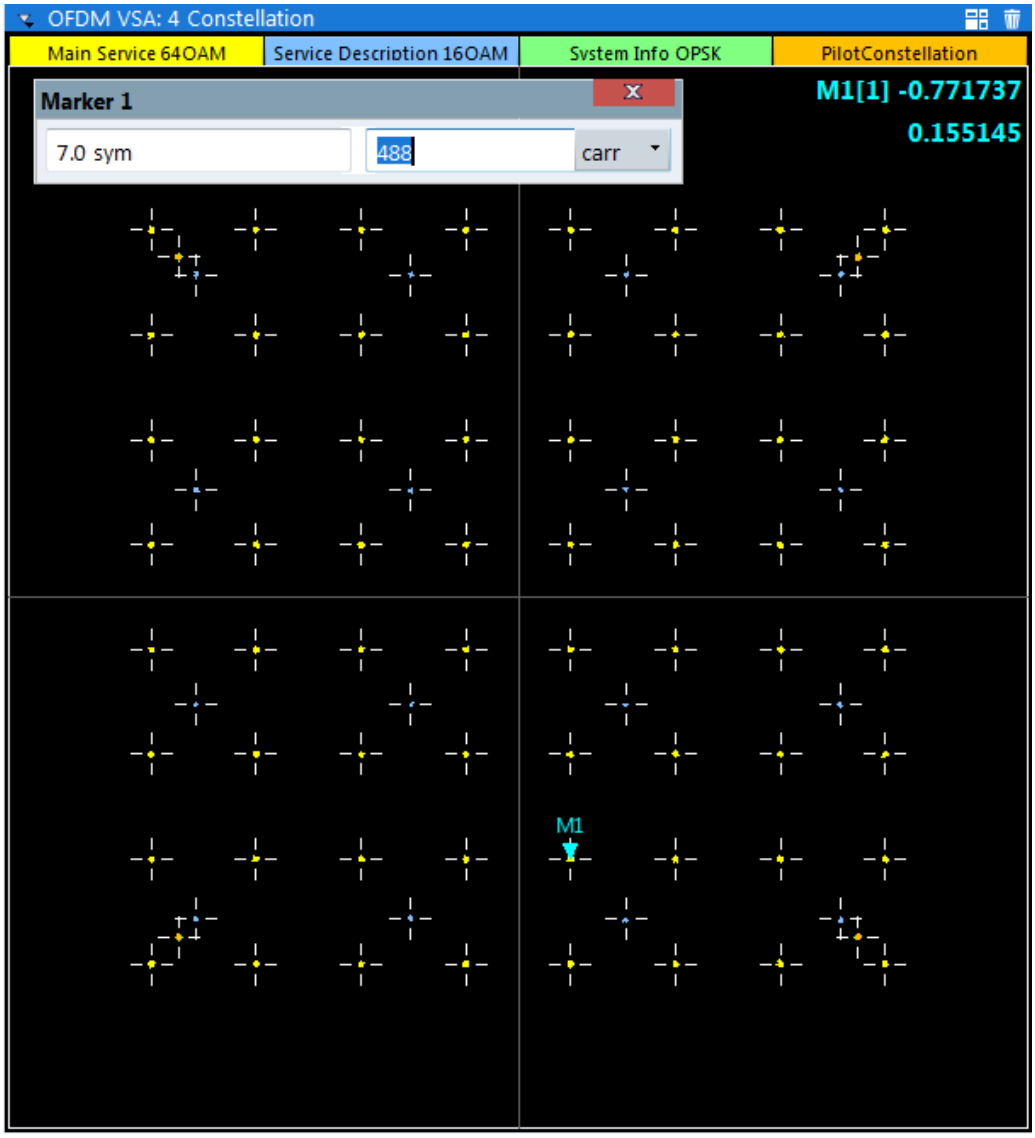


Figure 3-5: Marker in a Constellation diagram

See also "Markers in the Constellation diagram and Allocation Matrix" on page 63.

Remote command:
`LAY:ADD? '1',RIGH,CONS`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.4, "Constellation Diagram", on page 155
Marker I/Q values:
`CALCulate<n>:MARKer<m>:Z?` on page 147

Constellation vs Carrier
The Constellation vs. Carrier display shows the inphase and quadrature magnitude results of all analyzed symbols over the corresponding carriers. The inphase values are displayed as yellow dots; the quadrature-values are displayed as blue dots.

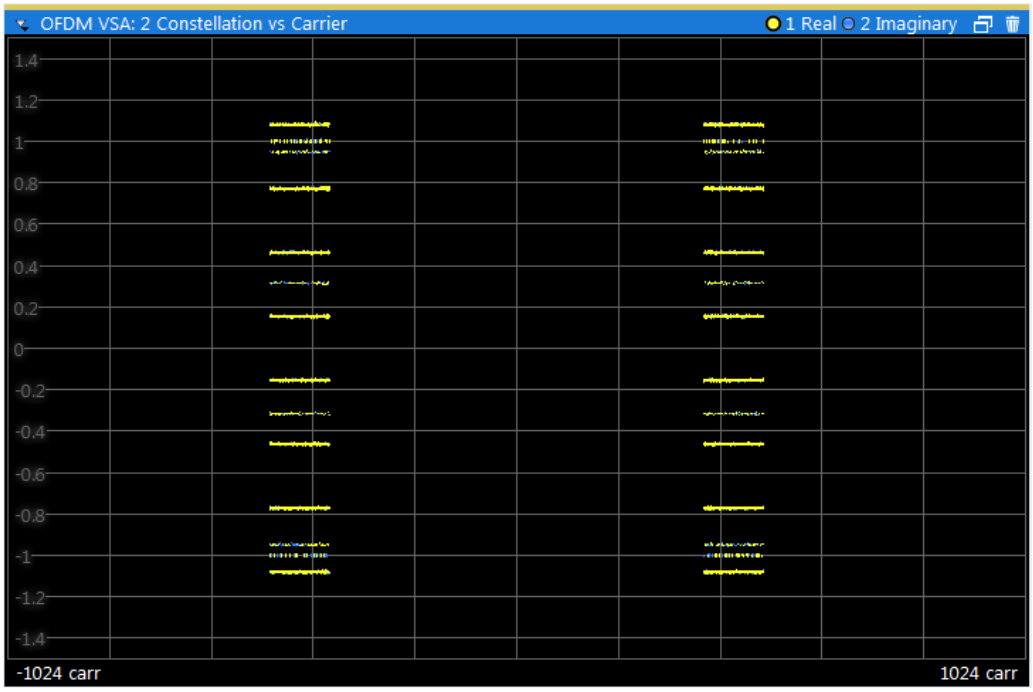


Figure 3-6: Constellation vs. Carrier display

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,CCAR`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4, "Using the TRACe[:DATA] Command", on page 154
Carrier unit: `UNIT:CAXes` on page 111

Constellation vs Symbol
The Constellation vs. Symbol display shows the inphase and quadrature magnitude results of all analyzed carriers over the corresponding symbols. The inphase values are displayed as yellow dots; the quadrature-values are displayed as blue dots.

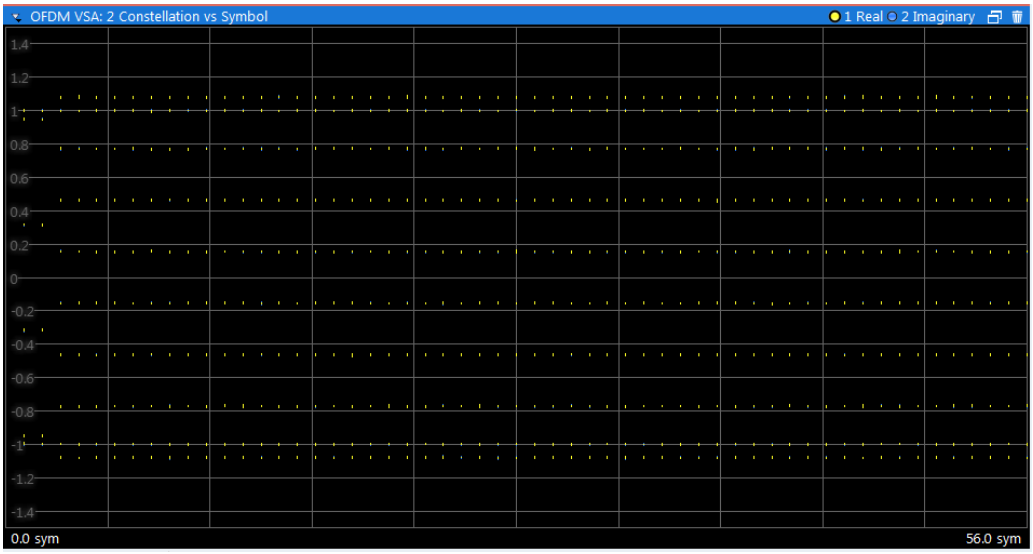


Figure 3-7: Constellation vs. Symbol display

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,CSYM`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4, "Using the TRACe[:DATA] Command", on page 154
Symbol unit: `UNIT:SAXes` on page 113

MER vs Carrier
The MER vs Carrier display shows the MER of each carrier of the analyzed subframe in the frequency domain. The results are provided in dB. Multiple traces display statistical evaluations over carriers.

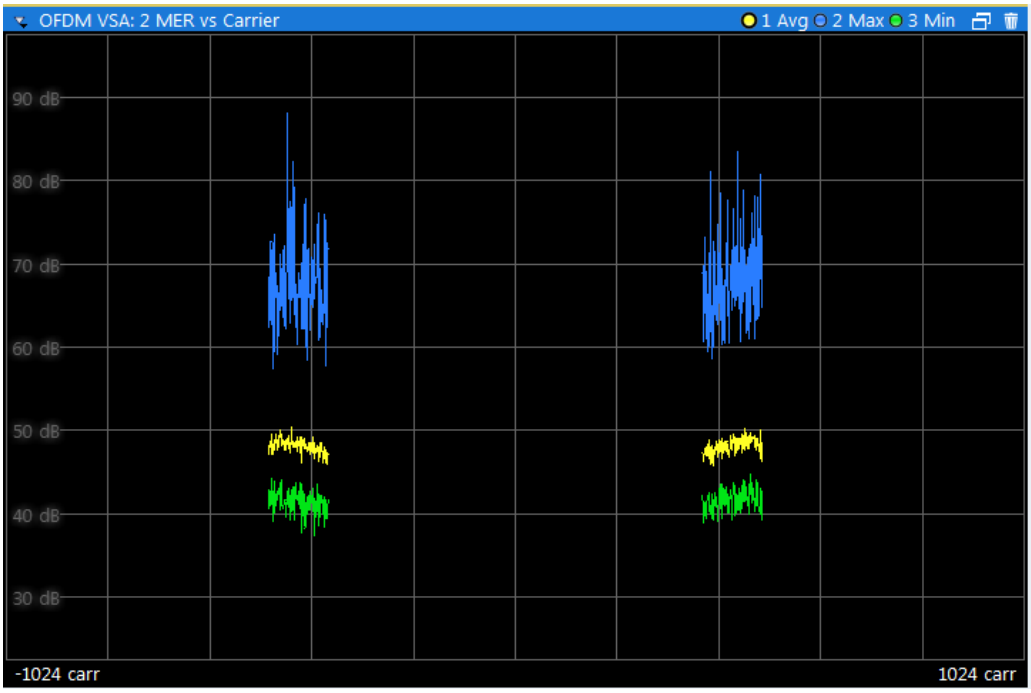


Figure 3-8: MER vs Carrier display

Note: This result display is only available if synchronization is successful.
Guard carriers to the left and right of the spectrum are not included in the MER calculation. However, zero cells and the DC carrier are included.

Remote command:
`LAY:ADD? '1',RIGH,MVC`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.7, "MER vs Carrier", on page 157
`TRACe<n>[:DATA]:X?` on page 151
Carrier unit: `UNIT:CAXes` on page 111

MER vs Symbol
The MER vs. Symbol display shows the MER of each symbol of the analyzed subframe in the time domain. The results are provided in dB. Multiple traces display statistical evaluations over symbols.

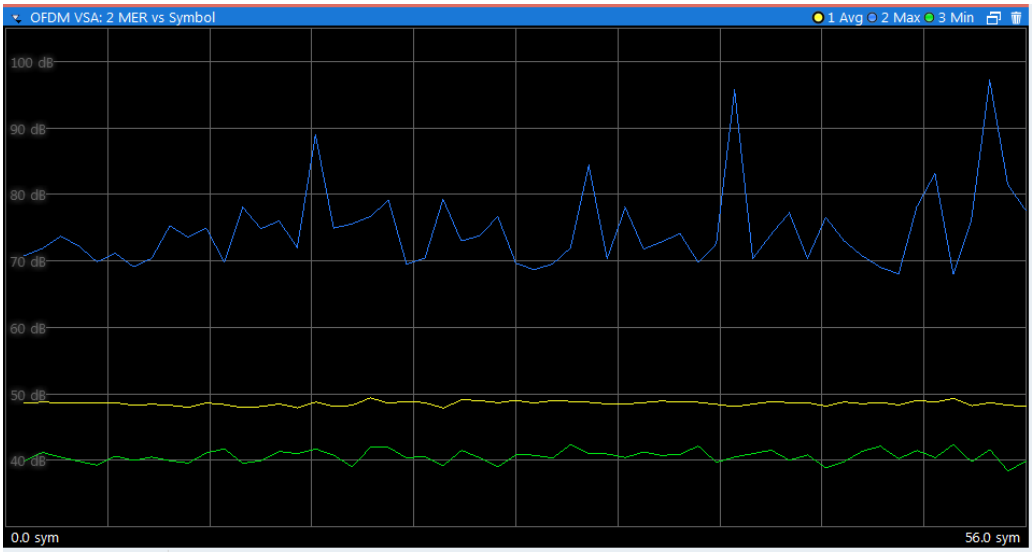


Figure 3-9: MER vs Symbol display

Note: This result display is only available if synchronization is successful.
Guard carriers to the left and right of the spectrum are not included in the MER calculation. However, zero cells and the DC carrier are included.

Remote command:
`LAY:ADD? '1',RIGH,MVSY`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.8, "MER vs Symbol", on page 157
`TRACe<n>[:DATA]:X?` on page 151
Symbol unit: `UNIT:SAXes` on page 113

MER vs Symbol vs Carrier

The MER vs Symbol vs Carrier display shows the MER of each carrier (frequency domain) and in each symbol (time domain) of the analyzed subframe.

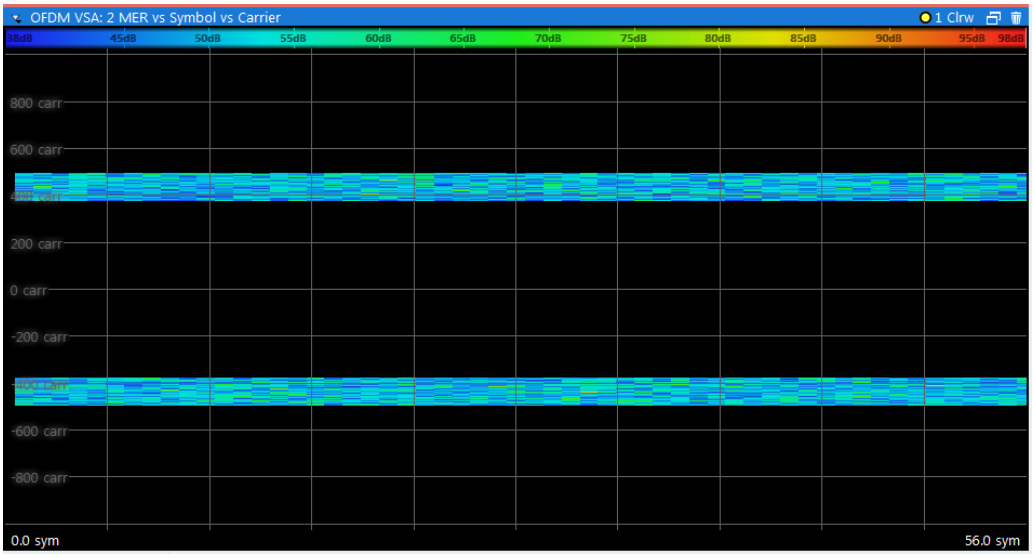


Figure 3-10: MER vs Symbol vs Carrier display

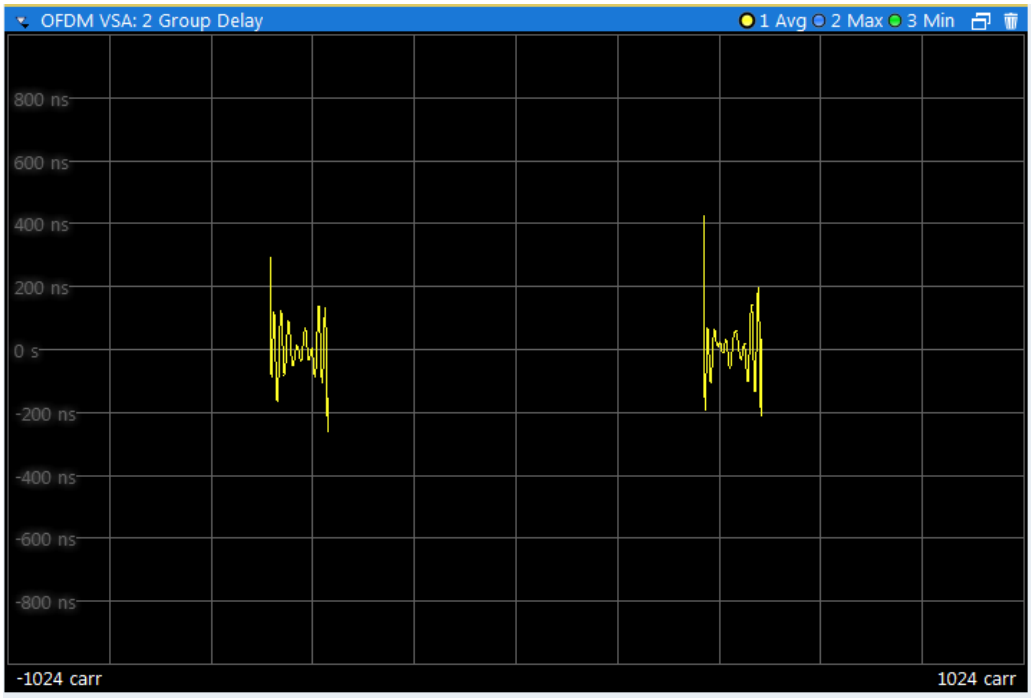
The MER values are represented by colors. The corresponding color map is displayed at the top of the result display.

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,MVSC`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.9, "MER vs Symbol vs Carrier", on page 157
`TRACe<n>[:DATA]:X?` on page 151
`TRACe<n>[:DATA]:Y?` on page 151
Carrier unit: `UNIT:CAXes` on page 111
Symbol unit: `UNIT:SAXes` on page 113

Group Delay
The Group Delay display shows the relative group delay of the transmission channel per carrier.

The group delay can only be calculated at valid carrier locations. This means that a gap appears between the upper and lower half subband for spectrum mode index 9, 10, 22, and 23.



Remote command:
`LAY:ADD? '1',RIGH,GDEL`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.11, "Group Delay", on page 158
`TRACe<n>[:DATA]:X?` on page 151
Carrier unit: `UNIT:CAXes` on page 111

Impulse Response
The Channel Impulse Response display shows the impulse response of the channel and its position within the guard interval. The start and the end of the cyclic prefix are marked with blue lines.

CP1 describes the cyclic prefix of the beacon. CP2 describes the cyclic prefix of the data body. The impulse response calculation is based on the data body, hence the valid echo detection range is indicated by CP2. Multiple traces display statistical evaluations over the upper and lower subband.

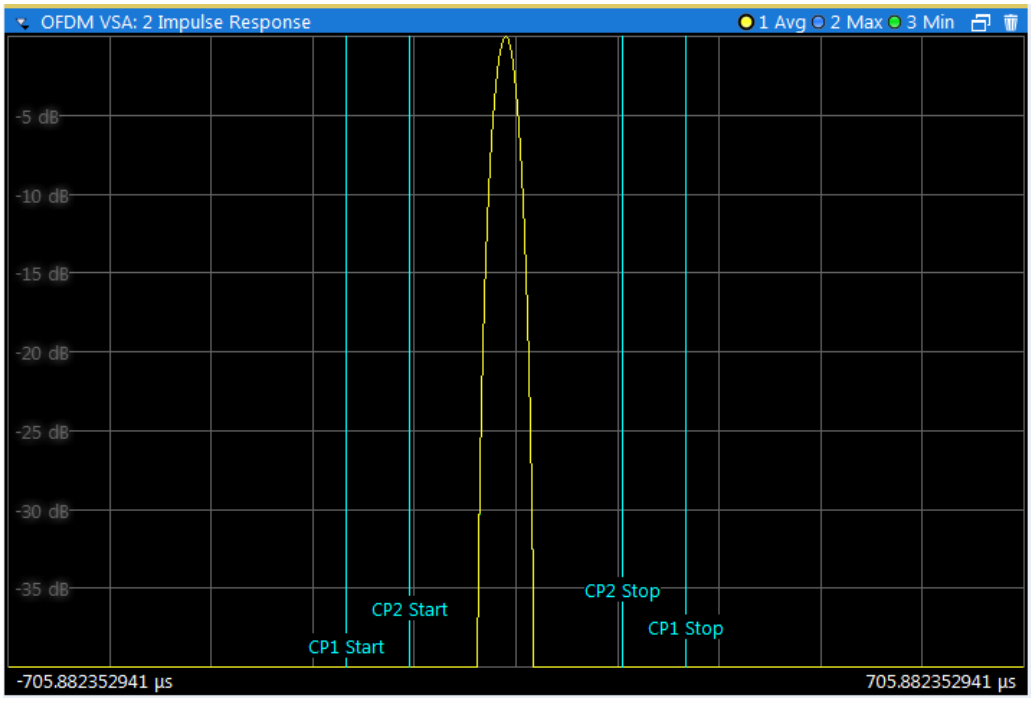


Figure 3-11: Channel Impulse Response Display

Remote command:
`LAY:ADD? '1',RIGH,IRES`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.12, "Impulse Response", on page 158
`TRACe<n>[:DATA]:X?` on page 151
Linear/ logarithmic scaling: `UNIT:IRESponse` on page 112

Magnitude Capture
The capture buffer contains the complete range of captured data for the last sweep. The Magnitude Capture display shows the power of the captured I/Q data in dBm versus time. The analyzed frames are identified with a green bar at the bottom of the Magnitude Capture display.

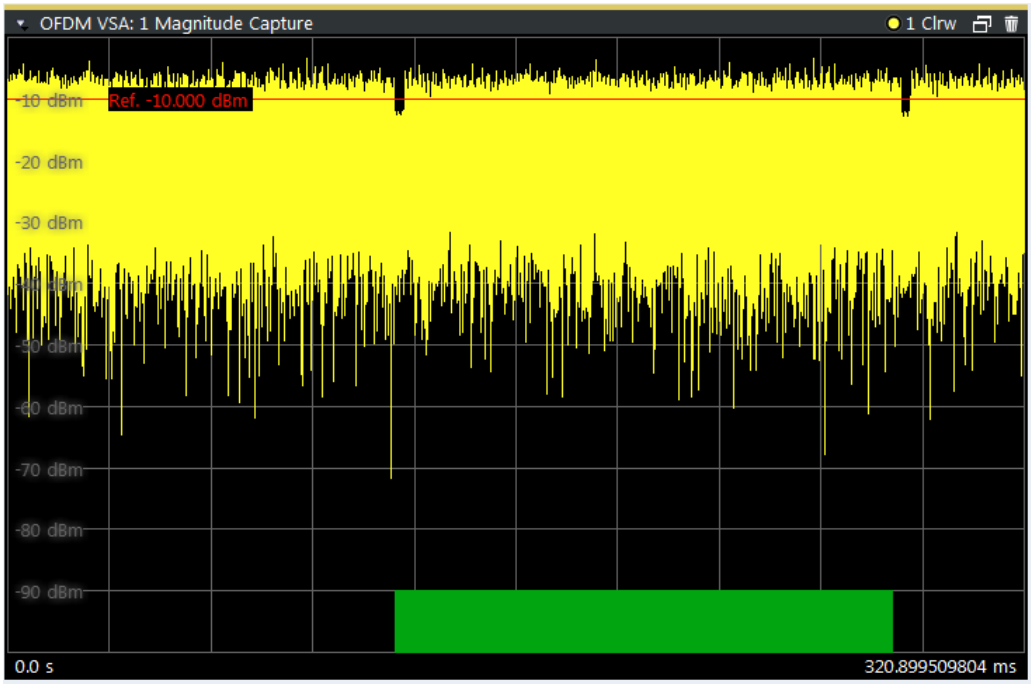


Figure 3-12: Magnitude Capture display

Remote command:
`LAY:ADD? '1',RIGH,MCAP`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.13, "Magnitude Capture", on page 159
`TRACe<n>[:DATA]:X?` on page 151
Time unit: `UNIT:TAXes` on page 113

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

3 Marker Table

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

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 132
Results:
`CALCulate<n>:MARKer<m>:X` on page 117
`CALCulate<n>:MARKer<m>:Y?` on page 147

Power vs Carrier
The Power vs. Carrier display shows the power of all OFDM symbols in the analyzed subframes for each carrier. The power is measured with a resolution bandwidth equal to the carrier spacing.

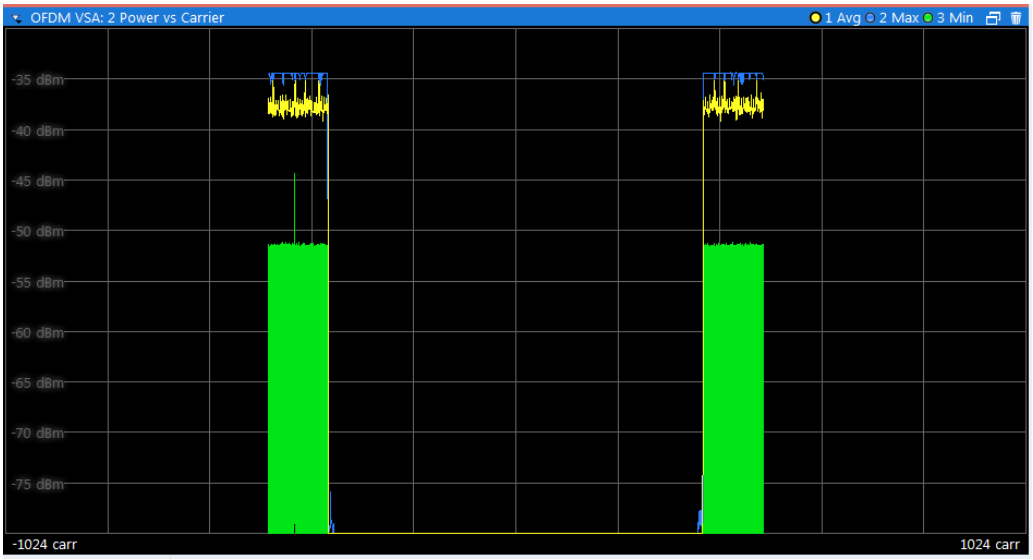


Figure 3-13: Power vs Carrier display

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,PCAR`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.14, "Power vs Carrier", on page 159
`TRACe<n>[:DATA]:X?` on page 151
Carrier unit: `UNIT:CAXes` on page 111

Power vs Symbol
The Power vs Symbol display shows the power of all OFDM carriers in the analyzed subframes for each symbol. The power is measured with a resolution bandwidth equal to the carrier spacing. Carriers which contain 'Zero'-cells over the complete symbol range (e.g. guard carriers or DC carrier) are excluded.

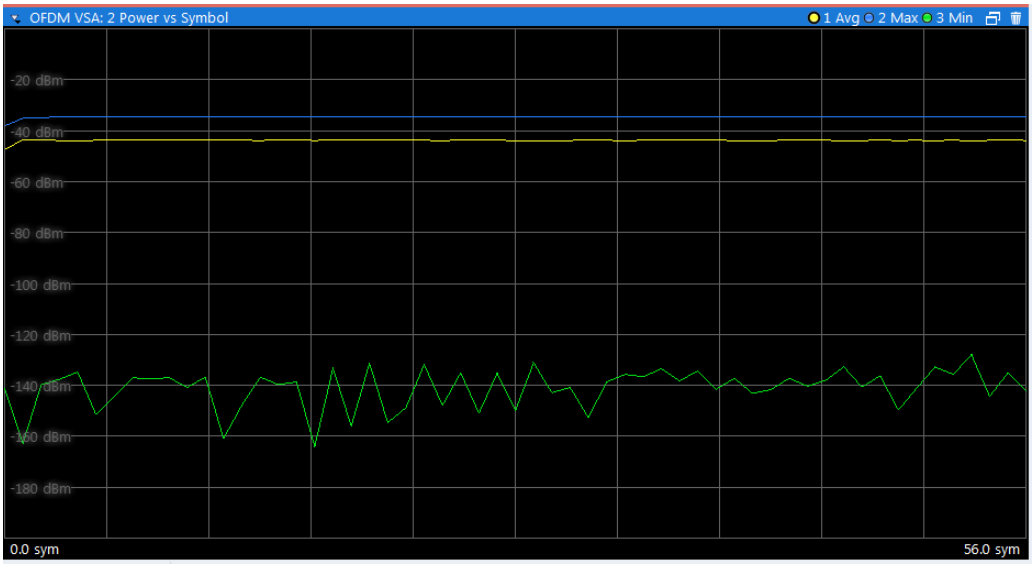


Figure 3-14: Power vs Symbol display

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,PSYM`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.15, "Power vs Symbol", on page 159
`TRACe<n>[:DATA]:X?` on page 151
Symbol unit: `UNIT:SAXes` on page 113

Power vs Symbol vs Carrier

The Power vs Carrier vs Symbol display shows the power of each carrier (= frequency domain) in each symbol (= time domain) of the analyzed subframes in dBm. The power is measured with a resolution bandwidth that equals the carrier spacing.

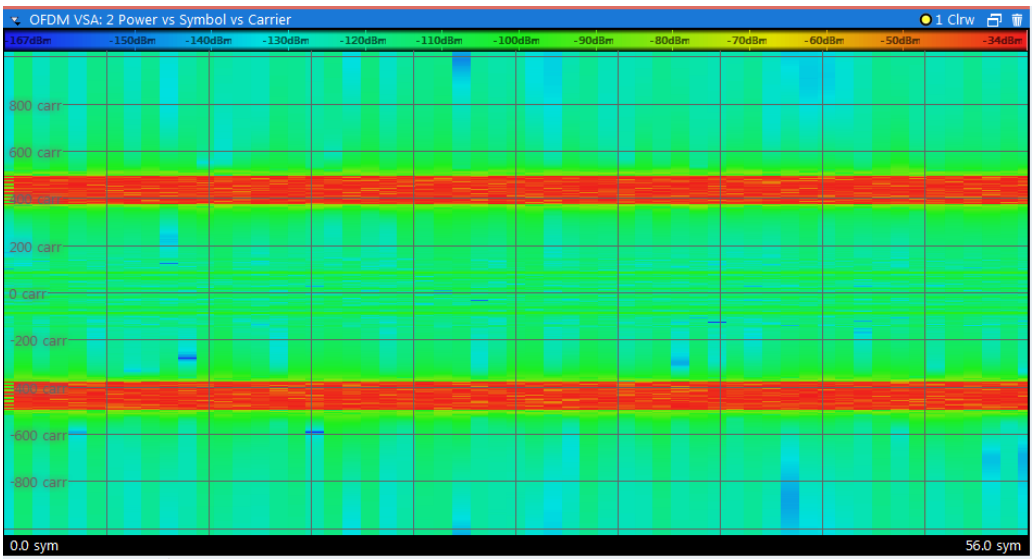


Figure 3-15: Power vs Symbol vs Carrier display

The power levels are represented by colors. The corresponding color map is displayed at the top of the result display.

Note: This result display is only available if synchronization is successful.

Remote command:
`LAY:ADD? '1',RIGH,PSC`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.16, "Power vs Symbol vs Carrier", on page 160
`TRACe<n>[:DATA]:X?` on page 151
`TRACe<n>[:DATA]:Y?` on page 151
Carrier unit: `UNIT:CAXes` on page 111
Symbol unit: `UNIT:SAXes` on page 113

Power Spectrum
The Power Spectrum display shows the power in dBm vs frequency results of the complete capture buffer. This display is always available.

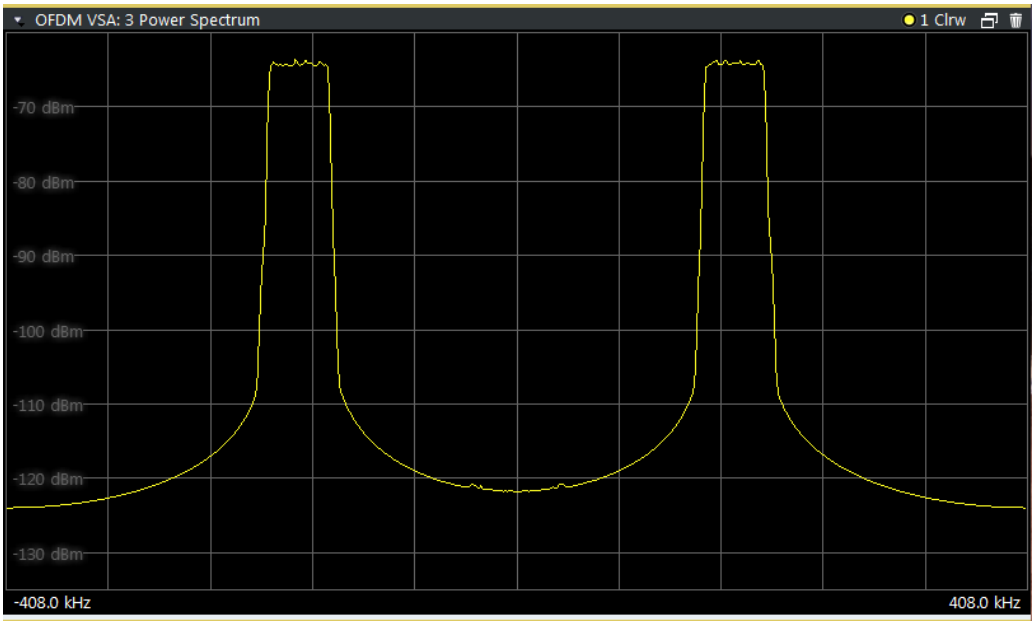
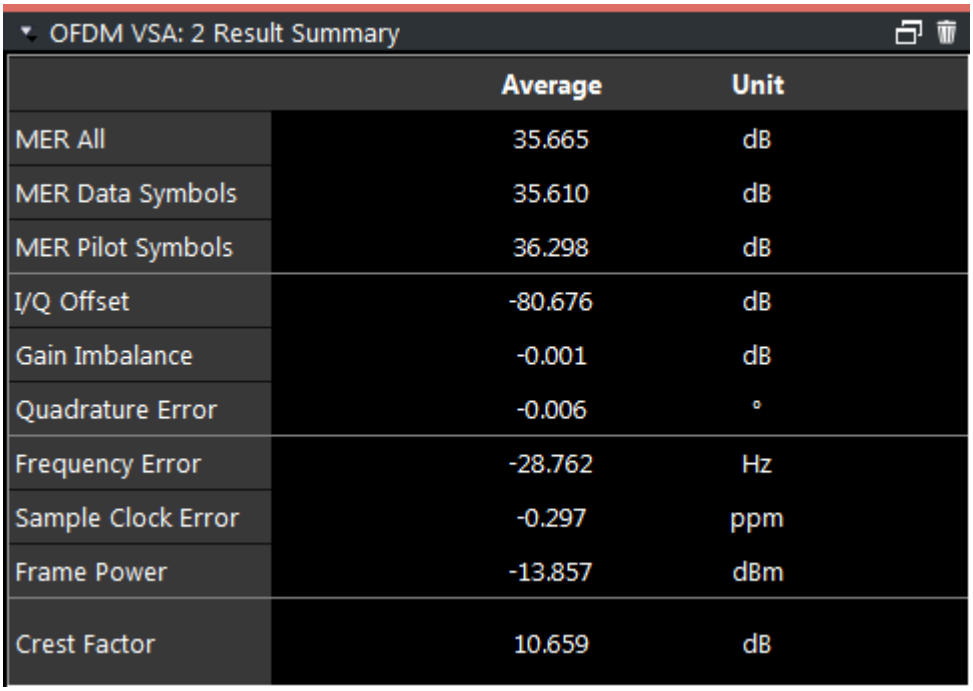


Figure 3-16: Power Spectrum display

Remote command:
`LAY:ADD? '1',RIGH,PSP`, see `LAYout:ADD[:WINDow]?` on page 132
`TRACe:DATA?`, see Chapter 7.7.4.17, "Power Spectrum", on page 160
Frequency unit: `UNIT:FAXes` on page 112

Result Summary
The Result Summary table provides numerical measurement results.


OFDM VSA: 2 Result Summary

	Average	Unit
MER All	35.665	dB
MER Data Symbols	35.610	dB
MER Pilot Symbols	36.298	dB
I/Q Offset	-80.676	dB
Gain Imbalance	-0.001	dB
Quadrature Error	-0.006	°
Frequency Error	-28.762	Hz
Sample Clock Error	-0.297	ppm
Frame Power	-13.857	dBm
Crest Factor	10.659	dB

Figure 3-17: Result Summary display

For details on the individual results, see Table 3-1.

Remote command:
`LAY:ADD? '1',RIGH,RSUM`, see `LAYout:ADD[:WINDow]?` on page 132
Results:
`FETCh:SUMMary[:ALL]?` on page 140

Signal Flow
The Signal Flow display shows a detailed description of the current measurement status. If demodulation is not successful, it provides useful hints on possible reasons. Unused blocks are shown in gray.

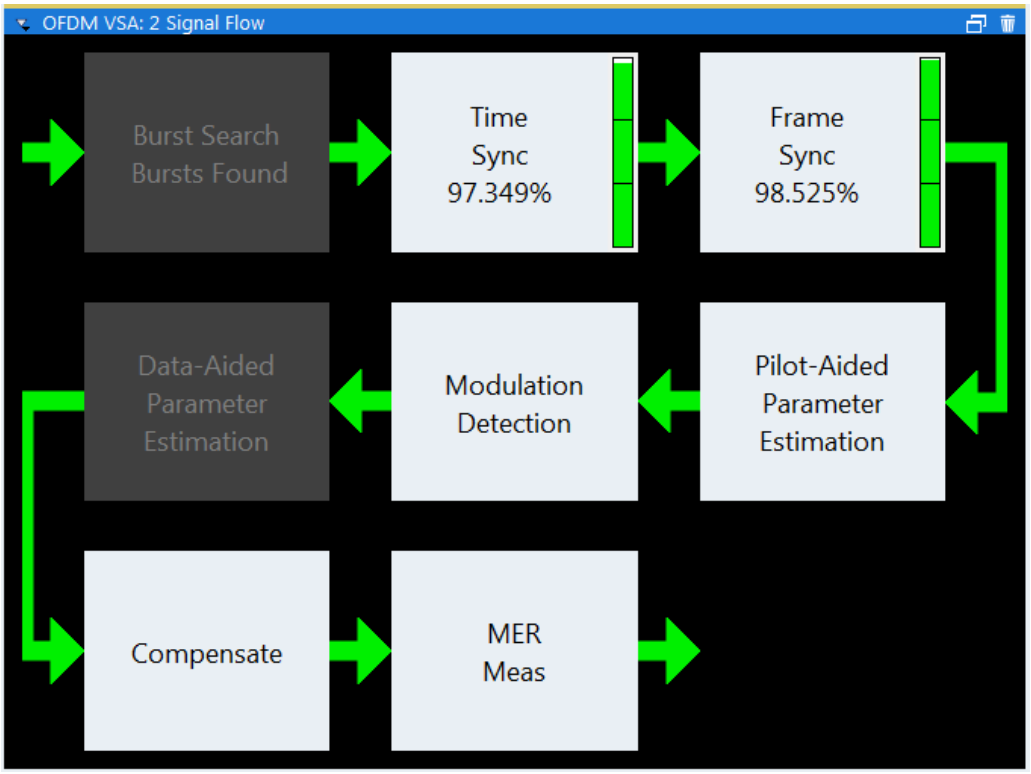


Figure 3-18: Signal Flow display

For the synchronization blocks, a colored bar provides information about the reliability of the synchronization result. If the level in the bar falls below the thresholds indicated by the horizontal line, the color of the bar changes from green to yellow and finally to red. If the synchronization of the block fails, all succeeding arrows change their color, too.

Remote command:
`LAY:ADD? '1',RIGH,SFL`, see `LAYout:ADD[:WINDow]?` on page 132
Retrieving results:
Chapter 7.7.2, "Retrieving Signal Flow Results", on page 141

4 Configuring CDR Measurements

CDR measurements require the R&S ETL-K470 CDR Signal Analysis Software license for the R&S ETL CDR software.

General R&S VSE functions

The application-independent functions for general tasks in the R&S VSE software are also available for CDR measurements and are described in the R&S VSE base software user manual. In particular, this comprises the following functionality:

- Controlling instruments and capturing I/Q data
- Data management
- General software preferences and information

4.1 Configuration Overview

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

The "Overview" is displayed when you select the "Overview" icon in the main toolbar, or the "Meas Setup > Overview" menu item.

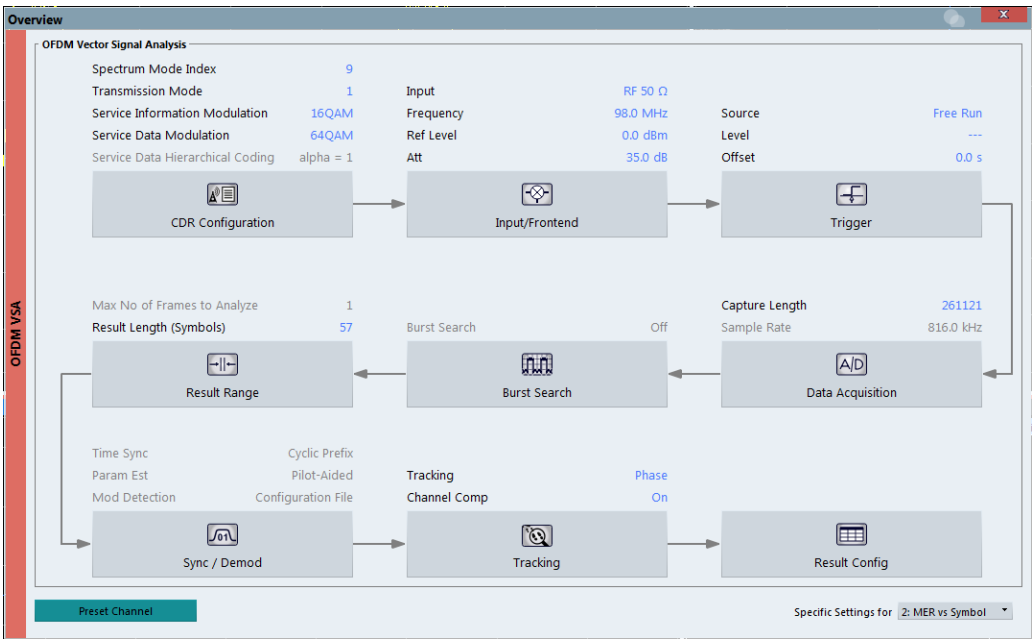


Figure 4-1: Configuration "Overview" for CDR measurements

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

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. CDR Configuration
   See Chapter 4.2, "CDR Configuration", on page 35
2. Input/Frontend
   See Chapter 4.3, "Input and Frontend Settings", on page 38
3. Trigger
   See Chapter 4.4, "Trigger Settings", on page 45
4. Data Acquisition
   See Chapter 4.5, "Data Acquisition", on page 48
5. Result Range
   See Chapter 4.6, "Result Ranges", on page 52
6. Synchronization and Demodulation Settings
   See Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52
7. Tracking
   See Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52
8. Result Configuration
   See Chapter 5.1, "Result Configuration", on page 57

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 left-hand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 79

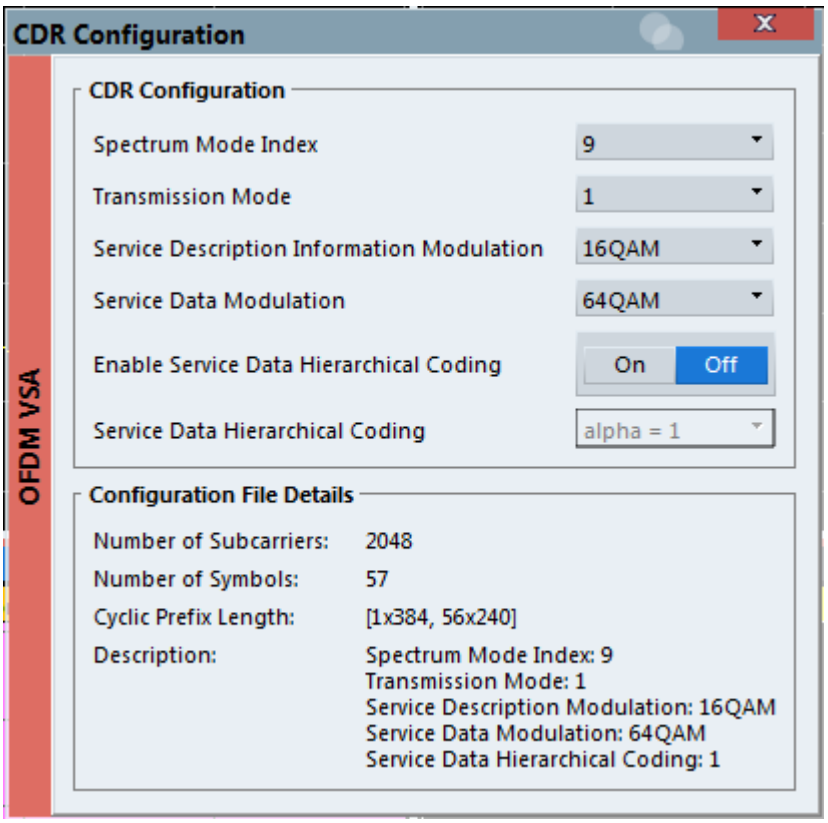
Specific Settings for
The channel may contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specific Settings 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.

4.2 CDR Configuration

You must describe the expected CDR input signal so that the R&S ETL CDR software can compare the measured signal to the expected reference signal. Depending on the CDR configuration, a predefined configuration file is loaded to the R&S ETL CDR software which contains all other parameters required for the CDR measurement.



Based on the CDR configuration, all relevant measurement parameters are set automatically in the R&S ETL CDR software:

- Configuration file
- Sample rate
- FFT
- CP length
- Filter settings
- Result length

Except for the filter settings, these parameters cannot be configured manually.

Filtering CDR signals

The R&S ETL CDR software uses an automatic filtering, especially designed for CDR signals. This filtering consists of two parts.

- The first filter is a channel filter to suppress the adjacent channels.
- The second filter is a high-pass filter to suppress the FM signal between the upper subband and the lower subband for spectrum mode index 9, 10, 22, or 23.

Depending on the spectrum mode index, the filter is automatically configured to remove the highest FM-deviation frequencies, without suppressing the CDR OFDM carriers. For the predefined filter configuration, a maximum carrier frequency offset of ±2 kHz is allowed. For higher frequency offsets, you must configure the Maximum Car-

rier Offset and the filters accordingly (see Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52 and "Filter Settings" on page 50).

Spectrum Mode Index
Defines the used spectrum mode according to the CDR standard. The spectrum mode index defines the distance between the lower and the upper half subband. The filter settings are adapted automatically according to the spectrum mode index.

See also "Filtering CDR signals" on page 36.

Remote command:
`CONFigure:CDR:SMODe` on page 81

Transmission Mode
Defines the used transmission mode according to the CDR standard. The transmission mode defines the CDR demodulation and measurement parameters. The following settings are adapted automatically according to the transmission mode:

- FFT
- CP length
- Result length

Remote command:
`CONFigure:CDR:TMODe` on page 81

Service Description Information Modulation
Defines the modulation type used for the service description information.

Remote command:
`CONFigure:CDR:IMODulation` on page 81

Service Data Modulation
Defines the modulation type used for the service data.

Remote command:
`CONFigure:CDR:DMODulation` on page 80

Enable Service Data Hierarchical Coding
If enabled, hierarchical coding for the service data is allowed (not for QPSK service data modulation). You can define the alpha parameter for coding in Service Data Hierarchical Coding.

If disabled, the coding parameter α = 1 is used.

Remote command:
CONFigure:CDR:HCODing:STATe on page 80

Service Data Hierarchical Coding
If hierarchical coding is enabled for service data (see Enable Service Data Hierarchical Coding), the alpha parameter for coding is defined here. Otherwise the coding parameter α = 1 is used.

Remote command:
CONFigure:CDR:HCODing on page 80

Configuration File Details
Indicates the most important measurement settings from the predefined configuration file for reference.

Number of Subcarriers ← Configuration File Details
Indicates the number of subcarriers used by the signal.

Number of Symbols ← Configuration File Details
Indicates the number of OFDM symbols.

Cyclic Prefix Length ← Configuration File Details
Indicates the length of the cyclic prefix (CP) area of an OFDM symbol in the time domain as a number of samples.

Since CDR signals use a beacon, two cyclic prefix lengths are indicated here.
- CP1 describes the cyclic prefix of the beacon.
- CP2 describes the cyclic prefix of the data body.

System description ← Configuration File Details
Provides a description of the signal configured in the file.

4.3 Input and Frontend Settings

Access: "Overview" > "Input/Frontend"

Or: "Input & Output"

The R&S ETL CDR software can evaluate signals from different input sources.

The frequency and amplitude settings represent the "frontend" of the measurement setup.

4.3.1 Input Source Settings

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

Or: "Input & Output" > "Input Source"

The R&S ETL CDR software can control the input sources of the connected instrument.

4.3.1.1 Radio Frequency Input

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

Or: "Input & Output" > "Input Source" > "Radio Frequency"

The default input source for the R&S ETL CDR software is "Radio Frequency".

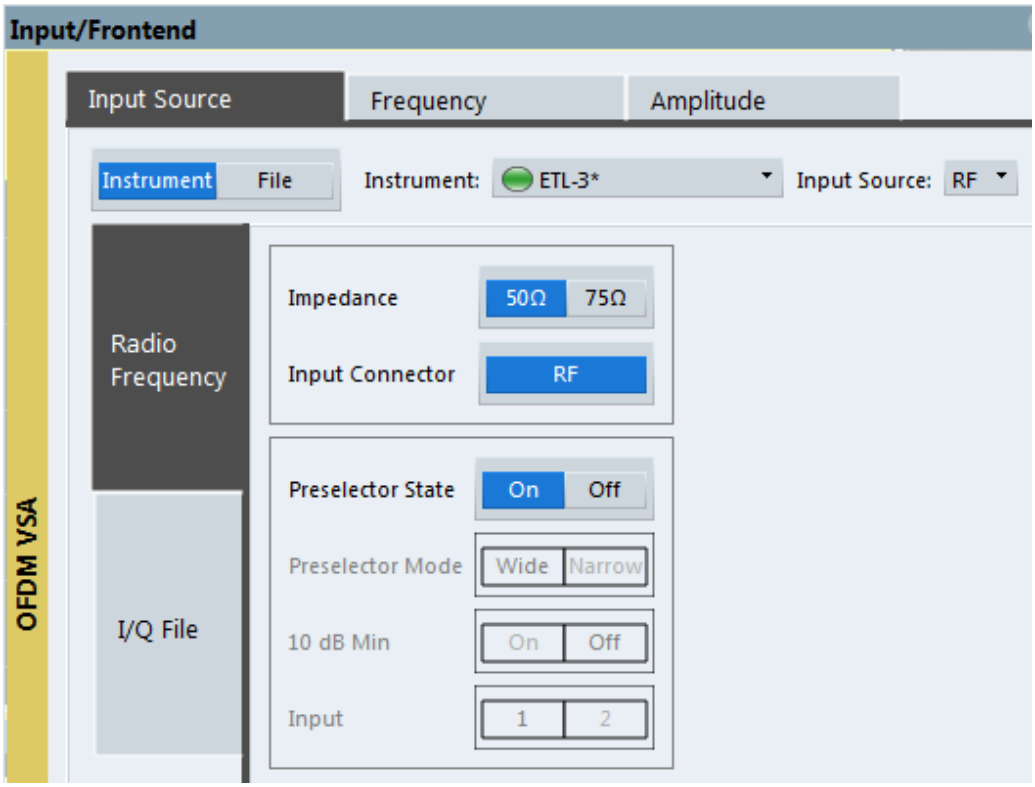


Figure 4-2: RF input source settings for an R&S ETL

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 85
`INPut<ip>:SELect` on page 84

Instrument
Specifies a configured instrument to be used for input.

For the R&S ETL CDR software, only an R&S ETL can be specified.

Impedance
By default, the R&S ETL has an input impedance of 50 Ω. If the optional preselector R&S ETL-B203 is installed, the reference impedance for the measured levels of the connected R&S ETL can be set to 50 Ω or 75 Ω.

This value also affects the unit conversion.

Remote command:
`INPut<ip>:IMPedance` on page 83

Preselector State
Turns the optional preselector R&S ETL-B203 on or off, if installed. No further settings are available for the preselector.

Remote command:
`INPut<ip>:PRESelection[:STATe]` on page 84

4.3.1.2 I/Q File Input

Access: "Overview" > "Input" > "Input Source" > "I/Q File"

Access: "Overview" > "Input/Frontend" > "Input Source" > "I/Q File"

Or: "Input & Output" > "Input Source" > "I/Q File"

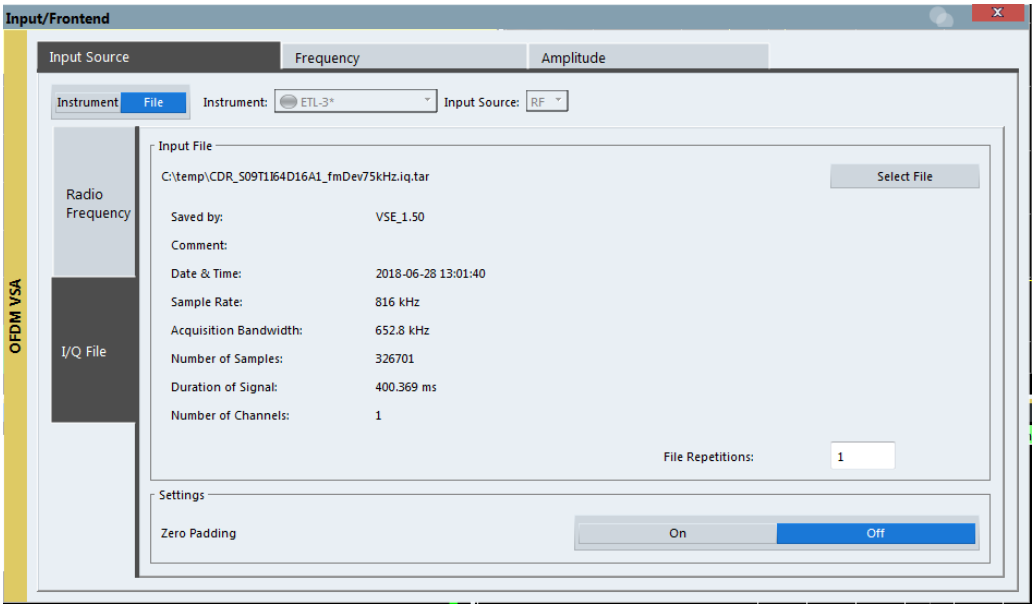
Alternatively to "live" data input from a connected instrument, measurement data to be analyzed by the R&S ETL CDR software can also be provided "offline" by a stored data file. This allows you to perform a measurement on any R&S ETL, store the results to a file, and analyze the stored data partially or as a whole at any time using the R&S ETL CDR software. Note that analysis with the R&S ETL CDR software requires an R&S ETL with the R&S ETL-K470 CDR Signal Analysis Software license installed to be connected.

Loading a file via drag&drop
You can load a file simply by selecting it in a file explorer and dragging it to the R&S ETL CDR software. Drop it into the "Measurement Group Setup" window or the channel bar for any channel. The channel is automatically configured for file input, if necessary. If the file contains all essential information, the file input is immediately displayed in the channel. Otherwise, the "Recall I/Q Recording" dialog box is opened for the selected file so you can enter the missing information.

For details see the R&S VSE base software user manual.

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

(See "Controlling Instruments and Capturing Data" in the R&S VSE base software user manual).



Encrypted `.wv` files can also be imported. Note, however, that traces resulting from encrypted file input cannot be exported or stored in a saveset.

See the Data Management chapter in the R&S VSE base software user manual.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Remote command:
`INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>` on page 85
`INPut<ip>:SELect` on page 84

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

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

(See "Data Management - Loading the I/Q Data File" in the R&S VSE base software user manual).

Zero Padding
Enables or disables zero padding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

If enabled, the required number of samples are inserted as zeros at the beginning and end of the file. The entire input data is analyzed. However, the additional zeros can effect the determined spectrum of the I/Q data. If zero padding is enabled, a status message is displayed.

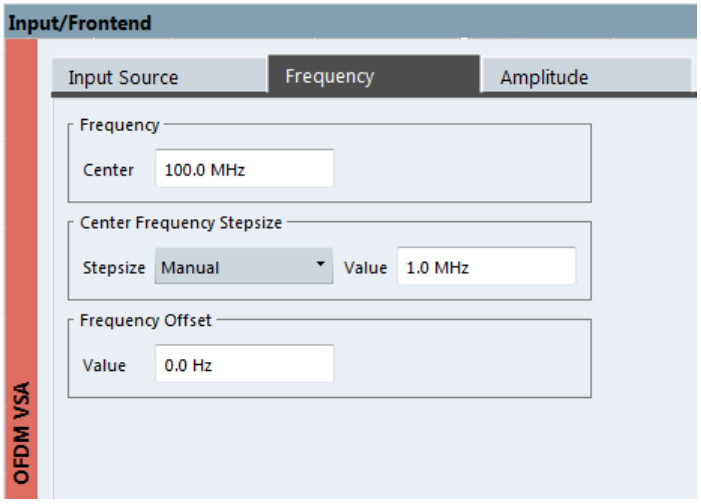
If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

Note: You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:
`INPut<ip>:FILE:ZPADing` on page 83

4.3.2 Frequency Settings

Access: "Input & Output" > "Frequency"



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

0 Hz ≤ f_{center} ≤ f_{max}

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

Note: For file input, you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the sample rate of the file data.

$$CF_{shift_{max}} = CF_{file} \pm \frac{SR_{file}}{2}$$

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

In order to ensure that the input data remains within the valid analysis bandwidth, define the center frequency and the analysis bandwidth for the measurement such that the following applies:

$$CF + \frac{ABW_{channel}}{2} > CF_{file} + \frac{ABW_{file}}{2}$$

$$CF - \frac{ABW_{channel}}{2} > CF_{file} - \frac{ABW_{file}}{2}$$

Remote command:
`[SENSe:]FREQuency:CENTer` on page 86

Center Frequency Stepsize
Defines the step size when scrolling through center frequency values. The step size can be set to a predefined value, or it can be manually set to a user-defined value.

"Auto" The step size is set to the default value of 1 MHz.

"Manual" Defines a user-defined step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
`[SENSe:]FREQuency:CENTer:STEP:AUTO` on page 87
`[SENSe:]FREQuency:CENTer:STEP` on page 87

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. However, if it shows frequencies relative to the signal's center frequency, it is not shifted.

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

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

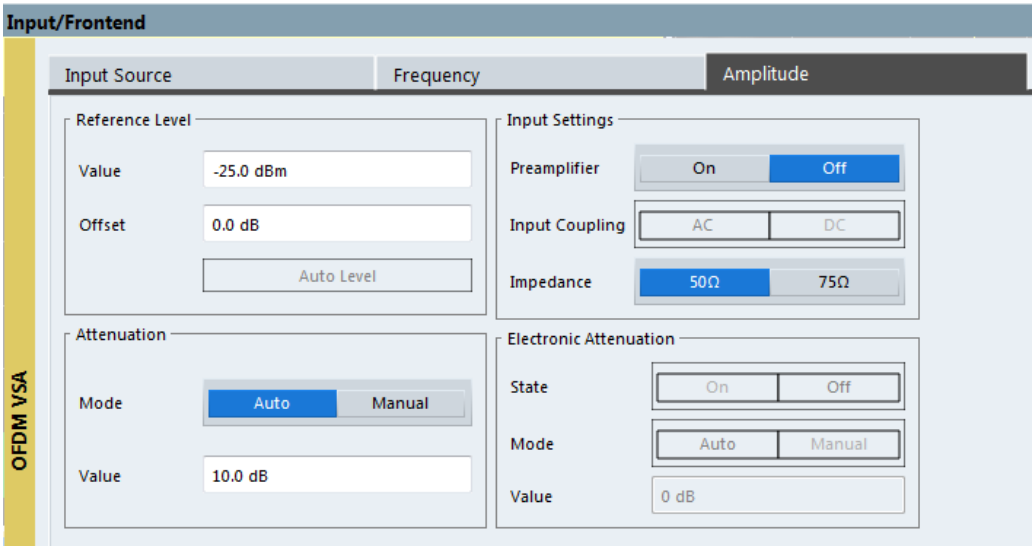
Remote command:
`[SENSe:]FREQuency:OFFSet` on page 87

4.3.3 Amplitude Settings

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

Or: "Input & Output" > "Amplitude"

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



Reference Level
Defines the expected maximum reference level. Signal levels above this value may not be measured correctly. This is indicated by an "IF Overload" status display.

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 connected R&S ETL 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 88

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 ETL CDR software 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 ETL CDR software 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 88

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

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

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

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

Remote command:
`INPut<ip>:ATTenuation` on page 88
`INPut<ip>:ATTenuation:AUTO` on page 89

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

Preamplifier ← Input Settings
You can use a preamplifier to analyze RF input from DUTs with low output power.

Remote command:
`INPut<ip>:GAIN:STATe` on page 91

Impedance ← Input Settings
By default, the R&S ETL has an input impedance of 50 Ω. If the optional preselector R&S ETL-B203 is installed, the reference impedance for the measured levels of the connected R&S ETL can be set to 50 Ω or 75 Ω.

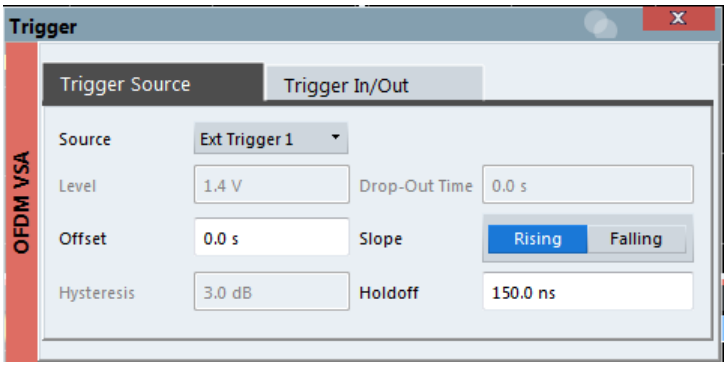
This value also affects the unit conversion.

Remote command:
`INPut<ip>:IMPedance` on page 83

4.4 Trigger Settings

Access: "Input & Output" > "Trigger"

Trigger settings determine when the input signal is measured.



Trigger Source
Selects 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 94

Free Run ← 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 94

External Trigger 1 ← Trigger Source
Data acquisition starts when the TTL signal fed into the trigger input connector of the R&S ETL CDR software meets or exceeds the specified trigger level.

(See " Trigger Level " on page 47).

Remote command:
`TRIG:SOUR EXT`
See `TRIGger[:SEQuence]:SOURce` on page 94

IF Power ← Trigger Source
The R&S ETL CDR software 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.

(The third IF represents the center frequency.)

This trigger source is only available for RF input.

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 94

Magnitude (Offline) ← Trigger Source
For (offline) input from a file, rather than an instrument. Triggers on a specified signal level.

Remote command:
`TRIG:SOUR MAGN`, see `TRIGger[:SEQuence]:SOURce` on page 94

Trigger Level
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 93

Trigger Offset
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)

(If supported by the connected R&S ETL.)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 92

Hysteresis
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" or "Magnitude (Offline)" trigger sources.

The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 92
`TRIGger[:SEQuence]:MAPower:HYSTeresis` on page 94

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

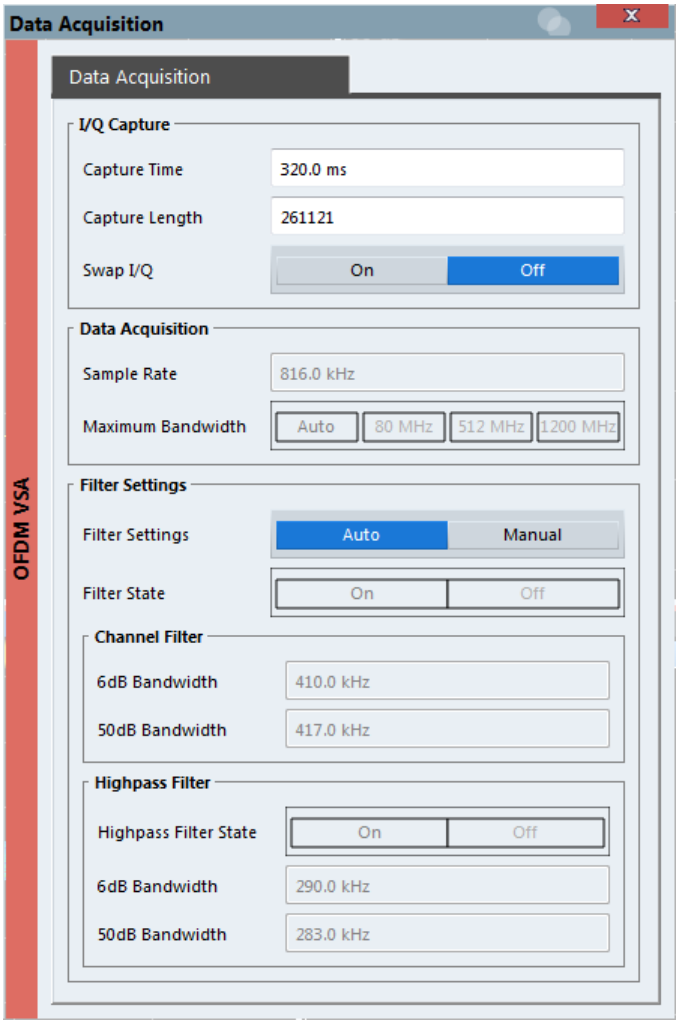
Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 92
`TRIGger[:SEQuence]:MAPower:HOLDoff` on page 93

Slope
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 94

4.5 Data Acquisition

Configure how data is to be acquired in the "Data Acquisition" dialog box.



Capture Time
Specifies the duration (and therefore the amount of data) to be captured in the capture buffer. If the capture time is too short, demodulation will fail. In particular, if the result length does not fit in the capture buffer, demodulation will fail.

For CDR, this means:

A CDR subframe has a duration of 160 ms. This is the minimal capture time for a successful demodulation for a triggered capture. The default capture time is 320.9 ms, so that untriggered captures will also contain one complete CDR subframe. For deactivated filters (see "Filter Settings" on page 50), the maximum capture time is 641.8 ms.

Remote command:
`[SENSe:]SWEep:TIME` on page 99

Capture Length
Defines the number of samples to be captured during each measurement. The required Capture Time is adapted accordingly.

Remote command:
`[SENSe:]SWEep:LENGth` on page 99

Swap I/Q
Activates or deactivates the inverted I/Q modulation. If the I and Q parts of the signal from the DUT are interchanged, the R&S ETL CDR software can do the same to compensate for it.

On	I and Q signals are interchanged Inverted sideband, Q+j*I
Off	I and Q signals are not interchanged Normal sideband, I+j*Q

Remote command:
`[SENSe:]SWAPiq` on page 98

Sample Rate
Defines the I/Q data sample rate of the R&S ETL CDR software.

For the R&S ETL CDR software, the sample rate is fixed to 816 kHz.

Remote command:
`TRACe:IQ:SRATe` on page 99

Maximum Bandwidth
Depending on the connected R&S ETL, the maximum bandwidth to be used by the R&S ETL CDR software for I/Q data acquisition can be restricted. This setting is only available if a bandwidth extension option is installed on the connected R&S ETL. Otherwise the maximum bandwidth is determined automatically.

The available values depend on the instrument and the installed bandwidth extension options. For details see the instrument's documentation.

For the R&S ETL CDR software, the maximum bandwidth is always determined automatically.

Remote command:
`TRACe:IQ:WBANd[:STATe]` on page 100
`TRACe:IQ:WBANd:MBWidth` on page 100

Filter Settings
Defines whether the filters are configured automatically according to the loaded configuration file.

Remote command:
`INPut<ip>:FILTer:CHANnel[:LPASs]:AUTO` on page 96

Filter State
Defines whether a channel filter - and a highpass filter, if active - is applied to the I/Q data before OFDM demodulation.

Remote command:
`INPut<ip>:FILTer:CHANnel[:LPASs][:STATe]` on page 98

6-dB Bandwidth
Configures the bandwidth of the channel filter at which an attenuation of 6 dB is reached (see Figure 4-3). The filter bandwidth cannot be higher than the current Sample Rate. If necessary, the filter bandwidth is adapted to the current sample rate.

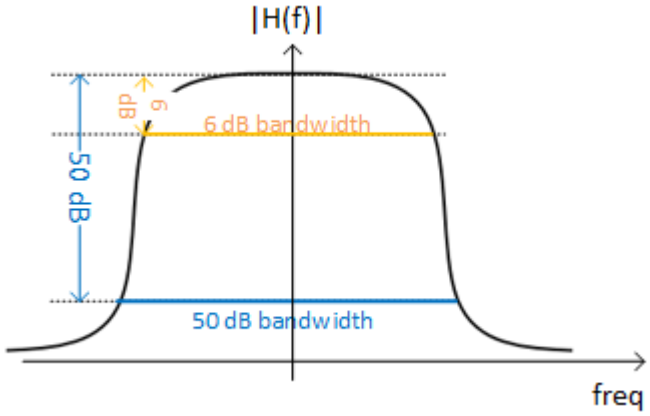


Figure 4-3: Definition of filter bandwidths

Remote command:
`INPut<ip>:FILTer:CHANnel[:LPASs]:SDBBw` on page 97

50-dB Bandwidth
Configures the 50-dB bandwidth of the channel filter. The 50-dB bandwidth is the bandwidth at which the filter reaches an attenuation of 50 dB (see Figure 4-3). This bandwidth must always be larger than the "6-dB Bandwidth" on page 50. If necessary, the 50-dB bandwidth is adapted to the current 6-dB bandwidth.

Remote command:
`INPut<ip>:FILTer:CHANnel[:LPASs]:FDBBw` on page 97

Highpass Filter State
Activates or deactivates an additional internal highpass filter.

Remote command:
`INPut<ip>:FILTer:CHANnel:HPASs[:STATe]` on page 97

6-dB Bandwidth
Configures the bandwidth of the high pass filter at which an attenuation of 6 dB is reached (see Figure 4-3). The filter bandwidth cannot be higher than the current 6-dB Bandwidth of the channel filter. If necessary, the filter bandwidth is adapted to the same value.

Remote command:
`INPut<ip>:FILTer:CHANnel:HPASs:SDBBw` on page 96

50-dB Bandwidth
Indicates the 50-dB bandwidth of the high pass filter. The 50-dB bandwidth is the bandwidth at which the filter reaches an attenuation of 50 dB (see Figure 4-3). This bandwidth must always be smaller than the 6-dB Bandwidth of the high pass filter.

The 50-dB bandwidth cannot be defined manually. It is automatically determined according to the relation between the 6-dB bandwidth and the 50-dB bandwidth of the channel filter (see 6-dB Bandwidth and 50-dB Bandwidth).

Remote command:
`INPut<ip>:FILTer:CHANnel:HPASs:FDBBw?` on page 96

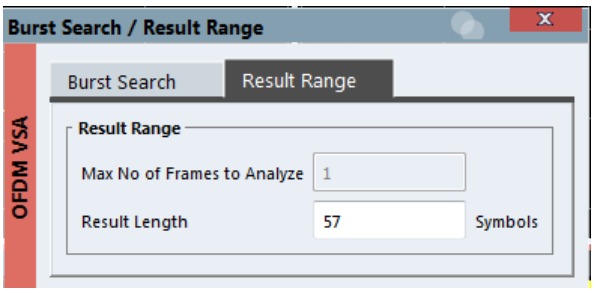
Refresh
Access: "Auto Set" toolbar:

Repeats the evaluation of the data currently in the capture buffer without capturing new data. This is useful after changing settings, for example filters or evaluation ranges.

Remote command:
`INITiate:REFResh` on page 96

4.6 Result Ranges

The result range is an extract from the capture buffer and defines the data basis used for further analysis.



Max No of Frames to Analyze
Defines the maximum number of OFDM frames from the current capture buffer to be included in analysis.

For the R&S ETL CDR software, a single subframe is analyzed.

Result Length
Configures the number of OFDM symbols per subframe to be analyzed. This value is determined automatically based on the Transmission Mode (see Chapter 4.2, "CDR Configuration", on page 35). Note that this default value is the maximum value, lower values can be entered manually.

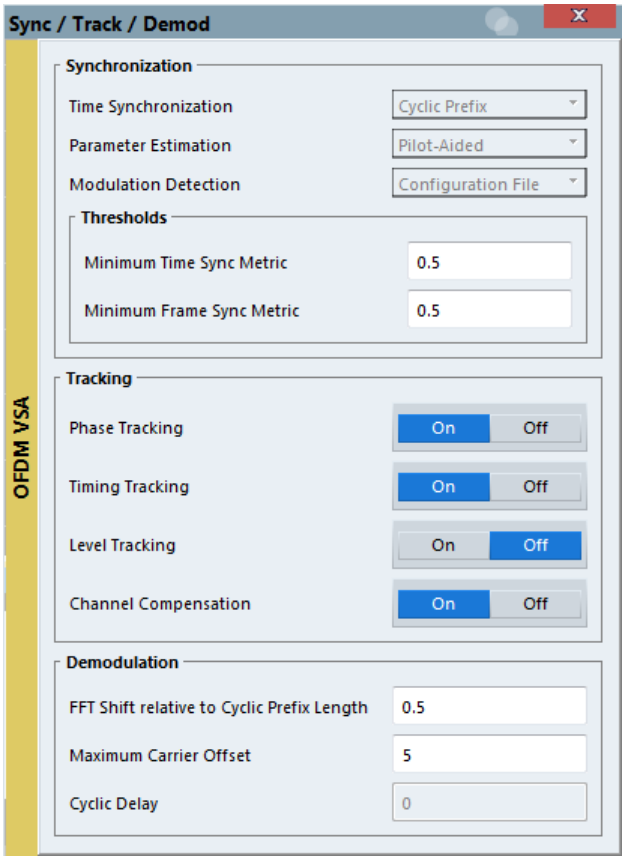
Remote command:
`[SENSe:]DEMod:FORMat:NOFSymbols` on page 100

4.7 Synchronization, Demodulation and Tracking

Access: "Overview" > "Sync / Demod"/"Tracking"

Or: "Meas Setup" > "Sync / Demod"/"Tracking"

The following settings determine how the input signal is synchronized, demodulated, and tracked.



Time Synchronization
Specifies the synchronization method in the time domain.

For the R&S ETL CDR software, time synchronization always uses the cyclic prefix method, which performs a correlation of the cyclic prefix with the end of the FFT interval.

Remote command:
`[SENSe:]DEMod:TSYNc` on page 103

Parameter Estimation
Defines which parts of the OFDM signal are used for the parameter estimation.

For the R&S ETL CDR software, parameter estimation always considers only the predefined pilot cells.

Remote command:
`[SENSe:]DEMod:FSYNc` on page 102

Modulation Detection
Specifies how the modulation of the data cells is detected.

The R&S ETL CDR software can use the modulation configured in the configuration file for each cell.

For the R&S ETL CDR software, modulation detection always uses the modulation format configured for the cell.

Remote command:
`[SENSe:]DEMod:MDETect` on page 103

Synchronization Thresholds
If you require a particular reliability in synchronization results, define thresholds for the success of synchronization required to calculate results. The current reliability is indicated in the Signal Flow.

High thresholds are useful if several similar, but not identical frames, must be distinguished. In this case, it is important that the application synchronizes only to the correct frame in order to obtain correct results.

On the other hand, if the signal quality is poor, only a low level of reliability in synchronization can be achieved. In this case, high thresholds may prevent the application from evaluating any frames at all.

Minimum Time Sync Metric ← Synchronization Thresholds
Defines the minimum reliability required for time synchronization.

Values between 0 and 1 are allowed, where:
- 0: low threshold, a very poor reliability is sufficient to synchronize successfully (always fulfilled)
- 1: high threshold, time synchronization must be absolutely reliable to be successful (only possible for ideal signal).

The default value is 0.5, that means: for a reliability of 50 %, time synchronization is successful.

Minimum Frame Sync Metric ← Synchronization Thresholds
Defines the minimum correlation rate of the CP or preample for frame synchronization to be successful.

Values between 0 and 1 are allowed, where:
- 0: low threshold, a very poor correlation is sufficient to synchronize successfully (always fulfilled)
- 1: high threshold, correlation must be very precise for frame synchronization to be successful (only possible for ideal signal).

The default value is 0.5, that means: for a correlation of 50 %, frame synchronization is successful.

Phase Tracking
Defines whether phase tracking is used to improve the signal quality. The compensation is done on a per-symbol basis.

Remote command:
`SENSe:TRACking:PHASe` on page 104

Timing Tracking
Defines whether timing tracking is used to improve the signal quality (for sample clock deviations). The compensation is done on a per-symbol basis.

Remote command:
`SENSe:TRACking:TIME` on page 104

Level Tracking
Defines whether level tracking is used to improve the signal quality (for power level deviations). The compensation is done on a per-symbol basis.

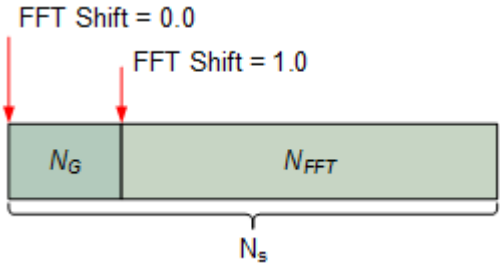
Remote command:
`SENSe:TRACking:LEVel` on page 103

Channel Compensation
Defines whether channel tracking is used to improve the signal quality (for the channel transfer function). The compensation is done on a per-carrier basis.

Remote command:
`[SENSe:]COMPensate:CHANnel` on page 101

FFT Shift relative to Cyclic Prefix Length
Defines the starting point of the FFT relative to the cyclic prefix length. Thus, you can shift the FFT start sample within the guard interval. This is useful if relevant parts of the channel impulse response fall outside the cyclic prefix interval.

A value of 0 is the first sample; a value of 1.0 is the last sample of the cyclic prefix.



Remote command:
`[SENSe:]DEMod:FFTShift` on page 102

Maximum Carrier Offset
The R&S ETL CDR software can compensate for possible carrier offsets. However, searching for offsets slows down the measurement. This setting defines the range of carriers in which the R&S ETL CDR software searches for an offset.

To eliminate the search for carrier offset altogether, set the number of carriers to 0. In this case, the center frequency offset must be less than half the carrier distance to obtain useful results.

The default value of 5 carriers allows for a frequency offset compensation of up to ±2 kHz.

Remote command:
`[SENSe:]DEMod:COFFset` on page 102

Cyclic Delay
Defines a cyclic shift of the FFT values for each OFDM symbol on the transmitter end before adding the cyclic prefix. This known shift should be compensated in the receiver to get a correct channel phase response.

For the R&S ETL CDR software, the cyclic delay is always assumed to be 0.

Remote command:
`[SENSe:]DEMod:CDD` on page 101

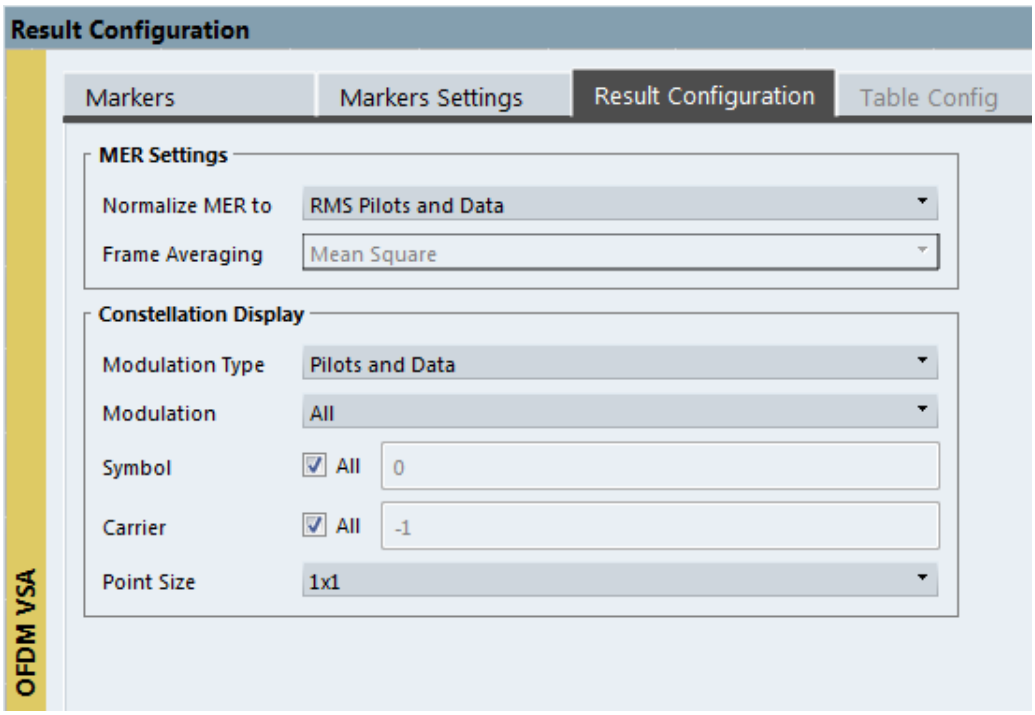
5 Analyzing CDR Vector Signals

Access: "Overview" > "Result Configuration"

General result analysis settings concerning the trace, markers, windows etc. can be configured. They are identical to the analysis functions in the base unit except for the special window functions.

5.1 Result Configuration

Some result displays provide further settings.



Normalize MER to
Specifies the OFDM cells which are averaged to get the reference magnitude for MER normalization.

"RMS Pilots & Data"	RMS value of the pilot and data cells
"RMS Data"	RMS value of the data cells
"RMS Pilots"	RMS value of the pilot cells
"Peak Pilots & Data"	Peak value of the pilot and data cells
"Peak Data"	Peak value of the data cells
"Peak Pilots"	Peak value of the pilot cells
"None"	Normalization is turned off.

Remote command:
`[SENSe:]DEMod:EVMCalc:NORMalize` on page 107

Frame Averaging
Not available for the R&S ETL CDR software.

Constellation Display - Modulation Type
The constellation diagram includes only symbols for the selected modulation types. The selected modulation types are indicated in the constellation diagram for reference.

Remote command:
`CONFigure:FILTer<n>:MODulation:TYPE` on page 108

Constellation Display - Modulation
The constellation diagram includes only symbols with the selected modulation.

Remote command:
`CONFigure:FILTer<n>:MODulation` on page 107

Constellation Display - Symbol
The constellation diagram includes all or only the specified symbol number. The first symbol number is 0.

Remote command:
`CONFigure:FILTer<n>:SYMBol` on page 108

Constellation Display - Carrier
The constellation diagram includes symbols for all or only for the specified carrier number.

Remote command:
`CONFigure:FILTer<n>:CARRier` on page 107

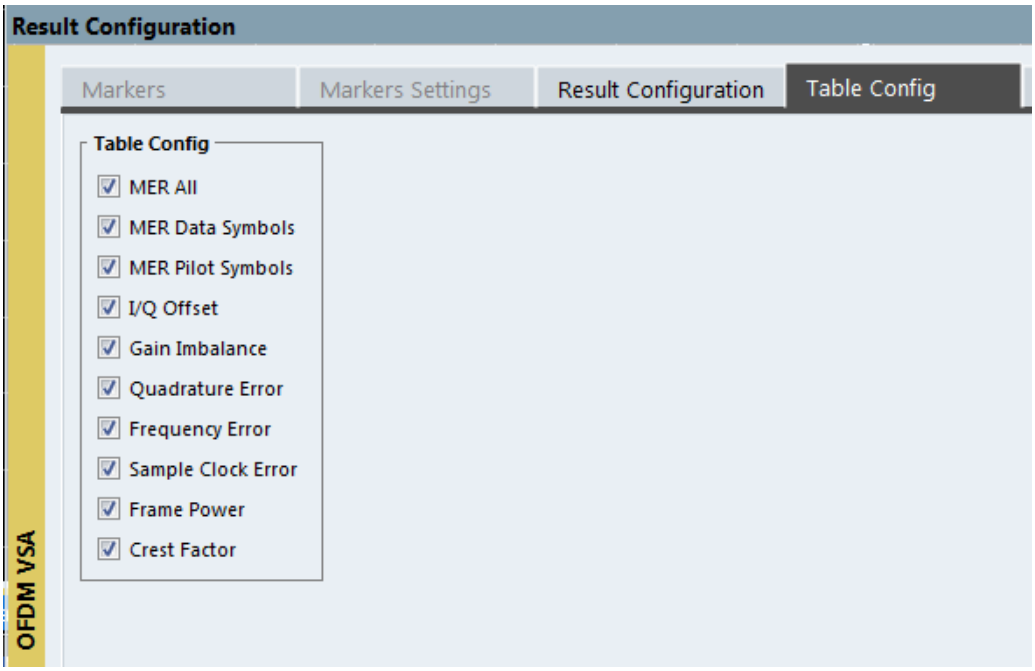
Constellation Display - Point Size
Defines the size of the individual points in a constellation diagram.

5.2 Table Configuration

Access: "Overview" > "Result Configuration" > "Table Config"

Or: "Meas Setup" > "Result Configuration" > "Table Config" tab

During each measurement, a large number of characteristic signal parameters are determined. Select the parameters to be included in the table. For a description of the individual parameters, see Chapter 3.1, "CDR Parameters", on page 14.

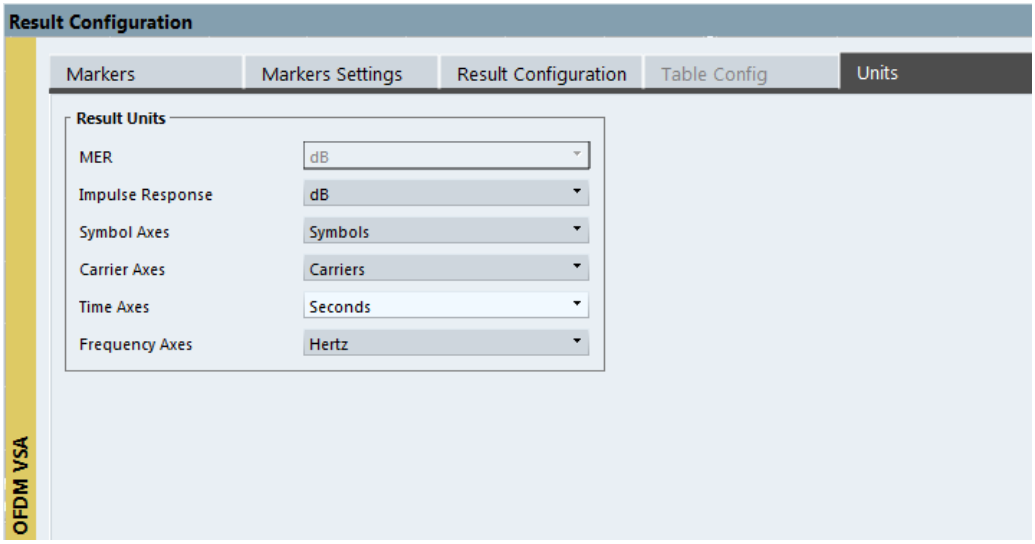


5.3 Units

Access: "Overview" > "Result Configuration" > "Units"

Or: "Meas Setup" > "Result Configuration" > "Units" tab

For some result configurations, the unit of the displayed values can be configured.



Remote command:

`UNIT:IRESponse` on page 112

`UNIT:SAXes` on page 113

`UNIT:CAXes` on page 111

`UNIT:TAXes` on page 113

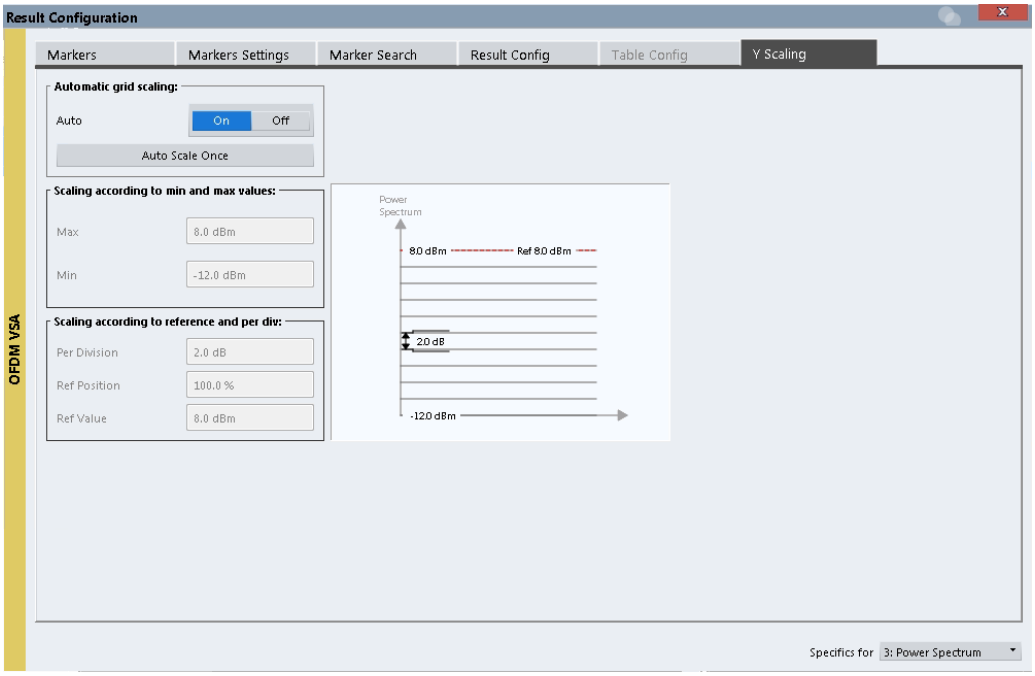
`UNIT:FAXes` on page 112

5.4 Y-Scaling

Access: "Overview" > "Result Configuration" > "Y Scaling"

Or: "Meas Setup" > "Result Configuration" > "Y Scaling" tab

The scaling for the vertical axis is highly configurable, using either absolute or relative values. Note that scaling settings are window-specific and not available for all result displays.



Automatic Grid Scaling
The y-axis is scaled automatically according to the current measurement settings and results (continuously).

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the Auto Scale Once function.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 109

Auto Scale Once
If enabled, both the x-axis and y-axis are automatically adapted to the current measurement results (only once, not dynamically) in the selected window.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 109

Absolute Scaling (Min/Max Values)
Define the scaling using absolute minimum and maximum values.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 109
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 110

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 110

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 111

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue` on page 111

5.5 Markers

Access: "Overview" > "Result Config" > "Markers"

Or: "Marker"

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

Markers in 3-dimensional diagrams

Some diagrams have a third dimension - in addition to the x-axis and y-axis they show a third dimension (z-dimension) of results using different colors. For such diagrams, you must define the position of the marker both in the x-dimension and in the y-dimension to obtain the results in the z-dimension.

Markers in the Constellation diagram and Allocation Matrix

Using markers in a Constellation diagram you can detect individual constellation points for a specific symbol or carrier. When you activate a marker in the Constellation diagram, its position is defined by the symbol and carrier number the point belongs to, while the marker result indicates the I and Q values of the point.

Similarly, you can define markers in an Allocation Matrix by selecting the symbol and carrier number.

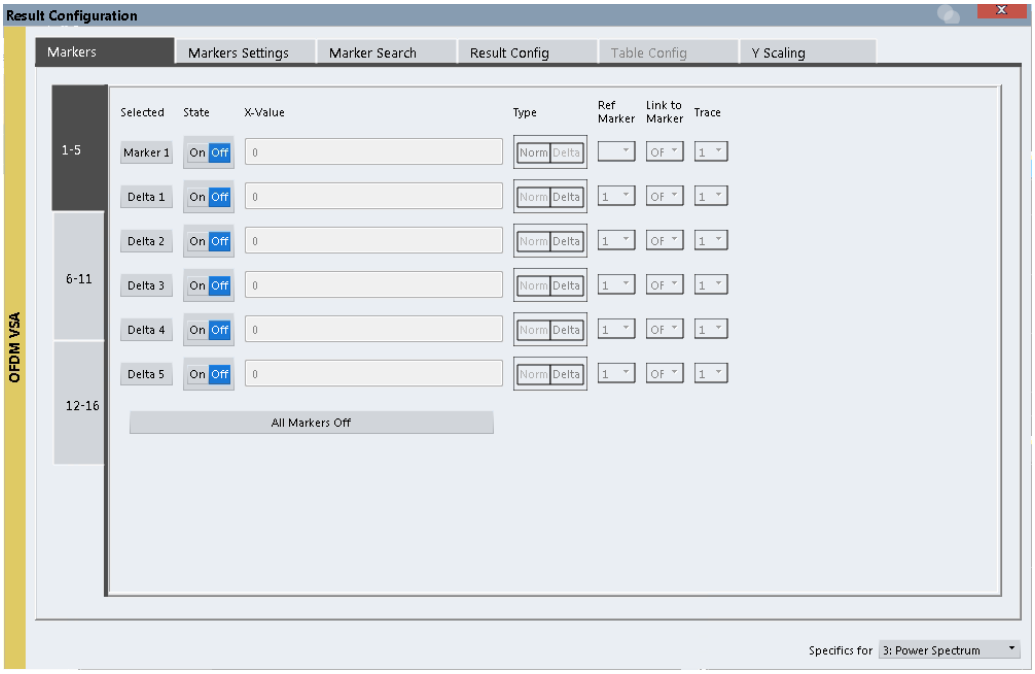
Using markers in the Constellation diagram and Allocation Matrix you can scroll through the points for a specific carrier, for example. Activate a marker, then use the rotary knob or mouse wheel to move the marker from one symbol to the next.

5.5.1 Individual Marker Settings

Access: "Overview" > "Result Config" > "Markers"

Or: "Marker" > "Marker"

In CDR evaluations, up to 16 markers can be activated in each diagram at any time.



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

Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16
To activate a marker, select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker" > "Select Marker" menu. Enter the marker position ("X-value") in the edit dialog box.

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

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 116
`CALCulate<n>:MARKer<m>:X` on page 117
`CALCulate<n>:MARKer<m>:Y?` on page 147
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 119
`CALCulate<n>:DELTamarker<m>:X` on page 119
`CALCulate<n>:MARKer<m>:Y?` on page 147
`CALCulate<n>:DELTamarker<m>:Y?` on page 145

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 116
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 119

X-value
Defines the position of the marker on the x-axis.

For Constellation diagrams, the position is defined by a symbol number.

Remote command:
`CALCulate<n>:DELTamarker<m>:X` on page 119
`CALCulate<n>:MARKer<m>:X` on page 117

Y-value
Defines the position of the marker on the y-axis for 3-dimensional diagrams.

For Constellation diagrams, the position is defined by a carrier number.

Remote command:
CALCulate<n>:DELTamarker<m>:Y? on page 145
CALCulate<n>:MARKer<m>:Y? on page 147

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 116
CALCulate<n>:DELTamarker<m>[:STATe] on page 119

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

If the reference marker is deactivated, the delta marker referring to it is also deactivated.

Remote command:
CALCulate<n>:DELTamarker<m>:MREF on page 118

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the initial marker is changed, the linked marker follows to the same position on the x-axis. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> on page 116
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> on page 118
CALCulate<n>:DELTamarker<m>:LINK on page 118

Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 117

All Marker Off

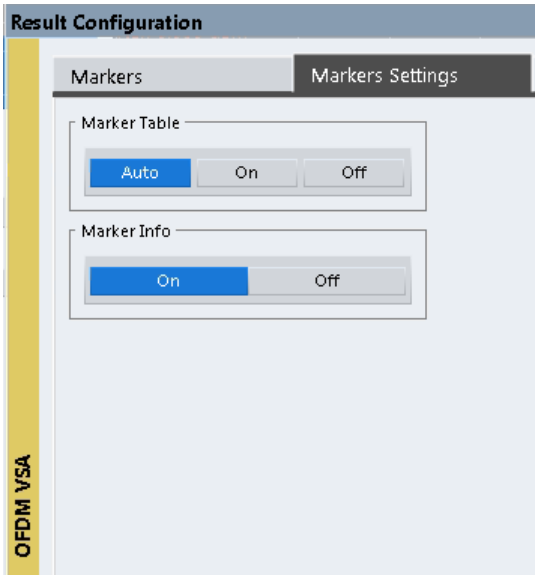
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 115

5.5.2 General Marker Settings

Access: "Overview" > "Result Configuration" > "Marker Settings"

Or: "Marker" > "Marker" > "Marker Settings" tab



Marker Table Display
Defines how the marker information is displayed.

"On" Displays the marker information in a table in a separate area beneath the diagram.

"Off" No separate marker table is displayed.

Remote command:
`DISPlay[:WINDow<n>]:MTABle` on page 120

Marker Info
Turns the marker information displayed in the diagram on and off.

Remote command:
DISPlay:MINFo[:STATe] on page 120

5.5.3 Marker Positioning Functions

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

Access: "Marker" toolbar

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 125
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 122

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 124
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 124
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 124
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 122
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 122
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 121

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 126
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 123

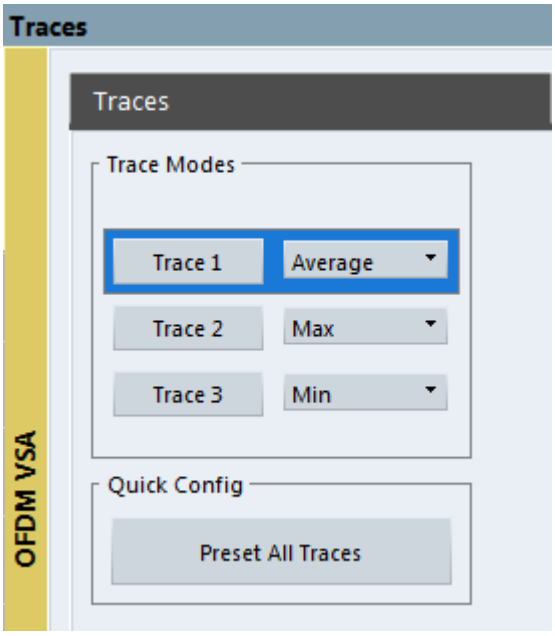
Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

«, »

Remote command:
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 125
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 125
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 125
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 123
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 122
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 123

5.6 Trace Settings

Access: "Trace" > "Trace"



The trace settings determine how the measured data is analyzed and displayed in the window.

Depending on the result display, between 1 and 3 traces are available.

Trace data can also be exported to an ASCII file for further analysis. For details, see Chapter 5.7, "Trace / Data Export Configuration", on page 70.

Trace 1/Trace 2/Trace 3
Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 115
Selected via numeric suffix of `TRACe<t>` commands

Trace Mode
Defines the update mode for subsequent traces.

"Clear/ Write" Overwrite mode (default): the trace is overwritten by each measurement.

"Max Hold" The maximum value is determined over several measurements and displayed. The R&S ETL CDR software 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 ETL CDR software 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 114

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
		Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
		Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold

Function	Trace Settings	
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

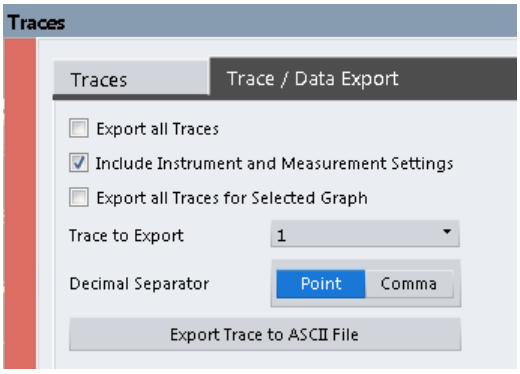
5.7 Trace / Data Export Configuration

Access: "Edit" > "Trace Export"

Traces resulting from encrypted file input cannot be exported.

The standard data management functions (e.g. saving or loading instrument settings, or exporting the I/Q data in other formats) that are available for all R&S VSE applications are not described here.

See the R&S VSE base software user manual for a description of the standard functions.



Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. Result Summary, marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`FORMat:DEXPort:TRACes` on page 149

Include Instrument & Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 149

Export All Traces for Selected Graph
Includes all traces for the currently selected graphical result display in the export file.

Remote command:
`FORMat:DEXPort:GRAPh` on page 149

Trace to Export
Defines an individual trace to be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 148

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (**`.dat`**) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Note: Traces resulting from encrypted file input cannot be exported.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 150

6 How to Perform Measurements in the R&S ETL CDR software

The following step-by-step instructions demonstrate how to perform measurements with the R&S ETL CDR software.

To perform a CDR measurement

1. By default, a CDR channel is active when you start the R&S ETL CDR software. If no channel is active, open a new channel or replace an existing one and select the "OFDM VSA" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a CDR measurement.
3. Select the "CDR Configuration" button and configure the expected signal characteristics.
4. Select the "Input/Frontend" button to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Add Window" icon from the toolbar to add further result displays for the CDR.
7. In the "Control" toolbar, or in the "Sequence" tool window, select "Single" capture mode, then select the ▶ "Capture" function to stop the continuous measurement mode and start a defined number of measurements.

   The measured data is stored in the capture buffer and can be analyzed.

7 Remote Commands for CDR Measurements

The following commands are required to perform CDR measurements in a remote environment.

It is assumed that the R&S ETL CDR software has already been set up for remote control in a network as described in the R&S VSE base software user manual.

General R&S VSE Remote Commands

The application-independent remote commands for general tasks in the R&S VSE software are also available for the R&S ETL CDR software and are described in the R&S VSE base software user manual. In particular, this comprises the following functionality:

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

Channel-specific commands

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

The following tasks specific to the R&S ETL CDR software are described here:

7.1 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 ETL CDR software.

Remote command examples

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

7.1.1 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 ETL CDR software 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**
  The default unit is 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.

7.1.2 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`.

7.1.3 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.

7.1.4 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.

7.1.5 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`.

7.1.6 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.

7.1.6.1 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.

7.1.6.2 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`

7.1.6.3 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 7.1.2, "Long and Short Form", on page 75.

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`

7.1.6.4 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'
```

7.1.6.5 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.

7.2 Common Suffixes

In the R&S ETL CDR software, the following common suffixes are used in remote commands:

Table 7-1: Common suffixes used in remote commands in the R&S ETL CDR software

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to x	Window (**in the currently selected channel**)

Suffix	Value range	Description
<t>	1 to 3	Trace
	1 to 8	Limit line

7.3 Activating CDR Measurements

CDR measurements require a special application in the R&S ETL CDR software. The common commands for configuring and controlling measurement channels, as well as blocks and sequences, are also used in the R&S ETL CDR software.

They are described in the R&S VSE base software user manual.

7.4 Configuring CDR Measurements

7.4.1 Restoring the Default Configuration (Preset)

SYSTem:PRESet:CHANnel[:EXEC]

This command restores the default software 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 35

7.4.2 CDR Configuration

CONFigure:CDR:DMODulation <DataModulation>
CONFigure:CDR:DMODulation? <DataModulation>

Defines the modulation type used for the service data.

Parameters for setting and query:
<DataModulation> QPSK | QAM16 | QAM64

Example: `CONF:CDR:DMOD 16QAM`

Manual operation: See "Service Data Modulation" on page 37

CONFigure:CDR:HCODing <HierarchicalCoding>
CONFigure:CDR:HCODing? <HierarchicalCoding>

Determines the alpha parameter for hierarchical coding of service data (not for QPSK service data modulation).

Parameters for setting and query:
<HierarchicalCoding> A1 | A2 | A4

*RST: A1

Example:
```
CONF:CDR:HCOD:STAT ON
CONF:CDR:HCOD 2
```

Manual operation: See "Service Data Hierarchical Coding" on page 38

CONFigure:CDR:HCODing:STATe <State>

If enabled, hierarchical coding for the service data is allowed (not for QPSK service data modulation). You can define the alpha parameter for coding using `CONFigure:CDR:HCODing` on page 80.

If disabled, the coding parameter α = 1 is used.

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

OFF | 0
Hierarchical coding for the service data is not allowed.

ON | 1
Hierarchical coding for the service data is allowed.

*RST: 0

Example:
```
CONF:CDR:HCOD:STAT ON
CONF:CDR:HCOD 2
```

Manual operation: See "Enable Service Data Hierarchical Coding" on page 37

CONFigure:CDR:IMODulation <InfoModulation>
CONFigure:CDR:IMODulation? <InfoModulation>

Defines the modulation type used for the service description information.

Parameters for setting and query:
<InfoModulation> QPSK | QAM16 | QAM64

Example:
```
CONF:CDR:IMOD 16QAM
```

Manual operation: See "Service Description Information Modulation" on page 37

CONFigure:CDR:SMODe <SpectrumMode>
CONFigure:CDR:SMODe? <SpectrumMode>

Defines the used spectrum mode according to the CDR standard.

Parameters for setting and query:
<SpectrumMode> S1 | S2 | S9 | S10 | S22 | S23

Example:
```
CONF:CDR:SMOD S9
```

Manual operation: See "Spectrum Mode Index" on page 37

CONFigure:CDR:TMODe <TransmissionMode>
CONFigure:CDR:TMODe? <TransmissionMode>

Defines the used transmission mode according to the CDR standard.

Parameters for setting and query:
<TransmissionMode> T1 | T2 | T3

Example:
```
CONF:CDR:TMOD T2
```

Manual operation: See "Transmission Mode" on page 37

7.4.3 RF Input

The following commands are required to configure data input.

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

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

Suffix:
<ip> 1 | 2
irrelevant

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

ON | 1
Attenuation levels of 10 dB or less are not allowed to protect the RF input connector of the connected R&S ETL.

OFF | 0
Attenuation levels of 10 dB or less are not blocked. You must provide appopriate protection for the RF input connector of the connected R&S ETL yourself.

*RST: 1

Example: `INP:ATT:PROT ON`
Turns on the input protection.

INPut<ip>:ATTenuation:PROTection:RESet [<DeviceName>]

This command resets the attenuator and reconnects the RF input with the input mixer for the connected R&S ETL 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.

For details on the protection mechanism see the instrument's documentation.

Suffix:
<ip> 1 | 2
irrelevant

Setting parameters:
<DeviceName> string

Name of the instrument for which the RF input protection is to be reset.

Example: `INP:ATT:PROT:RES 'MyDevice'`

INPut<ip>:FILE:ZPADing <ZeroPadding>

Enables or disables zeropadding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

Suffix:
<ip> irrelevant

Parameters:
<ZeroPadding> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:FILE:ZPAD ON`

Manual operation: See "Zero Padding" on page 41

INPut<ip>:IMPedance <Impedance>

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Impedance> 50 | 75

*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See " Impedance " on page 40

INPut<ip>:PRESelection:SET <Mode>

This command selects the preselector mode.

The command is available with the optional preselector.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Mode> **NARRow**
Performs a measurement by automatically applying all available combinations of low and high pass filters consecutively. These combinations all have a narrow bandwidth.

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

INPut<ip>:PRESelection[:STATe] <State>

This command turns the preselector on and off.

Suffix:
<ip> 1 | 2
irrelevant

Manual operation: See "Preselector State" on page 40

INPut<ip>: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 ETL CDR software.

Suffix:
<ip> 1 | 2
irrelevant

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

FIQ
I/Q data file

*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 39

INPut<ip>:TYPE <Input>

The command selects the input path.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Input> **INPUT1**
Selects RF input 1.
INPUT2
Selects RF input 2.
*RST: INPUT1

Example: //Select input path
`INP:TYPE INPUT1`

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

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

Suffix:
<si> 1 to 99
LTE-MIMO only: input source number

Parameters:
<Type> FILE | DEVice | NONE
FILE
A loaded file is used for input.
DEVice
A configured device provides input for the measurement
NONE
No input source defined.

Manual operation: See "Input Type (Instrument / File)" on page 39

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si>:TYPE <Source>

Configures the source of input to be used from the selected instrument.

Suffix:
<si> 1 to 99
LTE-MIMO only: input source number

Parameters:
<Source> **RF**
Radio Frequency ("RF INPUT" connector)
'Channel 1' | 'Channel 2' | 'Channel 3' | 'Channel 4'
Oscilloscope input channel 1, 2, 3, or 4
'Channel 1,2 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 2 (for oscilloscopes with 2 channels only)

'Channel 1,3 (I+Q)' | 'Channel 2,4 (I+Q)'
I/Q data provided by oscilloscope input channels 1 and 3, or 2 and 4 (for oscilloscopes with 4 channels only)

'Channels 1-4 (diff. I+Q)'
Differential I/Q data provided by oscilloscope input channels (for oscilloscopes with 4 channels only):
Channel 1: I (pos.)
Channel 2: $\bar{I}$ (neg.)
Channel 3: Q (pos.)
Channel 4: $\bar{Q}$ (neg.)

*RST: RF

Example: INST:BLOC:CHAN:SOUR:TYPE 'Channel 2,4 (I+Q)'
I/Q data is provided by oscilloscope input channels 2 and 4

7.4.4 Frontend Settings

The frequency and amplitude settings represent the "frontend" of the measurement setup.

7.4.4.1 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.

*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.

Manual operation: See " Center Frequency " on page 42

[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: //Set the center frequency to 110 MHz.

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Manual operation: See "Center Frequency Stepsize" on page 43

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

Defines the step width of the center frequency.

Setting parameters:

<LinkMode> ON | OFF

ON | 1
Links the step width to the current standard (currently 1 MHz for all standards)

OFF | 0
Sets the step width as defined using the `FREQ:CENT:STEP` command (see `[SENSe:]FREQuency:CENTer:STEP` on page 87).

*RST: ON

Manual operation: See "Center Frequency Stepsize" on page 43

[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.

Parameters:

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

Example:

```
FREQ:OFFS 1GHZ
```

Manual operation: See " Frequency Offset " on page 43

7.4.4.2 Amplitude Settings

Amplitude and scaling settings allow you to configure the vertical (y-)axis display and for some result displays also the horizontal (x-)axis.

Useful commands for amplitude settings described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 106

Remote commands exclusive to amplitude settings:

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`

Manual operation: See " Reference Level " on page 44

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 44

7.4.4.3 Attenuation

INPut<ip>:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Attenuation> Range: see data sheet
Increment: 5 dB (with optional electr. attenuator: 1 dB)
*RST: 10 dB (AUTO is set to ON)
Default unit: DB

Example: `INP:ATT 30dB`
Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Manual operation: See " Attenuation Mode / Value " on page 45

INPut<ip>:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S ETL CDR software determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Suffix:
<ip> 1 | 2
irrelevant

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

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

Manual operation: See " Attenuation Mode / Value " on page 45

INPut<ip>:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut<ip>:EATT:AUTO` on page 90).

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

Suffix:
<ip> 1 | 2
irrelevant

Parameters:

<Attenuation> attenuation in dB

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

Example:

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

INPut<ip>: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.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example:

```
INP:EATT:AUTO OFF
```

INPut<ip>:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Suffix:

<ip> 1 | 2
irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
INP:EATT:STAT ON
```

Switches the electronic attenuator into the signal path.

7.4.4.4 Configuring a Preamplifier

INPut<ip>:GAIN:STATe <State>

This command turns the preamplifier on and off.

If activated, the input signal is amplified by 20 dB.

Suffix:
<ip> 1 | 2
irrelevant

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

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `INP:GAIN:STAT ON`
Switches on 20 dB preamplification.

Manual operation: See " Preamplifier " on page 45

7.4.5 Triggering Measurements

The trigger commands define the beginning of a measurement.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

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

Parameters:

<DropoutTime> Dropout time of the trigger.

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

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

Defines the time offset between the trigger event and the start of the measurement.

Parameters:

<Offset> *RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See " Trigger Offset " on page 47

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

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

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See " Trigger Holdoff " on page 48

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 47

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

In the R&S ETL CDR software, only `EXTernal1` is supported.

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 47

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:
<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -10 dBm

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

TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

This command defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:
<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

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

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

This command defines the holding time before the next trigger event for (offline) input from a file.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example: `TRIG:SOUR MAGN`
Sets an offline magnitude trigger source.
`TRIG:MAP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See " Trigger Holdoff " on page 48

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

This command defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR MAP`
Sets the (offline) magnitude trigger source.
`TRIG:MAP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See " Hysteresis " on page 47

TRIGger[:SEQuence]:SLOPe <Type>

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See " Slope " on page 48

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note that the availability of trigger sources depends on the connected R&S ETL.

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.

EXT
Trigger signal from the corresponding "EXT TRIG" connector on the connected R&S ETL.
For details on the connectors see the instrument's Getting Started manual.

IFPower
Second intermediate frequency

MAGNitude
For (offline) input from a file, rather than an instrument.
The trigger level is specified by `TRIGger[:SEQuence]:LEVel:MAPower`.

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See " Trigger Source " on page 46
See " Free Run " on page 46
See " External Trigger 1 " on page 46
See " IF Power " on page 46
See " Magnitude (Offline) " on page 47

7.4.6 Configuring Data Acquisition

INITiate:REFResh

This command updates the current measurement results to reflect the current measurement settings.

No new I/Q data is captured. Thus, measurement settings apply to the I/Q data currently in the capture buffer.

The command applies exclusively to I/Q measurements. It requires I/Q data.

Example: `INIT:REFR`
Updates the IQ measurement results.

Usage: Event

Manual operation: See "Refresh" on page 52

INPut<ip>:FILTer:CHANnel:HPASs:FDBBw?

Suffix:
<ip> 1..n

Return values:
<Frequency> Default unit: HZ

Usage: Query only

Manual operation: See "50-dB Bandwidth" on page 51

INPut<ip>:FILTer:CHANnel:HPASs:SDBBw <Frequency>

Configures the bandwidth of the high pass filter at which an attenuation of 6 dB is reached. The filter bandwidth cannot be higher than the current sample rate. If necessary, the filter bandwidth is adapted to the current sample rate.

Suffix:
<ip> 1..n

Parameters:
<Frequency> Default unit: HZ

Example: `INPU:FILT:CHAN:HPAS:SDBB 30 MHZ`

Manual operation: See "6-dB Bandwidth" on page 51

INPut<ip>:FILTer:CHANnel[:LPASs]:AUTO <State>

Defines whether the filters are configured automatically according to the loaded configuration file.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<State> AUTO | MANual

Manual operation: See "Filter Settings" on page 50

INPut<ip>:FILTer:CHANnel:HPASs[:STATe] <State>

Activates an additional internal highpass filter.

Suffix:
<ip> 1..n

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

OFF | 0
Switches the filter off.

ON | 1
Switches the filter on

*RST: 0

Example: `INP:FILT:CHAN:HPAS ON`

Manual operation: See "Highpass Filter State" on page 51

INPut<ip>:FILTer:CHANnel[:LPASs]:FDBBw <Frequency>

Configures the 50-dB frequency of the channel filter. The 50-dB frequency is the distance from the center of the filter to the point at which the filter reaches an attenuation of 50 dB. This frequency must always be larger than the 6-dB passband (see `INPut<ip>:FILTer:CHANnel[:LPASs]:SDBBw` on page 97).

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Frequency> Default unit: HZ

Example: `INP:FILT:CHAN:FDBB 40MHZ`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "50-dB Bandwidth" on page 51

INPut<ip>:FILTer:CHANnel[:LPASs]:SDBBw <Frequency>

Configures the 6-dB bandwidth of the channel filter. The filter bandwidth cannot be higher than the current 50-dB frequency (see `INPut<ip>:FILTer:CHANnel[:LPASs]:FDBBw` on page 97).

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Frequency> Default unit: HZ

Example: `INP:FILT:CHAN:SDBB 30MHZ`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "6-dB Bandwidth" on page 50

INPut<ip>:FILTer:CHANnel[:LPASs][:STATe] <State>

This command turns an adjustable (lowpass) channel filter in the signal path on and off.

You can define its characteristics with

- `INPut<ip>:FILTer:CHANnel[:LPASs]:SDBBw` on page 97
- `INPut<ip>:FILTer:CHANnel[:LPASs]:FDBBw` on page 97

Suffix:
<ip> 1 | 2
irrelevant

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

Example: `INP:FILT:CHAN ON`
Turns on the adjustable channel filter.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "Filter State" on page 50

[SENSe:]SWAPiq <State>

This command defines whether or not the recorded I/Q pairs should be swapped (I<->Q) before being processed. Swapping I and Q inverts the sideband.

This is useful if the DUT interchanged the I and Q parts of the signal; then the R&S ETL CDR software can do the same to compensate for it.

Parameters:
<State> **ON | 1**
I and Q signals are interchanged
Inverted sideband, Q+j*I

OFF | 0
I and Q signals are not interchanged
Normal sideband, I+j*Q

*RST: 0

Manual operation: See " Swap I/Q " on page 49

[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.

[SENSe:]SWEep:LENGth <Length>

Defines the number of samples to be captured during each measurement.

Parameters:
<Length> integer
Range: 1 to 8 000 000

Example: `SENSe:SWEep:LENGth 1001`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "Capture Length" on page 49

[SENSe:]SWEep:TIME <Time>

This command defines the measurement time. It automatically decouples the time from any other settings.

Parameters:
<Time> refer to data sheet
*RST: depends on current settings (determined automatically)
Default unit: S

Example: `SWE:TIME 10s`

Manual operation: See "Capture Time" on page 49

TRACe:IQ:SRATe <SampleRate>

This command sets the final user sample rate for the acquired I/Q data. Thus, the user sample rate can be modified without affecting the actual data capturing settings on the R&S ETL CDR software.

Parameters:

<SampleRate> The valid sample rates depend on the connected R&S ETL. Refer to the instrument's documentation.

*RST: 32 MHz

Manual operation: See "Sample Rate" on page 49

TRACe:IQ:WBANd[:STATe] <State>

This command determines whether the wideband provided by bandwidth extension options is used or not (if installed).

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
If enabled, bandwidth extension options installed on the connected R&S ETL can be used.

OFF | 0
No bandwidth extension options installed on the connected R&S ETL are used. The maximum analysis bandwidth is restricted, depending on the used instrument.

*RST: 1

Manual operation: See "Maximum Bandwidth" on page 50

TRACe:IQ:WBANd:MBWidth <Limit>

Defines the maximum analysis bandwidth. Any value can be specified; the next higher fixed bandwidth is used.

The available fixed values depend on the connected R&S ETL and the installed bandwidth extension options.

Manual operation: See "Maximum Bandwidth" on page 50

7.4.7 Defining the Result Range

The result range determines which part of the capture buffer or burst is displayed.

[SENSe:]DEMod:FORMat:NOFSymbols <NSymbols>

This command defines the number of symbols in a frame.

Note that frames with fewer symbols are not analyzed.

Parameters:

<NSymbols> Range: 4 to 2000
*RST: 10

Example: DEM:FORM:NOFS 44
Defines 44 symbols per frame.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "Result Length" on page 52

7.4.8 Synchronization, Tracking and Demodulation

[SENSe:]COMPensate:CHANnel <State>

This command turns compensation for the estimated channel transfer function on and off.

Parameters:

<State> ON | OFF
*RST: ON

Example: COMP:CHAN ON
Turns on channel compensation.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Channel Compensation" on page 55

[SENSe:]DEMod:CDD <IQSamplingRate>

This command defines the cyclic delay.

Parameters:

<IQSamplingRate> Cyclic delay in samples.
Range: -<FFT_size> to +<FFT_size>
*RST: 0
Default unit: HZ

Example: DEM:CDD 5
Defines a cyclic delay of 5 samples.

Manual operation: See "Cyclic Delay" on page 56

[SENSe:]DEMod:COFFset <IQSamplingRate>

This command defines the maximum allowed carrier offset for frame synchronization.

Parameters:

<IQSamplingRate> Frequency offset in terms of (sub)carriers.

*RST: 0
Default unit: HZ

Example: `SENS:DEM:COFF 2`
Defines a frequency offset of two subcarriers.

Manual operation: See " Maximum Carrier Offset" on page 56

[SENSe:]DEMod:FFTShift <IQSamplingRate>

This command defines an offset for the FFT start sample in the guard interval.

Parameters:

<IQSamplingRate> Numeric value that defines the FFT shift.
The value is normalized to the length of the guard interval.

*RST: 0.5
Default unit: HZ

Example: `DEM:FFTS 0.6`
Defines an FFT shift of 0.6.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " FFT Shift relative to Cyclic Prefix Length" on page 55

[SENSe:]DEMod:FSYNc <Mode>

This command selects the parameter estimation mode.

Parameters:

<Mode> **DATA**
Demodulator uses pilot and data cells for synchronization.

PIL
Demodulator uses only pilot cells for synchronization.

NONE
Return value only.
The software returns `NONE` if no configuration file has been loaded.

*RST: PIL

Example: `DEM:FSYN PIL`
Selects synchronization based on the pilot cells.

Manual operation: See " Parameter Estimation" on page 54

[SENSe:]DEMod:MDETect <Mode>

This command selects the auto demodulation mode.

Parameters:

<Mode>

CARR
Assumes one constellation for all data cells in the carriers.

CFG
Evaluates the modulation matrix within the configuration file.

SYM
Assigns the data cells of each symbol to one constellation.

*RST: CFG

Example: `DEM:MDET CFG`
Selects evaluation of the modulation matrix in the configuration file.

Manual operation: See " Modulation Detection" on page 54

[SENSe:]DEMod:TSYNc <Mode>

This command selects the time synchronization mode.

Parameters:

<Mode>

CP
Performs time synchronization by correlating the cyclic prefix.

PREamble
Performs time synchronization by correlating the recurring preamble structure.

*RST: CP

Example: `DEM:TSYN CP`
Selects time synchronization based on the cyclic prefix.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Time Synchronization" on page 53

SENSe:TRACking:LEVel <State>

This command turns tracking of the power level on and off.

Note

The syntax element `[SENSe]` is not optional for this command.

Parameters:

<State>

ON | OFF

*RST: OFF

Example: `SENS:TRAC:LEV ON`
Turns on power level tracking.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Level Tracking" on page 55

SENSe:TRACking:PHASe <State>

This command turns phase tracking on and off.

Note

The syntax element `[SENSe]` is not optional for this command.

Parameters:

<State> ON | OFF
*RST: ON

Example: `SENS:TRAC:PHAS ON`
Turns on phase tracking.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Phase Tracking" on page 55

SENSe:TRACking:TIME <State>

This command turns tracking of the sample clock deviation on and off.

Note

The syntax element `[SENSe]` is not optional for this command.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `SENS:TRAC:TIME ON`
Turns on tracking of sample clock deviations.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Timing Tracking" on page 55

7.4.9 Adjusting Settings Automatically

Some settings can be adjusted by the R&S ETL CDR software automatically according to the current measurement settings.

[SENSe:]ADJust:CONFigure[:LEVel]:DURation <Duration>

In order to determine the ideal reference level, the R&S ETL CDR software performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure[:LEVel]: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.

[SENSe:]ADJust:CONFigure[:LEVel]:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S ETL CDR software performs a measurement on the current input data. This command selects the way the R&S ETL CDR software determines the length of the measurement .

Parameters:

<Mode>

AUTO
The R&S ETL CDR software determines the measurement length automatically according to the current input data.

MANual
The R&S ETL CDR software uses the measurement length defined by `[SENSe:]ADJust:CONFigure[:LEVel]:DURation` on page 105.

*RST: AUTO

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

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:LOW 2`
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

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

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: SENS:ADJ:CONF:HYST:UPP 2

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

[SENSe:]ADJust:CONFigure:TRIGger <State>

Defines the behavior of the measurement when adjusting a setting automatically (using SENS:ADJ:LEV ON, for example).

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

[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 ETL CDR software or limiting the dynamic range by an S/N ratio that is too small.

Example: ADJ:LEV

Usage: Event

7.5 Analysis

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

7.5.1 Result Configuration

[SENSe:]DEMod:EVMCalc:NORMalize <Method>

This command selects the normalization method for MER results.

Parameters:

<Method>

NONE
Normalization is turned off.

PDAT
MER normalized to the peak value of the data cells.

PPD
MER normalized to the peak value of the pilot and data cells.

PPIL
MER normalized to the peak value of the pilot cells.

RMSDAT
MER values normalized to the RMS value of the data cells.

RMSPD
MER values normalized to the RMS value of the pilot and data cells.

RMSPIL
MER values normalized to the RMS value of the pilot cells.

*RST: RMSPD

Example: `DEM:EVMC:NORM RMSDAT`
Selects normalization to the RMS value of the data cells.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See " Normalize MER to" on page 58

CONFigure:FILTer<n>:CARRier <Samples>

The constellation diagram includes symbols for all or only for the specified carrier number.

Suffix:

<n> 1..n
Window

Parameters:

<Samples>

Example: `CONF:FILT:CARR -2`

Manual operation: See "Constellation Display - Carrier" on page 58

CONFigure:FILTer<n>:MODulation <Modulation>

The constellation diagram includes only symbols for the selected modulation.

Suffix:

<n> 1..n
Window

Parameters:
<Modulation> ALL | 'string'
Modulation as defined in the configuration file.

Example: `CONF:FILT:MOD 'Zero'`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "Constellation Display - Modulation" on page 58

CONFigure:FILTer<n>:MODulation:TYPE <Modulation Type>

The constellation diagram includes only symbols for the selected modulation type.

Suffix:
<n> 1..n
Window

Parameters:
<Modulation Type> PDATa | PILots | DATA

Example: `CONF:FILT:MOD:TYPE DATA`
Only data symbols are displayed.

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Manual operation: See "Constellation Display - Modulation Type" on page 58

CONFigure:FILTer<n>:SYMBol <Samples>

The constellation diagram includes all or only the specified symbol number. The first symbol is 0.

Suffix:
<n> 1..n
Window

Parameters:
<Samples>

Example: `CONF:FILT:SYMB 2`

Manual operation: See "Constellation Display - Symbol" on page 58

7.5.2 Scaling

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

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

If enabled, the Y-axis is scaled automatically according to the current measurement.

Suffix:
<n> Window

<t> irrelevant

Parameters for setting and query:
<State> **OFF**
Switch the function off

ON
Switch the function on

*RST: ON

Manual operation: See "Automatic Grid Scaling" on page 61
See "Auto Scale Once" on page 61

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

This command defines the display range of the y-axis (for all traces).

Suffix:
<n> Window

<t> irrelevant

Example:
```
DISP:TRAC:Y 110dB
```

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 "Absolute Scaling (Min/Max Values)" on page 61

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 "Absolute Scaling (Min/Max Values)" on page 61

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.

In spectrum displays, for example, this command is not available.

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

Manual operation: See "Per Division" on page 62

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 ETL CDR software adjusts the scaling of the y-axis accordingly.

Suffix:
<n> Window

<t> irrelevant

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Ref Position" on page 62

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).

Suffix:
<n> Window

<t> irrelevant

Parameters:
<Value> numeric value in dBm

*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

Manual operation: See "Ref Value" on page 62

7.5.3 Units for Results

UNIT:CAXes <Unit>

This command selects the unit for result displays that show results on carrier level, for example the EVM vs Carrier.

Parameters:
<Unit> **CARR**
Carrier axis represents the subcarriers.

HZ
Carrier axis represents the frequency (Hz).

*RST: CARR

Example: `UNIT:CAX CARR`
Selects 'subcarriers' as the unit of the carrier axis.

Manual operation: See "Channel Flatness" on page 17
See "Constellation vs Carrier" on page 20
See "MER vs Carrier" on page 22
See "MER vs Symbol vs Carrier" on page 24
See "Group Delay" on page 25
See "Power vs Carrier" on page 27
See "Power vs Symbol vs Carrier" on page 29

UNIT:FAXes <Unit>

This command selects the unit for result displays that show results over the frequency, for example the Power Spectrum.

Parameters:
<Unit>

HZ
Frequency axis represents Hz.

SRAT
Frequency axis represents the sample rate.

CSP
Frequency axis represents the carrier spacing.

*RST: Hz

Example: `UNIT:FAX Hz`
Selects 'Hz' as the unit of the frequency axis.

Manual operation: See "Power Spectrum" on page 30

UNIT:IRESponse <Unit>

This command selects the unit for impulse response results.

Parameters:
<Unit>

DB
Returns impulse response results in dB.

LIN
Returns impulse response results normalized to 1.

*RST: LIN

Example: `UNIT:IRES DB`
Selects 'dB' as the unit for impulse response results.

Manual operation: See "Impulse Response" on page 25

UNIT:SAXes <Unit>

This command selects the unit for result displays that show results on symbol level, for example the EVM vs Symbol.

Parameters:

<Unit> SYMBol | SECond

SYM
Symbol axis represents symbols.

S
Symbol axis represents seconds.

*RST: SYM

Example: `UNIT:SAX SYM`
Selects 'symbols' as the unit of the symbol axis.

Manual operation: See "Allocation Matrix" on page 16
See "Constellation vs Symbol" on page 21
See "MER vs Symbol" on page 23
See "MER vs Symbol vs Carrier" on page 24
See "Power vs Symbol" on page 28
See "Power vs Symbol vs Carrier" on page 29

UNIT:TAXes <Unit>

This command selects the unit for result displays that show results over time, for example the Channel Impulse Response.

Parameters:

<Unit> **S**
Time axis represents seconds.

SAM
Time axis represents samples.

SYM
Time axis represents symbols.

*RST: S

Example: `UNIT:TAX S`
Selects 'seconds' as the unit of the time axis.

Manual operation: See "Magnitude Capture" on page 26

7.5.4 Configuring Traces

The trace settings determine how the measured data is analyzed and displayed on the screen. Depending on the result display, between 1 and 6 traces may be displayed.

Commands for storing trace data are described in Chapter 7.7.3, "Retrieving Trace Data and Marker Values", on page 145.

Useful commands for trace configuration described elsewhere:

- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]` on page 109

Remote commands exclusive to trace configuration:

CALCulate<n>:TRACe<t>[:VALue] <TrRefType>

This commands selects the signal to be used as the data source for a trace.

Suffix:
<t> Trace

Setting parameters:
<TrRefType> MEAS | REF | ERRor | TCAP

MEAS
Measurement signal

REF
Reference signal

ERR
Error

TCAP
Capture buffer

*RST: Depends on the current measurement.

Usage: SCPI confirmed

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode. If necessary, the selected trace is also activated.

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 69

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

Example: `DISP:TRAC3 ON`

Manual operation: See "Trace 1/Trace 2/Trace 3" on page 69

7.5.5 Working with Markers

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

7.5.5.1 Individual Marker Settings

In CDR evaluations, up to 5 markers can be activated in each diagram at any time.

Useful commands for configuring markers described elsewhere:

- `CALCulate<n>:MARKer<m>:Y?` on page 147
- `CALCulate<n>:DELTamarker<m>:Y?` on page 145

Remote commands exclusive to individual markers

CALCulate<n>:MARKer<m>:AOFF

This command turns off all markers.

Suffix:
<n> Window
<m> Marker

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

Usage: Event

Manual operation: See " All Marker Off " on page 66

CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Suffix:
<n> Window
<m> Marker

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

Example: CALC:MARK4:LINK:TO:MARK2 ON
Links marker 4 to marker 2.

Manual operation: See " Linking to Another Marker " on page 65

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:
<n> Window
<m> Marker

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

Example: CALC:MARK3 ON
Switches on marker 3.

Manual operation: See " M1 Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See " Marker State " on page 64
See " Marker Type " on page 65

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace>

Example: //Assign marker to trace 1
```
CALC:MARK3:TRAC 2
```

Manual operation: See " Assigning the Marker to a Trace " on page 66

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a specific 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:
<n> Window

<m> Marker

Parameters:
<Position> Numeric value that defines the marker position on the x-axis. The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example:
```
CALC:MARK2:X 1.7MHz
```
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See " Marker Table " on page 27
See " Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See "X-value" on page 64

CALCulate<n>:DELTamarker<m>:AOFF

This command turns off *all* delta markers.

Suffix:
<n> Window

<m> irrelevant

Example: `CALC:DELT:AOFF`
Turns off all delta markers.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Suffix:
<n> Window

<m> Marker

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

Example: `CALC:DELT2:LINK ON`

Manual operation: See " Linking to Another Marker " on page 65

CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Suffix:
<n> Window

<m> Marker

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

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See " Linking to Another Marker " on page 65

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference>

Example: CALC:DELT3:MREF 2
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See " Reference Marker " on page 65

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 | 1 | 0
*RST: 0

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

Manual operation: See " Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See " Marker State " on page 64
See " Marker Type " on page 65

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace> Trace number the marker is assigned to.

Example: CALC:DELT2:TRAC 2
Positions delta marker 2 on trace 2.

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 " Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See "X-value" on page 64

7.5.5.2 General Marker Settings

DISPlay:MINFo[:STATe] <DisplayMode>

This command turns the marker information in all diagrams on and off.

Parameters:
<DisplayMode> **ON | 1**
Displays the marker information in the diagrams.

OFF | 0
Hides the marker information in the diagrams.

*RST: 1

Example: `DISP:MINF OFF`
Hides the marker information.

Manual operation: See " Marker Info " on page 67

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode> **ON | 1**
Turns on the marker table.

OFF | 0
Turns off the marker table.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See " Marker Table Display " on page 66

7.5.5.3 Marker Positioning Settings

Several functions are available to set the marker to a specific position very quickly and easily.

Useful commands for positioning markers described elsewhere:

- `CALCulate<n>:MARKer<m>:TRACe` on page 117
- `CALCulate<n>:DELTamarker<m>:TRACe` on page 119

Remote commands exclusive to positioning markers:

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

This command positions the active marker or delta marker on the largest absolute peak value (maximum or minimum) of the selected trace.

Suffix:

<n> Window

<m> Marker

Usage: Event

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 67

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 67

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 67

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 67

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 68

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 68

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 67

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 68

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

sets the marker to the largest absolute peak value (maximum or minimum) of the selected trace.

Suffix:
<n> Window
<m> Marker

Usage: Event

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 67

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 67

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 67

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 67

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 68

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 68

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 68

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 67

CALCulate<n>:MARKer<m>:SEARch <MarkRealImag>

This command specifies whether the marker search works on the real or the imag trace (for all markers).

Suffix:
<n> Window
<m> Marker

Setting parameters:
<MarkRealImag> REAL | IMAG
*RST: REAL

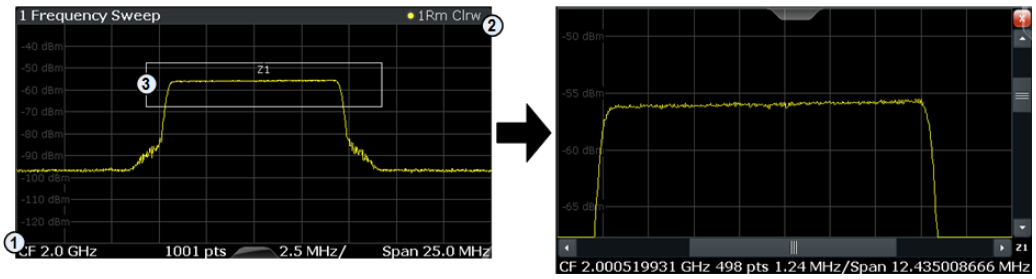
7.5.6 Zooming into the Display

7.5.6.1 Using the Single Zoom

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

This command defines the zoom area.

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



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

Suffix:
<n> Window

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

Range: 0 to 100
Default unit: PCT

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

This command turns the zoom on and off.

Suffix:
<n> Window

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

*RST: 0

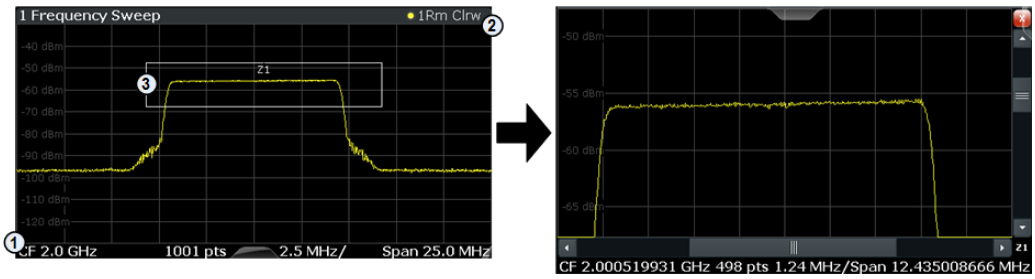
Example: `DISP:ZOOM ON`
Activates the zoom mode.

7.5.6.2 Using the Multiple Zoom

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

This command defines the zoom area for a multiple zoom.

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



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

Suffix:

<n> Window

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

Parameters:

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

Range: 0 to 100
Default unit: PCT

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

This command turns the multiple zoom on and off.

Suffix:

<n> Window

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

Parameters:

<State> ON | OFF | 1 | 0

*RST: 0

7.6 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

7.6.1 Global Layout Commands

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in Chapter 7.6.2, "Working with Windows in the Display", on page 132 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]?
<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

This command adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Parameters:

<ExChanName> string
Name of an existing channel

<ExWinName> string
Name of the existing window within the <ExChanName> channel the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows use the `LAYout:GLOBal:IDENtify[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | TAB
Direction the new window is added relative to the existing window.

TAB
The new window is added as a new tab in the specified existing window.

<NewChanName> string
Name of the channel for which a new window is to be added.

<NewWinType> string
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
```
LAYout:GLOBal:ADD:WINDow? 'IQ
Analyzer','1',RIGH,'IQ Analyzer2','FREQ'
```
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage: Query only

LAYout:GLOBal:CATalog[:WINDow]?

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

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example:
```
LAY:GLOB:CAT?
```
Result:
```
IQ Analyzer: '1',1,'2',2
Analog Demod: '1',1,'4',4
```
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

This command queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example:
```
LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,
'Spectrum',FREQ
```
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example:
```
LAYout:GLOBal:IDENtify? 'IQ Analyzer',
'Spectrum'
```
Result:
```
2
```
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>,<WindowName>

This command removes a window from the display.

Parameters:

<ChannelName> String containing the name of the channel.

<WindowName> String containing the name of the window.

Usage: Event

LAYout:GLOBal:REPLace[:WINDow]
<ExChannelName>,<WindowName>,<NewChannelName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Parameters:

<ExChannelName> String containing the name of the channel in which a window is to be replaced. The channel name is displayed as the tab label for the measurement channel.

<WindowName> String containing the name of the existing window.
To determine the name and index of all active windows, use the `LAYout:GLOBal:CATalog[:WINDow]?` query.

<NewChannelName> String containing the name of the channel for which a new window will be created.

<WindowType> Type of result display you want to use in the existing window.
Note that the window type must be valid for the specified channel (<NewChannelName>).
See `LAYout:ADD[:WINDow]?` on page 132 for a list of available window types.

Example: `LAY:GLOB:REPL:WIND 'IQ Analyzer','1', 'AnalogDemod',MTAB`
Replaces the I/Q Analyzer result display in window 1 by a marker table for the AnalogDemod channel.

7.6.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a channel as you do in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected channel.

Note that the suffix <n> always refers to the window *in the currently selected channel*.

To configure the layout of windows across channels, use the Chapter 7.6.1, "Global Layout Commands", on page 129.

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

This command adds a window to the display in the active 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.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType> text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.
Note that the window type must be valid for the active channel.
To create a window for a different channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Manual operation: See "Allocation Matrix" on page 16
See "CCDF" on page 17
See "Channel Flatness" on page 17
See "Constellation Diagram" on page 18
See "Constellation vs Carrier" on page 20
See "Constellation vs Symbol" on page 21
See "MER vs Carrier" on page 22
See "MER vs Symbol" on page 23
See "MER vs Symbol vs Carrier" on page 24
See "Group Delay" on page 25
See "Impulse Response" on page 25
See "Magnitude Capture" on page 26
See " Marker Table " on page 27
See "Power vs Carrier" on page 27
See "Power vs Symbol" on page 28
See "Power vs Symbol vs Carrier" on page 29
See "Power Spectrum" on page 30
See "Result Summary" on page 30
See "Signal Flow" on page 31

Table 7-2: <WindowType> parameter values for OFDM VSA application

Parameter value	Window type
AMATrix	Allocation Matrix
CCARrier	Constellation vs Carrier
CCDF	CCDF
CHFLatness	Channel Flatness
CONStell	Constellation Diagram
CSYMbol	Constellation vs Symbol
GDELay	Group Delay
IRESponse	Impulse Response

Parameter value	Window type
MCAPture	Magnitude Capture
MTABle	Marker Table
MVCarrier	MER vs Carrier
MVSCarrier	MER vs Symbol vs Carrier
MVSYmbol	MER vs Symbol
PCARrier	Power vs Carrier
PSC	Power vs Symbol vs Carrier
PSPectrum	Power Spectrum
PSYMbol	Power vs Symbol
RSUMmary	Result Summary
SFLow	Signal Flow

LAYout:CATalog[:WINDow]?

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

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all channels use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different channel use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

Setting parameters:

<WindowName> String containing the name of an existing window that is to be moved.
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 channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowName> String containing the name of an existing window the selected window is placed next to or replaces.
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 channel, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | REPLace

Destination the selected window is moved to, relative to the reference window.

Example: `LAY:MOVE '4','1',LEFT`
Moves the window named '4' to the left of window 1.

Example: `LAY:MOVE '1','3',REPL`
Replaces the window named '3' by window 1. Window 3 is deleted.

Usage: Setting only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active channel.

To remove a window for a different channel use the `LAYout:GLOBal:REMove[:WINDow]` command.

Setting 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 channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting 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 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 132 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

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 132 for a list of available window types.
Note that the window type must be valid for the active channel.
To create a window for a different channel use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
```
LAY:WIND1:ADD? LEFT,MTAB
```
Result:
```
'2'
```
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active 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 channel.

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

To remove a window in a different channel use the `LAYout:GLOBal: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 channel.

The effect 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

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 132 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel use the LAYout:GLOBal:REPLace[:WINDow] command.

Example: LAY:WIND2:REPL MTAB
Replaces the result display in window 2 with a marker table.

Usage: Setting only

7.7 Retrieving Results

The following commands are required to retrieve the calculated CDR parameters.

7.7.1 Retrieving Numerical Results

These commands return the average, maximum or minimum result of the specified parameter. For details and an assignment of the parameters to the keywords see

FETCh:BURSt:COUNt?

This command returns the number of analyzed bursts from the current capture buffer.

Return values:
<Value>

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

FETCh:BURSt:LENGths?

This command returns the length of the analyzed bursts from the current measurement.

The result is a comma-separated list of lengths, one for each burst.

Return values:
<Value> Default unit: s

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

FETCh:BURSt:STARts?

This command returns the start position of each analyzed burst in the current capture buffer.

Return values:
<Value> Offset of the burst start from the beginning of the capture buffer.
Default unit: s

Example:
```
FETC:BURS:STAR?
//Result:
//6.04e-05
```

Usage: Query only

FETCh:SUMMary[:ALL]?

Returns all values in the result summary, in the same order as in the display (see "Result Summary" on page 30).

For details on the individual parameters see Chapter 3.1, "CDR Parameters", on page 14.

Return values:

<Result> <EVMAll_dB_Min>,<EVMAll_dB_Avg>,<EVMAll_dB_Max>, <EVMAll_PCT_Min>,<EVMAll_PCT_Avg>,<EVMAll_PCT_Max>, <EVMData_dB_Min>,<EVMData_dB_Avg>,<EVMData_dB_Max>, <EVMData_PCT_Min>,<EVMData_PCT_Avg>,<EVMData_PCT_Max>, <EVMPilot_dB_Min>,<EVMPilot_dB_Avg>,<EVMPilot_dB_Max>, <EVMPilot_PCT_Min>,<EVMPilot_PCT_Avg>,<EVMPilot_PCT_Max>, <MER_Min>,<MER_Avg>,<MER_Max>, <I/QOffset_Min>,<I/QOffset_Avg>,<I/QOffset_Max>, <GainImbalance_Min>,<GainImbalance_Avg>,<GainImbalance_Max>, <QuadError_Min>,<QuadError_Avg>,<QuadError_Max>, <FreqErr_Min>,<FreqErr_Avg>,<FreqErr_Max>, <SampleClockErr_Min>,<SampleClockErr_Avg>,<SampleClockErr_Max>, <FramePower_Min>,<FramePower_Avg>,<FramePower_Max>, <CrestFactor_Min>,<CrestFactor_Avg>,<CrestFactor_Max>,

Comma-separated list with 3 statistical values for each result.

Example:

```
FETC:SUMM:ALL?
//-34.6742,-34.6742,-34.6742,
//1.84624,1.84624,1.84624,
//-34.5875,-34.5875,-34.5875,
//1.86477,1.86477,1.86477,
//-35.5229,-35.5229,-35.5229,
//1.67439,1.67439,1.67439,
//34.6742,34.6742,34.6742,
//-75.106,-75.106,-75.106,
//0.00573547,0.00573547,0.00573547,
//-0.0159425,-0.0159425,-0.0159425,
//0.272241,0.272241,0.272241,
//0.219516,0.219516,0.219516,
//-23.1036,-23.1036,-23.1036,
//9.84252,9.84252,9.84252
```

Usage: Query only

Manual operation: See "Result Summary" on page 30

FETCh:SUMMary:CRESt[:AVERage]?
FETCh:SUMMary:FERRor[:AVERage]?
FETCh:SUMMary:GIMBalance[:AVERage]?
FETCh:SUMMary:IQOFfset[:AVERage]?
FETCh:SUMMary:MER[:ALL][:AVERage]?

FETCh:SUMMary:MER:DATA[:AVERage]?
FETCh:SUMMary:MER:PILot[:AVERage]?
FETCh:SUMMary:POWer[:AVERage]?
FETCh:SUMMary:QUADerror[:AVERage]?
FETCh:SUMMary:SERRor[:AVERage]?
FETCh:SUMM:<parameter>[:AVERage]

These commands return the average result of the specified parameter. For details and an assignment of the parameters to the keywords see Table 3-1.

FETCh:TTFRame?

Retrieves the time offset between the trigger event and the start of the first OFDM frame.

Return values:
<Time> Default unit: s

Example: `FETC:TTFR?`

Usage: Query only

7.7.2 Retrieving Signal Flow Results

The following commands are required to retrieve the results of the signal flow stages. See also "Signal Flow" on page 31.

FETCh:SFLow:FSYNc?

This command returns the Frame Synchronisation value.

Return values:
<Value>

Example: `FETC:SFL:FSYN?`

Usage: Query only

FETCh:SFLow:STATe:ALL?

Returns the state of the individual stages of the signal flow. The result is a comma-separated list of states, one for each stage. The stages are in the following order:

- Burst Detection
- Time Sync
- Frame Sync
- Data-Aided Parameter estimation
- Modulation detection
- Pilot-aided parameter estimation
- Compensate
- EVM meas

Return values:

<Value>
0
Not successful
1
Successful
-1
Inactive

Example: `FETC:SFL:STAT:ALL?`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

FETCh:SFLow:STATe:BDETection?

Returns the state of the burst detection stage of the signal flow.

Return values:

<Value>
0
Not successful
1
Successful
-1
Inactive

Example: `FETC:SFL:STAT:BDET?`

Usage: Query only

FETCh:SFLow:STATe:COMPensate?

Returns the state of the compensation stage of the signal flow.

Return values:

<Value>
0
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:COMP?`

Usage: Query only

FETCh:SFLow:STATe:DESTimation?

Returns the state of the data-aided parameter estimation stage of the signal flow.

Return values:

<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:DEST?`

Usage: Query only

FETCh:SFLow:STATe:EVMMeas?

Returns the state of the EVM measurement stage of the signal flow.

Return values:

<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:EVMM?`

Usage: Query only

FETCh:SFLow:STATe:FSYNc?

Returns the state of the frame synchronization stage of the signal flow.

Return values:

<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:FSYN?`

Usage: Query only

FETCh:SFLow:STATe:MDETection?

Returns the state of the modulation detection stage of the signal flow.

Return values:
<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:MDET?`

Usage: Query only

FETCh:SFLow:STATe:PESTimation?

Returns the state of the pilot-aided parameter estimation stage of the signal flow.

Return values:
<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:PEST?`

Usage: Query only

FETCh:SFLow:STATe:TSYNc?

Returns the state of the time synchronization stage of the signal flow.

Return values:
<Value> **0**
Not successful

1
Successful

-1
Inactive

Example: `FETC:SFL:STAT:TSYN?`

Usage: Query only

FETCh:SFLow:TSYNc?

This command returns the Time Synchronisation value.

Return values:
<Value>

Example: `FETC:SFL:TSYN?`

Usage: Query only

7.7.3 Retrieving Trace Data and Marker Values

In order to retrieve the trace and marker results in a remote environment, use the following commands:

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:MARKer<m>:X` on page 117

Remote commands exclusive to retrieving trace data and marker values:

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

The unit depends on the application of the command.

Suffix:
<m> Marker

<n> Window

Return values:
<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

Manual operation: See "M1 Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See "Y-value" on page 65

CALCulate<n>:DELTamarker<m>:Y:RELative?

Suffix:
<n>

<m>

Return values:
<XValue> Default unit: HZ

Usage: Query only

CALCulate<n>:DELTamarker<m>:Z?

This command queries a delta marker's current position on the z-axis in a 3-dimensional diagram.

Suffix:
<m> Marker

<n> Window

Return values:
<Result> Result at the position of the delta marker.
The unit depends on the type of data displayed on the z-axis.

Usage: Query only

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.

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 27
See " Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
See "Y-value" on page 65

CALCulate<n>:MARKer<m>:Z?

This command queries a marker's current position on the z-axis in a 3-dimensional diagram.

For Constellation diagrams, the result is the I/Q value pair for the marker position.

Suffix:
<m> Marker

<n> Window

Return values:
<Result> Result at the position of the delta marker.
The unit depends on the type of data displayed on the z-axis.

Usage: Query only

Manual operation: See "Constellation Diagram" on page 18

FORMat[:DATA] <Format>[, <BitLength>]

This command selects the data format that is used for transmission of trace data from the R&S ETL CDR software to the controlling computer.

Note that the command has no effect for data that you send to the R&S ETL CDR software. The R&S ETL CDR software automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format> ASCii | REAL | UINT | MATLab

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
Floating-point numbers (according to IEEE 754) in the "definite length block format".

<BitLength> 16 | 32 | 64

Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

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.

Manual operation: See " Decimal Separator " on page 71

FORMat:DEXPort:GRAPh <State>

If enabled, all traces for the currently selected graphical result display are included in the export file.

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See " Export All Traces for Selected Graph " on page 71

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See " Include Instrument & Measurement Settings " on page 71

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see MMEMory:STORe<n>:TRACe on page 150).

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACe command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See " Export all Traces and all Table Results " on page 70

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

Trace data resulting from encrypted file input cannot be queried.

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 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Manual operation: See " Export Trace to ASCII File " on page 71

TRACe<n>[:DATA]? <Trace>

This command returns the y-values of the trace data for the current measurement or result display.

For 3-dimensional displays, such as the Allocation Matrix, this command returns the data values for the third (z-) dimension.

For more information see Chapter 7.7.4, "Using the TRACe[:DATA] Command", on page 154.

Trace data resulting from encrypted file input cannot be queried.

Suffix:
<n> 1..n
Window

Query parameters:
<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

Manual operation: See "Allocation Matrix" on page 16

TRACe<n>[:DATA]:X? <Trace>

This command returns the x-values for the trace data in the selected result display.

For information on how many values are returned see Chapter 7.7.4, "Using the TRACe[:DATA] Command", on page 154.

Trace data resulting from encrypted file input cannot be queried.

Suffix:
<n> 1..n
Window

Query parameters:
<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Example: `TRAC2:DATA:X?`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

Manual operation: See "Allocation Matrix" on page 16
See "CCDF" on page 17
See "Channel Flatness" on page 17
See "MER vs Carrier" on page 22
See "MER vs Symbol" on page 23
See "MER vs Symbol vs Carrier" on page 24
See "Group Delay" on page 25
See "Impulse Response" on page 25
See "Magnitude Capture" on page 26
See "Power vs Carrier" on page 27
See "Power vs Symbol" on page 28
See "Power vs Symbol vs Carrier" on page 29

TRACe<n>[:DATA]:Y? <Trace>

This command returns the y-values for 3-dimensional trace data in the selected result display.

For information on how many values are returned see Chapter 7.7.4, "Using the TRACe[:DATA] Command", on page 154.

Trace data resulting from encrypted file input cannot be queried.

Suffix:
<n> 1..n
Window

Query parameters:
<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Example: `TRAC2:DATA:Y?`

Example: See Chapter 7.9.1, "Example: CDR Analysis", on page 164

Usage: Query only

Manual operation: See "Allocation Matrix" on page 16
See "MER vs Symbol vs Carrier" on page 24
See "Power vs Symbol vs Carrier" on page 29

TRACe:IQ:DATA?

This command initiates a measurement with the current settings and returns the captured data from I/Q measurements.

This command corresponds to:

`INIT:IMM;*WAI;: TRACe:IQ:DATA:MEMory?`

However, the `TRACe:IQ:DATA?` command is quicker in comparison.

Trace data resulting from encrypted file input cannot be queried.

Return values:

<Results> Measured voltage for I and Q component for each sample that has been captured during the measurement.

Default unit: V

Example:

```
TRAC:IQ:STAT ON
```
Enables acquisition of I/Q data
```
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096
```
Measurement configuration:
Sample Rate = 32 MHz
Trigger Source = External
Trigger Slope = Positive
Pretrigger Samples = 0
Number of Samples = 4096
```
FORMat REAL,32
```
Selects format of response data
```
TRAC:IQ:DATA?
```
Starts measurement and reads results

Usage: Query only

TRACe:IQ:DATA:FORMat <Format>

This command selects the order of the I/Q data.

Parameters:

<Format> COMPatible | IQBLock | IQPair

COMPatible
I and Q values are separated and collected in blocks: A block (512k) of I values is followed by a block (512k) of Q values, followed by a block of I values, followed by a block of Q values etc. (I,I,I,I,Q,Q,Q,Q,I,I,I,I,Q,Q,Q,Q...)

IQBLock
First all I-values are listed, then the Q-values (I,I,I,I,I,I,...Q,Q,Q,Q,Q,Q)

IQPair
One pair of I/Q values after the other is listed (I,Q,I,Q,I,Q...).

*RST: IQBL

TRACe:IQ:DATA:MEMory? [<OffsetSamples>,<NoOfSamples>]

This command queries the I/Q data currently stored in the capture buffer of the R&S ETL CDR software.

By default, the command returns all I/Q data in the memory. You can, however, narrow down the amount of data that the command returns using the optional parameters.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command returns the same results as `TRACe:IQ:DATA?`. (Note, however, that the `TRAC:IQ:DATA?` command initiates a new measurement before returning the captured values, rather than returning the existing data in the memory.)

Trace data resulting from encrypted file input cannot be queried.

The command returns a comma-separated list of the measured values in floating point format (comma-separated values = CSV). The number of values returned is 2 * the number of complex samples.

The total number of complex samples is displayed in the channel bar in manual operation and can be calculated as:

<SampleRate> * <CaptureTime>

Parameters:

<OffsetSamples> Selects an offset at which the output of data should start in relation to the first data. If omitted, all captured samples are output, starting with the first sample.

Range: 0 to <# of samples> – 1, with <# of samples> being the maximum number of captured values
*RST: 0

<NoOfSamples> Number of samples you want to query, beginning at the offset you have defined. If omitted, all captured samples (starting at offset) are output.

Range: 1 to <# of samples> - <offset samples> with <# of samples> maximum number of captured values
*RST: <# of samples>

Return values:

<IQData> Measured value pair (I,Q) for each sample that has been recorded.
The data format of the individual values depends on `FORMat[:DATA]` on page 148.

Default unit: V

Example:
// Perform a single I/Q capture.
```
INIT;*WAI
```
// Determine output format (binary float32)
```
FORMat REAL,32
```
// Read 1024 I/Q samples starting at sample 2048.
```
TRAC:IQ:DATA:MEM? 2048,1024
```

Usage: Query only

7.7.4 Using the TRACe[:DATA] Command

This chapter contains information on the TRACe:DATA command and a detailed description of the characteristics of that command.

The TRACe:DATA command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. For results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

Trace data resulting from encrypted file input cannot be queried.

For several result displays, the command also supports various SCPI parameters in combination with the query. If available, each SCPI parameter returns a different aspect of the results. If SCPI parameters are supported, you have to quote one in the query.

Example:
```
TRAC:DATA? TRACE1
```

The format of the return values is either in ASCII or binary characters and depends on the format you have set with `FORMat[:DATA]` on page 148.

Following this detailed description, you will find a short summary of the most important functions of the command (`TRACe<n>[:DATA]?` on page 150).

7.7.4.1 Allocation Matrix

The values in the allocation matrix represent the modulation type for that symbol and carrier. Depending on the parameter, the modulation is provided in different formats.

`TRACe<n>:DATA? TRACe1` returns the modulation indexes used for each symbol (column-wise from the matrix).

`TRACe<n>:DATA? TRACe2` returns the modulation names used for each symbol (column-wise from the matrix).

To obtain a list of the symbols (corresponding to the x-axis in the matrix), use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

To obtain a list of the subcarriers (corresponding to the y-axis in the matrix), use `TRACe<n>:DATA:Y? TRACe1`, see `TRACe<n>[:DATA]:Y?` on page 151.

7.7.4.2 CCDF

The command returns the complementary cumulative probability distribution for each sample in the capture buffer, relative to the average power.

To obtain a list of the average power per sample, use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

7.7.4.3 Channel Flatness

The command returns the spectrum flatness as a list over all subcarriers. The list consists of one value for each trace point.

`<relative power>, ...`

The unit is always dB.

The following parameters are supported.

- TRACE1
  Returns the average power over all frames.
- TRACE2
  Returns the minimum power found over all frames.
- TRACE3
  Returns the maximum power found over all frames.

7.7.4.4 Constellation Diagram

The command returns two values (I/Q) for each constellation point, for each carrier, in each symbol, in each frame, as defined in the Allocation matrix.

<I[F_0][Sym_0][$Carr_1$]>, <Q[F_0][Sym_0][$Carr_1$]>, ..., <I[F_0][Sym_0][$Carr_n$]>, <Q[F_0][Sym_0][$Carr_n$]>,
<I[F_0][Sym_1][$Carr_1$]>, <Q[F_0][Sym_1][$Carr_1$]>, ..., <I[F_0][Sym_1][$Carr_n$]>, <Q[F_0][Sym_1][$Carr_n$]>,
<I[F_0][Sym_n][$Carr_1$]>, <Q[F_0][Sym_n][$Carr_1$]>, ..., <I[F_0][Sym_n][$Carr_n$]>, <Q[F_0][Sym_n][$Carr_n$]>,
<I[F_1][Sym_0][$Carr_1$]>, <Q[F_1][Sym_0][$Carr_1$]>, ..., <I[F_1][Sym_0][$Carr_n$]>, <Q[F_1][Sym_0][$Carr_n$]>,
<I[F_1][Sym_1][$Carr_1$]>, <Q[F_1][Sym_1][$Carr_1$]>, ..., <I[F_1][Sym_1][$Carr_n$]>, <Q[F_1][Sym_1][$Carr_n$]>,
<I[F_n][Sym_n][$Carr_1$]>, <Q[F_n][Sym_n][$Carr_1$]>, ..., <I[F_n][Sym_n][$Carr_n$]>, <Q[F_n][Sym_n][$Carr_n$]>

Where:

- F = frame
- Sym = symbol of that subframe
- Carr = subcarrier in that symbol

The I and Q values have no unit.

7.7.4.5 Constellation vs Carrier

The command returns one value (I or Q) for each constellation point, for each symbol, for each carrier, in each frame. Whether the I or Q values are returned depends on the parameter:

`TRACe1:DATA? TRACe1` returns I values

`TRACe1:DATA? TRACe2` returns Q values

Table 7-3: Results for TRACe1:DATA? TRACe1

<I[F_0][$Carr_0$][Sym_0]>,<I[F_0][$Carr_0$][Sym_1]>, ..., <I[F_0][$Carr_0$][Sym_n]>,
<I[F_0][$Carr_1$[Sym_0]]>,<I[F_0][$Carr_1$[Sym_1]]> , ..., <I[F_0][$Carr_1$][Sym_n]>,
<I[F_0][$Carr_n$][Sym_0]>,<I[F_0][$Carr_n$][Sym_1]> , ..., <I[F_0][$Carr_n$][Sym_n]>,
<I[F_1][$Carr_0$][Sym_0]>,<I[F_1][$Carr_0$][Sym_1]> , ..., <I[F_1][$Carr_0$][Sym_n]>,
<I[F_1][$Carr_1$][Sym_0]>,<I[F_1][$Carr_1$][Sym_1]> , ..., <I[F_1][$Carr_1$][Sym_n]>,
<I[F_n][$Carr_n$][Sym_0]>,<I[F_n][$Carr_n$][Sym_1]> , ..., <I[F_n][$Carr_n$][Sym_n]>

Where:

- F = frame
- Carr = subcarrier in that frame
- Sym = symbol of that subcarrier

The I and Q values have no unit.

To obtain a list of the subcarriers (corresponding to the x-axis in the matrix), use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

Example for a result length of 4, FFT size = 64:

-32,-32,-32-,32,-31,-31,-31,-31,-30,-30,-30,-30, ... ,+30,+30,+30,+30,+31,+31,+31,+31

7.7.4.6 Constellation vs Symbol

The command returns one value (I or Q) for each constellation point, for each carrier, in each symbol, in each frame, in the same order as for the common Constellation diagram. Whether the I or Q values are returned depends on the parameter:

`TRACe1:DATA? TRACe1` returns I values

`TRACe1:DATA? TRACe2` returns Q values

The I and Q values have no unit.

To obtain a list of the symbols (corresponding to the x-axis in the matrix), use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

Example for a result length of 4:

0,0,0,0, ... ,0,1,1,1,1, ... , 1,2,2,2,2, ... ,2,3,3,3,3 ... , 3

7.7.4.7 MER vs Carrier

The command returns one value for each carrier that has been analyzed.

The following parameters are supported.

- TRACE1
  Returns the average MER over all symbols.
- TRACE2
  Returns the minimum MER found over all symbols.
- TRACE3
  Returns the maximum MER found over all symbols.

7.7.4.8 MER vs Symbol

The command returns one value for each OFDM symbol that has been analyzed.

The following parameters are supported.

- TRACE1
  Returns the average MER over all carriers.
- TRACE2
  Returns the minimum MER found over all carriers.
- TRACE3
  Returns the maximum MER found over all carriers.

7.7.4.9 MER vs Symbol vs Carrier

The command returns one value for each OFDM cell.

<[F0][Symb0][Carrier1]>, ..., <[F0][Symb0][Carrier(n)]>,
<[F0][Symb1][Carrier1]>, ..., <[F0][Symb1][Carrier(n)]>,
<[F0][Symb(n)][Carrier1]>, ..., <[F0][Symb(n)][Carrier(n)]>,
<[F1][Symb0][Carrier1]>, ..., <[F1][Symb0][Carrier(n)]>,
<[F1][Symb1][Carrier1]>, ..., <[F1][Symb1][Carrier(n)]>,
<[F(n)][Symb(n)][Carrier1]>, ..., <[F(n)][Symb(n)][Carrier(n)]>

With F = frame and Symb = symbol of that subframe.

The following parameters are supported.

- TRACE1
  Returns the MER over all carriers.

To obtain a list of the symbols (corresponding to the x-axis in the matrix), use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

To obtain a list of the subcarriers (corresponding to the y-axis in the matrix), use `TRACe<n>:DATA:Y? TRACe1`, see `TRACe<n>[:DATA]:Y?` on page 151.

7.7.4.10 Frequency Error

The command returns one value for each OFDM symbol that has been analyzed.

```
<frequency error>,...
```

The unit is always Hz.

The following parameters are supported.

- TRACE1

7.7.4.11 Group Delay

The command returns one value for each trace point.

```
<group delay>, ...
```

The unit is always ns.

The following parameters are supported.

- TRACE1
  Returns the average group delay over all frames.
- TRACE2
  Returns the minimum group delay found over all frames.
- TRACE3
  Returns the maximum group delay found over all frames.

7.7.4.12 Impulse Response

The command returns one value for each trace point.

```
<impulse response>, ...
```

The channel impulse response is the inverse FFT of the estimated channel transfer function. The time axis spans one FFT interval.

The following parameters are supported.

- TRACE1
  Returns the average impulse response over all frames.
- TRACE2
  Returns the minimum impulse response found over all frames.
- TRACE3
  Returns the maximum impulse response found over all frames.

7.7.4.13 Magnitude Capture

The command returns one value for each I/Q sample in the capture buffer.

```
<absolute power>, ...
```

The unit is always dBm.

The following parameters are supported.

- TRACE1

7.7.4.14 Power vs Carrier

The command returns one value for each carrier that has been analyzed.

```
<power>,...
```

The unit is always dBm.

The following parameters are supported.

- TRACE1
  Returns the average power over all symbols.
- TRACE2
  Returns the minimum power found over all symbols.
- TRACE3
  Returns the maximum power found over all symbols.

7.7.4.15 Power vs Symbol

The command returns one value for each OFDM symbol that has been analyzed.

```
<power>,...
```

The unit is always dBm.

The following parameters are supported.

- TRACE1
  Returns the average power over all carriers.

- TRACE2
  Returns the minimum power found over all carriers.
- TRACE3
  Returns the maximum power found over all carriers.

7.7.4.16 Power vs Symbol vs Carrier

The command returns one value for each OFDM cell.

<[F0][Symb0][Carrier1]>, ..., <[F0][Symb0][Carrier(n)]>,
<[F0][Symb1][Carrier1]>, ..., <[F0][Symb1][Carrier(n)]>,
<[F0][Symb(n)][Carrier1]>, ..., <[F0][Symb(n)][Carrier(n)]>,
<[F1][Symb0][Carrier1]>, ..., <[F1][Symb0][Carrier(n)]>,
<[F1][Symb1][Carrier1]>, ..., <[F1][Symb1][Carrier(n)]>,
<[F(n)][Symb(n)][Carrier1]>, ..., <[F(n)][Symb(n)][Carrier(n)]>

With F = frame and Symb = symbol of that subframe.

The unit depends on is always dBm.

The following parameters are supported.

- TRACE1
  Returns the power over all carriers.

To obtain a list of the symbols (corresponding to the x-axis in the matrix), use `TRACe<n>:DATA:X? TRACe1`, see `TRACe<n>[:DATA]:X?` on page 151.

To obtain a list of the subcarriers (corresponding to the y-axis in the matrix), use `TRACe<n>:DATA:Y? TRACe1`, see `TRACe<n>[:DATA]:Y?` on page 151.

7.7.4.17 Power Spectrum

The command returns one value for each trace point.

`<power>,...`

The unit is always dBm/Hz.

The following parameters are supported.

- TRACE1

7.8 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, e.g. information on errors or limit violations which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

In this section, only the status registers/bits specific to the R&S ETL CDR software are described.

For details on the common R&S VSE status registers refer to the description of remote control basics in the R&S VSE base software user manual.

*RST does not influence the status registers.

Description of the Status Registers

In addition to the registers provided by the base system, the following register is used in the R&S ETL CDR software.

The `STATus:QUEStionable` register "sums up" the information from all subregisters (e.g. bit 11 sums up the information for all `STATus:QUEStionable:SYNC` registers). For some subregisters, there may be separate registers for each active channel. Thus, if a status bit in the `STATus:QUEStionable` register indicates an error, the error may have occurred in any of the channel-specific subregisters. In this case, you must check the subregister of each channel to determine which channel caused the error. By default, querying the status of a subregister always returns the result for the currently selected channel.

This register contains application-specific information about synchronization errors or errors during burst detection for each window in each CDR channel. It can be queried with commands `STATus:QUEStionable:SYNC:CONDition?` on page 161 and `STATus:QUEStionable:SYNC[:EVENt]?` on page 162.

Table 7-4: Status error bits in STATus:QUEStionable:SYNC register for the R&S ETL CDR software

Bit	Definition
0	Not used.
1	Sync not found This bit is set if synchronization failed.
2 to 14	Not used.
15	This bit is always 0.

The following commands query the contents of the individual status registers.

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[: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: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.

7.9 Programming Examples: OFDM Vector Signal Analysis

The following examples demonstrate how to perform OFDM vector signal analysis in a remote environment. They use I/Q data from the demo files provided with the R&S ETL CDR software software as input.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

7.9.1 Example: CDR Analysis

```
//-----------Preparing the measurement channel ------------
//Reset the software
*RST
DEVice:DELete:ALL

//Create CDR channel as replacement for default I/Q Analyzer channel
INST:CRE:REPL 'IQ Analyzer',CDR,'MyCDR'

//--------------Configuring the CDR signal --------------

//--------------Configuring data acquisition--------------
//Capture 40000 samples with a sample rate of 20 MHz
SWE:LENG 40000
TRAC:IQ:SRAT 20000000

//Enable burst search
DEM:FORM:BURS ON
//Max 1 frame to be demodulated, result length = 100 symbols per frame
DEM:FORM:MAXF 1
DEM:FORM:NOFS 100

//--------------Configuring synchronization, tracking, demodulation
//Time synchronization using cp
DEM:TSYN CP
//Enable phase tracking and channel comp., disable timing and level tracking
SENS:TRAC:TIME OFF
SENS:TRAC:PHAS ON
SENS:TRAC:LEV OFF
SENS:COMP:CHAN ON
//FFT shift relative to cp length: 0.5
DEM:FFTS 0.5

//---------------Configuring Results
// Default displays:
//1: Magnitude Capture 3: Power Spectrum
//2: Result Summary    4: Constellation

//Replace power spectrum by Power vs. symbol vs. carrier
LAY:REPL:WIND '3',PSC

//Normalize EVM to Peak Pilots and Data
DEM:EVMC:NORM PPD

//Filter constellation - show only data symbols with 64QAM mod.
CONF:FILT4:MOD:TYPE DATA
CONF:FILT4:MOD '64QAM'

//--------------Performing the Measurement-----
```

```
//Select single sweep mode.
INIT:CONT OFF

//Initiate a new measurement and wait until the sweep has finished.
INIT:IMM;*OPC?

//---------------Retrieving Results-------------
//Query frame burst count and length (1 frame, 40 symbols)
FETC:BURS:COUN?
FETC:BURS:LENG?

//Query max. MER of data symbols
FETC:SUMM:MER:DATA:MAX?

//Query the state of the individual signal flow stages
FETC:SFL:STAT:ALL?

//Retrieve trace data for power vs symbol vs carrier diagram
TRAC3:DATA:X? TRACe1
TRAC3:DATA:Y? TRACe1
TRAC3:DATA? TRACe1

//Retrieve trace data for filtered constellation diagram
TRAC4:DATA? TRACE1
```

Annex

A Menu Reference

Most functions in the R&S ETL CDR software are available from the menus.

A.1 Common R&S ETL CDR software Menus

The following menus provide **basic functions for all applications**:

A.1.1 File Menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> Rename Group	-	Changes the name of the selected group
> New Measurement Channel	-	Inserts a new channel in the selected group
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Rename Measurement Channel	-	Changes the name of the selected channel.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.

Menu item	Corresponding icon in toolbar	Description
Instruments >	-	Configures instruments to be used for input to the R&S ETL CDR software software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> Selected Channel	-	Restores the default software configuration for an individual channel
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S ETL CDR software
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S ETL CDR software

A.1.2 Window Menu

The "Window" menu allows you to hide or show individual windows.

Menu item	Corresponding icon in toolbar	Description
Player	-	Displays the "Player" tool window to recall I/Q data recordings
Instruments	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measurement channel

Menu item	Corresponding icon in toolbar	Description
Channel Information >	-	Displays the channel bar with global channel information for the selected measurement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated

A.1.3 Help Menu

The "Help" menu provides access to help, support and licensing functions.

Menu item	Corresponding icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Attempts to create an email with the default mail program (if available) to the Rohde & Schwarz support address for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.2 CDR Signal Analysis Menus

The following menus are only available if a CDR Signal Analysis channel is selected.

A.2.1 Edit Menu

The "Edit" menu contains functions for processing the temporarily stored current measurement results.

Menu item	Corresponding icon in toolbar	Description
Results Export	-	Stores the currently selected results in the active window to an ASCII file. See Chapter 5.7, "Trace / Data Export Configuration", on page 70.
Copy to Clipboard	-	Copies the graphical measurement results (ASCII data) to the Windows clipboard for further processing.

A.2.2 Input & Output Menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table A-1: "Input" menu items for CDR Signal Analysis

Menu item	Description
Amplitude	Chapter 4.3.3, "Amplitude Settings", on page 43
Scale	Chapter 5.4, "Y-Scaling", on page 60
Frequency	Chapter 4.3.2, "Frequency Settings", on page 42
Trigger	Chapter 4.4, "Trigger Settings", on page 45
Input Source	Chapter 4.3.1, "Input Source Settings", on page 38
Output	-

A.2.3 Meas Setup Menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table A-2: "Meas Setup" menu items for CDR Signal Analysis

Menu item	Description
CDR Configuration	See Chapter 4.2, "CDR Configuration", on page 35
Input/Frontend	Chapter 4.3, "Input and Frontend Settings", on page 38
Data Acquisition	Chapter 4.5, "Data Acquisition", on page 48
Result Range	Chapter 4.6, "Result Ranges", on page 52
Sync/Tracking	Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52
Demodulation	Chapter 4.7, "Synchronization, Demodulation and Tracking", on page 52

Menu item	Description
Result Configuration	Chapter 5.1, "Result Configuration", on page 57
Overview	Chapter 4.1, "Configuration Overview", on page 33

A.2.4 Trace Menu

The "Trace" menu provides access to trace-specific functions.

See Chapter 5.6, "Trace Settings", on page 68

This menu is application-specific.

Table A-3: "Trace" menu items for CDR Signal Analysis

Menu item	Description
Trace <x>	Selects the corresponding trace for configuration. The currently selected trace is highlighted blue
Trace ...	Opens the "Traces" configuration dialog box

A.2.5 Marker Menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table A-4: "Marker" menu items for CDR Signal Analysis

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		" Marker 1 / Delta Marker 1 / Delta Marker 2 / Delta Marker 16 " on page 64
Marker to Trace	-	" Assigning the Marker to a Trace " on page 66
All Markers Off		" All Marker Off " on page 66
Marker		Chapter 5.5.1, "Individual Marker Settings", on page 63
Search		Chapter 5.5.2, "General Marker Settings", on page 66

A.2.6 Limits Menu

The "Limits" menu is not used by the R&S ETL-CDR application.

B Reference of Toolbar Functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

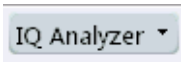
"Main" toolbar

Table B-1: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel
	MultiView mode: displays windows for all active measurement channels (disabled: only windows for currently selected channel are displayed)

"Control" toolbar

Table B-2: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement mode for next capture
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

Table B-3: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

Table B-4: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
	Zoom off: displays the diagram in its original size

Table B-5: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
	Select marker
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table B-6: Functions in the "AutoSet" toolbar

Icon	Description
	Refresh measurement results (R&S ETL CDR software VSA and OFDM VSA applications only)
	Auto level
	Auto frequency
	Auto trigger (R&S ETL CDR software GSM application only)
	Auto frame (R&S ETL CDR software GSM application only)
	Auto search (R&S ETL CDR software 3GPP FDD application only)
	Auto scale (R&S ETL CDR software 3GPP FDD + Pulse applications only)
	Auto scale all (R&S ETL CDR software 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

C Formulae

C.1 I/Q Impairments

The I/Q imbalance can be written as

$$r(t) = G_I \cdot \Re\{s(t)\} + j \cdot G_Q \cdot \Im\{s(t)\}$$

where s(t) is the transmit signal, r(t) is the received signal, and G_I and G_Q are the weighting factors.

Variable	Meaning	Definition from Transmitter Model
G_I	Gain I-branch	1
G_Q	Gain Q-branch	$1 + \Delta Q$ (complex)

$$\text{Gain-Imbalance} = 20 \log\left(\frac{|G_Q|}{|G_I|}\right) \text{dB}$$

$$\text{Quadrature-Error} = \arctan\left(\frac{\text{Im}\{G_Q\}}{\text{Re}\{G_Q\}}\right) . 180^{\circ} / \pi$$

List of Remote Commands (ETL CDR)

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