

# R&S®VSE-K96

## OFDM Vector Signal Analysis

### Application

### User Manual



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Version 12

**ROHDE & SCHWARZ**  
Make ideas real



This manual applies to the following software, version 2.31 and later:

- R&S®VSE Enterprise Edition base software (1345.1105.06)
- R&S®VSE Basic Edition base software (1345.1011.06)

The following software options are described:

- R&S VSE-K96 (1320.7922.02)
- R&S VSE-KT96 (1345.1792.02)
- R&S VSE-KP96 (1345.2499.xx)

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, e.g. R&S®VSE is indicated as R&S VSE.

# Contents

<b>1</b>	<b>Welcome to the OFDM vector signal analysis (VSA) application.....</b>	<b>5</b>
1.1	Introduction to vector signal analysis.....	5
1.2	Starting the R&S VSE OFDM VSA application.....	6
1.3	Understanding the display information.....	7
<b>2</b>	<b>OFDM VSA measurement and results.....</b>	<b>9</b>
2.1	OFDM VSA parameters.....	9
2.2	Evaluation methods for OFDM VSA measurements.....	10
<b>3</b>	<b>Measurement basics.....</b>	<b>30</b>
3.1	General information on OFDM signals.....	30
3.2	Signal processing.....	37
3.3	Sample rate, record length and analysis bandwidth.....	41
3.4	DFT-S precoding.....	42
<b>4</b>	<b>Configuring OFDM VSA measurements.....</b>	<b>45</b>
4.1	Configuration overview.....	45
4.2	Signal description.....	47
4.3	Input and frontend settings.....	52
4.4	Trigger settings.....	65
4.5	Data acquisition.....	69
4.6	Burst search.....	72
4.7	Result ranges.....	73
4.8	Synchronization, demodulation and tracking.....	74
4.9	Adjusting settings automatically.....	78
<b>5</b>	<b>Creating a configuration file using the wizard.....</b>	<b>81</b>
5.1	Understanding the R&S VSE-K96 Configuration File Wizard display.....	82
5.2	Configuration steps.....	89
5.3	Reference of wizard menu functions.....	96
5.4	Example: creating a configuration file from an input signal.....	101
<b>6</b>	<b>Analyzing OFDM VSA vector signals.....</b>	<b>109</b>
6.1	Result configuration.....	109
6.2	Table configuration.....	111

6.3	Units.....	112
6.4	Y-Scaling.....	113
6.5	Markers.....	115
6.6	Trace settings.....	121
6.7	Trace / data export configuration.....	123
7	How to perform measurements in the R&S VSE OFDM VSA application.....	125
8	Remote commands for OFDM VSA.....	127
8.1	Introduction.....	127
8.2	Common suffixes.....	132
8.3	Activating OFDM VSA measurements.....	132
8.4	Configuring OFDM VSA.....	133
8.5	Analysis.....	202
8.6	Configuring the result display.....	227
8.7	Retrieving results.....	237
8.8	Status reporting system.....	263
8.9	Deprecated commands.....	265
8.10	Programming examples: OFDM vector signal analysis.....	267
	<b>Annex.....</b>	<b>271</b>
A	<b>Menu reference.....</b>	<b>273</b>
A.1	Common R&S VSE menus.....	273
A.2	OFDM vector signal analysis menus.....	275
B	<b>Reference of toolbar functions.....</b>	<b>278</b>
C	<b>Formulae.....</b>	<b>282</b>
C.1	Error vector magnitude (EVM).....	282
C.2	I/Q impairments.....	283
D	<b>Reference: IQW format specification for user-defined constellation points.....</b>	<b>284</b>
	<b>List of commands (OFDM VSA).....</b>	<b>286</b>
	<b>Index.....</b>	<b>293</b>

# 1 Welcome to the OFDM vector signal analysis (VSA) application

The R&S VSE OFDM VSA application performs vector and scalar measurements on digitally modulated OFDM signals. To perform the measurements it converts RF signals into the complex baseband.

The R&S VSE OFDM VSA application features:

- Analysis of non-standard and standard-conform OFDM systems
- I/Q-based measurement results such as EVM, constellation diagrams, power spectrum

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

Functions that are not discussed in this manual are the same as in the I/Q Analyzer application and are described in the R&S VSE base software user manual. The latest version is available for download at the product homepage <http://www.rohde-schwarz.com/product/VSE.html>.

- [Introduction to vector signal analysis](#)..... 5
- [Starting the R&S VSE OFDM VSA application](#)..... 6
- [Understanding the display information](#)..... 7

## 1.1 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 VSE OFDM VSA application 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 EVM ("Error Vector Magnitude") measurement. Here, the complex baseband reference signal is subtracted from the complex baseband measurement signal. The magnitude of this error vector represents the EVM value. The EVM has the advantage that it "summarizes" all potential errors and distortions in one single value. If the EVM value is low, the signal quality of the DUT is high.

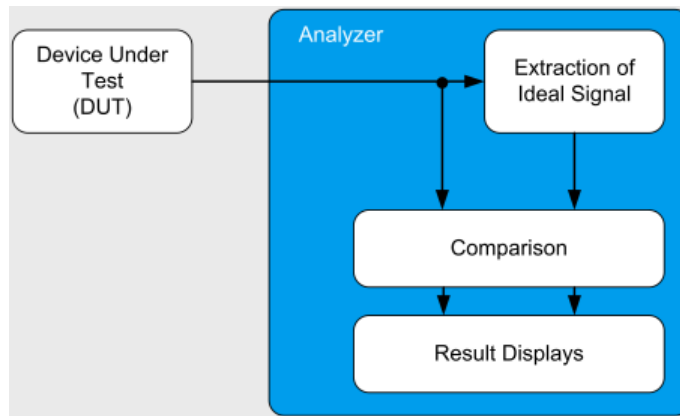
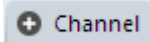


Figure 1-1: Simplified schema of vector signal analysis

## 1.2 Starting the R&S VSE OFDM VSA application

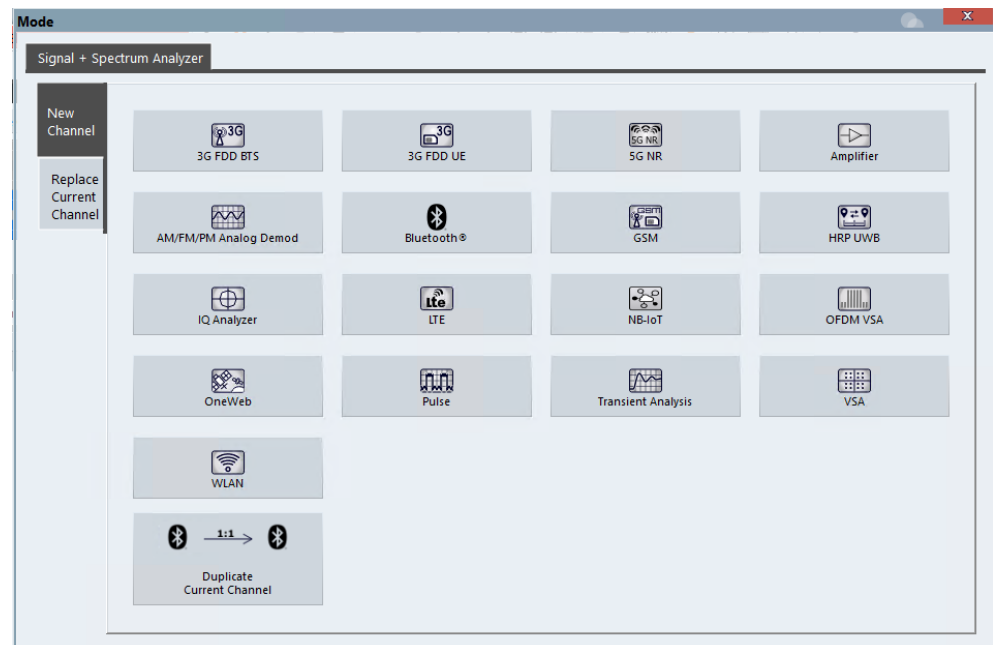
OFDM Vector Signal Analysis is a separate application on the R&S VSE. It is activated by creating a new measurement channel in OFDM VSA mode.

### To activate the R&S VSE OFDM VSA application

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.



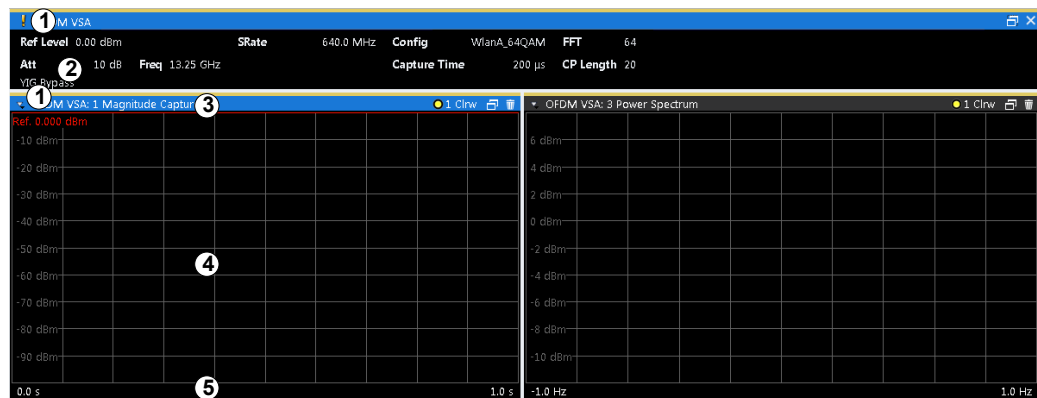
2. Select the "OFDM VSA" item.



The R&S VSE opens a new measurement channel for the R&S VSE OFDM VSA application.

### 1.3 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 VSE OFDM VSA application, the R&S VSE shows the following settings:

**Table 1-1: Information displayed in the channel bar in R&S VSE OFDM VSA application application**

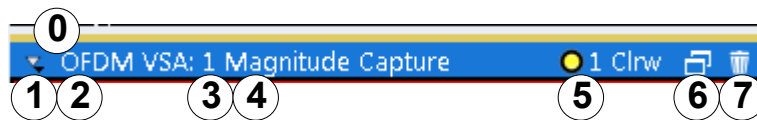
<b>Ref Level</b>	Reference level
<b>Att</b>	Mechanical and electronic RF attenuation
<b>Freq</b>	Center frequency for the RF signal
<b>Offset</b>	Reference level offset
<b>SRate</b>	Sample Rate
<b>Config</b>	Currently loaded configuration file
<b>Capture Time</b>	How long data was captured in current sweep

<b>FFT</b>	FFT size
<b>CP Length</b>	Cyclic prefix length
<b>Res Len</b>	Result length

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 1-2: Window title bar information in R&S VSE OFDM VSA application**

- 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 2.2, "Evaluation methods for OFDM VSA measurements"](#), on page 10).

### 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.



## 2 OFDM VSA 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 VSE to meet your requirements. All windows that belong to the same measurement (including the channel bar) are indicated by a colored line at the top of the window title bar.

### To add further result displays for the OFDM VSA 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.

- [OFDM VSA parameters](#)..... 9
- [Evaluation methods for OFDM VSA measurements](#)..... 10

### 2.1 OFDM VSA 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 282.

**Table 2-1: OFDM VSA parameters**

Parameter	Description	SCPI Parameter *)
EVM All [%/dB]	Error Vector Magnitude of the payload symbols over all carriers (except the guard carriers)	EVM[:ALL]
EVM Data Symbols [%/dB]	Error Vector Magnitude of the payload symbols over all data carriers	EVM:DATA
EVM Pilot Symbols [%/dB]	Error Vector Magnitude of the payload symbols over all pilot carriers	EVM:PILOt
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]
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

\*) Required to retrieve the parameter result,

See `FETCh:SUMM:<parameter>:<statistic>` on page 241

Parameter	Description	SCPI Parameter *)
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
Frequency Error [Hz]	Frequency error between the signal and the currently defined center frequency  The absolute frequency error includes the frequency error of the connected instrument and that of the DUT. If possible, the transmitter connected instrument 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 VSE in parts per million (ppm), i.e. the symbol timing error  The sample clock error is only estimated if at least one of the following conditions applies: <ul style="list-style-type: none"> <li>At least 2 subcarriers have 4 or more pilot cells</li> <li>At least 256 subcarriers have 2 or more pilot cells</li> </ul> Otherwise, the sample clock error is indicated as "---" and treated as 0 for compensation purposes.  If possible, the transmitter connected instrument 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 signal frame	POWer
Crest factor [dB]	The ratio of the peak power to the mean power of the analyzed signal frame	CRESt
*) Required to retrieve the parameter result, See <code>FETCh:SUMM:&lt;parameter&gt;:&lt;statistic&gt;</code> on page 241		

The R&S VSE OFDM VSA application also performs statistical evaluation over several frames and displays the following results:

**Table 2-2: Calculated summary results**

Result type	Description
Min	Minimum measured value
Average	Average measured value
Max	Maximum measured value

## 2.2 Evaluation methods for OFDM VSA measurements

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

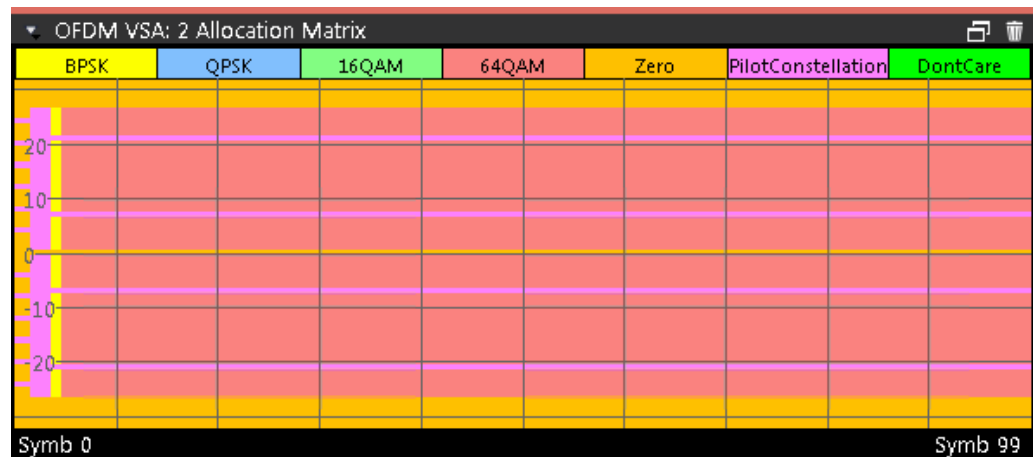
The OFDM VSA measurement provides the following evaluation methods:

Allocation Matrix.....	11
Bitstream.....	12
CCDF.....	13
Channel Flatness.....	14
Constellation Diagram.....	14
Constellation vs Carrier.....	16
Constellation vs Symbol.....	17
EVM vs Carrier.....	18
EVM vs Symbol.....	19
EVM vs Symbol vs Carrier.....	20
Group Delay.....	21
Impulse Response.....	22
Magnitude Capture.....	23
Marker Table.....	24
Power vs Carrier.....	24
Power vs Symbol.....	25
Power vs Symbol vs Carrier.....	26
Power Spectrum.....	27
Result Summary.....	28
Signal Flow.....	29
Trigger to Sync.....	29

### Allocation Matrix

The Allocation Matrix display is a graphical representation of the OFDM cell structure defined in the currently loaded configuration file.

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



**Figure 2-1: Allocation Matrix**

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

**Note:** 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 115.

Remote command:

LAY:ADD? '1',RIGH,AMATrix, see LAYout:ADD[:WINDOW]? on page 231

TRACe<n>[:DATA]? on page 251, see Chapter 8.7.4.1, "Allocation matrix", on page 256

TRACe<n>[:DATA]:X? on page 252

TRACe<n>[:DATA]:Y? on page 252

Symbol unit: UNIT:SAXes on page 210

**Bitstream**

This result display shows a demodulated data stream for the symbols in the currently analyzed result ranges. The different modulation types are indicated by color, as shown in the legend at the top of the window. Guard carriers are not included in the display, but are returned as non-data cells ("---") in trace export files.

OFDM VSA: 3 Bitstream (Hexadecimal)																				
	BPSK		OPSK		16OAM		64OAM		Zero		PilotConstellation		DontCare							
	+	1	+	3	+	5	+	7	+	9	+	11	+	13	+	15	+	17	+	19
Symbol 3																				
-26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
-6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Symbol 4																				
-26	0	1	0	0	0	---	0	0	0	0	0	0	1	1	0	1	1	0	0	---
-6	1	1	1	0	0	0	---	1	1	0	0	1	0	---	0	0	1	0	0	0
14	0	1	0	0	1	1	---	0	1	1	1	1								
Symbol 5																				
-26	25	09	0B	29	10	---	2D	31	13	24	11	31	04	24	17	22	0B	20	04	---
-6	14	17	04	01	31	33	---	31	02	31	21	16	2C	---	02	27	1A	00	03	3D
14	07	32	11	38	20	05	38	---	26	0D	0D	18	04							
Symbol 6																				
-26	3C	3A	0A	01	03	---	13	0F	0F	23	11	13	37	10	02	01	27	09	37	---
-6	16	02	31	3C	2A	3A	---	1A	06	25	34	16	0A	---	0B	0E	01	19	04	35
14	23	25	01	3F	24	09	17	---	0A	19	22	12	2B							
Symbol 7																				
-26	3A	2B	00	3B	20	---	11	13	28	04	15	2F	09	2F	3A	0B	22	2D	0B	---
-6	22	0E	1E	0C	16	35	---	18	24	18	1F	25	11	---	38	1C	1B	38	14	3F
14	2A	30	1A	3F	22	27	15	---	27	2F	3D	18	10							

The bitstream is derived from the order of the constellation points in the configuration file.

**Example:**

For QPSK, the value that is in the first position defines "00", the value that is in the second position defines "01", the value that is in the third position "10" and the last value "11".

```

<Constellation>
  <ID>1</ID>
  <Name>QPSK</Name>
  <HumanReadableName>QPSK</HumanReadableName>
  <ScalingFactor>1.0</ScalingFactor>
  <AllocationType>DataConstellation</AllocationType>
  <IQSymbols>
    <IQ>
      <Re>0.70711</Re>      Bits "00"
      <Im>0.70711</Im>
    </IQ>
    <IQ>
      <Re>-0.70711</Re>    Bits "01"
      <Im>0.70711</Im>
    </IQ>
    <IQ>
      <Re>-0.70711</Re>    Bits "10"
      <Im>-0.70711</Im>
    </IQ>
    <IQ>
      <Re>0.70711</Re>     Bits "11"
      <Im>-0.70711</Im>
    </IQ>
  </IQSymbols>
</Constellation>

```

Figure 2-2: Extract from configuration file defining the constellation points

Remote command:

LAY:ADD? '1', RIGH, BITS, see LAYout:ADD[:WINDow]? on page 231

TRACe:DATA?, see Chapter 8.7.4.2, "Bitstream", on page 256

**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.

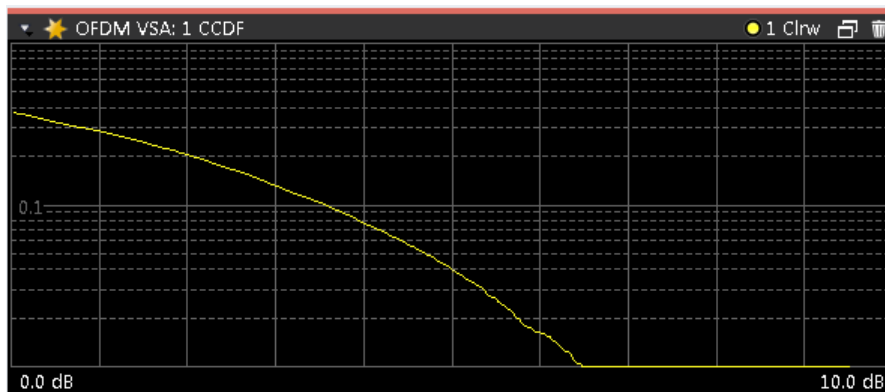


Figure 2-3: CCDF display

Remote command:

LAY:ADD? '1', RIGH, CCDF, see LAYout:ADD[:WINDow]? on page 231

TRACe:DATA?, see Chapter 8.7.4.3, "CCDF", on page 256

TRACe<n>[:DATA]:X? on page 252

### Channel Flatness

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

The statistic is performed over all analyzed frames.

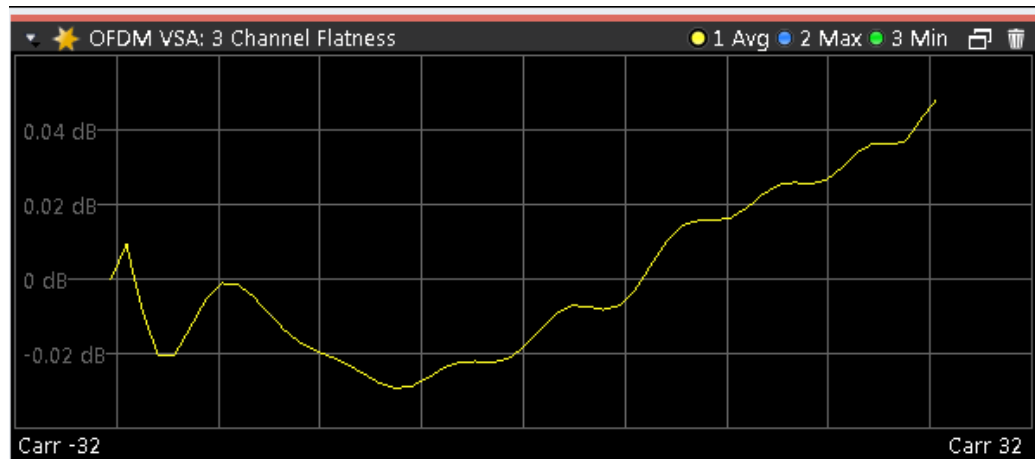


Figure 2-4: Channel Flatness Display

Remote command:

LAY:ADD? '1', RIGH, CHFL, see [LAYout:ADD\[:WINDow\]?](#) on page 231

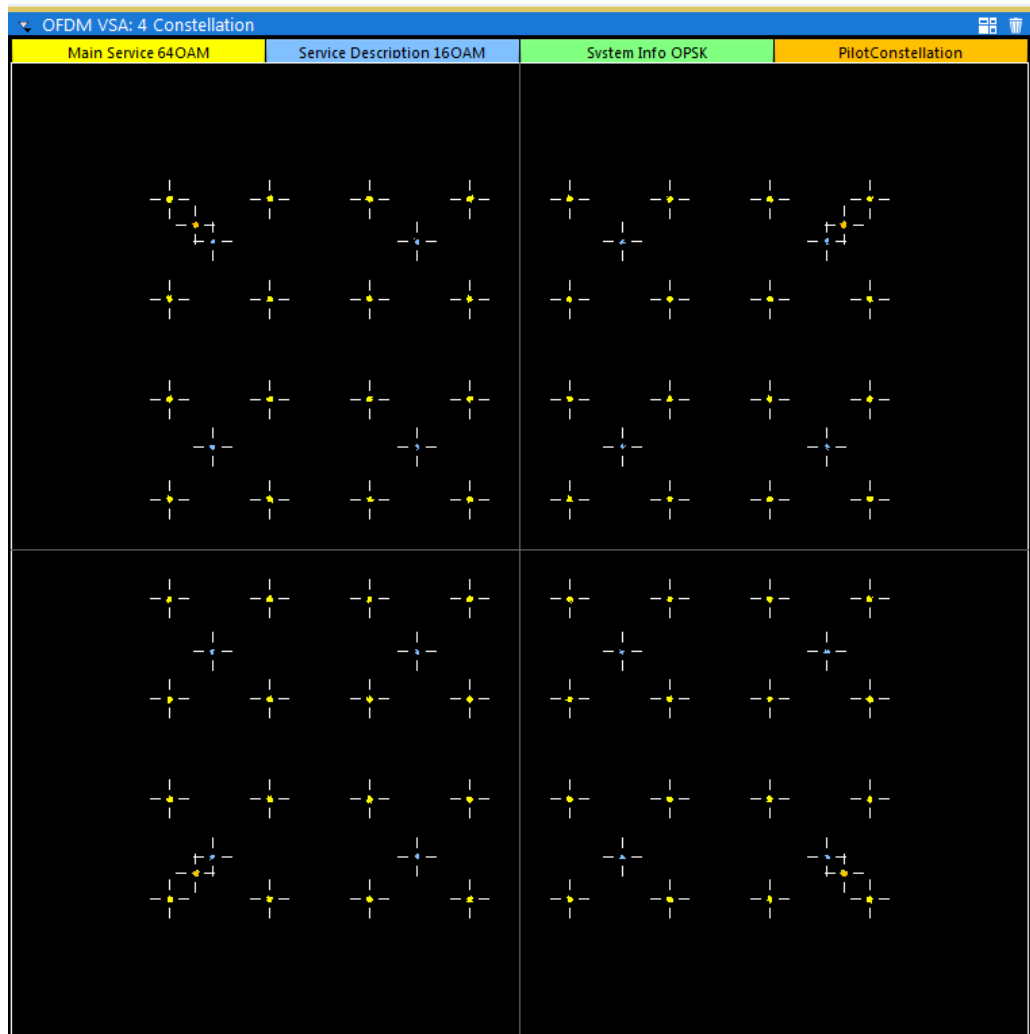
TRACe:DATA?, see [Chapter 8.7.4.4, "Channel flatness"](#), on page 257

TRACe<n>[:DATA]:X? on page 252

Carrier unit: [UNIT:CAXes](#) on page 208

### 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 2-5: 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 6.1, "Result configuration"](#), on page 109.

**Note:** 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.

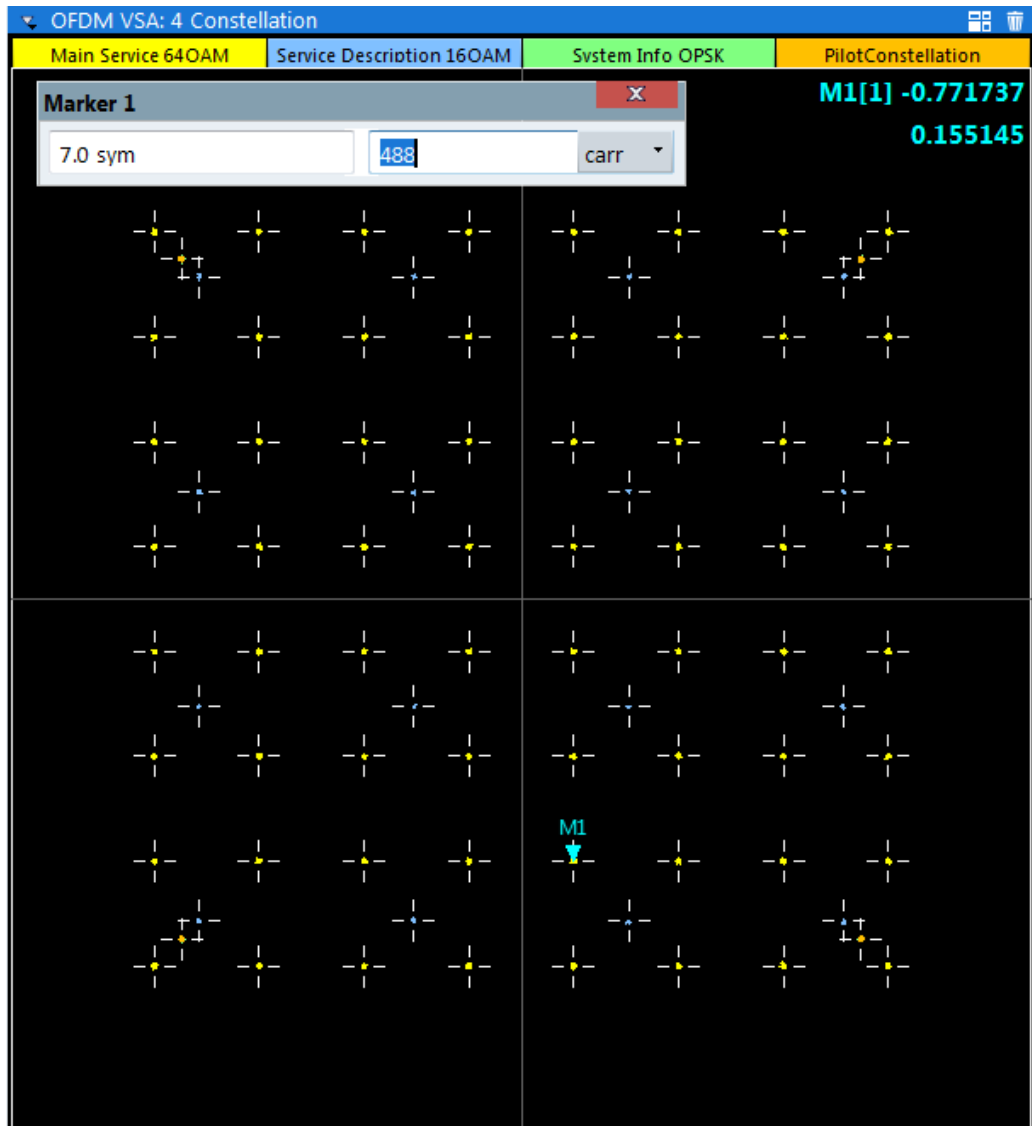


Figure 2-6: Marker in a Constellation diagram

See also "[Markers in the Constellation diagram and Allocation Matrix](#)" on page 115.

Remote command:

LAY:ADD? '1', RIGH, CONS, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.5, "Constellation diagram"](#), on page 257

Marker I/Q values:

[CALCulate<n>:MARKer<m>:Z](#) on page 248

### 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.



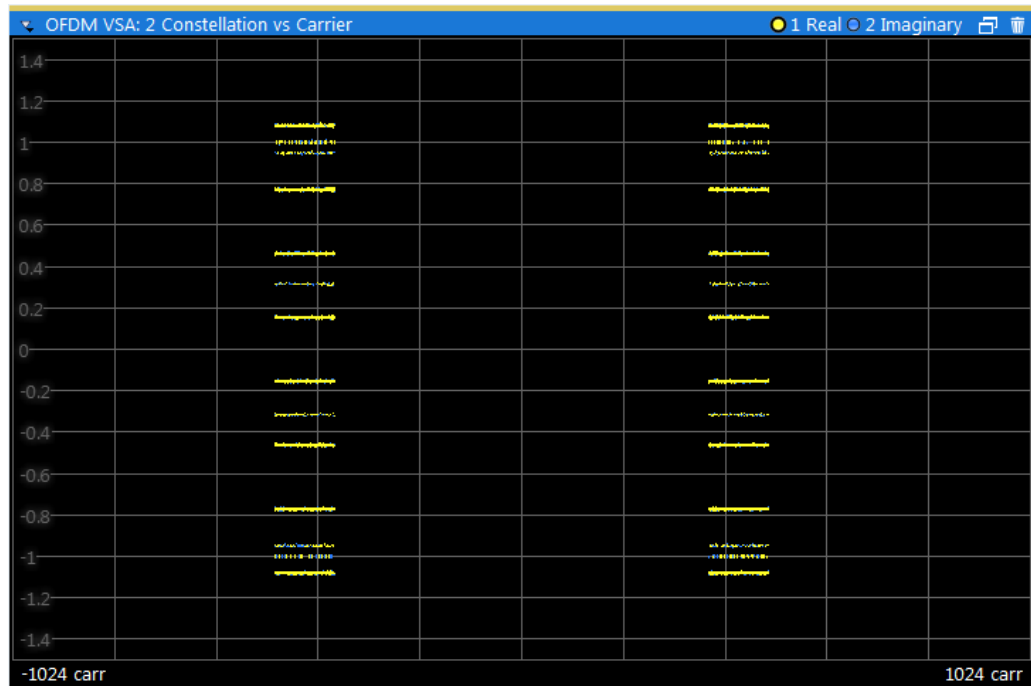


Figure 2-7: Constellation vs. Carrier display

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

Remote command:

LAY:ADD? '1', RIGH, CCAR, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255

Carrier unit: [UNIT:CAXes](#) on page 208

Symbol selection for marker: [CALCulate<n>:MARKer<m>:Z](#) on page 248

### 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.

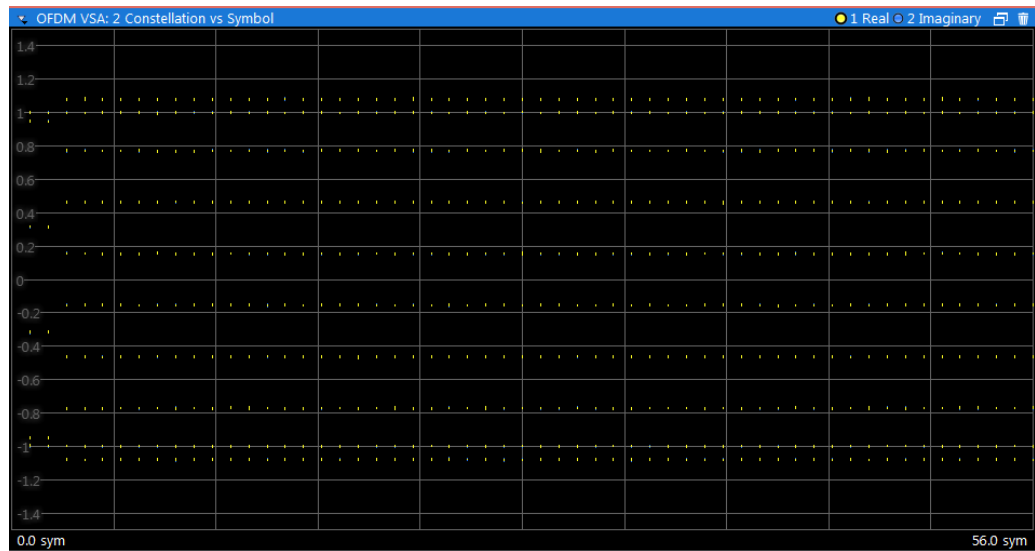


Figure 2-8: Constellation vs. Symbol display

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

Remote command:

LAY:ADD? '1', RIGH, CSYM, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255

Symbol unit: [UNIT:SAXes](#) on page 210

Carrier selection for marker: [CALCulate<n>:MARKer<m>:Z](#) on page 248

### EVM vs Carrier

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

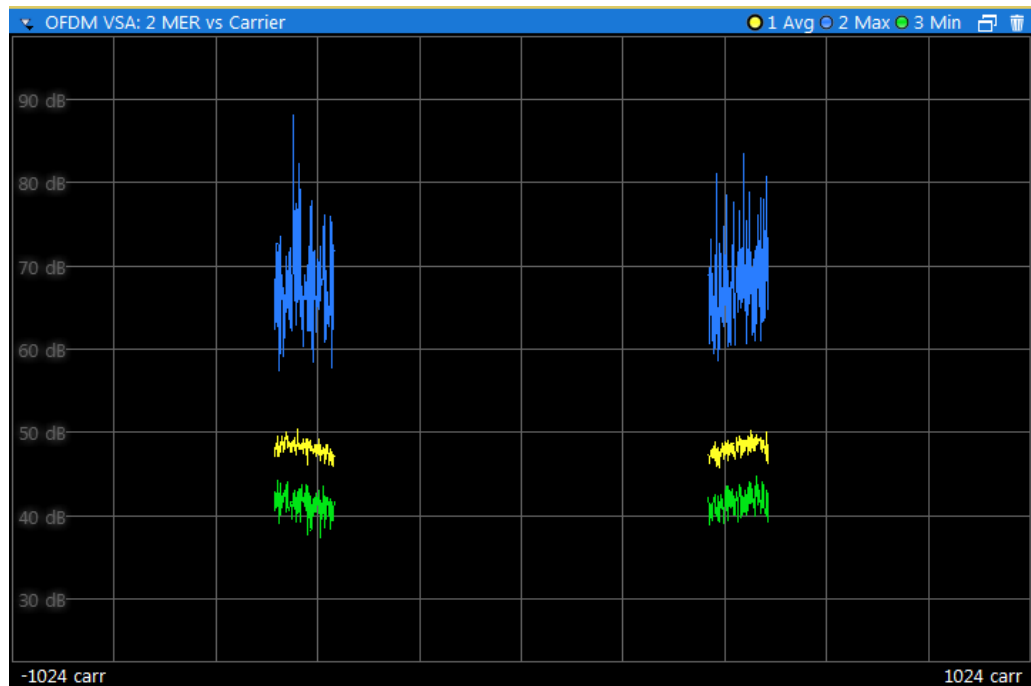


Figure 2-9: EVM vs Carrier display

**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 EVM calculation. However, zero cells and the DC carrier are included.

Remote command:

LAY:ADD? '1', RIGH, EVC, see LAYout:ADD[:WINDow]? on page 231

TRACe:DATA?, see Chapter 8.7.4.8, "EVM vs carrier", on page 260

TRACe<n>[:DATA]:X? on page 252

Carrier unit: UNIT:CAXes on page 208

EVM unit: UNIT:EVM on page 209

### EVM vs Symbol

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

Blue lines indicate the border between different OFDM frames if more than one frame is analyzed.

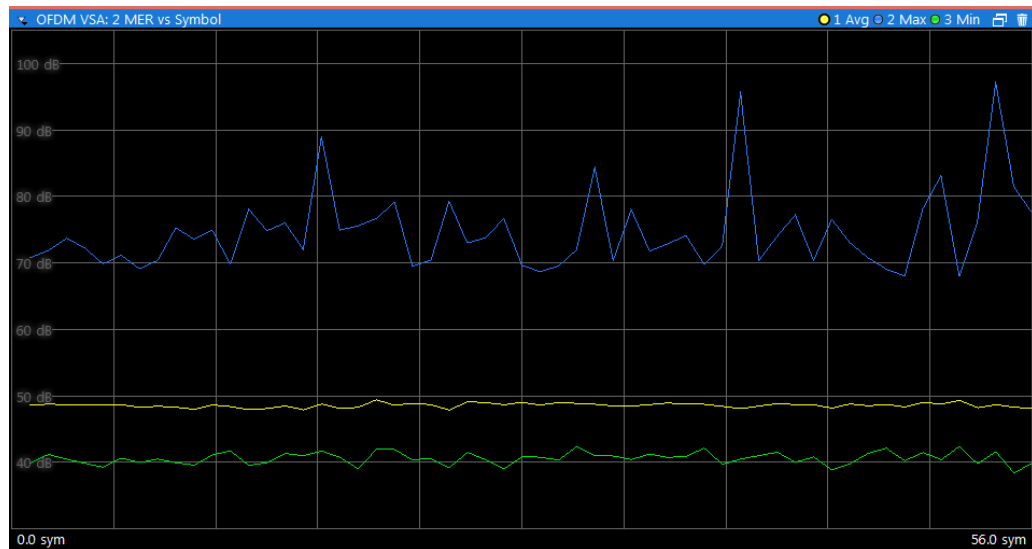


Figure 2-10: EVM vs Symbol display

**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 EVM calculation. However, zero cells and the DC carrier are included.

Remote command:

LAY:ADD? '1', RIGH, EVSY, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.9, "EVM vs symbol"](#), on page 260

TRACe<n>[:DATA]:X? on page 252

Symbol unit: [UNIT:SAXes](#) on page 210

EVM unit: [UNIT:EVM](#) on page 209

### EVM vs Symbol vs Carrier

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

The results are provided in dB or percent, depending on the unit settings.

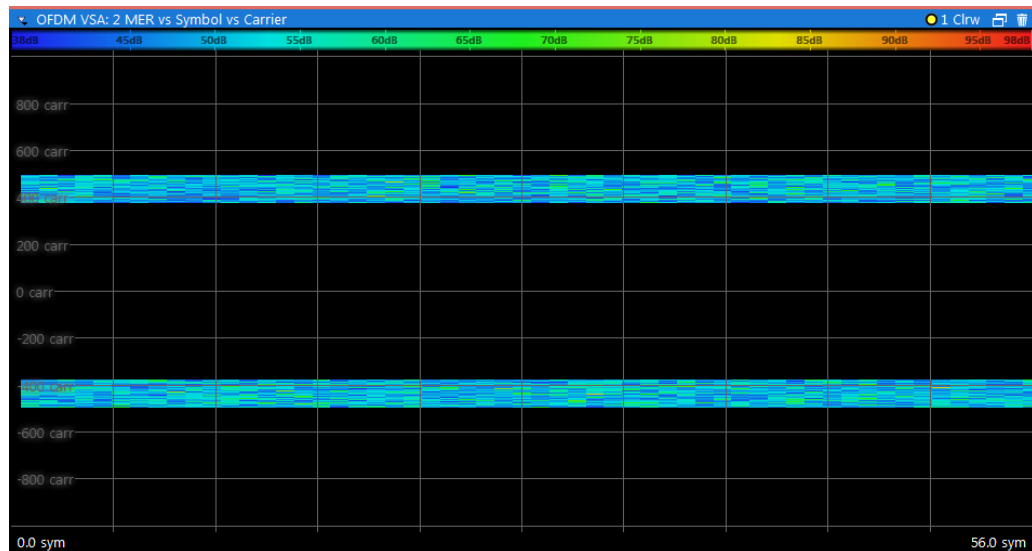


Figure 2-11: EVM vs Symbol vs Carrier display

The EVM 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, EVSC, see [LAYOUT:ADD\[:WINDOW\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.10, "EVM vs symbol vs carrier"](#), on page 260

TRACe<n>[:DATA]:X? on page 252

TRACe<n>[:DATA]:Y? on page 252

Carrier unit: [UNIT:CAXes](#) on page 208

Symbol unit: [UNIT:SAXes](#) on page 210

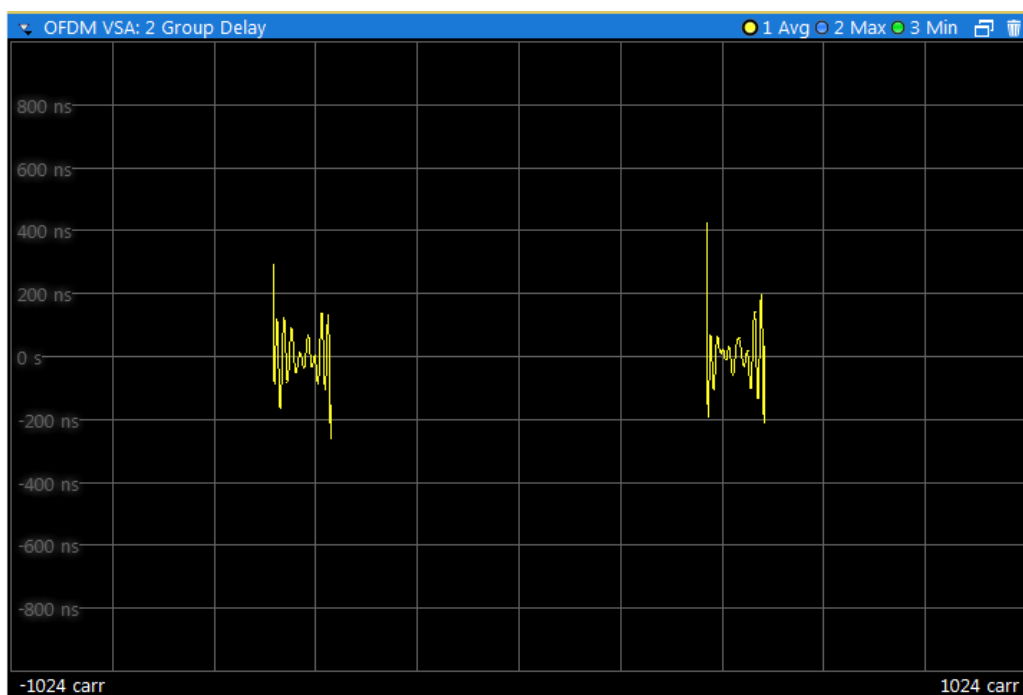
EVM unit: [UNIT:EVM](#) on page 209

Carrier selection for marker: [CALCulate<n>:MARKer<m>:Z](#) on page 248

### Group Delay

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

Multiple traces display statistical evaluations over all analyzed frames.



Remote command:

LAY:ADD? '1', RIGH, GDEL, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.11, "Group delay"](#), on page 261

TRACe<n>[:DATA]:X? on page 252

Carrier unit: [UNIT:CAXes](#) on page 208

### 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.

Multiple traces display statistical evaluations over all analyzed frames.

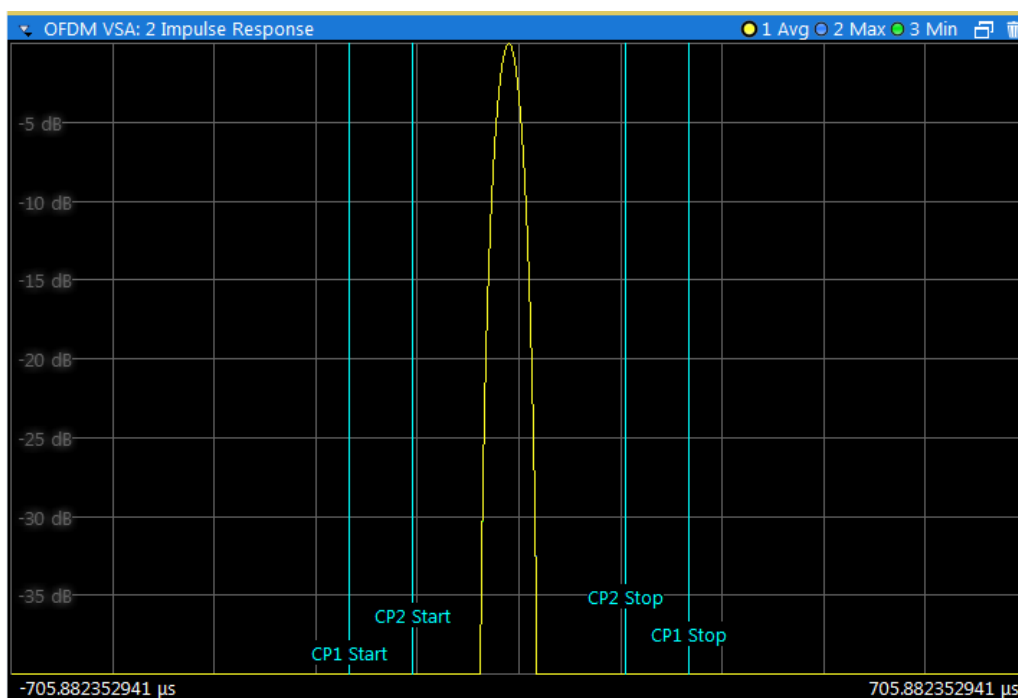


Figure 2-12: Channel Impulse Response Display

Remote command:

LAY:ADD? '1', RIGH, IRES, see LAYout:ADD[:WINDow]? on page 231

TRACe:DATA?, see Chapter 8.7.4.12, "Impulse response", on page 261

TRACe<n>[:DATA]:X? on page 252

Linear/ logarithmic scaling: UNIT:IRESpone on page 210

### 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 2-13: Magnitude Capture display

Remote command:

LAY:ADD? '1', RIGH, MCAP, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.13, "Magnitude capture"](#), on page 261

TRACe<n>[:DATA]:X? on page 252

Time unit: UNIT:TAXes on page 210

### Marker Table

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

This table is displayed automatically if configured accordingly.

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 231

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 215

[CALCulate<n>:MARKer<m>:Y?](#) on page 248

### Power vs Carrier

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



Multiple traces display statistical evaluations over all analyzed frames.



Figure 2-14: 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 231

TRACe:DATA?, see [Chapter 8.7.4.14, "Power vs carrier"](#), on page 262

TRACe<n>[:DATA]:X? on page 252

Carrier unit: [UNIT:CAXes](#) on page 208

### Power vs Symbol

The Power vs Symbol display shows the power of all OFDM carriers in the analyzed signal frames 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.

Multiple traces display statistical evaluations over all analyzed frames.

Vertical blue lines indicate the borders between frames.

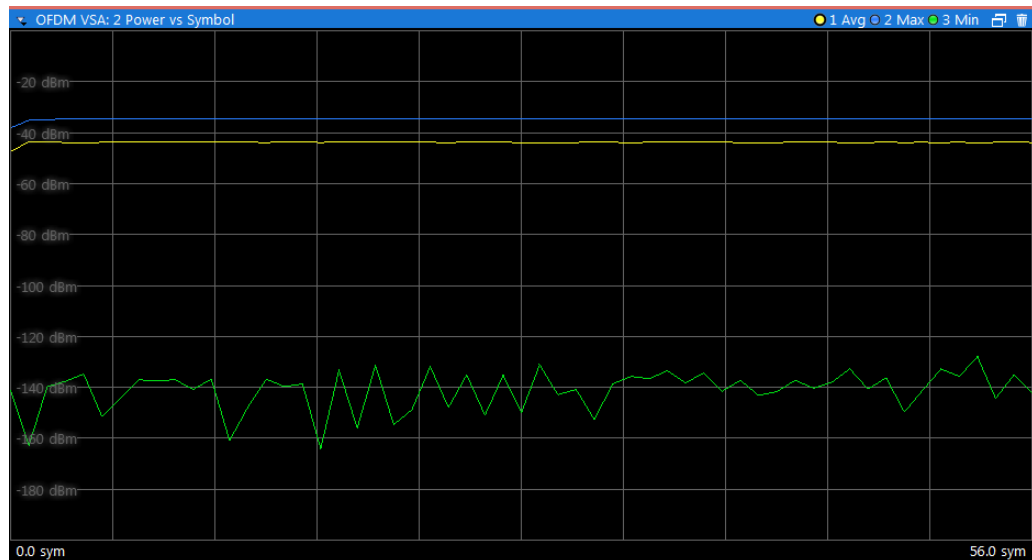


Figure 2-15: Power vs Symbol display

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

Remote command:

LAY:ADD? '1', RIGH, PSYM, see [LAYout:ADD\[:WINDow\]?](#) on page 231

TRACe:DATA?, see [Chapter 8.7.4.15, "Power vs symbol"](#), on page 262

TRACe<n>[:DATA]:X? on page 252

Symbol unit: UNIT:SAXes on page 210

### 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 signal frames in dBm. The power is measured with a resolution bandwidth that equals the carrier spacing.

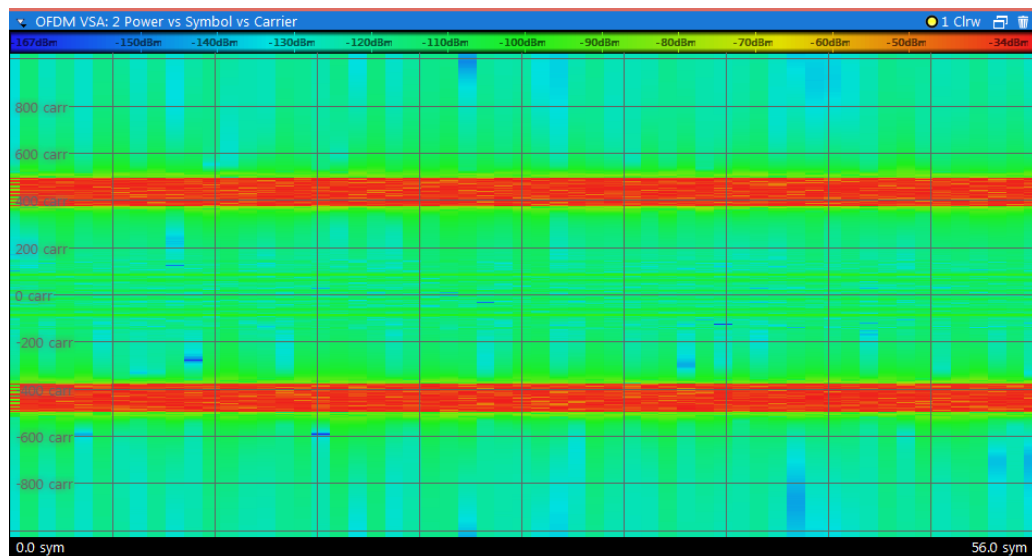


Figure 2-16: Power vs Symbol vs Carrier display

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 231

TRACe:DATA?, see Chapter 8.7.4.16, "Power vs symbol vs carrier", on page 262

TRACe<n>[:DATA]:X? on page 252

TRACe<n>[:DATA]:Y? on page 252

Carrier unit: UNIT:CAXes on page 208

Symbol unit: UNIT:SAXes on page 210

Carrier selection for marker: CALCulate<n>:MARKer<m>:Z on page 248

### Power Spectrum

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

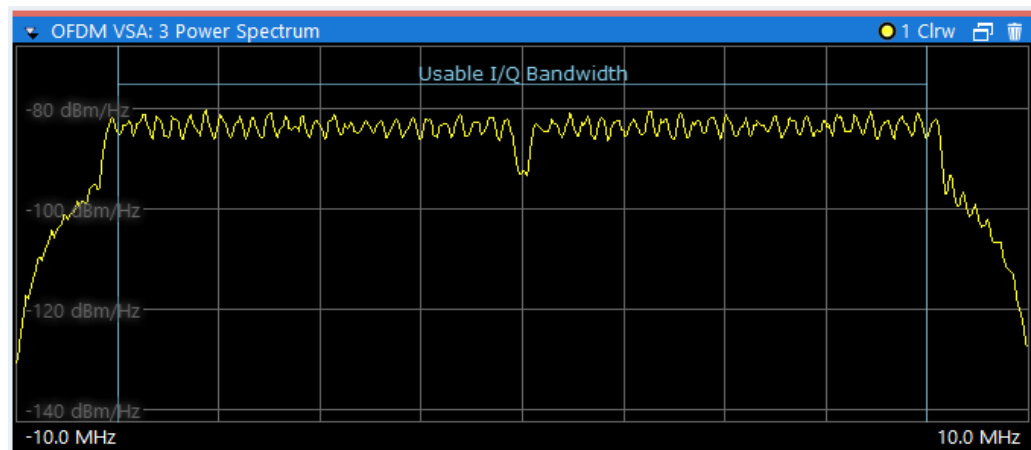


Figure 2-17: Power Spectrum display

The usable I/Q bandwidth is indicated for reference. If a channel filter is active, the 6-dB-bandwidth of the filter is indicated instead.

See Chapter 4.5, "Data acquisition", on page 69.

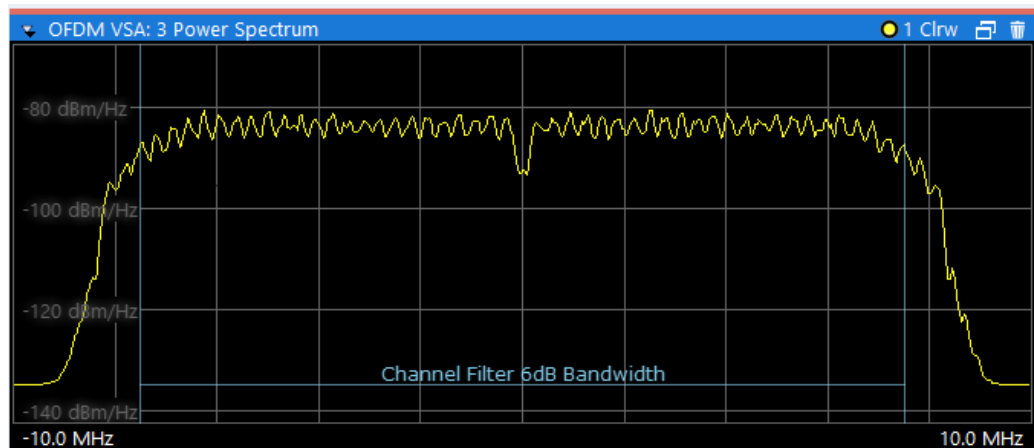


Figure 2-18: Power spectrum with active channel filter

Remote command:

LAY:ADD? '1', RIGH, PSP, see LAYout:ADD[:WINDow]? on page 231

TRACe:DATA?, see Chapter 8.7.4.17, "Power spectrum", on page 263

Frequency unit: UNIT:FAXes on page 209

### Result Summary

The Result Summary table provides numerical measurement results.

Statistical evaluation is performed over all analyzed frames within the capture buffer.

OFDM VSA: 2 Result Summary				
	Min	Average	Max	Unit
EVM All	-34.708	-34.669	-34.627	dB
	1.839	1.847	1.856	%
EVM Data Symbols	-34.596	-34.562	-34.503	dB
	1.863	1.870	1.883	%
EVM Pilot Symbols	-35.901	-35.750	-35.523	dB
	1.603	1.631	1.674	%
MER	34.627	34.670	34.708	dB
I/Q Offset	-78.978	-74.875	-71.935	dB
Gain Imbalance	-0.001	0.002	0.006	dB
Quadrature Error	-0.016	0.008	0.021	°
Frequency Error	0.040	0.168	0.272	Hz
Sample Clock Error	0.008	0.084	0.220	ppm
Frame Power	-23.189	-23.142	-23.104	dBm
Crest Factor	8.946	9.417	9.931	dB

Figure 2-19: Result Summary display

**Note:** If only one frame is available for analysis, the minimum and maximum values are not displayed, as they are identical to the average value.

For details on the individual results, see Table 2-1.

Remote command:

LAY:ADD? '1', RIGH, RSUM, see LAYout:ADD[:WINDow]? on page 231

Results:

FETCh:SUMMary[:ALL]? on page 239

### 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.

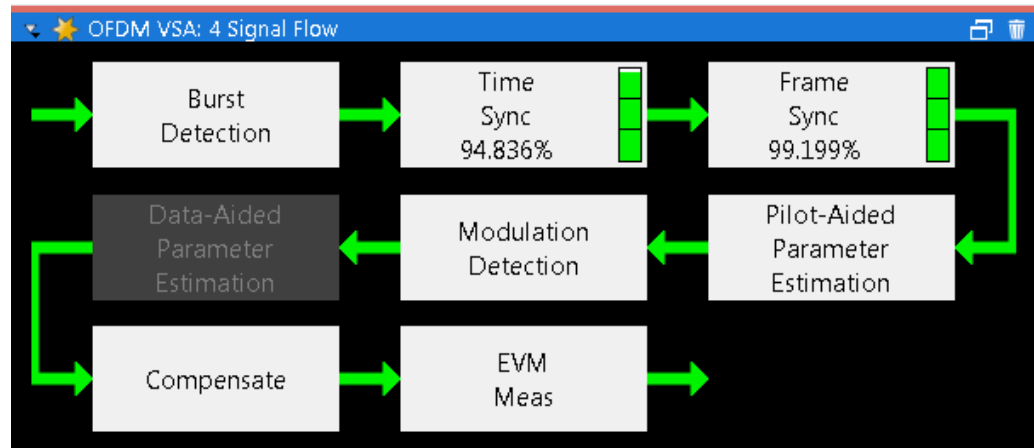


Figure 2-20: Signal Flow display

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.

For detailed information about the complete synchronization process, refer to [Chapter 3.2.2.1, "Synchronization block"](#), on page 40.

Remote command:

LAY:ADD? '1', RIGH, SFL, see LAYout:ADD[:WINDow]? on page 231

Retrieving results:

[Chapter 8.7.2, "Retrieving signal flow results"](#), on page 242

### Trigger to Sync

Indicates the time offset between the trigger event and the start of the first OFDM frame. One value per capture is displayed.

Remote command:

LAY:ADD? '1', RIGH, TRIG, see LAYout:ADD[:WINDow]? on page 231

Retrieving results:

FETCh:TTFRame? on page 241

## 3 Measurement basics

Some background knowledge on basic terms and principles used in OFDM vector signal analysis is provided here for a better understanding of the required configuration settings.

- [General information on OFDM signals](#).....30
- [Signal processing](#).....37
- [Sample rate, record length and analysis bandwidth](#)..... 41
- [DFT-S precoding](#).....42

### 3.1 General information on OFDM signals

- [OFDMA](#)..... 30
- [OFDM parameterization](#).....32

#### 3.1.1 OFDMA

In an OFDM system, the available spectrum is divided into multiple carriers, called subcarriers, which are orthogonal to each other. Each of these subcarriers is independently modulated by a low rate data stream.

OFDM is used as well in WLAN, WiMAX and broadcast technologies like DVB. OFDM has several benefits including its robustness against multipath fading and its efficient receiver architecture.

[Figure 3-1](#) shows a representation of an OFDM signal taken from 3GPP TR 25.892. Data symbols are independently modulated and transmitted over a high number of closely spaced orthogonal subcarriers. In the OFDM-VSA common modulation schemes as QPSK, 16QAM, and 64QAM can be defined as well as arbitrarily distributed constellation points.

In the time domain, a guard interval can be added to each symbol to combat inter-OFDM-symbol-interference due to channel delay spread. In EUTRA, the guard interval is a cyclic prefix which is inserted before each OFDM symbol.

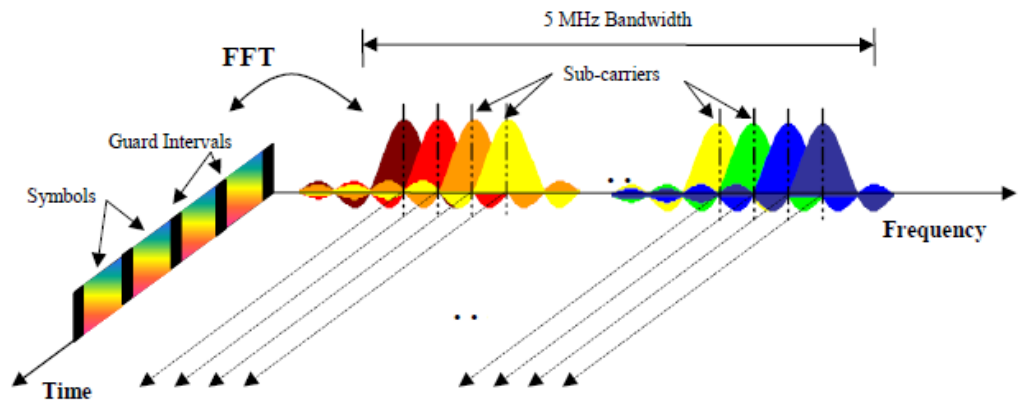


Figure 3-1: Frequency-time representation of an OFDM signal

In practice, the OFDM signal can be generated using the inverse fast Fourier transform (IFFT) digital signal processing. The IFFT converts a number  $N$  of complex data symbols used as frequency domain bins into the time domain signal. Such an  $N$ -point IFFT is illustrated in Figure 3-2, where  $a(mN+n)$  refers to the  $n^{\text{th}}$  subchannel modulated data symbol, during the time period  $mT_u < t \leq (m+1)T_u$ .

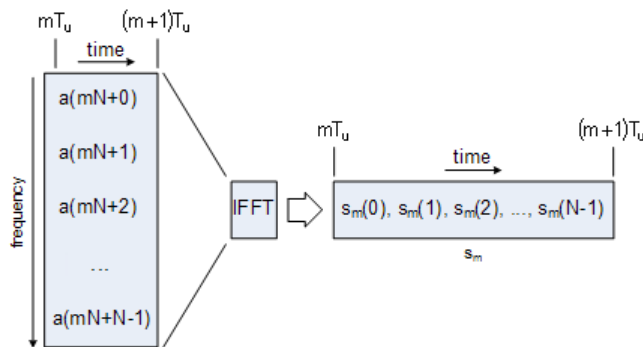


Figure 3-2: OFDM useful symbol generation using an IFFT

The vector  $s_m$  is defined as the useful OFDM symbol. It is the time superposition of the  $N$  narrowband modulated subcarriers. Therefore, from a parallel stream of  $N$  sources of data, each one independently modulated, a waveform composed of  $N$  orthogonal subcarriers is obtained. Each subcarrier has the shape of a frequency sinc function (see Figure 3-1).

Figure 3-3 illustrates the mapping from a serial stream of QAM symbols to  $N$  parallel streams, used as frequency domain bins for the IFFT. The  $N$ -point time domain blocks obtained from the IFFT are then serialized to create a time domain signal. Not shown in Figure 3-3 is the process of cyclic prefix insertion.

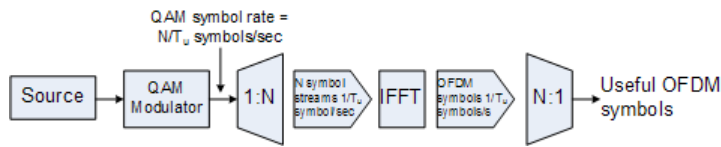


Figure 3-3: OFDM signal generation chain

### 3.1.2 OFDM parameterization

A generic OFDM analyzer supports various OFDM standards. Therefore a common parameterization of OFDM systems has to be defined.

- Time domain description..... 32
- Frequency domain description..... 32
- Preamble description..... 37

#### 3.1.2.1 Time domain description

The fundamental unit of an OFDM signal in the time domain is a *sample*.

An *OFDM symbol* with a length of  $N_S$  samples consists of:

- A *guard interval* of length  $N_G$
- An *FFT interval* of length  $N_{FFT}$

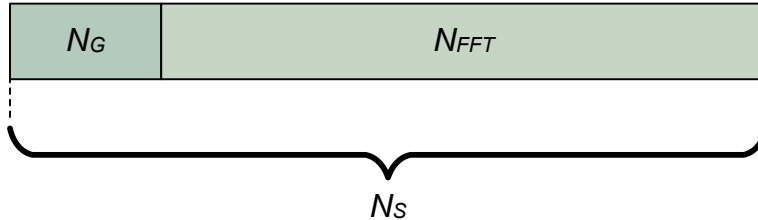


Figure 3-4: OFDM symbol in time domain

#### 3.1.2.2 Frequency domain description

The FFT intervals of the OFDM symbols are transformed into the frequency domain using a discrete Fourier transformation. The successive symbols of the OFDM signal are displayed in time-frequency matrices. The fundamental unit of an OFDM signal in the frequency domain is a *cell*.

The total area of a time-frequency matrix is called *frame*. A frame is the highest level unit used in OFDM VSA.



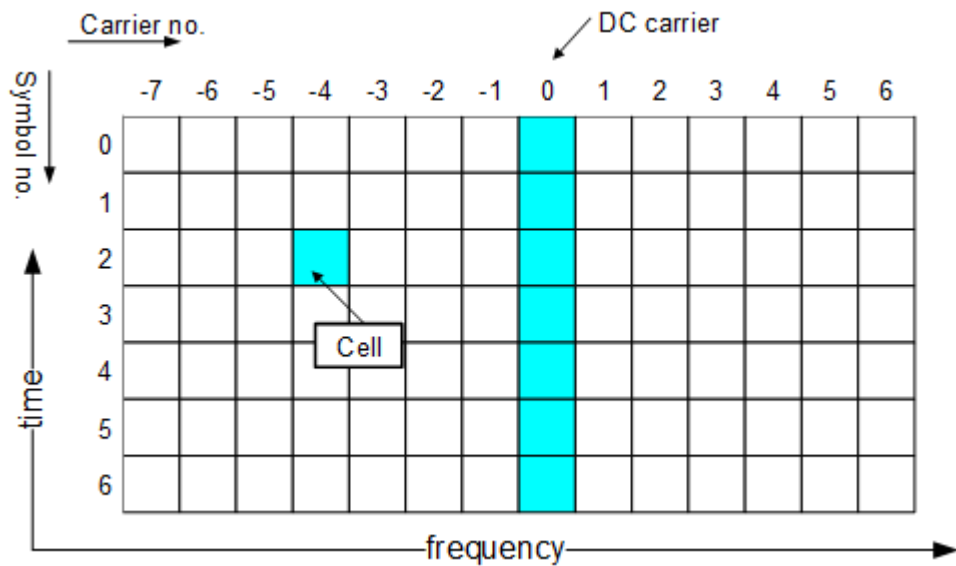


Figure 3-5: Time-Frequency matrix

### Carriers

A column of cells at the same frequency is called *carrier*.

The carrier number is the column index of a time-frequency matrix. The number '0' is assigned to the *DC-carrier*, which lies at the transmitter center frequency. The total number of subcarriers is  $N_{FFT}$ . The *DC-carrier offset* determines the position of the DC carrier relative to the lowermost subcarrier. The offset is an inherent attribute of the FFT algorithm.

Table 3-1: Relationship between FFT length and subcarrier range

FFT length $N_{FFT}$	DC-Carrier offset	Range
even	$\frac{N_{FFT}}{2}$	$\left[ -\frac{N_{FFT}}{2}, \frac{N_{FFT}}{2} - 1 \right]$
odd	$\frac{N_{FFT} - 1}{2}$	$\left[ -\frac{N_{FFT} - 1}{2}, \frac{N_{FFT} - 1}{2} \right]$

### OFDM system sample rate

In an OFDM system, an FFT (with the length  $N_{FFT}$ ) is performed for each symbol. Each FFT bin corresponds to one subcarrier. For each FFT bin, one sample must be captured in the time domain for each OFDM symbol. The minimum number of samples required for the measurement is thus the number of subcarriers (or the number of FFT bins), multiplied by the number of symbols to measure. To avoid intersymbol interference, the cyclic prefix is added as the guard interval.

$$No\_samples_{min} = (<FFT\_size> + <CyclicPrefixLength>) * <No\_symbols\_to\_measure>$$

Generally, the number of samples acquired per second is referred to as the sample rate. The sample rate required by a specific OFDM system is referred to as the *OFDM system sample rate*. It depends on parameters that characterize the OFDM system and is defined by the following equation:

$$SR_{OFDM} = \langle carrier\_spacing \rangle * \langle FFT\_size \rangle$$

For the R&S VSE OFDM VSA application to demodulate OFDM symbols, it is important that the number of acquired samples in the application corresponds to the OFDM system sample rate.

### Symbols

A row of cells at the same time is called *symbol*.

The symbol number is the row index of a time frequency matrix. The first symbol gets the number '0'.

### Allocation matrix

The allocation matrix defines the complete frame and subdivides the OFDM system into the following cell types:

- **Pilot cells:** Contain known values and are used for various synchronization and parameter estimation purposes.
- **Data cells:** Contain the user data or *payload* of the transmission. The modulation format of the data cells must be known or can be estimated in a modulation estimation block.
- **"Don't Care" cells:** Cells that are not evaluated for EVM measurement, but contain signal power.
- **Zero cells:** Contain no signal power at all; Typically, guard carriers around DC or at the edges of the carrier axis.

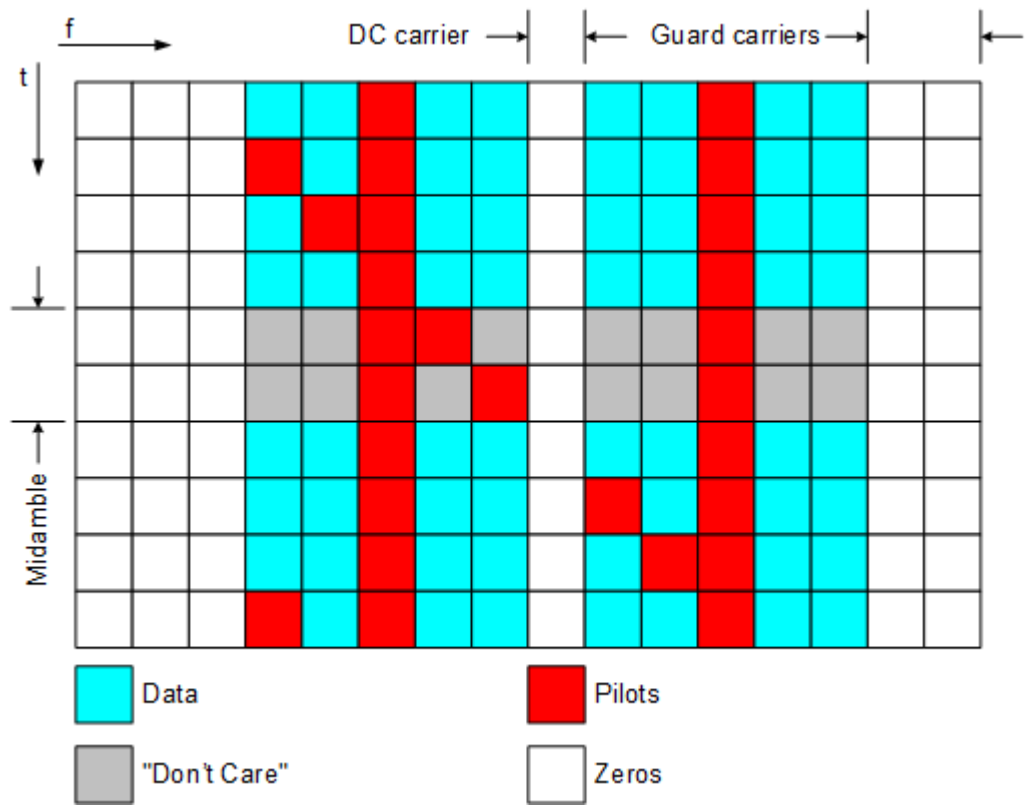


Figure 3-6: Allocation matrix

### Pilot matrix

A pilot matrix contains known complex numbers in the matrix cells, which are defined as pilot cells in the allocation matrix. Within the analyzer, the pilot matrix is correlated with the received time frequency matrix. Thus, it obtains the frame start and the frequency offset of the received signal relative to the given allocation matrix.

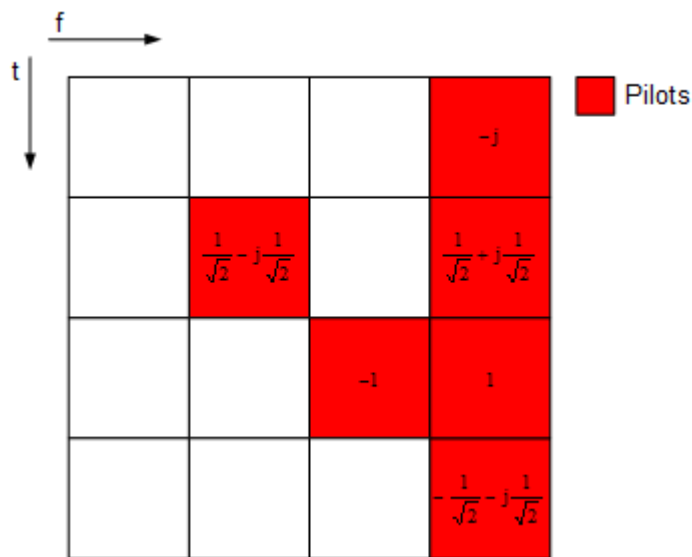


Figure 3-7: Pilot matrix

### Constellation vector

A constellation vector contains all possible numbers in the complex plane that belong to a specific modulation format. Constellation vectors must be defined for each possible data modulation format. The magnitude within the constellation vectors must be scaled according to the pilot matrix. One entry in the constellation vector is called *constellation point*.

Differential modulation is not supported. The respective absolute modulation scheme must be used instead (e.g. QPSK instead of DQPSK). Periodically rotated constellations are not supported. The set union of all constellations must be used instead (e.g. 8PSK instead of PI/4-DQPSK).

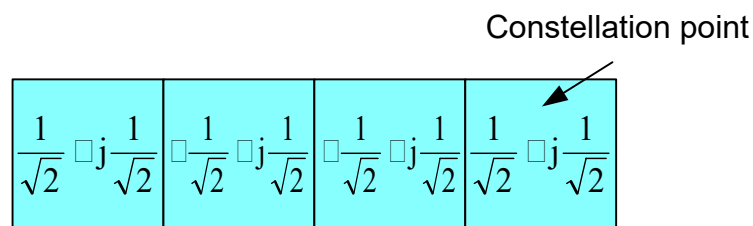


Figure 3-8: QPSK constellation vector

### Modulation matrix

A modulation matrix contains numbers to the underlying constellation vector for each cell, which is defined as data cell in the allocation matrix. Clusters of data cells with the same modulation therefore share the same number. A data cell can also contain an unused number, that is a number for which no constellation vector is defined. In this case, all data cells sharing that number are assumed to use only one of the valid con-

stellation vectors. This method can be used within the R&S VSE OFDM VSA application to allow for automatic modulation detection.

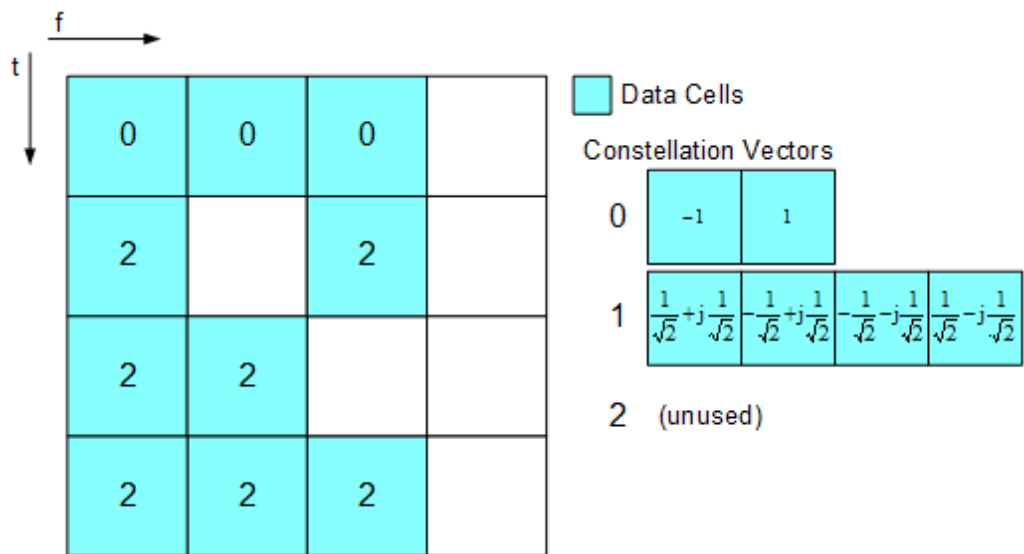


Figure 3-9: Modulation matrix

### 3.1.2.3 Preamble description

The OFDM demodulator must support synchronization on repetitive preamble symbols. A repetitive preamble contains several repetitions of one time domain block. The Figure 3-10 shows exemplarily the parameterization of a repetitive preamble symbol, which contains a five times repetition of block T. The allocation matrix can have an arbitrary offset to the beginning of the preamble symbol. If the offset is zero or negative, the preamble is also contained within the frame and is used for further estimation processes.

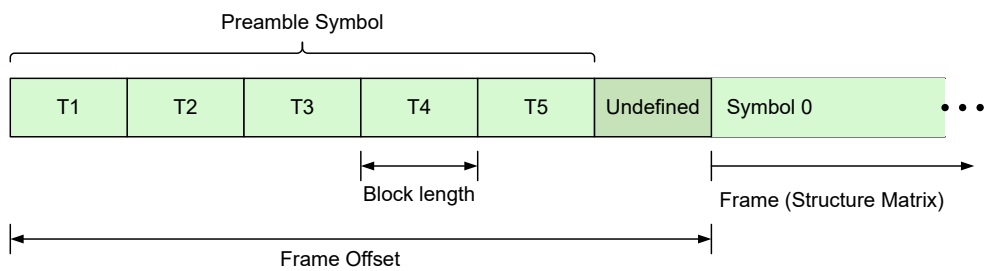


Figure 3-10: Description of a repetitive preamble symbol

## 3.2 Signal processing

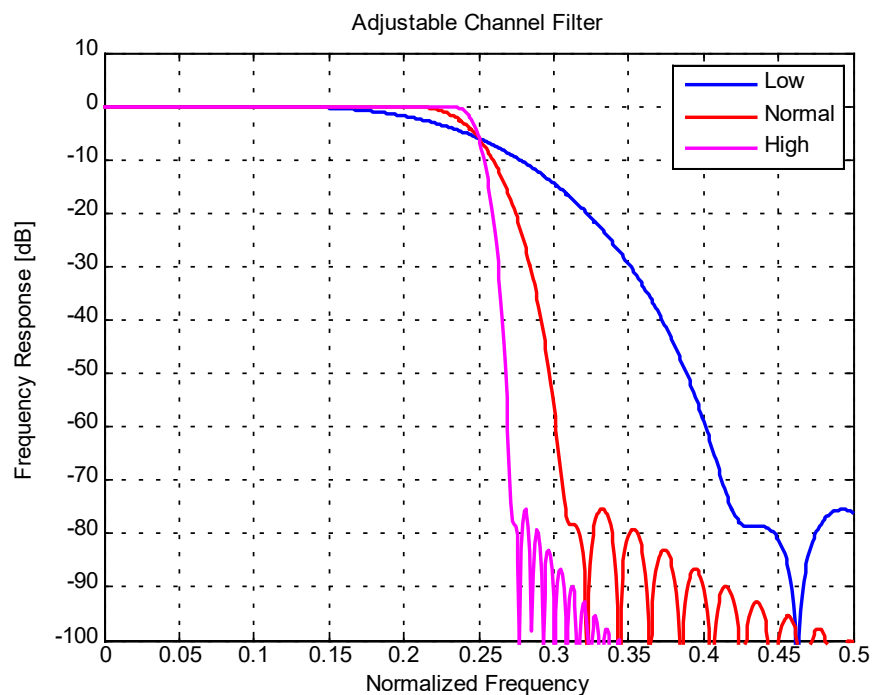
- Channel filter.....38
- OFDM measurement.....39

### 3.2.1 Channel filter

The R&S VSE OFDM VSA application can use the internal channel filter of the instrument or apply an adjustable channel filter. The filter bandwidth of the internal channel filter is fully equalized within the digital hardware.

Alternatively to the internal filters, you can apply a channel filter with adjustable bandwidth and slope characteristics to the input signal. The R&S VSE OFDM VSA application then designs a window-based finite impulse response filter. The bandwidth is defined as two times the 6-dB cutoff frequency. The 50-dB cutoff frequency determines the slope characteristics.

Choosing the correct filter settings is a trade-off between selectivity and filter impulse response length. A steep filter leads to superior selectivity between adjacent channels. On the other hand, such a filter has a long channel impulse response, which can produce intersymbol interference if used in systems with small guard intervals. Flat filters require a higher distance between channels and possibly attenuate the outer carriers of the signal. In contrast, the channel impulse response is short and suited for systems with short guard intervals.



**Figure 3-11: Slope characteristics for different channel filters (with low, normal, high steepness)**

The adjustable channel filter performs a decimation at its output. Thus, the user-definable maximum output sample rate is reduced compared to the internal filter setting. Therefore, data is captured by the R&S VSE with an oversampling factor before the adjustable channel filter is applied.

**Example:**

Assume you want to analyze a 20-MHz WLAN-A signal. The specified (demodulation) sample rate is 20 MHz.

If the adjustable channel filter is disabled, the R&S VSE captures I/Q data and resamples it to 20 MHz. The instrument's hardware defines the flat bandwidth, filter slope and stopband frequency of the used filter. The R&S VSE OFDM VSA application receives the data with the required sample rate of 20 MHz.

If the adjustable channel filter is enabled, the R&S VSE captures I/Q data using a doubled sample rate of 40 MHz, that is: an oversampling factor of 2 is applied. The R&S VSE OFDM VSA application then applies the adjustable channel filter. The user-defined 6-dB bandwidth defines the overall bandwidth of the filter. The distance between the 6-dB bandwidth and the user-defined 50-dB bandwidth defines the filter slope (see Figure 3-11). The 20-MHz region of interest in the middle of the signal is not affected by the filter. Finally, the R&S VSE OFDM VSA application decimates the filtered data from 40 MHz to the required sample rate of 20 MHz.

**3.2.2 OFDM measurement**

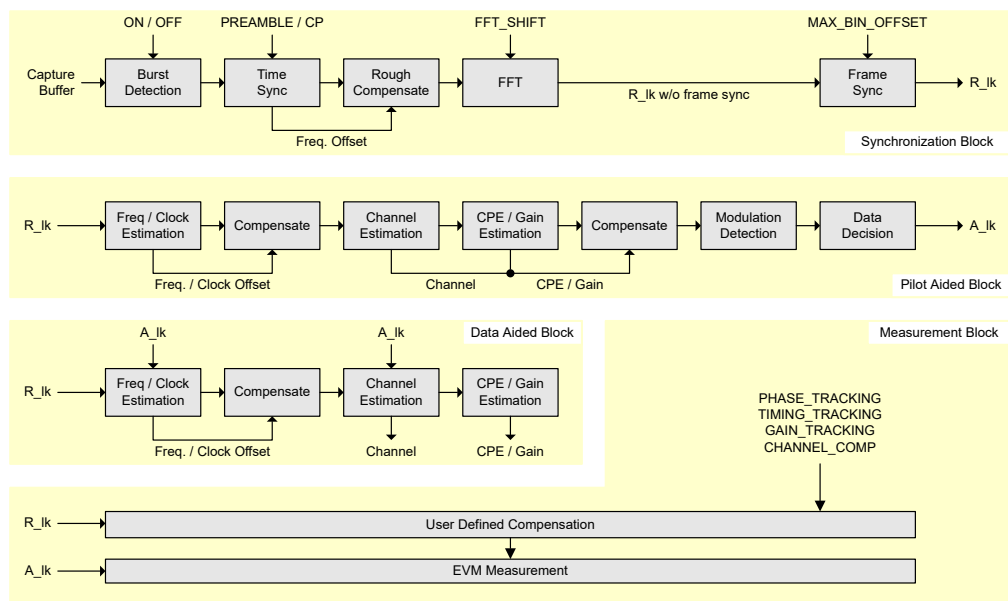


Figure 3-12: Block diagram of the R&S VSE OFDM VSA application

The block diagram in Figure 3-12 shows the R&S VSE OFDM VSA application process from the capture buffer containing the I/Q data to the actual analysis block. The signal processing chain can be divided in four major blocks:

- Synchronization block..... 40
- Pilot-aided block..... 40
- Data aided block..... 41
- Measurement block..... 41

### 3.2.2.1 Synchronization block

The synchronization starts with a burst detection that extracts transmission areas within a burst signal by a power threshold. For seamless transmission, as is the case in most broadcast systems, it is possible to bypass this block. The following time synchronization uses either the preamble or the cyclic prefix of each OFDM symbol to find the optimum starting point for the FFT by a correlation metric. If preamble synchronization is selected, the correlation is done between successive blocks of a repetitive preamble structure. Alternatively, the cyclic prefix synchronization correlates the guard interval of each symbol with the end of the FFT part. In addition, both methods return an estimation of the fractional frequency offset by evaluating the phase of the correlation maximum. This frequency offset has to be compensated before the FFT to avoid intercarrier interference.

By default, the FFT starting point is put in the center of the guard interval assuming a symmetric impulse response, but it can optionally be shifted within the guard interval. After performing the FFT for each available OFDM symbol, a time-frequency matrix  $R_{l,k}$  with symbol index  $l$  and subcarrier index  $k$  is available.

The subsequent frame synchronization determines the frame start within this matrix and the integer carrier frequency offset. It is determined by a two-dimensional correlation of  $R_{l,k}$  with the known pilot matrix from the configuration file. To avoid unnecessary computing time for signals with low frequency offset, the search length in the frequency direction can be limited by a control parameter.

Furthermore, a threshold for the reliability of time and frame synchronization can be defined to ensure that only correct frames are evaluated. A threshold is particularly useful for 5G signals, for example. In this case, the pilot structure in the second half of the frame is similar, but not identical to the first half. Thus, frame synchronization can be off by half a frame, but since the pilots do not match completely, the reliability is poor. The EVM results are also poor. By defining a threshold, only the correctly synchronized frames are evaluated.

### 3.2.2.2 Pilot-aided block

The pilot-aided block within the signal processing chain uses the predefined pilot cells for parameter estimation and subsequent compensation of the signal impairments. It starts with maximum likelihood estimation of the remaining frequency error and sample clock offset. While a frequency error leads to a phase offset linearly increasing with time, the clock offset introduces an additional phase error linearly increasing with frequency. The estimator determines the most probable parameters that lead to the phase offsets observed on the pilot cells. The resulting offset values are compensated in the frequency domain by rerotating the phase of the  $R_{l,k}$  matrix. However, for severe clock offsets it can be necessary to resample the received signal in the time domain and repeat the FFT stage.

The subsequent channel estimator determines the channel transfer function at the known pilot positions and uses interpolation to get a complete frequency response vector for all subcarriers. It does not extrapolate the channel transfer function for the guard carriers (which are defined by zero or "don't care" cell types). Since the presented measurement system is intended for stationary channels, the interpolation is performed



along the frequency direction only. The node values on the frequency axis are determined by averaging all available pilots of each subcarrier over time. Depending on the layout of the pilots on the frequency axis, an interpolation filter bank with optimum Wiener filter coefficients is calculated in advance. The Wiener filter is designed under the assumption that the maximum impulse response length does not exceed the cyclic prefix length.

Although the channel is assumed to be stationary, common phase error and power level variations are estimated symbol by symbol over the complete frame. The estimation takes settling effects of oscillators and power amplifiers into account. All estimated impairments are fully compensated to get an optimum signal for the subsequent modulation-detection and data decision stage.

The modulation-detection block determines the modulation type of the data cells. Either each carrier or each symbol can be assigned to one specific constellation. Alternatively, the modulation information provided in the configuration file is evaluated to extract clusters of data cells with consistent modulation. The estimator uses a maximum likelihood approach. Each cluster of data cells is compared with all possible modulation hypotheses and the most probable constellation for each cluster is used for the subsequent data decision. The data decision block finally outputs a reference signal matrix  $A_{i,k}$  which is an optimum estimate of the actual transmitted OFDM frame.

#### 3.2.2.3 Data aided block

The data aided block can be activated optionally to refine the parameter estimations with the help of the reference signal. Whereas the previous stages could only include pilot cells for the estimation algorithms, the data aided part can treat data cells as additional pilots. Thus, the accuracy of the estimates increases in good signal to noise environments without data decision errors. However, if the reference signal matrix  $A_{i,k}$  contains falsely decided data cells, the data aided estimation part can corrupt the results and should be omitted.

#### 3.2.2.4 Measurement block

The last part of the signal processing chain comprises the user-defined compensation and the measurement of modulation quality. The measurement block takes the received OFDM symbols  $R_{i,k}$  and the previously determined reference OFDM symbols  $A_{i,k}$  to calculate the error vector magnitude (EVM). The received OFDM symbols can optionally be compensated using phase, timing and level deviations and the channel transfer function.

### 3.3 Sample rate, record length and analysis bandwidth

#### Definitions

- **Input sample rate (ISR):** the sample rate of the useful data provided by the device connected to the input of the connected instrument

- (User, Output) **Sample rate (SR)**: the sample rate that is defined by the user (e.g. in the "Data Acquisition" dialog box in the "I/Q Analyzer" application) and which is used as the basis for analysis or output
- **Usable I/Q (analysis) bandwidth**: the bandwidth range in which the signal remains undistorted in regard to amplitude characteristic and group delay; this range can be used for accurate analysis by the R&S VSE
- **Record length**: the number of I/Q samples the connected instrument captures during the specified measurement time; calculated as the measurement time multiplied by the sample rate. By default, the record length is set to the number of measurement points, and the measurement time and sample rate are adapted accordingly. The maximum record length is 524288, but must not exceed the number of samples provided by the connected instrument.

For the I/Q data acquisition, digital decimation filters are used internally in the connected instrument. The passband of these digital filters determines the *maximum usable I/Q bandwidth*. In consequence, signals within the usable I/Q bandwidth (passband) remain unchanged, while signals outside the usable I/Q bandwidth (passband) are suppressed. Usually, the suppressed signals are noise, artifacts, and the second IF sideband. If frequencies of interest to you are also suppressed, try to increase the output sample rate to increase the maximum usable I/Q bandwidth.

As a rule, the usable I/Q bandwidth is proportional to the output sample rate. However, the bandwidth used by the R&S VSE software is restricted by the bandwidth provided by the connected instrument.

### 3.4 DFT-S precoding

DFT-s-OFDM and SC-FDMA are different names for a method that can be applied to lower the crest factor of the RF signal.

For DFT-s-OFDM, an additional digital Fourier transformation (DFT) is included in the transmitter's signal processing stage, referred to as *precoding*. If this method is used by the input signal, enable the "Transform Precoding" option to decode the precoding transformation using an iDFT. The R&S VSE OFDM VSA application tries to detect contiguous groups of data cells for each OFDM symbol and decode them using an inverse DFT. Zero cells are ignored.

If "Transform Precoding" is enabled, you can define how to process OFDM symbols that contain "Don't Care" and pilot cells:

- OFDM symbols that contain pilot or "Don't Care" cells are decoded, but these cells are ignored.
- OFDM symbols that contain a pilot or a "Don't Care" cell are skipped and not decoded.

The "Ignore pilot/don't care" setting has no effect if the signal generator does not use interspersed pilots in any OFDM symbol that uses DFT-S precoding on DATA cells. In this case, either there are DATA-only symbols with DFT-S, or PILOT-only symbols without DFT-s.

### Configuration files for precoded signals

If precoding is enabled, take special care when editing the configuration file. Make sure that all cells are allocated correctly, that is:

- No cell is falsely allocated as a data cell.
- All data cells are allocated as data cells.

Otherwise, the iDFT parameters (length, start, stop) are not correct and *all* data cells in that OFDM symbol are demodulated inaccurately.

### Example: Processing a precoded DFT-S signal

The following example demonstrates how a precoded DFT-S signal is processed for analysis.

#### On the signal generator:

Assume that the signal generator uses DFT-S precoding and interspersed pilots in a certain OFDM symbol. Before encoding, this OFDM symbol consists of the following cells:

D1 D2 P1 D3 D4 P2 D5 D6

with D = Data cells, P = Pilots cells

Encoding is performed on data cells only, omitting the pilots:

$[D1' D2' D3' D4' D5' D6'] = \text{FFT}([D1 D2 D3 D4 D5 D6])$

Then the encoded data cells are sorted back into correct positions:

D1' D2' P1 D3' D4' P2 D5' D6'

These encoded I/Q symbols are used for further OFDM modulation and then transmitted.

#### In the R&S VSE OFDM VSA application:

For this OFDM symbol, the received I/Q symbols are in an early stage:

D1' D2' P1 D3' D4' P2 D5' D6'

Since we know that DFT-S was used, we select "Signal description" > "Transform precoding" : "on". The R&S VSE OFDM VSA application tries to revert the DFT-S precoding, but it detects the disturbing pilots. Now there are two ways to deal with this OFDM symbol:

- "Ignore pilot/don't care" enabled:  
The R&S VSE OFDM VSA application is told to ignore the disturbing pilots. The resulting IFFT ignores the pilot cells in the input buffer:  
 $[D1 D2 D3 D4 D5 D6] = \text{IFFT}([D1' D2' D3' D4' D5' D6'])$   
The cells are sorted back into their correct position:  
D1 D2 P1 D3 D4 P2 D5 D6  
The result is identical to what was sent, so the EVM in this OFDM symbol is OK.
- "Ignore pilot/don't care" disabled:  
The R&S VSE OFDM VSA application is not told to just ignore those disturbing pilots. The R&S VSE OFDM VSA application only performs the IFFT for data-only

OFDM symbols. Since the planned IFFT cannot be performed, it is skipped entirely for this OFDM symbol.

The received I/Q symbols remain unchanged:

D1' D2' P1 D3' D4' P2 D5' D6'

This result is not identical to the sent I/Q symbols D1 D2 P1 D3 D4 P2 D5 D6. The EVM in this symbol is high.

## 4 Configuring OFDM VSA measurements



### General R&S VSE functions


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

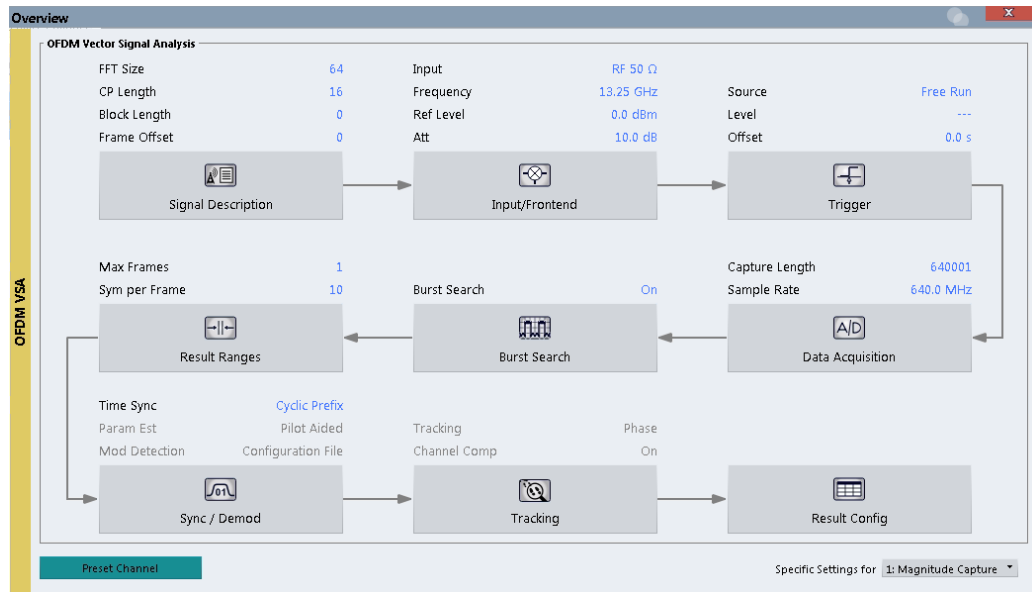
- Controlling instruments and capturing I/Q data
- Data management
- General software preferences and information

• <a href="#">Configuration overview</a> .....	45
• <a href="#">Signal description</a> .....	47
• <a href="#">Input and frontend settings</a> .....	52
• <a href="#">Trigger settings</a> .....	65
• <a href="#">Data acquisition</a> .....	69
• <a href="#">Burst search</a> .....	72
• <a href="#">Result ranges</a> .....	73
• <a href="#">Synchronization, demodulation and tracking</a> .....	74
• <a href="#">Adjusting settings automatically</a> .....	78

### 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 OFDM VSA 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. Signal Description  
See [Chapter 4.2, "Signal description"](#), on page 47
2. Input/Frontend  
See [Chapter 4.3, "Input and frontend settings"](#), on page 52
3. Trigger  
See [Chapter 4.4, "Trigger settings"](#), on page 65
4. Data Acquisition  
See [Chapter 4.5, "Data acquisition"](#), on page 69
5. Burst Search  
See [Chapter 4.6, "Burst search"](#), on page 72
6. Result Range  
See [Chapter 4.7, "Result ranges"](#), on page 73
7. Synchronization and Demodulation Settings  
See [Chapter 4.8, "Synchronization, demodulation and tracking"](#), on page 74
8. Tracking  
See [Chapter 4.8, "Synchronization, demodulation and tracking"](#), on page 74
9. Result Configuration

See [Chapter 6.1, "Result configuration"](#), on page 109

### 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.

<a href="#">Preset Channel</a> .....	47
<a href="#">Specific Settings for</a> .....	47

### Preset Channel

Select "Preset Channel" 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 133

### Specific Settings for

The channel can 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 Signal description

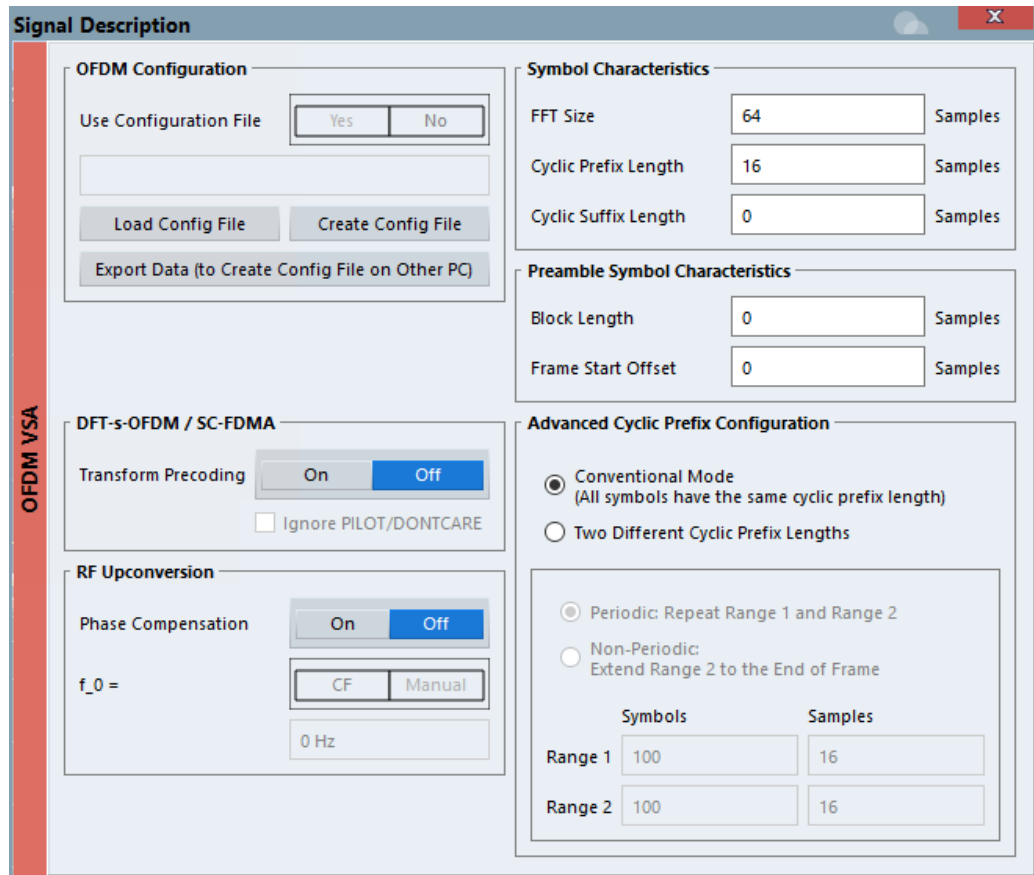
**Access:** "Overview" > "Signal Description"

You must describe the expected input signal so that the R&S VSE OFDM VSA application can compare the measured signal to the expected reference signal. You can load an existing configuration file, or create one interactively using a wizard for the current input signal (see [Chapter 5, "Creating a configuration file using the wizard"](#), on page 81).



The R&S VSE OFDM VSA application provides some sample files for I/Q input data and configuration files in the

C:\ProgramData\Rohde-Schwarz\VSE\`<version_no>`\user\demo\OFDM-VSA directory.



Use Configuration File.....48

Load Configuration File.....49

Create Configuration File.....49

Export Data (to Create Config File on Other PC).....49

DFT-s-OFDM / SC-FDMA: Transform Precoding.....49

    └ Ignore PILOT/DONTCARE.....49

RF Upconversion: Phase Compensation.....50

FFT Size.....50

Cyclic Prefix Length.....50

Cyclic Suffix Length.....50

Preamble Symbol Characteristics: Block Length.....51

Frame Start Offset.....51

Advanced Cyclic Prefix Configuration.....51

Different cyclic prefix lengths.....51

    └ Cyclic prefix definition per range (Symbols / Samples).....52

**Use Configuration File**

Determines whether the configuration from the currently loaded file is used for the measurement. Alternatively, you can configure the OFDM signal manually.

The currently loaded configuration file is indicated for reference.

Remote command:

CONFigure:SYSTem:CFILe on page 138



**Load Configuration File**

Opens a file selection dialog box to select the configuration (.XML) file for the measurement.

**Note:** Configuration files with more than 100 different modulation types cannot be loaded.

**Tip:** You can load a configuration file simply by selecting it in a file explorer and dragging it to the R&S VSE software. Drop it into the "Measurement Group Setup" window or the channel bar for any R&S VSE OFDM VSA application channel.

Remote command:

[MMEMory:LOAD:CFGFile](#) on page 140

**Create Configuration File**

Opens a wizard that helps you create a new configuration file interactively. See [Chapter 5, "Creating a configuration file using the wizard"](#), on page 81.

**Export Data (to Create Config File on Other PC)**

Exports the current settings to a .K96\_wizv file. Use this input file to create a configuration file using the wizard on another PC.

**DFT-s-OFDM / SC-FDMA: Transform Precoding**

DFT-s-OFDM and SC-FDMA are different names for a method that can be applied to lower the crest factor of the RF signal.

For DFT-s-OFDM, an additional digital Fourier transformation (DFT) is included in the transmitter's signal processing stage, referred to as *precoding*. If this method is used by the input signal, enable the "Transform Precoding" option to decode the precoding transformation using an iDFT. The R&S VSE OFDM VSA application tries to detect contiguous groups of data cells for each OFDM symbol and decode them using an inverse DFT. Zero cells are ignored.

For details, see [Chapter 3.4, "DFT-S precoding"](#), on page 42.

Remote command:

[CONFigure:TPRecoding](#) on page 139

**Ignore PILOT/DONTCARE ← DFT-s-OFDM / SC-FDMA: Transform Precoding**

If "Transform Precoding" is enabled, define how to process OFDM symbols that contain "Don't Care" and pilot cells:

"Ignore pilot/don't care" enabled:

OFDM symbols that contain pilot or "Don't Care" cells are decoded, but these cells are ignored.

"Ignore pilot/don't care" disabled:

OFDM symbols that contain a pilot or a "Don't Care" cell are skipped and not decoded.

Remote command:

[CONFigure:TPRecoding:IGNore](#) on page 139

### RF Upconversion: Phase Compensation

For example, in 5G uplink signals, the phase shifts from one OFDM symbol to the next. In this case, the R&S VSE OFDM VSA application must revert the phase compensation that is applied to the signal during RF upconversion. The phase compensation is based on a fixed frequency, which can either be the center frequency, or you can define the frequency for the shift manually.

Remote command:

[CONFigure:RFUC:STATe](#) on page 135

[CONFigure:RFUC:FZERo:MODE](#) on page 135

[CONFigure:RFUC:FZERo:FREQuency](#) on page 134

### FFT Size

Defines the useful length of an OFDM symbol in the time domain as the number of samples. This setting determines the number of samples used as input for each FFT calculation.

This setting is not available if a configuration file is active (see ["Use Configuration File"](#) on page 48). In this case, the FFT length defined in the file is displayed for reference only.

Remote command:

[CONFigure\[:SYMBOL\]:NFFT](#) on page 137

### Cyclic Prefix Length

Defines the length of the cyclic prefix (CP) area between two OFDM symbols in samples. The cyclic prefix area defines the guard interval and is expected to contain a copy of the samples at the end of the OFDM symbol.

The cyclic prefix length must be smaller than or equal to the ["FFT Size"](#) on page 50.

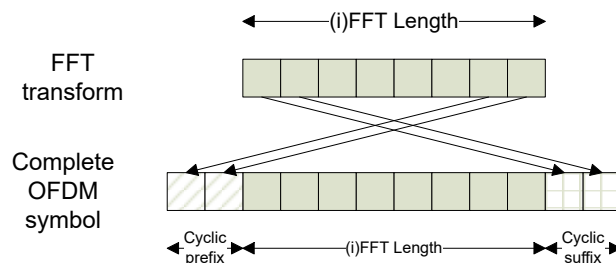
Remote command:

[CONFigure\[:SYMBOL\]:NGUard<cp>](#) on page 137

### Cyclic Suffix Length

Defines the length of the cyclic suffix between two OFDM symbols in samples. The cyclic suffix is expected to contain a copy of the first N samples at the beginning of the OFDM symbol.

[Figure 4-2](#) shows how the complete OFDM symbol is retrieved for an FFT length of 8 and a cyclic prefix and suffix length of 2.



**Figure 4-2: OFDM symbol with cyclic prefix and suffix**

The cyclic suffix length must be smaller than or equal to the ["FFT Size"](#) on page 50.

Remote command:

`CONFigure[:SYMBOL]:NSUFFIX` on page 138

### Preamble Symbol Characteristics: Block Length

Instead of using the cyclic prefix for the time synchronization, the R&S VSE OFDM VSA application can also use a preamble that contains repetitive blocks of samples (if available in the signal). This setting specifies the length of one data block within the repetitive preamble as a number of samples.

Remote command:

`CONFigure:PREamble:BLENGTH` on page 134

### Frame Start Offset

Specifies the time offset from the preamble start to the actual frame start as a number of samples.

Remote command:

`CONFigure:PREamble:FOFFset` on page 134

### Advanced Cyclic Prefix Configuration

Additional settings for non-conventional cyclic prefixes are displayed when you select "Advanced", and hidden when you select "Basic".

By default, "Conventional Mode" is assumed, that is: each OFDM symbol has the same cyclic prefix length. Thus, only the basic cyclic prefix settings are shown.

Remote command:

`CONFigure[:SYMBOL]:GUARD:MODE` on page 136

### Different cyclic prefix lengths

Some OFDM signals change their cyclic prefix over time (e.g. 802.11ac). This setting defines the behavior in such a case.

"Periodic" One "slot" that consists of the two defined ranges is repeated over and over until the number of symbols specified by the result range parameter is reached. The ranges are repeated periodically, first range 1, then range 2, then range 1, etc.



Figure 4-3: Non-Conventional cyclic prefix case: Periodic mode

"Non-Periodic" A fixed preamble has a different cyclic prefix length than the rest of the frame (e.g. WLAN 802.11ac signals). In this case, the length of the second range is extended until the end of the demodulated frame. Therefore, the length of the second range cannot be specified in this case.

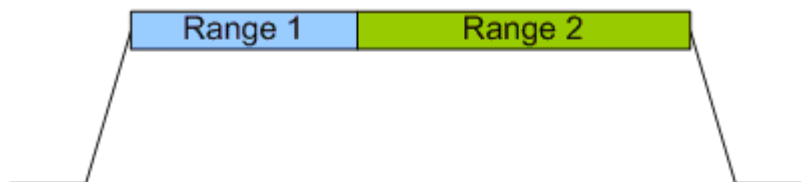


Figure 4-4: Non-Conventional cyclic prefix case: Non-Periodic mode

Remote command:

`CONFigure[:SYMBOL]:GUARd:PERiodic` on page 137

#### Cyclic prefix definition per range (Symbols / Samples) ← Different cyclic prefix lengths

For each range, configure the number of symbols the cyclic prefix length is applied to, and the length of the cyclic prefix as a number of samples.

For non-periodic cyclic prefixes, the length of the second range cannot be specified. It is extended to the end of the demodulated frame.

Remote command:

`CONFigure[:SYMBOL]:GUARd:NSYMBOLs<cp>` on page 136

`CONFigure[:SYMBOL]:NGUard<cp>` on page 137

## 4.3 Input and frontend settings

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

**Or:** "Input & Output"

The R&S VSE OFDM VSA application can evaluate signals from different input sources.

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

For the R&S VSE OFDM VSA application, no output settings are available.

- [Input source settings](#)..... 52
- [Frequency settings](#)..... 60
- [Amplitude settings](#)..... 61

### 4.3.1 Input source settings

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

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

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



### Input from other sources

The R&S VSE OFDM VSA application can also process input from the following optional sources:

- External mixer
- External frontend
- Oscilloscope baseband input

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

- [Radio frequency input](#)..... 53
- [I/Q file input](#)..... 58

#### 4.3.1.1 Radio frequency input

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

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

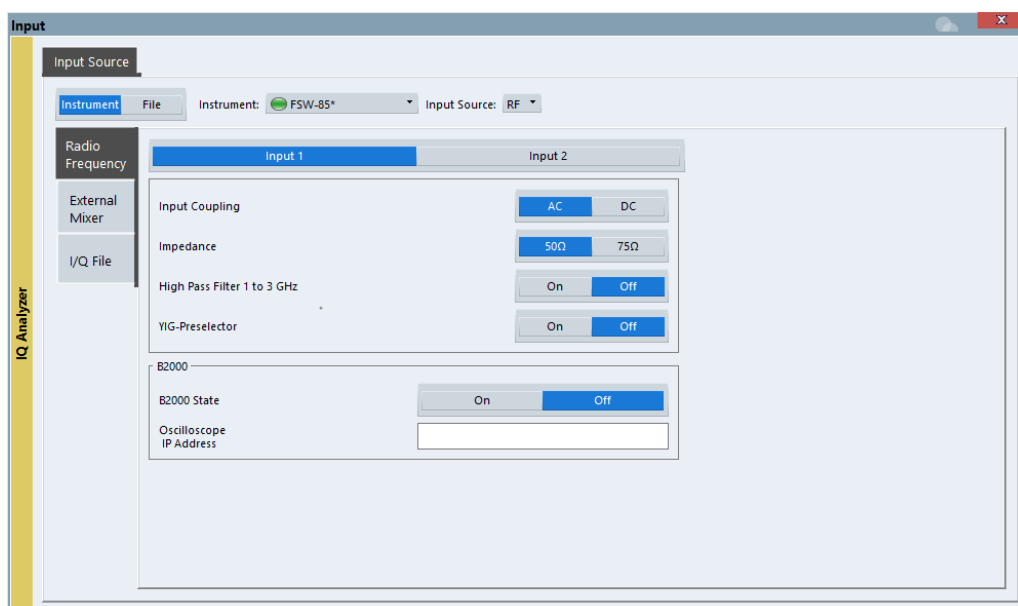


Figure 4-5: RF input source settings for an R&S FSW with B2000 option



If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE OFDM VSA application also supports frequency response correction using Touchstone (.snp) files or .fres files.

For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

Input Type (Instrument / File).....	54
Instrument.....	54
Input 1 / Input 2.....	54
Input Coupling.....	54
Impedance.....	55
Direct Path.....	55
High Pass Filter 1 to 3 GHz.....	55
YIG-Preselector.....	56
B2000 State.....	56
Oscilloscope Splitter Mode.....	56
Oscilloscope IP Address.....	57
Preselector State.....	57
Preselector Mode.....	57
10 dB Minimum Attenuation.....	57

### Input Type (Instrument / File)

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

**Note:** External mixers are only available for input from a connected instrument.

**Note:** If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:

`INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>` on page 147

`INPut:SELEct` on page 146

### Instrument

Specifies a configured instrument to be used for input.

### Input 1 / Input 2

For instruments with two input connectors, you must define which input source is used for each measurement channel.

If an external frontend is active, select the connector the external frontend is connected to. You cannot use the other RF input connector simultaneously for the same channel. However, you can configure the use of the other RF input connector for another active channel at the same time.

"Input 1" R&S FSW85: 1.00 mm RF input connector for frequencies up to 85 GHz (90 GHz with option R&S FSW-B90G)

"Input2" R&S FSW85: 1.85 mm RF input connector for frequencies up to 67 GHz

Remote command:

`INPut:TYPE` on page 147

### Input Coupling

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

The RF input of the connected instrument can be coupled by alternating current (AC) or direct current (DC).

Not available for input from the optional "Analog Baseband" interface.

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

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

Remote command:

[INPut<ip>:COUPling<ant>](#) on page 141

### Impedance

For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50  $\Omega$  or 75  $\Omega$ .

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

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50  $\Omega$  is always used.

Remote command:

[INPut<ip>:IMPedance<ant>](#) on page 144

### Direct Path

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

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

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

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

"Off" The analog mixer path is always used.

Remote command:

[INPut<ip>:DPATH](#) on page 142

### High Pass Filter 1 to 3 GHz

Activates an additional internal highpass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

For some connected instruments, this function requires an additional hardware option on the instrument.

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

Remote command:

[INPut<ip>:FILTer:HPASs\[:STATe\]](#) on page 143

### YIG-Preselector

Enables or disables the YIG-preselector.

This setting requires an additional option on the connected instrument.

**Note:** Note that the YIG-preselector is active only higher frequencies, depending on the connected instrument. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

To use the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

To use the optional 54 GHz frequency extension (R&S FSV3-B54G), the YIG-preselector must be disabled.

Remote command:

[INPut<ip>:FILTer:YIG\[:STATe\]](#) on page 143

### B2000 State

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

**Note:** The R&S VSE software supports input from a connected R&S FSW with a B2000 option installed. However, the R&S FSW interface to the oscilloscope must be set up and aligned directly on the instrument before the R&S VSE software can start analyzing the input.

The analysis bandwidth is defined in the data acquisition settings of the application as usual. Note that the maximum bandwidth cannot be restricted manually as for other bandwidth extension options.

Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

Remote command:

[SYSTem:COMMunicate:RDEvice:OSCilloscope\[:STATe\]](#) on page 148

### Oscilloscope Splitter Mode

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&S FSW and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the R&S FSW I/Q Analyzer and I/Q Input user manual.

Remote command:

[SYSTem:COMMunicate:RDEvice:OSCilloscope:PSMode\[:STATe\]](#) on page 149



**Oscilloscope IP Address**

When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an R&S FSW as the connected instrument, the entire measurement, as well as both instruments, are controlled by the R&S VSE software. Thus, the instruments must be connected via LAN, and the TCPIP address of the oscilloscope must be defined in the R&S VSE software.

For tips on how to determine the computer name or TCPIP address, see the oscilloscope's user documentation.

Remote command:

[SYSTem:COMMunicate:RDEvice:OSCilloscope:TCPIP](#) on page 149

**Preselector State**

Turns the preselector on and off.

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

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

Remote command:

[INPut<ip>:PRESelection\[:STATe\]](#) on page 144

**Preselector Mode**

Selects the preselection filters to be applied to the measurement.

- |               |                                                                                                                                                                                                                                                                                                                                                                                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "Auto"        | Automatically applies all available bandpass filters in a measurement. Available with the optional preamplifier.                                                                                                                                                                                                                                                               |
| "Auto Wide"   | Automatically applies the wideband filters consecutively: <ul style="list-style-type: none"> <li>• Lowpass 40 MHz</li> <li>• Bandpass 30 MHz to 2250 MHz</li> <li>• Bandpass 2 GHz to 8 GHz</li> <li>• Bandpass 8 GHz to 26.5 GHz</li> </ul> Available with the optional preselector.                                                                                          |
| "Auto Narrow" | Automatically applies the most suitable narrowband preselection filters in a measurement, depending on the bandwidth you have selected. For measurement frequencies up to 30 MHz, the connected instrument uses combinations of lowpass and highpass filters. For higher frequencies, the connected instrument uses bandpass filters. Available with the optional preselector. |
| "Manual"      | Applies the filter settings you have defined manually.                                                                                                                                                                                                                                                                                                                         |

Remote command:

[INPut<ip>:PRESelection:SET](#) on page 144

**10 dB Minimum Attenuation**

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

When you turn on this feature, the attenuation is always at least 10 dB. This minimum attenuation protects the input mixer and avoids accidental setting of 0 dB, especially if you measure EUTs with high RFI voltage.

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

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

Remote command:

`INPut:ATTenuation:PROtection:RESet` on page 141

#### 4.3.1.2 I/Q file input

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



The R&S VSE OFDM VSA application provides some sample files for I/Q input data (and configuration files) in the

C:\ProgramData\Rohde-Schwarz\VSE\`<version_no>`\user\OFDM-VSA directory.



#### 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 VSE 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.

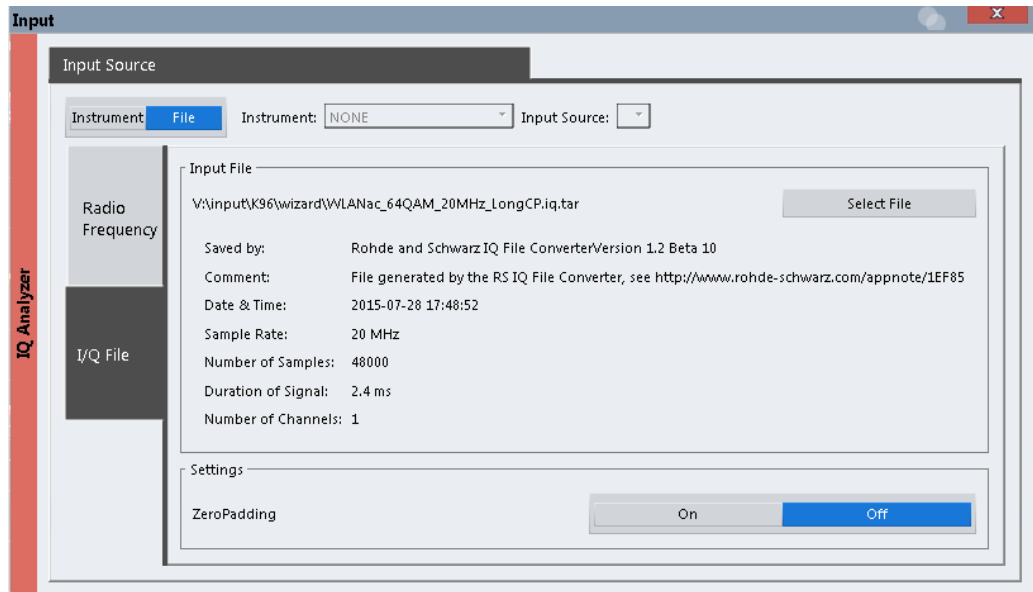
If the file contains data from multiple channels (e.g. from LTE measurements), it can be loaded to individual input sources, if the application supports them.

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 User Manual).



If the Frequency Response Correction option (R&S VSE-K544) is installed, the R&S VSE OFDM VSA application also supports frequency response correction using Touchstone (.snp) files or .fres files.

For details on user-defined frequency response correction, see 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.

<a href="#">Input Type (Instrument / File)</a> .....	59
<a href="#">Input File</a> .....	59
<a href="#">Zero Padding</a> .....	60

### Input Type (Instrument / File)

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

**Note:** External mixers are only available for input from a connected instrument.

**Note:** If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:

`INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>` on page 147

`INPut:SElect` on page 146

### 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).

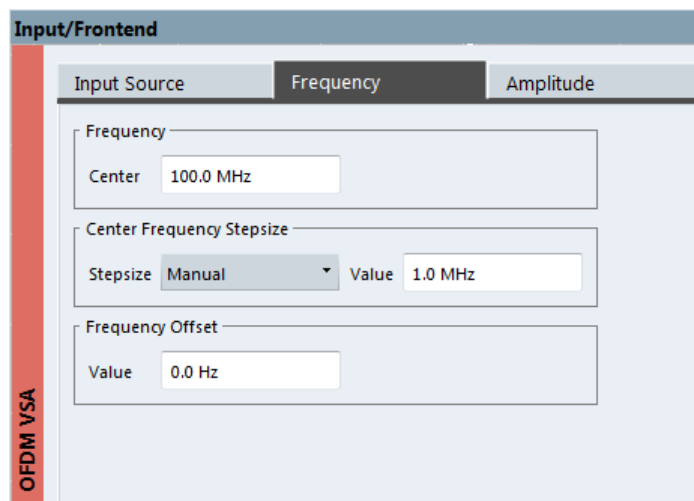
**Note:** You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:

`INPut<ip>:FILE:ZPADing` on page 142

## 4.3.2 Frequency settings

**Access:** "Input & Output" > "Frequency"



Center Frequency.....	60
Center Frequency Stepsize.....	61
Frequency Offset.....	61

### Center Frequency

Defines the center frequency of the signal in Hertz.

$$0 \text{ Hz} \leq f_{\text{center}} \leq f_{\text{max}}$$

$f_{\text{max}}$  and  $\text{span}_{\text{min}}$  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.

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:

[\[SENSe<ip>:\]FREQuency:CENTer](#) on page 177

### 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 178

[\[SENSe:\]FREQuency:CENTer:STEP](#) on page 178

### 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, 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 -1 THz to 1 THz. The default setting is 0 Hz.

Remote command:

[\[SENSe<ip>:\]FREQuency:OFFSet](#) on page 178

## 4.3.3 Amplitude settings

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

**Or:** "Input & Output" > "Amplitude"

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

Configuring amplitude settings allows you to:

- Adapt the instrument hardware to the expected maximum signal level by setting the **Reference Level** to this maximum
- Consider an external attenuator or preamplifier (using the "Offset").
- Optimize the SNR of the measurement for low signal levels by configuring the **Reference Level** as high as possible without introducing compression, clipping or overload. Use early amplification by the preamplifier and a low attenuation.
- Optimize the SNR for high signal levels and ensure that the instrument hardware is not damaged, using high attenuation and AC coupling (for DC input voltage).
- Adapt the reference impedance for power results when measuring in a 75-Ohm system by connecting an external matching pad to the RF input.

Which amplitude settings are available depends on the connected instrument.

Amplitude settings for input from the optional "Analog Baseband" interface are described in the R&S VSE I/Q Analyzer and I/Q Input User Manual.

The screenshot shows the 'Amplitude' settings menu. It is organized into four main sections:

- Reference Level:** Contains a 'Value' field set to 0.0 dBm, an 'Offset' field set to 0.0 dB, a 'Unit' dropdown menu set to dBm, and an 'Auto Level' button.
- Input Settings:** Contains three rows of controls: 'Preamplifier' with 'On' and 'Off' buttons (Off is selected), 'Input Coupling' with 'AC' and 'DC' buttons (AC is selected), and 'Impedance' with '50Ω' and '75Ω' buttons (50Ω is selected).
- Attenuation:** Contains a 'Mode' section with 'Auto' and 'Manual' buttons (Auto is selected) and a 'Value' field set to 10.0 dB.
- Electronic Attenuation:** Contains a 'State' section with 'On' and 'Off' buttons (Off is selected), a 'Mode' section with 'Auto' and 'Manual' buttons (Auto is selected), and a 'Value' field set to 0.0 dB.

Reference Level.....	63
L Shifting the Display (Offset).....	63
L  Setting the Reference Level Automatically (Auto Level).....	63
Attenuation Mode / Value.....	63
Using Electronic Attenuation.....	64
Input Settings.....	64
L Preamplifier.....	64

**Reference Level**

Defines the expected maximum input signal level. Signal levels above this value are possibly not measured correctly, which is indicated by the "IF Overload" status display ("OVLD" for baseband input).

Defines the expected maximum reference level. Signal levels above this value are possibly not measured correctly. Signals above the reference level are indicated by an "IF Overload" status display.

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

Since the hardware of the connected instrument 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 optimal measurement (no compression, good signal-to-noise ratio).

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 179

**Shifting the Display (Offset) ← Reference Level**

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

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

The setting range is  $\pm 200$  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 VSE must handle. Do not rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet` on page 180

** Setting the Reference Level Automatically (Auto Level) ← Reference Level**

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

Remote command:

`[SENSe<ip>:]ADJJust:LEVel` on page 202

**Attenuation Mode / Value**

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

The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). Automatic attenuation 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 can lead to hardware damage.

Remote command:

`INPut<ip>:ATTenuation` on page 180

`INPut<ip>:ATTenuation:AUTO` on page 181

### Using Electronic Attenuation

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

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

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

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

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

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

Remote command:

`INPut:EATT:STATe` on page 182

`INPut:EATT:AUTO` on page 181

`INPut:EATT` on page 181

### Input Settings

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

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

See [Chapter 4.3.1.1, "Radio frequency input"](#), on page 53.

### Preamplifier ← Input Settings

If the (optional) internal preamplifier hardware is installed on the connected instrument, a preamplifier can be activated for the RF input signal.

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

**Note:** If an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.



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

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

Remote command:

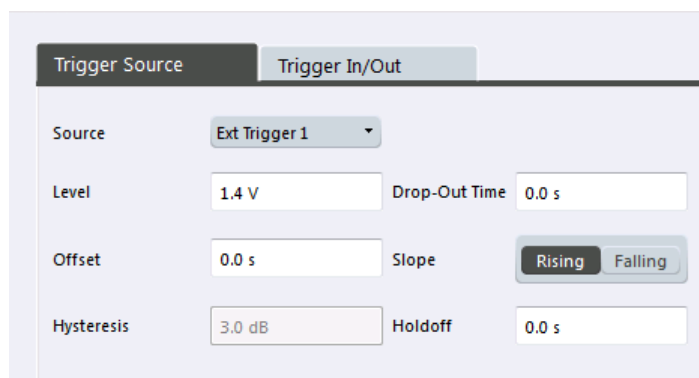
`INPut<ip>:GAIN<ant>:STATe` on page 182

`INPut<ip>:GAIN<ant>[:VALue]` on page 183

## 4.4 Trigger settings

or: "Input & Output" > "Trigger"

Trigger settings determine when the input signal is measured. Which settings are available depends on the connected instrument.



External triggers from one of the [TRIGGER INPUT/OUTPUT] connectors on the connected instrument are also available.

Trigger Source.....	66
L Free Run.....	66
L External Trigger / Trigger Channel X.....	66
L External Analog.....	66
L RF Power.....	66
L Time.....	67
L Magnitude (Offline).....	67
L Manual.....	67
Trigger Level.....	67
Repetition Interval.....	67
Drop-Out Time.....	68
Trigger Offset.....	68
Hysteresis.....	68
Trigger Holdoff.....	68
Slope.....	68

**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.

Note that the availability of trigger sources depends on the connected instrument.

Remote command:

TRIGger [ :SEquence ] :SOURce on page 187

**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 187

**External Trigger / Trigger Channel X ← Trigger Source**

Data acquisition starts when the signal fed into the specified input connector or input channel of the connected instrument meets or exceeds the specified trigger level.

**Note:** Which input and output connectors are available depends on the connected instrument. For details, see the instrument's documentation.

For a connected R&S oscilloscope, the following signals are used as trigger input:

- "External Trigger": EXT TRIGGER INPUT connector on rear panel of instrument
- "Trigger Channel 2"/"Trigger Channel 3"/"Trigger Channel 4": Input at channel connectors CH 2/3/4 on front panel of instrument - if not used as an input source

Remote command:

TRIG:SOUR EXT, TRIG:SOUR EXT2, TRIG:SOUR EXT3, TRIG:SOUR EXT4

See TRIGger [ :SEquence ] :SOURce on page 187

**External Analog ← Trigger Source**

Data acquisition starts when the signal fed into the EXT TRIGGER INPUT connector on the oscilloscope meets or exceeds the specified trigger level.

This trigger source is only available if the optional 2 GHz bandwidth extension (R&S FSW-B2000) is active in power splitter mode. For details, see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Remote command:

TRIG:SOUR EXT, see TRIGger [ :SEquence ] :SOURce on page 187

**RF Power ← Trigger Source**

Defines triggering of the measurement via signals which are outside the displayed measurement range.

For this purpose, the software uses a level detector at the first intermediate frequency.

The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels, see the instrument's data sheet.

**Note:** If the input signal contains frequencies outside of this range (e.g. for fullspan measurements), the measurement can be aborted. A message indicating the allowed input frequencies is displayed in the status bar.

A "Trigger Offset", "Trigger Polarity" and "Trigger Holdoff" (to improve the trigger stability) can be defined for the RF trigger, but no "Hysteresis".

Not available for input from the optional "Analog Baseband" interface.

If the trigger source "RF Power" is selected and you enable baseband input, the trigger source is automatically switched to "Free Run".

Remote command:

TRIG:SOUR RFP, see [TRIGger\[:SEquence\]:SOURce](#) on page 187

#### **Time ← Trigger Source**

Triggers in a specified repetition interval.

See ["Repetition Interval"](#) on page 67.

For file input, data is taken from the file in the specified time interval. Overlap settings for the R&S VSE Player are ignored.

Remote command:

TRIG:SOUR TIME, see [TRIGger\[:SEquence\]:SOURce](#) on page 187

#### **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 187

#### **Manual ← Trigger Source**

Only available for a connected R&S RTP:

Any trigger settings in the R&S VSE software are ignored; only trigger settings defined on the connected instrument are considered. Thus, you can make use of the more complex trigger settings available on an R&S RTP.

Remote command:

TRIG:SOUR MAN, see [TRIGger\[:SEquence\]:SOURce](#) on page 187

#### **Trigger Level**

Defines the trigger level for the specified trigger source.

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

Remote command:

[TRIGger\[:SEquence\]:LEVel\[:EXternal<port>\]](#) on page 185

For baseband input only:

[TRIGger\[:SEquence\]:LEVel:BBPower](#) on page 185

#### **Repetition Interval**

Defines the repetition interval for a time trigger.

The shortest interval is 2 ms.

Set the repetition interval to the exact pulse period, burst length, frame length or other repetitive signal characteristic. If the required interval cannot be set with the available granularity, configure a multiple of the interval that can be set. Thus, the trigger remains synchronized to the signal.

Remote command:

[TRIGger\[:SEquence\]:TIME:RINterval](#) on page 188

**Drop-Out Time**

Defines the time that the input signal must stay below the trigger level before triggering again.

**Note:** For input from the optional "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns. This avoids unintentional trigger events (as no hysteresis can be configured in this case).

Remote command:

[TRIGger\[:SEquence\]:DTIME](#) on page 183

**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 instrument.)

Remote command:

[TRIGger\[:SEquence\]:HOLDoff\[:TIME\]](#) on page 184

**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 depends on the connected instrument.

Remote command:

[TRIGger\[:SEquence\]:IFPower:HYSteresis](#) on page 184

[TRIGger\[:SEquence\]:MAPower:HYSteresis](#) on page 186

**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 184

[TRIGger\[:SEquence\]:MAPower:HOLDoff](#) on page 186

**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.

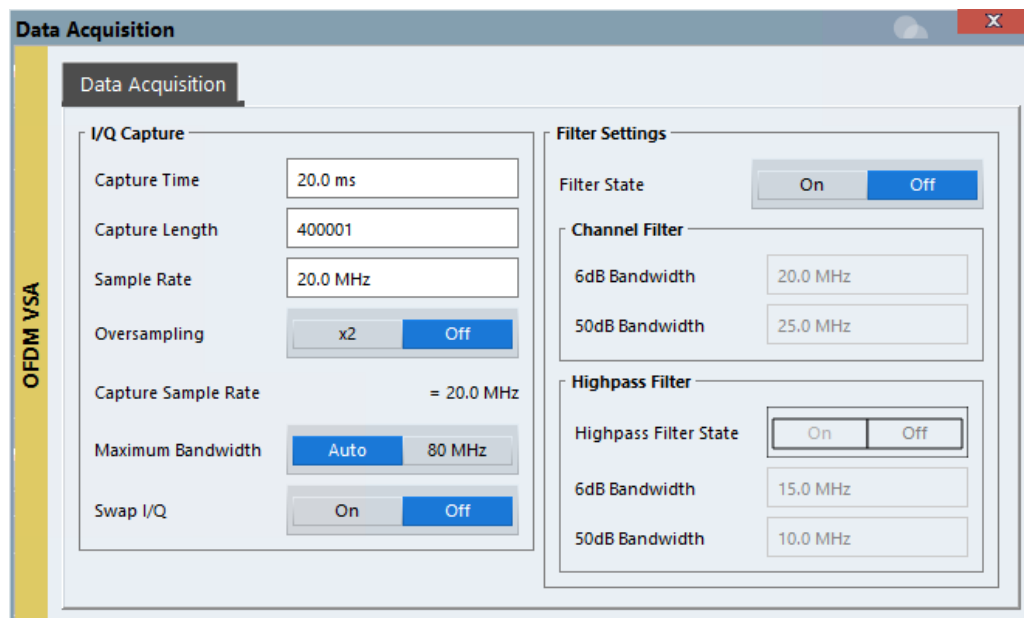
When using the optional 2 GHz bandwidth extension (R&S FSW-B2000) with an IF power trigger, only rising slopes can be detected.

Remote command:

[TRIGger\[:SEquence\]:SLOPe](#) on page 187

## 4.5 Data acquisition

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



Capture Time.....	69
Capture Length.....	69
Sample Rate.....	70
Oversampling / Capture Sample Rate.....	70
Maximum Bandwidth.....	70
Swap I/Q.....	71
Filter State.....	71
6-dB Bandwidth.....	71
50-dB Bandwidth.....	72
Highpass Filter State.....	72
6-dB Bandwidth.....	72
50-dB Bandwidth.....	72
Refresh.....	72

### 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.

Remote command:

[SENSe:] SWEep: TIME on page 193

### Capture Length

Defines the number of samples to be captured during each measurement. The required [Capture Time](#) is adapted accordingly.

A maximum of 8 000 000 samples can be captured.

Remote command:

[SENSe:] SWEep:LENGth on page 192

### Sample Rate

Defines the I/Q data sample rate of the R&S VSE OFDM VSA application used for demodulation.

Note that the sample rate in the R&S VSE OFDM VSA application must correspond to the [OFDM system sample rate](#), otherwise demodulation can fail.

Remote command:

TRACe: IQ:SRATe on page 193

### Oversampling / Capture Sample Rate

By default, the R&S VSE OFDM VSA application captures data with a usable I/Q bandwidth that is  $0.8 * \text{sample rate}$ .

(See [Chapter 3.3, "Sample rate, record length and analysis bandwidth"](#), on page 41)

However, for some signals and measurements, a higher bandwidth is required. In this case, you can force the R&S VSE OFDM VSA application to capture with twice the sample rate, which is referred to as *capture oversampling*.

Oversampling is not available in the following cases:

- A channel filter is enabled (see ["Filter State"](#) on page 71).  
In this case, an oversampling factor of 2 is applied automatically.
- The defined [Sample Rate](#) is higher than half the maximum sample rate the R&S VSE supports.

The actual "Capture Sample Rate", that is: the rate with which the R&S VSE OFDM VSA application samples data, is calculated as:

[Sample Rate](#) \* Oversampling factor

If you are analyzing data from an input file, the "Capture Sample Rate" indicates the rate with which the R&S VSE OFDM VSA application initially processes the data in the file.

"2x"                    An oversampling of 2 is applied. The sample rate with which the R&S VSE OFDM VSA application captures data is twice the system sample rate.

"Off"                    No oversampling is applied, the capture sample rate of the R&S VSE OFDM VSA application and the system sample rate are identical.

Remote command:

[SENSe:] CAPTure:OVERsampling on page 191

### Maximum Bandwidth

Depending on the connected instrument, the maximum bandwidth to be used by the R&S VSE for I/Q data acquisition can be restricted. This setting is only available if a bandwidth extension option is installed on the connected instrument. 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.

Remote command:

[TRACe:IQ:WBANd\[:STATe\]](#) on page 193

[TRACe:IQ:WBANd:MBWidth](#) on page 194

### 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 VSE 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 191

### Filter State

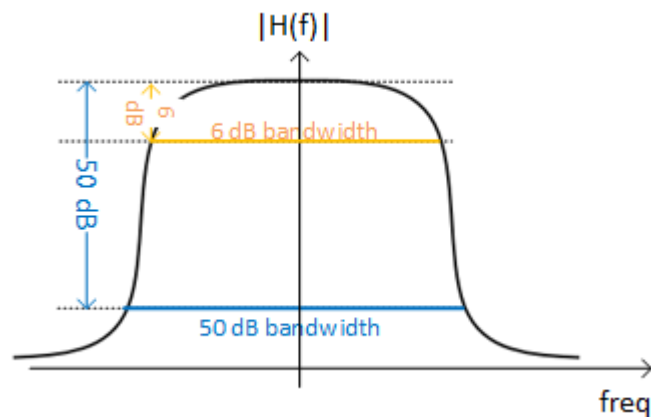
Defines whether a channel filter - and a highpass filter, if active - is applied to the I/Q data before OFDM demodulation.

Remote command:

[INPut:FILTer:CHANnel\[:LPASs\]\[:STATe\]](#) on page 191

### 6-dB Bandwidth

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



**Figure 4-6: Definition of filter bandwidths**

Remote command:

[INPut:FILTer:CHANnel\[:LPASs\]:SDBBw](#) on page 190

**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 4-6](#)). This bandwidth must always be larger than the "6-dB Bandwidth" on page 71. If necessary, the 50-dB bandwidth is adapted to the current 6-dB bandwidth.

Remote command:

`INPut:FILTer:CHANnel[:LPASs]:FDBBw` on page 190

**Highpass Filter State**

Activates or deactivates an additional internal highpass filter.

Remote command:

`INPut:FILTer:CHANnel:HPASs[:STATe]` on page 190

**6-dB Bandwidth**

Configures the bandwidth of the high pass filter at which an attenuation of 6 dB is reached (see [Figure 4-6](#)). 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:FILTer:CHANnel:HPASs:SDBBw` on page 189

**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 4-6](#)). 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:FILTer:CHANnel:HPASs:FDBBw?` on page 189

**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:

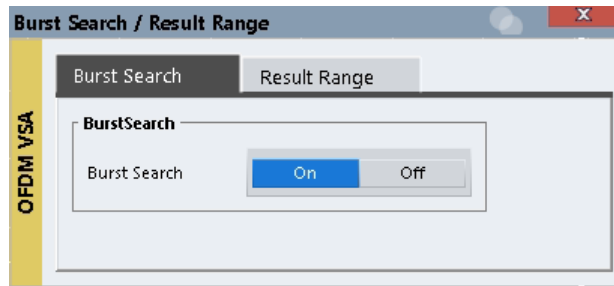
`INITiate:REFresh` on page 189

## 4.6 Burst search

**Access:** "Overview" > "Burst Search"

**Or:** "Meas Setup" > "Burst Search"





During a burst search, the capture buffer is searched for bursts that comply with the signal description. If no bursts are detected, the entire capture buffer is considered to be a single burst. A list of the detected bursts is passed on to the next processing stage.

See also [Chapter 3.2.2, "OFDM measurement"](#), on page 39.

[Burst Search State](#).....73

**Burst Search State**

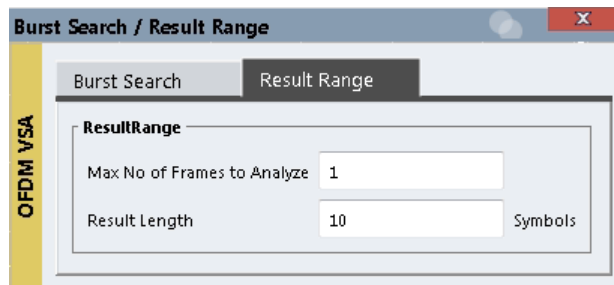
Activates or deactivates a burst search.

Remote command:

[\[SENSe:\] DEMod: FORMat: BURSt](#) on page 194

## 4.7 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](#).....73

[Result Length](#).....74

**Max No of Frames to Analyze**

Defines the maximum number of OFDM frames from the current capture buffer to be included in analysis.

If a configuration file is available, the contents of the file determine the frame. If no file is available, a single result range is considered a frame.

Remote command:

[\[SENSe:\] DEMod: FORMat: MAXFrames](#) on page 194

### Result Length

Configures the number of OFDM symbols per frame to be analyzed. Note that this is not the maximum, but a precise number. If this number is higher than the actual number of symbols found in the signal, the result is not considered a frame, and not analyzed.

**Note:** If a loaded configuration file contains a `<DefaultResultLength>` entry, the specified value is used as the default result length for the current measurement setup.

Remote command:

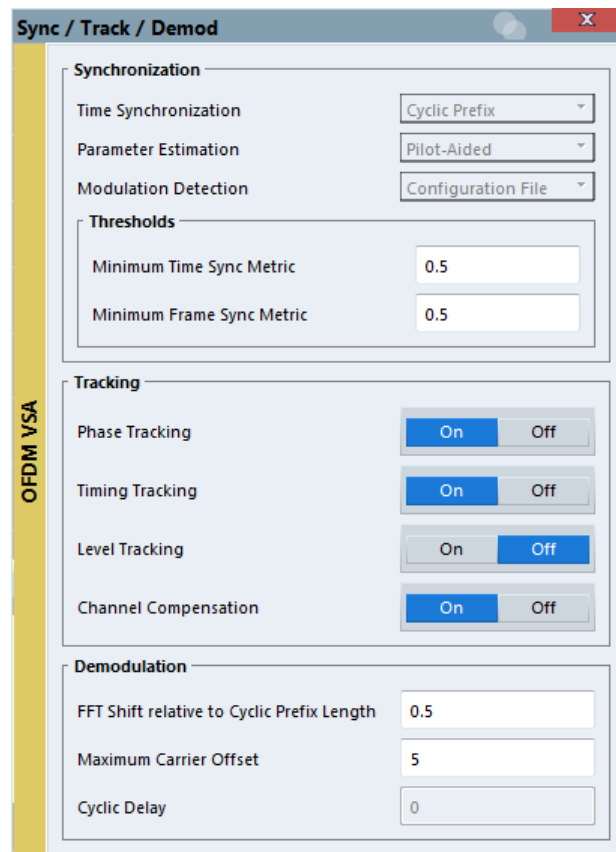
`[SENSe:]DEMod:FORMat:NOFSymbols` on page 195

## 4.8 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.....	75
Parameter Estimation.....	75
Modulation Detection.....	75
Synchronization Thresholds.....	76

L Minimum Time Sync Metric.....	76
L Minimum Frame Sync Metric.....	76
Phase Tracking.....	76
Timing Tracking.....	77
Level Tracking.....	77
Channel Compensation.....	77
FFT Shift relative to Cyclic Prefix Length.....	77
Maximum Carrier Offset.....	78
Cyclic Delay.....	78

### Time Synchronization

Specifies the synchronization method in the time domain.

"Cyclic Prefix" The cyclic prefix method performs a correlation of the cyclic prefix with the end of the FFT interval.

"Preamble" The preamble method searches for the repetitive preamble blocks.

Remote command:

[SENSe:] DEMod: TSYNc on page 198

### Parameter Estimation

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

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48). In manual configuration mode without a configuration file, no parameter estimation is performed.

"Pilot-Aided" Uses only the predefined pilot cells for parameter estimation

"Pilot And Data-Aided" Uses both pilots and detected data cells for an additional synchronization step.

Remote command:

[SENSe:] DEMod: FSYNc on page 196

### Modulation Detection

Specifies how the modulation of the data cells is detected.

The R&S VSE OFDM VSA application can use the modulation configured in the configuration file for each cell.

Alternatively, the R&S VSE OFDM VSA application tries to detect the used modulation automatically based on the available modulation types (which are also defined in the configuration file). For automatic detection, the R&S VSE OFDM VSA application analyzes the modulation type per carrier or per symbol.

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48).

"Configuration File" The modulation format configured for the cell is used  
Note that if the actual modulation of a constellation point differs from the configured modulation for the cell, the EVM is increased.

"Symbolwise" A common modulation format for all data cells within one OFDM symbol is determined

"Carrierwise" A common modulation format for all data cells within one OFDM carrier is determined

Remote command:

[SENSe:] DEMod: MDETECT on page 197

### 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.

For details see [Chapter 3.2.2.1, "Synchronization block"](#), on page 40.

### 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, 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 reliability of 50 %, time synchronization is successful.

Remote command:

[SENSe:] DEMod: THRESHOLD: TIME on page 197

### Minimum Frame Sync Metric ← Synchronization Thresholds

Defines the minimum correlation rate of the CP or preamble 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.

Remote command:

[SENSe:] DEMod: THRESHOLD: FRAME on page 198

### Phase Tracking

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

This setting is only available if a configuration file is loaded and active (see ["Use Configuration File"](#) on page 48).

Remote command:

`SENSe:TRACking:PHASe` on page 199

### 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.

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48).

Remote command:

`SENSe:TRACking:TIME` on page 199

### 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.

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48).

Remote command:

`SENSe:TRACking:LEVEl` on page 198

### 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.

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48).

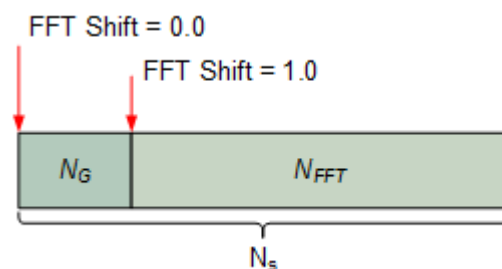
Remote command:

`[SENSe:]COMPensate:CHANnel` on page 195

### 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 196

**Maximum Carrier Offset**

The R&S VSE OFDM VSA application 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 VSE OFDM VSA application 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.

This setting is only available if a configuration file is loaded and active (see "Use Configuration File" on page 48).

Remote command:

[SENSe:] DEMod:COFFset on page 196

**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.

Remote command:

[SENSe:] DEMod:CDD on page 195

## 4.9 Adjusting settings automatically

**Access:** "Auto Set" toolbar

Depending on the connected instrument, some settings can be adjusted by the instrument automatically according to the current measurement settings. To do so, a measurement is performed. The duration of this measurement can be defined automatically or manually.

To activate the automatic adjustment of a setting from the R&S VSE, select the corresponding function in the "Auto Set" toolbar or in the configuration dialog box for the setting, where available.


**Adjusting settings automatically during triggered measurements**

When you select an auto adjust function a measurement is performed to determine the optimal settings. If you select an auto adjust function for a triggered measurement, you are asked how the connected instrument should behave:

- (default:) The measurement for adjustment waits for the next trigger
- The measurement for adjustment is performed without waiting for a trigger. The trigger source is temporarily set to "Free Run". After the measurement is completed, the original trigger source is restored. The trigger level is adjusted as follows for IF Power and RF Power triggers:  
Trigger Level = Reference Level - 15 dB

**Remote command:**

[SENSe<ip>:] ADJust:CONFigure:TRIGger on page 201

 <b>Setting the Reference Level Automatically (Auto Level)</b> .....	79
<b>Auto Settings Configuration</b> .....	79
L <b>Automatic Measurement Time Mode and Value</b> .....	79
L <b>Upper Level Hysteresis</b> .....	79
L <b>Lower Level Hysteresis</b> .....	80

### **Setting the Reference Level Automatically (Auto Level)**

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

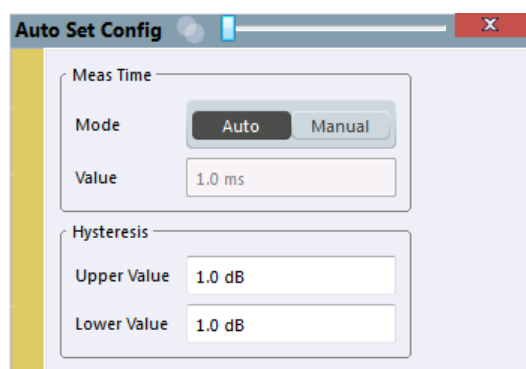
Remote command:

`[SENSe<ip>:]ADJust:LEVel` on page 202



### **Auto Settings Configuration**

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



### **Automatic Measurement Time Mode and Value** ← **Auto Settings Configuration**

To determine the optimal reference level automatically, a level measurement is performed on the connected instrument. You can define whether the duration of this measurement is determined automatically or manually.

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

Remote command:

`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` on page 200

`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 200

### **Upper Level Hysteresis** ← **Auto Settings Configuration**

When the reference level is adjusted automatically using the **Auto Level** function, the internal attenuators and the preamplifier (if available) of the connected instrument are also adjusted. To avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold that the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

`[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:UPPer` on page 201

**Lower Level Hysteresis ← Auto Settings Configuration**

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

Remote command:

`[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:LOWer` on page 201



## 5 Creating a configuration file using the wizard

The R&S VSE-K96 Configuration File Wizard (referred to as *wizard* here) is a tool that supports you in defining the configuration of your OFDM signal directly in the R&S VSE OFDM VSA application.

The R&S VSE OFDM VSA application has to know the configuration of the OFDM system to be able to demodulate an OFDM signal correctly. By *configuration*, we refer to the complete description of the OFDM system:

- The number of subcarriers (i.e. the FFT size)
- The number of symbols
- The number of samples in the cyclic prefix (also referred to as guard length)
- The position (carrier number, symbol number) of the:
  - Pilot symbols
  - Data symbols
  - Zero symbols
  - "Do not care" symbols
- The modulation format of the data symbols (e.g. QPSK, 16QAM etc.)
- The I/Q values of the pilot symbols
- Optional: the definition of the preamble

This section describes how to generate the OFDM system configuration file in the R&S VSE OFDM VSA application for the current input signal.



The R&S VSE OFDM VSA application provides some sample files for I/Q input data and configuration files in the

C:\ProgramData\Rohde-Schwarz\VSE\\user\demo\OFDM-VSA directory.

The R&S VSE-K96 Configuration File Wizard is provided with the R&S VSE OFDM VSA application software.

It is available from the Windows "Start" menu.

- [Understanding the R&S VSE-K96 Configuration File Wizard display](#)..... 82
- [Configuration steps](#)..... 89
- [Reference of wizard menu functions](#)..... 96
- [Example: creating a configuration file from an input signal](#)..... 101

## 5.1 Understanding the R&S VSE-K96 Configuration File Wizard display

The following figure shows the R&S VSE-K96 Configuration File Wizard user interface. All different areas are labeled. They are explained in more detail in the following sections.

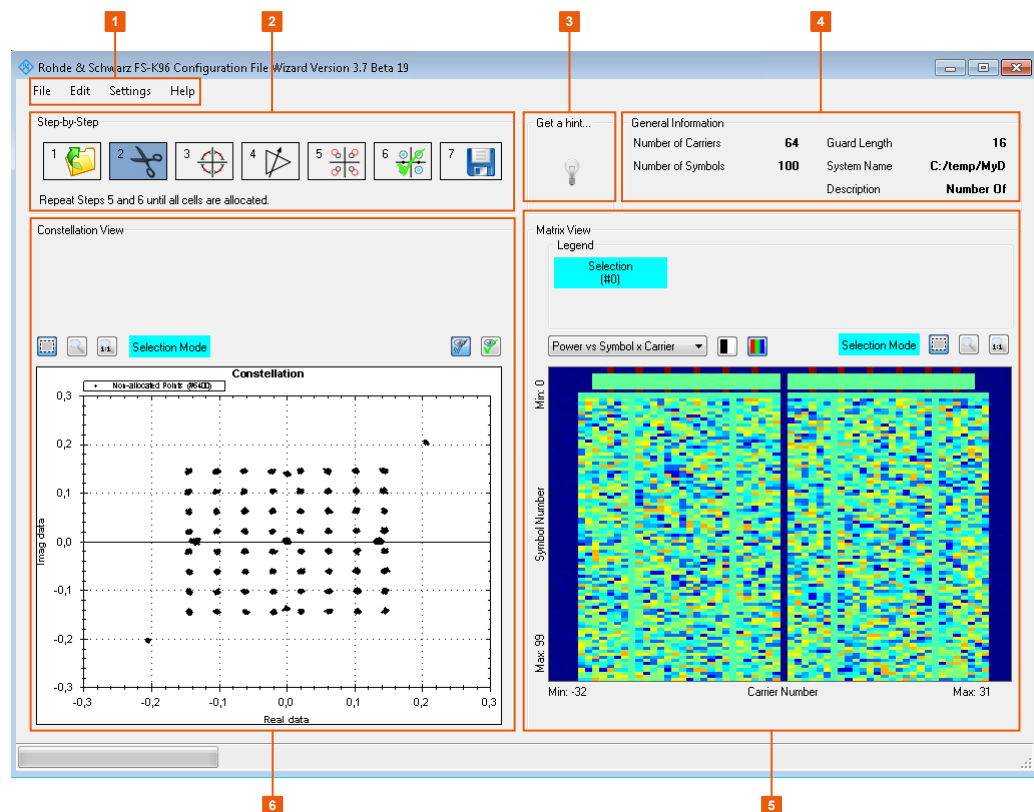


Figure 5-1: Elements of the wizard user interface

- 1 = Menu functions (see [Chapter 5.3, "Reference of wizard menu functions"](#), on page 96)
- 2 = Progress indicator (see [Chapter 5.2, "Configuration steps"](#), on page 89)
- 3 = Constellation view
- 4 = Access to wizard help (see [Chapter 5.3.4, "Help"](#), on page 101)
- 5 = General signal information
- 6 = Matrix view

• <a href="#">General signal information</a> .....	82
• <a href="#">Constellation view</a> .....	84
• <a href="#">Matrix view</a> .....	85

### 5.1.1 General signal information

General information on the configured signal is provided here for reference. Some values are derived from the configuration settings in the R&S VSE OFDM VSA application, others are generated by the wizard. The values displayed here are also included

in the generated configuration file. If specified in the description, some values are shown in the "Signal Description" dialog box when you load the file in the R&S VSE OFDM VSA application.

General Information			
Number of Carriers	<b>64</b>	Cyclic Prefix	<b>16</b>
Number of Symbols	<b>10</b>	System Name	<b>C:/Users/SIE</b>
		Description	<b>Number Of</b>

<a href="#">Number of Carriers</a> .....	83
<a href="#">Number of Symbols</a> .....	83
<a href="#">Cyclic Prefix Length</a> .....	83
<a href="#">System Name</a> .....	83
<a href="#">System Description</a> .....	83

### Number of Carriers

Indicates the number of subcarriers used by the signal. This value corresponds to the "FFT Size" on page 50.

### Number of Symbols

The number of OFDM symbols corresponds to the result length configured in the "Result Range" settings in the R&S VSE OFDM VSA application (see "Result Length" on page 74).

### Cyclic Prefix Length

Defines the length of the cyclic prefix (CP) area between two OFDM symbols in samples. The cyclic prefix area defines the guard interval and is expected to contain a copy of the samples at the end of the OFDM symbol.

The cyclic prefix length must be smaller than or equal to the "FFT Size" on page 50.

Remote command:

`CONFigure[:SYMBOL]:NGUard<cp>` on page 137

### System Name

Defines the name of the stored configuration file. The default name is `MyData`. You can change the name in the "Settings" (see Chapter 5.3.3, "Settings", on page 97).

### System Description

Provides a description of the signal configured in the file.

By default, the following main characteristics are included:

- [Number of Carriers](#)
- [Number of Symbols](#)
- [Cyclic Prefix Length](#)

If you deactivate the "Default" setting, you can overwrite the text with any other.

## 5.1.2 Constellation view

The "Constellation View" shows the constellation points (= I/Q values) for the OFDM cells in the defined result range. Using this view, you can assign the measured constellation points to specific cell types for the allocation matrix in the configuration file.

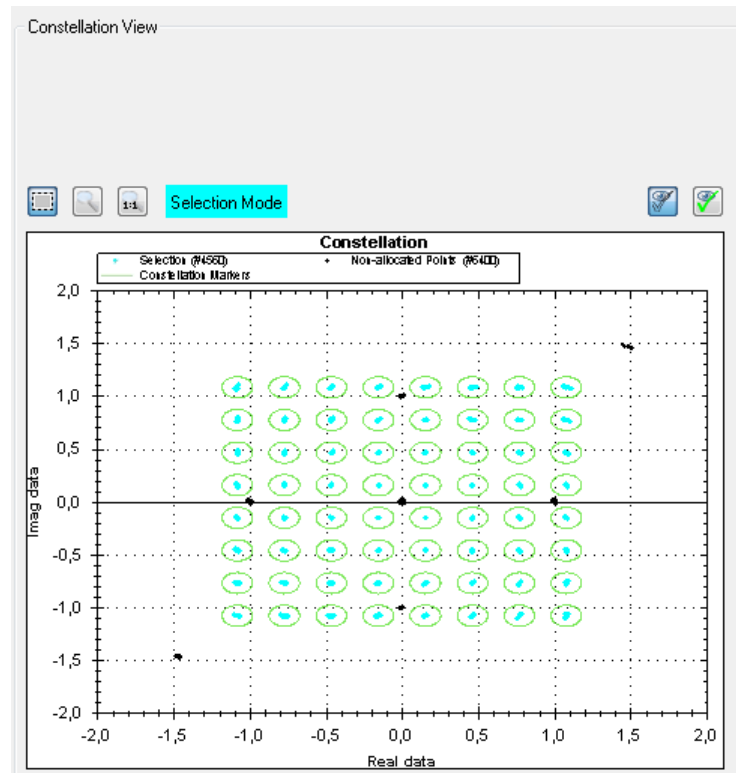


Figure 5-2: Constellation View



### Selection tool

Sets the cursor action to selection mode. All cells in the selection area are highlighted in color. The [Selection Mode / Zoom Mode indicator](#) shows which color is used. Any subsequent functions are applied to the selected cells.

Click in the diagram and move the cursor, holding the mouse button, to display a dotted rectangle and define the selection area.

Press [Shift] and click in the diagram to extend the selection to neighboring symbols.

Press [CTRL] and click in the diagram to add further (non-neighboring) points to the existing selection. Click the same points again to deselect them.



### Zoom

Sets the cursor action to zoom mode. Click in the diagram and move the cursor, holding the mouse button, to display a rectangle and define the zoom area. The zoomed area is enlarged in the display. Repeat the action to zoom in further.

The [Selection Mode / Zoom Mode indicator](#) above the diagram shows that zoom mode is active.

To change the cursor function and stop zooming, select [Selection tool](#).

**Zoom Off**

Displays the diagram in its original size.

Note that this function does not change the cursor function. To change the cursor function and stop zooming, select [Selection tool](#).

The [Selection Mode / Zoom Mode indicator](#) above the diagram shows that zoom mode is active.

**Selection Mode****Selection Mode / Zoom Mode indicator**

Indicates whether the current cursor action is to select cells (selection mode), or to define the zoom area. In selection mode, the color used to highlight selected cells is indicated.

**Show non-allocated constellation points**

Displays or hides the constellation points not yet allocated to a cell type in the "Constellation View".

**Show allocated constellation points**

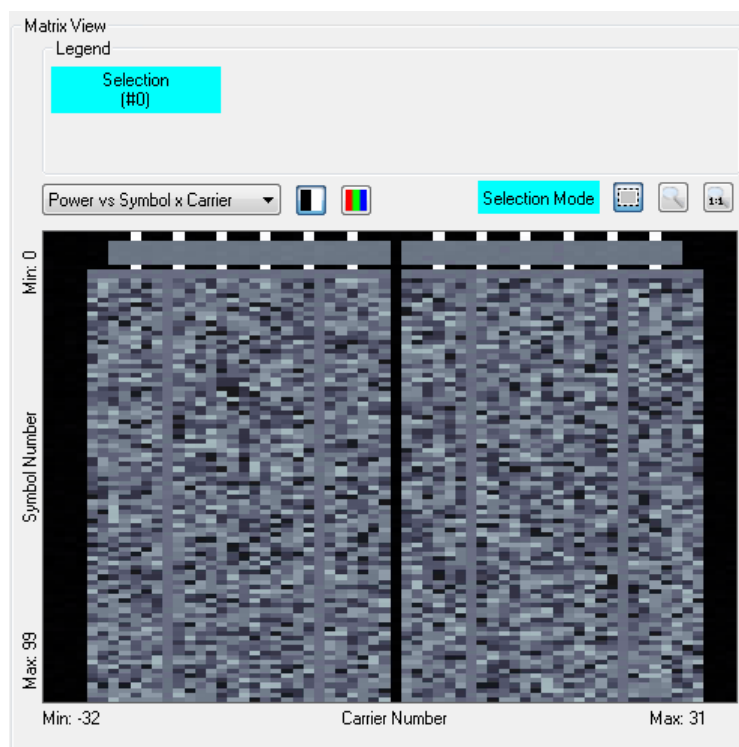
Displays or hides the constellation points already allocated to a cell type in the "Constellation View".

### 5.1.3 Matrix view

The "Matrix View" displays two different diagrams of the measured symbols (y-axis) vs carriers (x-axis).

- "Power vs Symbol x Carrier" diagram

Shows a colored rectangle (= OFDM cell) for each symbol and carrier, with a different color for each measured power range. Thus, you can easily identify symbols with a similar power value, which therefore most likely belong to the same cell type.



**Figure 5-3: Matrix View with Power vs Symbol x Carrier diagram**

Either a colored or a black-and-white (gray shades) power indication is available (see [Black and white color map](#) / [Colored color map](#)). The darker the color, the lower the power of the corresponding OFDM cell.

- "Allocation Matrix"  
Shows a colored point for each allocated symbol and carrier, with a different color for each cell type.

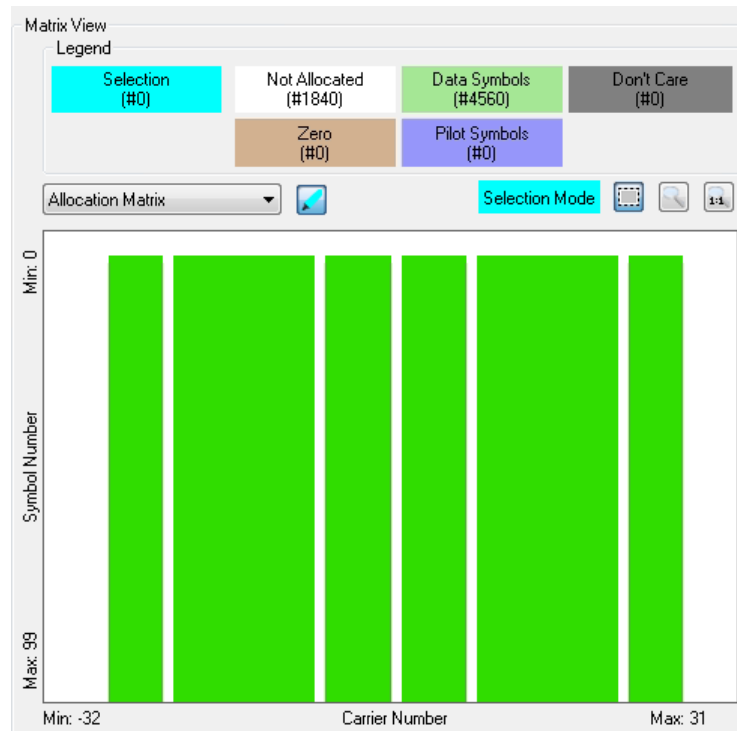


Figure 5-4: Matrix View with Allocation Matrix

Optionally, the selected symbols can be highlighted in the matrix.

Similarly to the "Constellation View", you can also select cells in the "Matrix View" to assign them to specific cell types.

Further zoom and selection functions are provided in the context menu for the diagram (right-click in the diagram).

- Black and white color map..... 88
- Colored color map..... 88
- Highlight selected cells..... 88
- Selection Mode / Zoom Mode indicator..... 88
- Selection tool..... 88
- Deselect All (context-menu)..... 88
- Zoom..... 88
- Zoom Off..... 88
- Select Symbol / Select Carrier (context-menu)..... 89
- Select Specific Symbol / Select Specific Carrier (context-menu)..... 89
- Select Symbol/Carrier Range (context-menu)..... 89
  - L Start..... 89
  - L Step..... 89
  - L Stop..... 89
- Deselect All (context-menu)..... 89
- Extract Symbols (context-menu)..... 89

**Black and white color map**

The different modulation types in the "Power vs Symbol x Carrier" diagram are displayed in different shades of black, white, and gray. The lighter the shade of gray, the higher the power level in the OFDM cell.

**Colored color map**

The different modulation types in the "Power vs Symbol x Carrier" diagram are displayed in different colors. The used colors are indicated in the legend above the diagram.

**Highlight selected cells**

The cells in the area selected by the [Selection tool](#) are highlighted in the "Allocation Matrix".

**Selection Mode****Selection Mode / Zoom Mode indicator**

Indicates whether the current cursor action is to select cells (selection mode), or to define the zoom area. In selection mode, the color used to highlight selected cells is indicated.

**Selection tool**

Sets the cursor action to selection mode. All cells in the selection area are highlighted in color. The [Selection Mode / Zoom Mode indicator](#) shows which color is used. Any subsequent functions are applied to the selected cells.

Click in the diagram and move the cursor, holding the mouse button, to display a dotted rectangle and define the selection area.

Press [Shift] and click in the diagram to extend the selection to neighboring symbols.

Press [CTRL] and click in the diagram to add further (non-neighboring) points to the existing selection. Click the same points again to deselect them.

**Deselect All (context-menu)**

Deselects all currently selected symbols or carriers.

**Zoom**

Sets the cursor action to zoom mode. Click in the diagram and move the cursor, holding the mouse button, to display a rectangle and define the zoom area. The zoomed area is enlarged in the display. Repeat the action to zoom in further.

The [Selection Mode / Zoom Mode indicator](#) above the diagram shows that zoom mode is active.

To change the cursor function and stop zooming, select [Selection tool](#).

**Zoom Off**

Displays the diagram in its original size.

Note that this function does not change the cursor function. To change the cursor function and stop zooming, select [Selection tool](#).

The [Selection Mode / Zoom Mode indicator](#) above the diagram shows that zoom mode is active.



**Select Symbol / Select Carrier (context-menu)**

Selects the symbol or carrier at the current cursor position.

**Select Specific Symbol / Select Specific Carrier (context-menu)**

Opens an input field to enter a specific symbol or carrier number for selection.

**Select Symbol/Carrier Range (context-menu)**

Opens a dialog box to define a range of symbols or carriers for selection.

Note that when you accept a range using "OK", it is added to the current selection, instead of replacing it. Thus, you can add a sequence of symbols or carriers before allocating the entire selection in one step. If necessary, use the [Deselect All \(context-menu\)](#) function to empty the selection first.

**Start ← Select Symbol/Carrier Range (context-menu)**

Selects the first carrier or symbol of a range.

**Step ← Select Symbol/Carrier Range (context-menu)**

Selects the steps between individual carriers or symbols of a range, for example to select every second one.

**Stop ← Select Symbol/Carrier Range (context-menu)**

Selects the last carrier or symbol of a range.

**Deselect All (context-menu)**

Deselects all currently selected symbols or carriers.

**Extract Symbols (context-menu)**

Extracts a range of symbols from the imported signal for further analysis.

**Note:** To restore discarded symbols for analysis, you must re-import the signal.

This function is identical to [Chapter 5.2.3, "Step 2: \(Optional:\) Adjusting the analysis region"](#), on page 91.

## 5.2 Configuration steps

The wizard guides you through the process of creating a configuration file. The progress bar (see [Figure 5-1](#)) indicates which step you are currently working on. After you complete all required steps, you have created a configuration file that you can import to the R&S VSE OFDM VSA application for signal analysis.

• Starting the R&S VSE-K96 Configuration File Wizard.....	90
• Step 1: (Optional:) Importing existing files.....	91
• Step 2: (Optional:) Adjusting the analysis region.....	91
• Step 3: Synchronizing the measured data.....	92
• Step 4: Adjusting the gain.....	93
• Steps 5 + 6: Allocating signal components.....	94
• Step 7: Storing results.....	95

## 5.2.1 Starting the R&S VSE-K96 Configuration File Wizard

### To start the R&S VSE-K96 Configuration File Wizard within the R&S VSE

1. Configure the required input signal in the R&S VSE OFDM VSA application, either from a connected instrument or from an input file.
2. Configure the basic OFDM settings:
  - a) In the "Signal Description" settings:
    - "FFT size", that is: the number of subcarriers
    - "Cyclic prefix length"
    - "Cyclic suffix length"
    - If a preamble exists and is used for synchronization: "Preamble Symbol Characteristics":
      - "Block Length"
      - "Frame Start Offset"
  - b) "Burst search", if the signal is bursted
  - c) In the "Sync/Demod/Tracking" settings:
    - "FFT Shift relative to Cyclic Prefix Length"
    - "Cyclic delay"
    - If a preamble is configured: "Time Synchronization": "Preamble"
3. Open a "Signal Flow" and a "Constellation" result display.
4. Select [RUN SINGLE].
5. The initial coarse time synchronization must be sufficiently reliable to ensure that demodulation is successful before you can start the R&S VSE-K96 Configuration File Wizard. Note that the signal need not be perfectly synchronized in this step. The wizard provides means to compensate for remaining small frequency, phase or timing errors.

Check the "Signal Flow" result display to ensure the time synchronization meets the [Minimum Time Sync Metric](#). Define the threshold in the "Sync/Demod/Tracking" settings (see ["Minimum Time Sync Metric"](#) on page 76).

**Note:** Without a configuration file, only the timing synchronization metric, which is based on cyclic prefix or preamble, is relevant. The frame synchronization metric, which is based on pilots, is only useful in the next analysis stage that uses the configuration file.

6. Check the "Constellation" result display to ensure that the signal is as expected, e.g. the constellation points do not show a severe rotation.

**Note:** If the data cells use DFT-S precoding, the R&S VSE OFDM VSA application cannot demodulate the transformed data cells correctly without a configuration file (see also "[DFT-s-OFDM / SC-FDMA:Transform Precoding](#)" on page 49). Since the R&S VSE OFDM VSA application does not know which cells are data cells, the I/Q symbols of the data cells look like noise. Nevertheless, synchronization using the cyclic prefix is still successful. The pilot cells are not affected, and are demodulated correctly.

7. Select "Overview" > "Signal Description" > "Create New Configuration File".

The R&S VSE-K96 Configuration File Wizard starts.

### 5.2.2 Step 1: (Optional:) Importing existing files

The wizard requires demodulated data as input. When you open the wizard directly from the R&S VSE OFDM VSA application, the demodulated data from the input signal is stored in a `.K96_wizv` file internally. The wizard automatically loads this file when it is started and you start with step 2.

If a configuration file already exists, you can load it to the wizard and use it to create a new one.

#### To import an existing configuration file

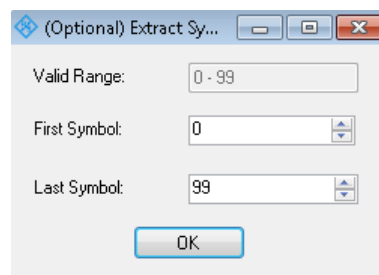
1. Select "Step 1" in the progress bar ("Step-by-Step").
2. Select the `.K96_wizv` file to load.

The constellation diagram and "Allocation Matrix" are updated according to the stored data.

### 5.2.3 Step 2: (Optional:) Adjusting the analysis region

By default, the result range configured in the R&S VSE OFDM VSA application defines the number of symbols displayed in the "Constellation View". If the result range was correctly configured to comprise exactly one frame, you do not need to adjust the analysis region.

If necessary, you can restrict the analysis region.



**Example:**

The result range in [Figure 5-5](#) contains 4 bursts, indicated by green bars. To configure the configuration file using the wizard, only one burst is required. Thus, you can extract the symbols for one burst to be used as the analysis region.

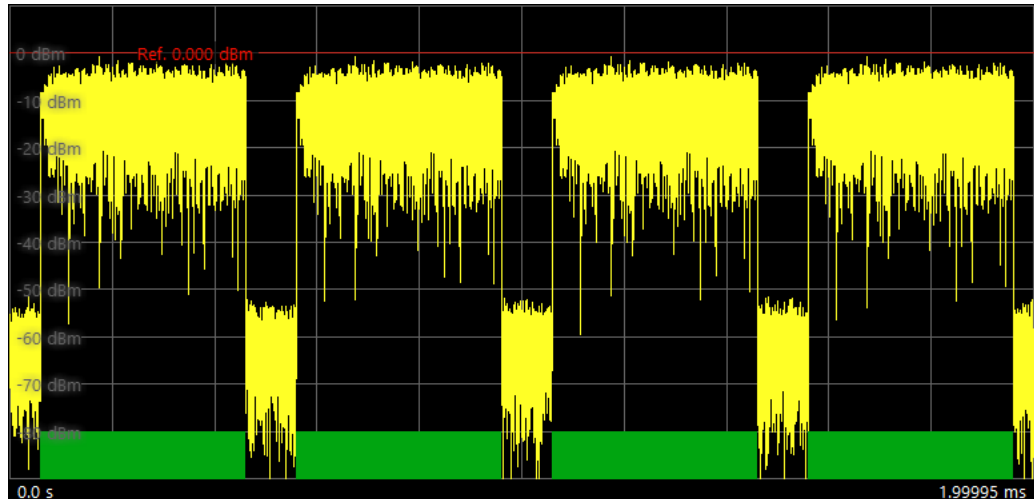


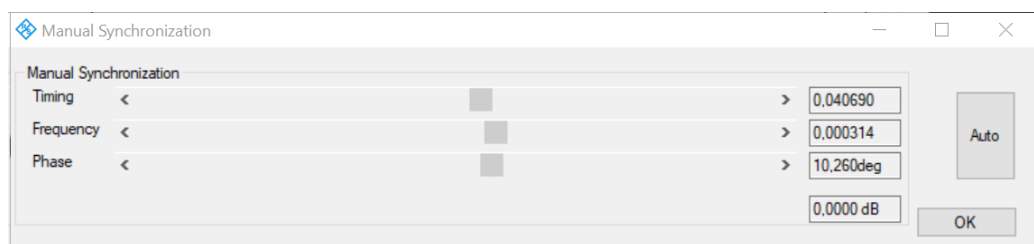
Figure 5-5: Sample result range with multiple bursts

**To restrict the analysis region**

1. Select "Step 2" in the progress bar ("Step-by-Step").
2. Define the first and last symbols of the result range to analyze.

**5.2.4 Step 3: Synchronizing the measured data**

The wizard can synchronize the measured data in terms of time, frequency, and phase, automatically. If necessary, improve the synchronization manually.

**To synchronize the measured data**

1. Select "Step 3" in the progress bar ("Step-by-Step").
2. Select "Auto" to perform automatic synchronization.
3. If necessary, move the sliders for timing, frequency, or phase until the constellation diagram shows an optimal display.

**Tip:** Click directly on the "Phase" slider to rotate the constellation in 45° steps.

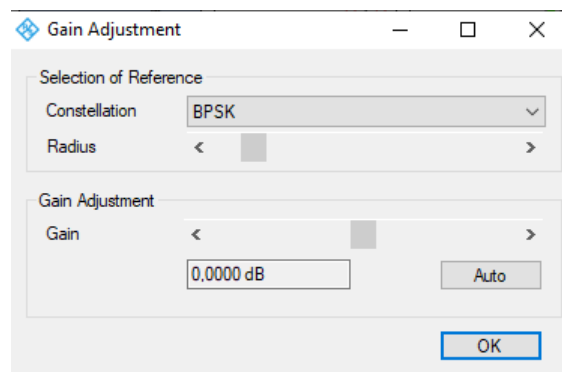
Click the arrows of the slider or move the slider handle to rotate the constellation by smaller degrees.

The currently selected values are indicated for reference. You can also enter a value directly.

### 5.2.5 Step 4: Adjusting the gain

The power gain for individual OFDM cells is determined in reference to the power measured for a specific constellation. It is recommended that you define a reference constellation that comprises many cells with similar power. Usually, the data cells of the OFDM signal are a good selection to be used as a reference.

The reference can be defined automatically or manually.



#### To select the reference for the gain

1. Select "Step 4" in the progress bar ("Step-by-Step").
2. Select the constellation type to use as a reference.
3. The "Radius" defines the area around the constellation point used to detect the symbol and calculate the power of the symbol. As a rule, define the radius such that neighboring constellation markers do not overlap.

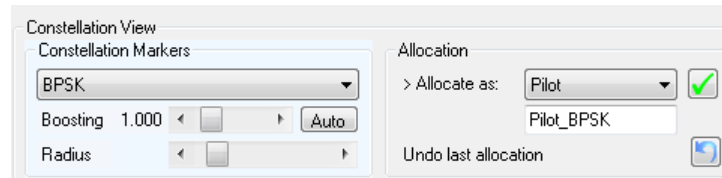
The currently used radius is indicated by a circle around the ideal constellation points in the "Constellation View".

#### To adjust the gain

1. Select "Auto" to perform a gain estimation based on the power measured in the selected constellation type.
2. To increase the reference gain, move the slider to the right.  
To reduce the reference gain, move the slider to the left.  
The currently selected value is indicated for reference. You can also enter a value directly.
3. Select "OK" to define the measured power of the selected cells as the reference power for gain settings of other cells.

## 5.2.6 Steps 5 + 6: Allocating signal components

In this step, you configure the main characteristics of each OFDM cell. To do so, you select the OFDM cells that belong to a specific cell type, configure their characteristics, and then allocate them. The result is an "Allocation Matrix" that contains information for each OFDM cell of the current OFDM frame.



### How to allocate the individual signal components

The characteristics that cells of the same type have in common are referred to as "Constellation Markers".

Select constellation markers that match your demodulated constellation, or a subset of your demodulated constellation. If you cannot see a clear constellation, improve the synchronization as described in [Chapter 5.2.4, "Step 3: Synchronizing the measured data"](#), on page 92.

1. Select "Step 5" in the progress bar ("Step-by-Step").


**Note:** Steps 5 and 6 use the same display, therefore it is not necessary to switch from step 5 to 6.

2. The selection from [Step 4: Adjusting the gain](#) is maintained, so you can allocate the cell type used for gain adjustment first.
  - a) Optionally, edit the name of the cell type, which is used for the legend of the "Allocation Matrix". By default, the name consists of the cell type and modulation.
  - b) Select the  checkmark and confirm the message to allocate the selected cells to the selected cell type.
3. For all other cell types, in the "Constellation View", select the modulation type.
  - a) For pilot cells, you can select:
    - "Pilot as received": the received (demodulated and synchronized) I/Q symbol is stored. Thus, you do not require the ideal constellation value. However, during demodulation, the application cannot correct minor symbol errors. Use this setting only if the signal and synchronization are of high quality, e.g. from a file import.
    - Any other modulation type: the received I/Q symbol is demodulated and synchronized, and if necessary, mapped to the closest ideal I/Q constellation point. The ideal value is stored.
  - b) For a user-specific, unusual constellation of a signal component, you can configure the constellation in an IQW file in advance. Then load the file to the wizard instead of selecting a predefined modulation for a specific signal component. For details see [Chapter D, "Reference: IQW format specification for user-defined constellation points"](#), on page 284.

The symbols with the selected modulation are highlighted.

4. For "Don't care" cells, for which no characteristic modulation applies, define or edit the selection manually using the [Selection tool](#).
5. Another characteristic stored for each cell is the gain value. By default, the reference power defined in [Step 4: Adjusting the gain](#) is assumed. Thus, a "Boosting" factor of 1.000 - relative to the reference power - is defined. For cells with different gain values, define a different boosting factor to apply to the reference power.
  - To determine the required boosting automatically from the constellation points, select "Auto".
  - If you know the required factor, click the boosting value and enter the value directly.

**Note:** The more accurate the boosting is defined, the more accurate the EVM results in the R&S VSE OFDM VSA application.

6. The "Radius" defines the area around the ideal constellation point used to detect the measured constellation points that correspond to the currently selected constellation type. As a rule, select the radius such that the circles around the ideal constellation points do not overlap.  
If necessary, adapt the radius around the ideal constellation points to include all and only constellation points that belong to the selected constellation type.
7. In the "Constellation View", in the "Allocation" area, select the cell type of the selected OFDM cells, for example "Pilot" or "Data".
8. Optionally, edit the name of the cell type, which is used for the legend of the "Allocation Matrix". By default, the name consists of the cell type and modulation.
-  9. Select the checkmark and confirm the message to allocate the selected cells to the selected cell type.

The cells are indicated in the color shown in the legend above the "Allocation Matrix". The cells are no longer displayed if you selected only [Show non-allocated constellation points](#) in the "Constellation View".



10. If necessary, you can revert the last allocation.

The allocated OFDM cells are indicated as non-allocated (but still selected).

11. Repeat these steps until all OFDM cells are allocated. When the last cell type is allocated, a message prompts you to store the results.

**Tip:** In the "Constellation View", select  [Show non-allocated constellation points](#) and deselect  ["Show allocated constellation points"](#) on page 85 to see which cells are still missing in the "Allocation Matrix".

### 5.2.7 Step 7: Storing results

When you have allocated all constellation points in the "Constellation View" to a cell type and configured all other settings as required, store the results to a file. The result-

ing configuration file can then be used for analysis in the R&S VSE OFDM VSA application.

#### To store a configuration file

1. At the end of [Steps 5 + 6: Allocating signal components](#), when all OFDM cells are allocated, the wizard prompts you to store the configuration file.  
At any other point in the configuration process, select "Step 7" in the progress bar ("Step-by-Step"), or select the "File" > "Save Configuration File" menu item.
2. Select a filename and storage location for the configuration file.
3. Select "Save".

## 5.3 Reference of wizard menu functions

The following functions are provided in the menus of the configuration file wizard.

• <a href="#">File functions</a> .....	96
• <a href="#">Edit functions</a> .....	97
• <a href="#">Settings</a> .....	97
• <a href="#">Help</a> .....	101

### 5.3.1 File functions

<a href="#">New</a> .....	96
<a href="#">Import Data from R&amp;S OFDM VSA</a> .....	96
<a href="#">Load Configuration File</a> .....	96
<a href="#">Save Configuration File</a> .....	96
<a href="#">Exit</a> .....	97

#### New

Creates a new, empty configuration file. This function is similar to a preset function. Any information from the input signal in the R&S VSE OFDM VSA application is no longer available in the wizard. Load existing signal or configuration data to continue.

See "[Import Data from R&S OFDM VSA](#)" on page 96 and "[Load Configuration File](#)" on page 96.

#### Import Data from R&S OFDM VSA

Opens a file selection dialog box to import I/Q data from an existing `.K96_wizv` file (created by the R&S VSE OFDM VSA application).

#### Load Configuration File

Opens a file selection dialog box to load an existing `.xml` configuration file, for example as the basis for a similar configuration.

#### Save Configuration File

Opens a file selection dialog box to save the current configuration to an `.xml` file.



This function is identical to [Chapter 5.2.7, "Step 7: Storing results"](#), on page 95.

**Note:** At the end of [Steps 5 + 6: Allocating signal components](#), when all symbols have been allocated, you are automatically asked if you want to store the configuration file.

#### Exit

Closes the wizard without a confirmation. Use [Save Configuration File](#) to store your current configuration before exiting.

### 5.3.2 Edit functions

<a href="#">Reset All Allocations</a> .....	97
<a href="#">Undo Last Allocation</a> .....	97
<a href="#">Extract Symbols (context-menu)</a> .....	97
<a href="#">Shift Left by 1 Carrier / Shift Right by 1 Carrier</a> .....	97

#### Reset All Allocations

Removes all applied allocations. All cells are indicated as non-allocated.

#### Undo Last Allocation

Reverts the most recently applied allocation. The allocated cells are indicated as non-allocated (but still selected).

This function is identical to using the  icon in the "Constellation View".

#### Extract Symbols (context-menu)

Extracts a range of symbols from the imported signal for further analysis.

**Note:** To restore discarded symbols for analysis, you must re-import the signal.

This function is identical to [Chapter 5.2.3, "Step 2: \(Optional:\) Adjusting the analysis region"](#), on page 91.

#### Shift Left by 1 Carrier / Shift Right by 1 Carrier

Shifts the carrier information for all symbols by one carrier. Shifting is useful to compensate for a frequency offset that could not be corrected by the automatic synchronization function.

### 5.3.3 Settings

<a href="#">System Name</a> .....	98
<a href="#">System Description</a> .....	98
<a href="#">Cyclic Prefix / Suffix</a> .....	98
L <a href="#">Cyclic Prefix Length</a> .....	98
L <a href="#">Cyclic prefix mode</a> .....	99
L <a href="#">Different cyclic prefix lengths</a> .....	99
L <a href="#">Cyclic prefix definition per range (Symbols / Samples)</a> .....	99
L <a href="#">Cyclic Suffix Length</a> .....	100
<a href="#">Preamble</a> .....	100
L <a href="#">Set Preamble</a> .....	100

L Block Length.....	100
L Frame Start Offset.....	100
Cyclic Delay Diversity.....	101

### System Name

Defines the name of the stored configuration file. The default name is `MyData`. You can change the name in the "Settings" (see [Chapter 5.3.3, "Settings"](#), on page 97).

### System Description

Provides a description of the signal configured in the file.

By default, the following main characteristics are included:

- [Number of Carriers](#)
- [Number of Symbols](#)
- [Cyclic Prefix Length](#)

If you deactivate the "Default" setting, you can overwrite the text with any other.

### Cyclic Prefix / Suffix

Configures the cyclic prefix and suffix, if applicable.

### Cyclic Prefix Length ← Cyclic Prefix / Suffix

Defines the length of the cyclic prefix (CP) area between two OFDM symbols in samples. The cyclic prefix area defines the guard interval and is expected to contain a copy of the samples at the end of the OFDM symbol.

The cyclic prefix length must be smaller than or equal to the ["FFT Size"](#) on page 50.

Remote command:

`CONFigure[:SYMBOL]:NGuard<cp>` on page 137

**Cyclic prefix mode ← Cyclic Prefix / Suffix**

Determines how the cyclic prefix is configured.

By default, "Conventional Mode" is assumed, that is: each OFDM symbol has the same cyclic prefix length.

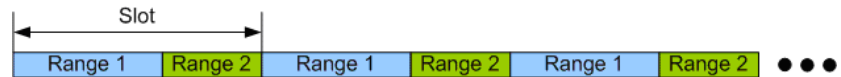
Remote command:

`CONFigure[:SYMBOL]:GUARd:MODE` on page 136

**Different cyclic prefix lengths ← Cyclic Prefix / Suffix**

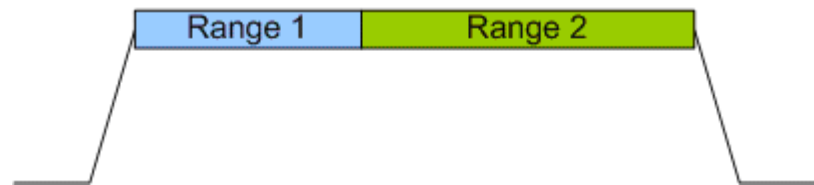
Some OFDM signals change their cyclic prefix over time (e.g. 802.11ac). This setting defines the behavior in such a case.

"Periodic" One "slot" that consists of the two defined ranges is repeated over and over until the number of symbols specified by the result range parameter is reached. The ranges are repeated periodically, first range 1, then range 2, then range 1, etc.



*Figure 5-6: Non-Conventional cyclic prefix case: Periodic mode*

"Non-Periodic" A fixed preamble has a different cyclic prefix length than the rest of the frame (e.g. WLAN 802.11ac signals). In this case, the length of the second range is extended until the end of the demodulated frame. Therefore, the length of the second range cannot be specified in this case.



*Figure 5-7: Non-Conventional cyclic prefix case: Non-Periodic mode*

Remote command:

`CONFigure[:SYMBOL]:GUARd:PERiodic` on page 137

**Cyclic prefix definition per range (Symbols / Samples) ← Different cyclic prefix lengths ← Cyclic Prefix / Suffix**

For each range, configure the number of symbols the cyclic prefix length is applied to, and the length of the cyclic prefix as a number of samples.

For non-periodic cyclic prefixes, the length of the second range cannot be specified. It is extended to the end of the demodulated frame.

Remote command:

`CONFigure[:SYMBOL]:GUARd:NSYMBOLs<cp>` on page 136

`CONFigure[:SYMBOL]:NGUard<cp>` on page 137

**Cyclic Suffix Length ← Cyclic Prefix / Suffix**

Defines the length of the cyclic suffix between two OFDM symbols in samples. The cyclic suffix is expected to contain a copy of the first N samples at the beginning of the OFDM symbol.

Figure 4-2 shows how the complete OFDM symbol is retrieved for an FFT length of 8 and a cyclic prefix and suffix length of 2.

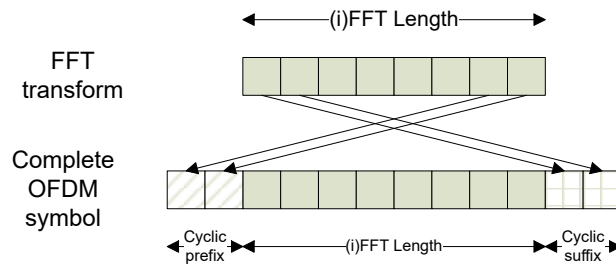


Figure 5-8: OFDM symbol with cyclic prefix and suffix

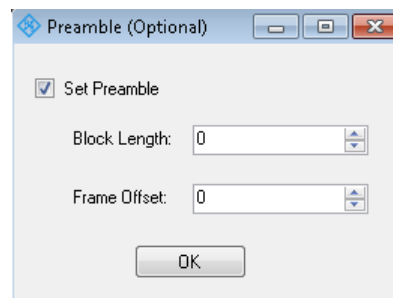
The cyclic suffix length must be smaller than or equal to the "FFT Size" on page 50.

Remote command:

`CONFigure[:SYMBOL]:NSUFFIX` on page 138

**Preamble**

Preamble symbol characteristics can be stored in the configuration file. These settings correspond to the settings in the "Signal Description" dialog in the R&S VSE OFDM VSA application (see Chapter 4.2, "Signal description", on page 47). The information can be used by the R&S VSE OFDM VSA application, for example for synchronization.

**Set Preamble ← Preamble**

If activated, the defined preamble symbol characteristics are stored in the configuration file.

**Block Length ← Preamble**

Specifies the length of one data block within the repetitive preamble as a number of samples.

**Frame Start Offset ← Preamble**

Specifies the time offset from the preamble start to the actual frame start as a number of samples.

**Cyclic Delay Diversity**

Defines a cyclic shift of the FFT values for each OFDM symbol before adding the cyclic prefix.

**5.3.4 Help**

Provides context-sensitive help on the configuration process, according to the currently selected process step.

**5.4 Example: creating a configuration file from an input signal**

The wizard requires demodulated data as input for the configuration file. You can configure a basic measurement for the input signal in the R&S VSE OFDM VSA application as described in [Chapter 7, "How to perform measurements in the R&S VSE OFDM VSA application"](#), on page 125, or load existing I/Q data to the application.

For this example, we use the I/Q data in the demo file

C:\ProgramData\Rohde-Schwarz\VSE\<>version\_no>\user\demo\OFDM-VSA\WlanA\_64QAM.iq.tar provided with the R&S VSE software.

The following signal parameters are already known:

- FFT size (= number of subcarriers): 64 samples
- Cyclic prefix length: 16 samples
- OFDM system sample rate: 20 MHz
- Pilot modulation: QPSK + 45°QPSK
- Data modulation: 64QAM + BPSK

1. Define the basic signal parameters so the R&S VSE OFDM VSA application can demodulate the data.

a) Select the "Meas Setup > Signal Description" menu item.

- Set "FFT Size" = 64.
- Set "Cyclic Prefix Length" = 16.

b) Select the "Meas Setup > Data Acquisition" menu item.

- Set "Sample Rate" = 20 MHz.

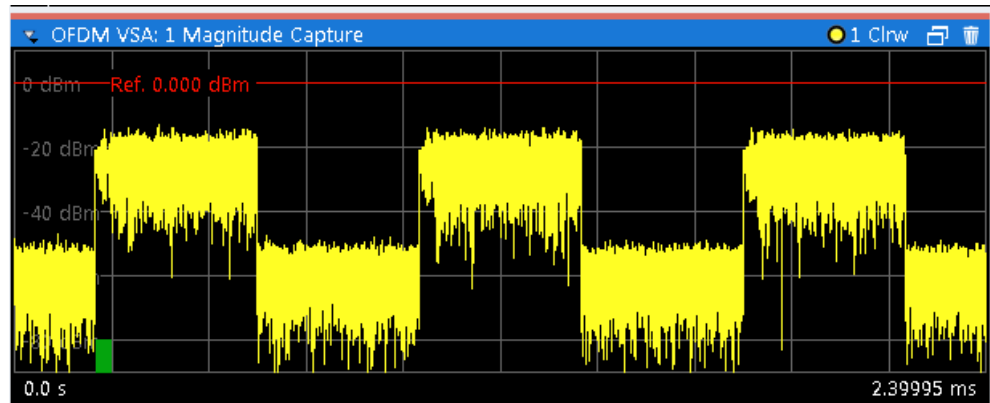
2. Drag the

C:\ProgramData\Rohde-Schwarz\VSE\<>version\_no>\user\demo\OFDM-VSA\WlanA\_64QAM.iq.tar file from the file explorer to the OFDM VSA channel in the R&S VSE software.

The input type is set to "File", and the selected file is loaded as input for the OFDM VSA channel.

The Magnitude Capture display shows the bursted signal.

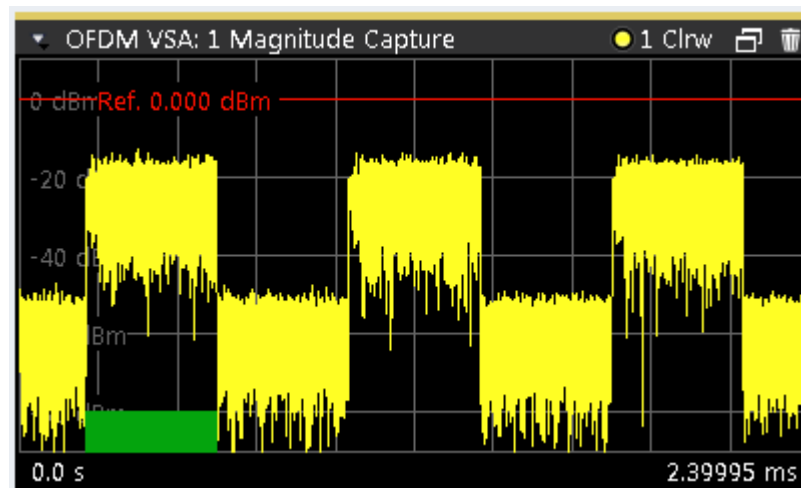
Example: creating a configuration file from an input signal



3. The green bar in the Magnitude Capture diagram does not cover an entire frame. Increase the result range to include all symbols of a frame.

a) Select the "Meas Setup > Result Range" menu item.

- Set "Result Length" = 100.



The data is now demodulated correctly and can be used as input for a new configuration file.

4. In the "Signal Description" dialog box, select "Create New Configuration File".
5. Since it is a bursted signal and the result range is large enough, the analysis range corresponds to exactly one frame. We can start directly with step 3, synchronization. Our constellation diagram is slightly rotated and generally does not show an ideal constellation, so we must improve the synchronization settings.

Example: creating a configuration file from an input signal

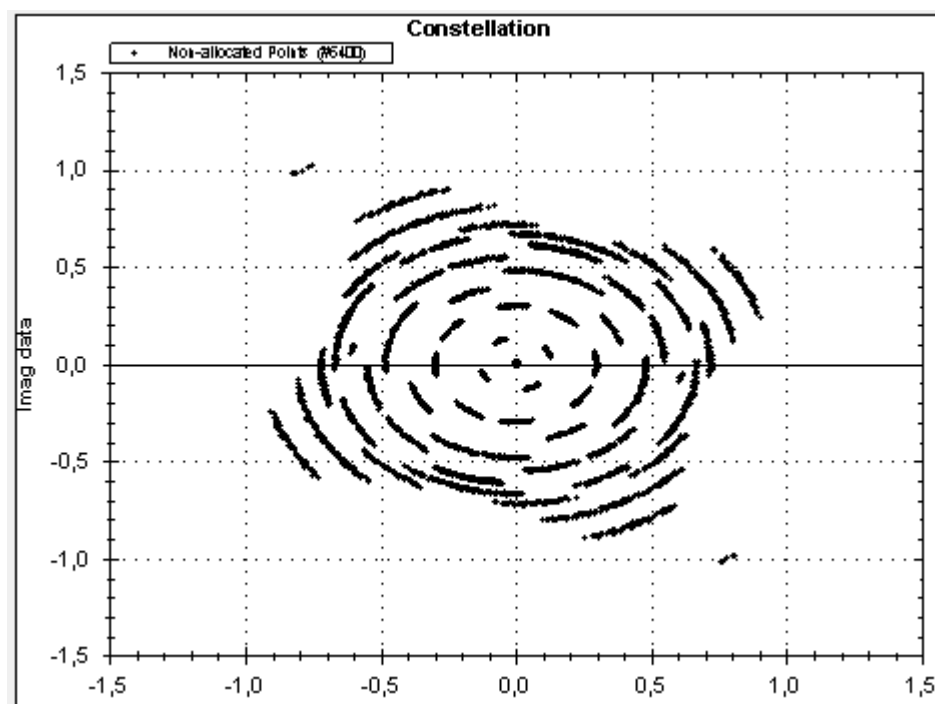


Figure 5-9: Constellation diagram for loaded WLAN signal data

Select "Step 3" in the progress bar.

a) Select "Auto" to perform automatic synchronization.

Example: creating a configuration file from an input signal

- b) If necessary, move the sliders for timing, frequency, or phase until the constellation diagram shows an optimal display.

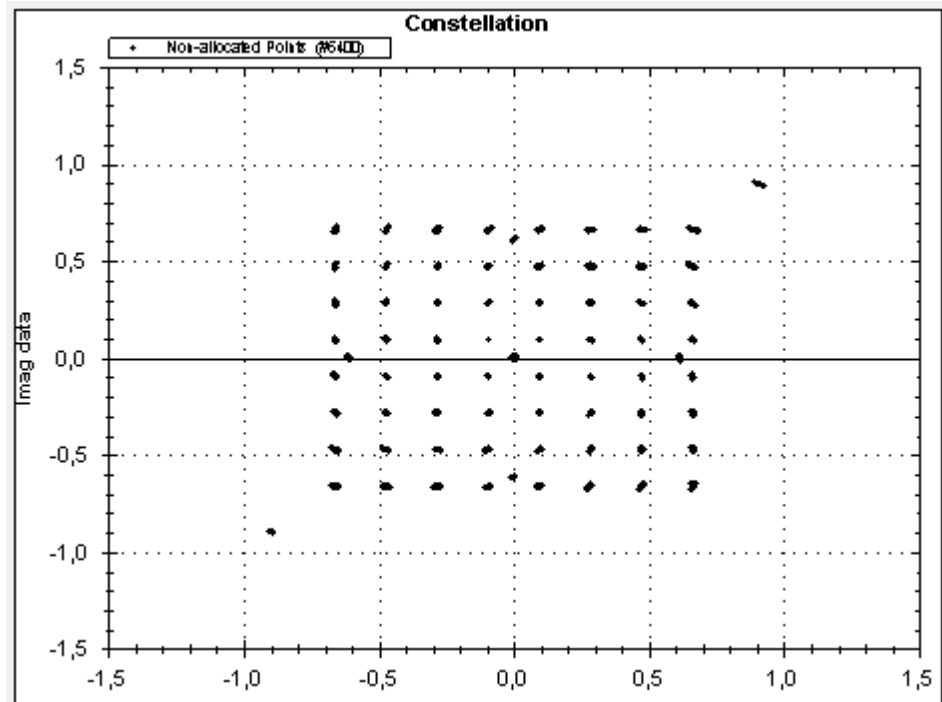


Figure 5-10: Constellation diagram after automatic synchronization

6. The reference constellation for the gain calculation is best defined by the data cells in this signal, which use a 64QAM modulation.  
Select "Step 4" in the progress bar.
- a) In the "Gain Adjustment" dialog box, select "Constellation" = "64QAM".



Example: creating a configuration file from an input signal

- b) Select "Gain Adjustment" > "Auto".

The data cells which use this modulation are highlighted both in the "Constellation View" and the "Matrix View".

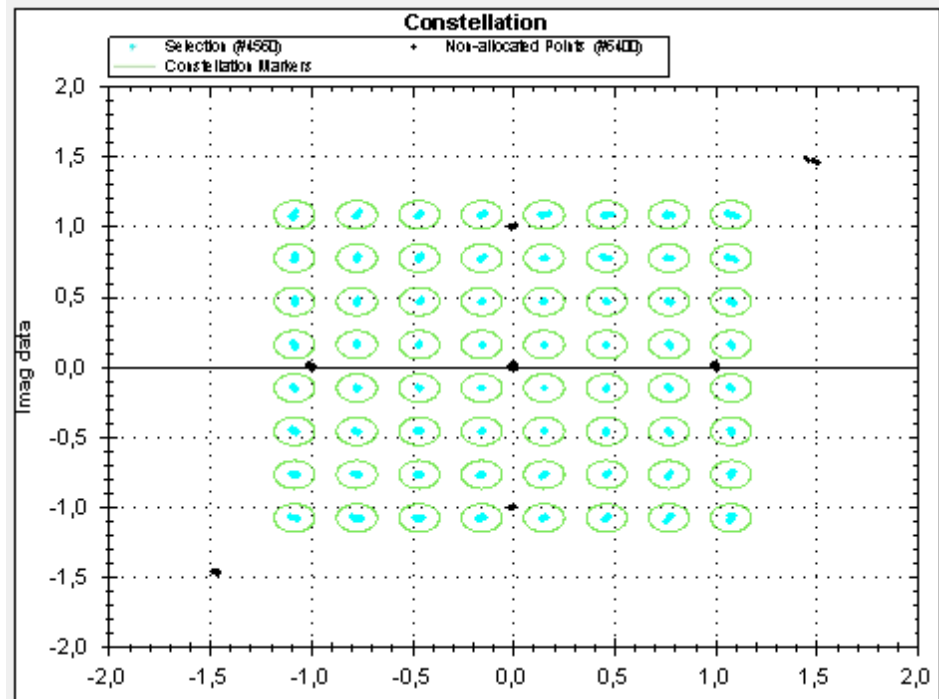


Figure 5-11: Highlighted data points in 64QAM constellation

The power for the highlighted constellation points is stored as the reference power, that is: as the boosting factor "1.0".

7. Since the data cells are already selected, we allocate those cells in the matrix first.
  - a) Select "Step 5" in the progress bar.
  - b) In the "Constellation View", "Allocation" area, select "Allocate as:" "Data"
  - c) Select the  green checkmark icon.

The data cells in the "Allocation Matrix" are indicated in the specified color for data symbols.

8. Next we allocate the symbols with a power level of 0 V - the "Zero" cells.
  - a) In the "Constellation View", select the modulation type "Zero" as a constellation marker.
  - b) In the "Constellation View", "Allocation" area, select "Allocate as:" = "Zero".
  - c) Select the  green checkmark icon.

The zero cells in the "Allocation Matrix" are indicated in the specified color for "Zero" symbols.

9. Allocate the "Pilot" cells.

Example: creating a configuration file from an input signal

- a) In the "Constellation View", select the modulation type "QPSK" as a constellation marker.

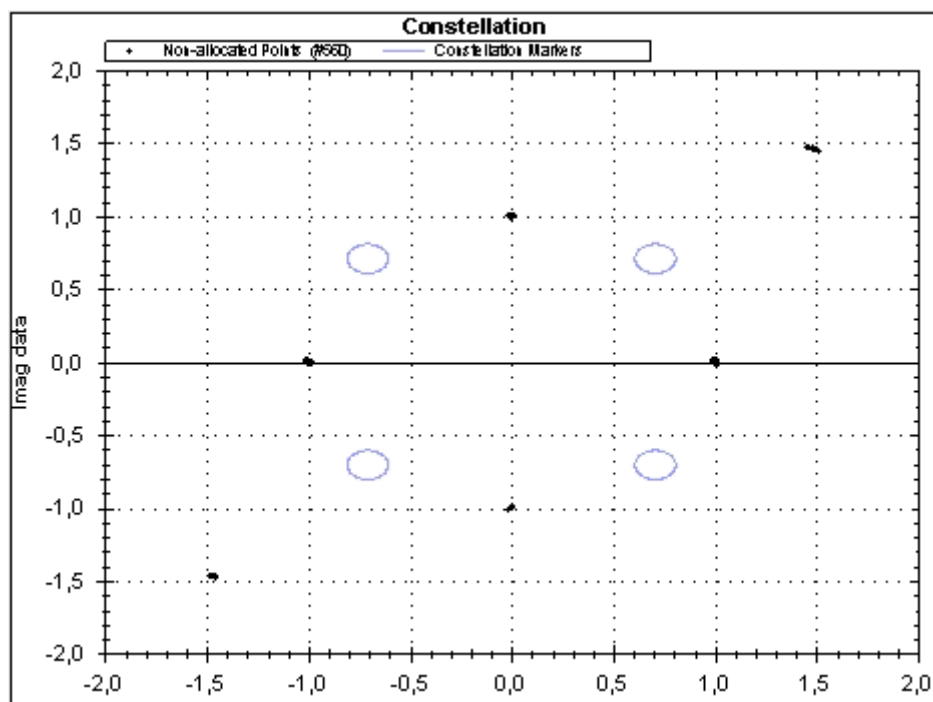


Figure 5-12: Symbols with QPSK constellation

Although we know some of the pilots use QPSK modulation, none of the symbols are highlighted. Possibly a boosting factor was applied.

Example: creating a configuration file from an input signal

- b) Select the "Boosting" - "Auto" function.  
A boosting of 2.079 is detected and applied to the symbols. Now some of the symbols are highlighted.

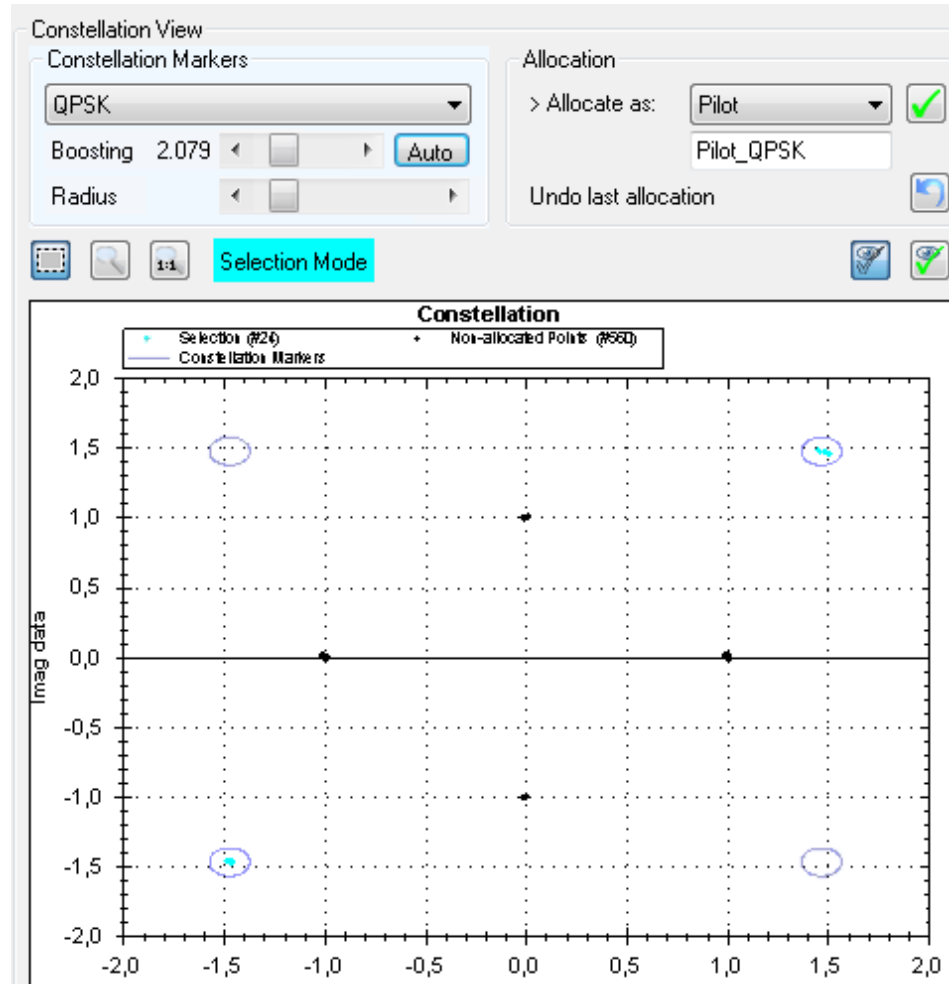


Figure 5-13: Symbols with QPSK modulation and applied boosting

- c) In the "Constellation View", "Allocation" area, select "Allocate as:" "Pilots".  
d) Select the  green checkmark icon.

The pilot cells in the "Allocation Matrix" are indicated in the specified color for "Pilot" symbols, and the selected cells are stored with a boosting factor of 2.079.

10. Some of the remaining cells are data cells with a BPSK modulation.
- In the "Constellation View", select the modulation type "BPSK" as a constellation marker.
  - In the "Constellation View", "Allocation" area, select "Allocate as:" = "Data".
  - Select the  green checkmark icon.
11. The last remaining cells are pilot cells with a 45°QPSK modulation.
- In the "Constellation View", select the modulation type "45°QPSK" as a constellation marker.

Example: creating a configuration file from an input signal

- b) In the "Constellation View", "Allocation" area, select "Allocate as:" = "Pilot".
- c) Select the  green checkmark icon.

A message is displayed informing you that all symbols are allocated.

12. Store the configuration file.

Select "Step 7" in the progress bar.

- a) Enter the filename and storage location for the configuration file:

```
C:\ProgramData\Rohde-Schwarz\VSE\<<version_no>\user\demo\  
OFDM-VSA\MyWlanA_64QAM.xml
```

13. Close the wizard.

Now you can load the configuration file in the R&S VSE OFDM VSA application.

See [step 4](#).

## 6 Analyzing OFDM VSA vector signals

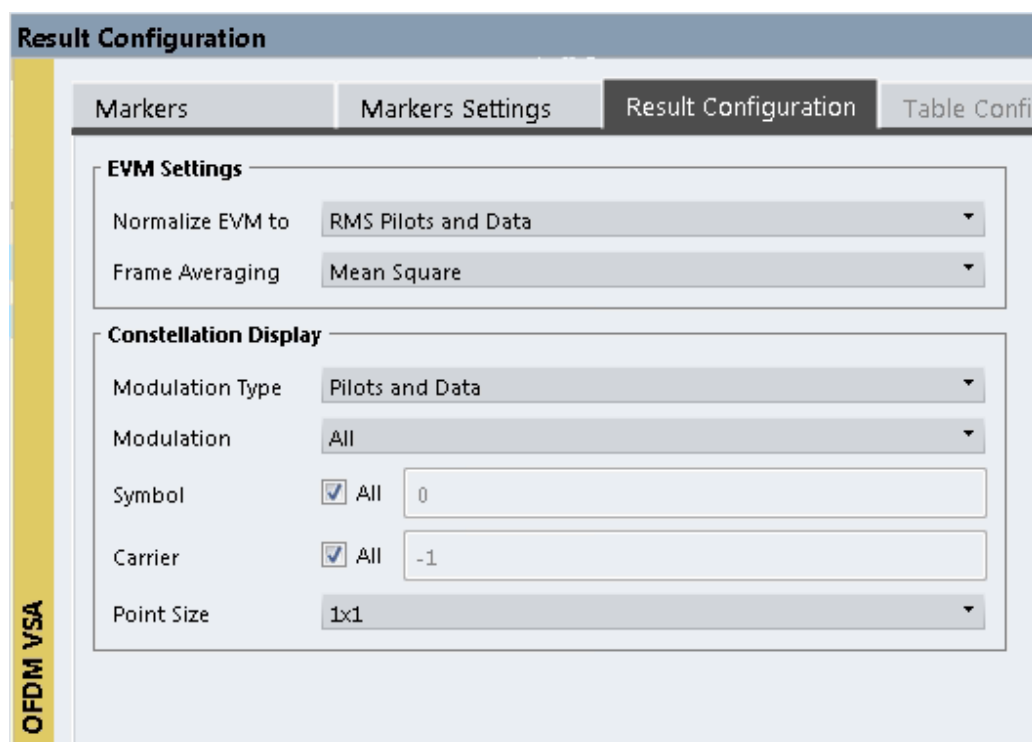
**Access:** "Overview" > "Result Configuration"

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.

- [Result configuration](#)..... 109
- [Table configuration](#)..... 111
- [Units](#)..... 112
- [Y-Scaling](#)..... 113
- [Markers](#)..... 115
- [Trace settings](#)..... 121
- [Trace / data export configuration](#)..... 123

### 6.1 Result configuration

Some result displays provide further settings.



- [Normalize EVM to](#)..... 110
- [Frame Averaging](#)..... 110
- [Constellation Display - Modulation Type](#)..... 110
- [Constellation Display - Modulation](#)..... 110

Constellation Display - Symbol.....	111
Constellation Display - Carrier.....	111
Constellation Display - Point Size.....	111

### Normalize EVM to

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

(See [Chapter C.1, "Error vector magnitude \(EVM\)"](#), on page 282 for details).

"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 203

### Frame Averaging

Specifies the method of averaging over multiple OFDM frames in one capture buffer used to get the mean EVM values in the result list.

Frame Averaging	Averaged EVM over N frames
Mean square	$\sqrt{\frac{1}{N} \sum_{i=0}^{N-1} EVM_i^2}$
RMS	$\frac{1}{N} \sum_{i=0}^{N-1} EVM_i$

Mean square averaging is consistent with the EVM calculation within one frame. However, some standards, e.g. 802.11a, require RMS averaging.

Remote command:

[\[SENSe:\]DEMod:EVMCalc:FAverage](#) on page 203

### 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 204

### Constellation Display - Modulation

The constellation diagram includes only symbols with the selected modulation.

Remote command:

[CONFigure:FILTer<n>:MODulation](#) on page 204

#### **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 205

#### **Constellation Display - Carrier**

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

The range of valid carrier numbers is:

$[- \text{FFT Size}/2, + \text{FFT Size}/2]$

Remote command:

[CONFigure:FILTer<n>:CARRier](#) on page 204

#### **Constellation Display - Point Size**

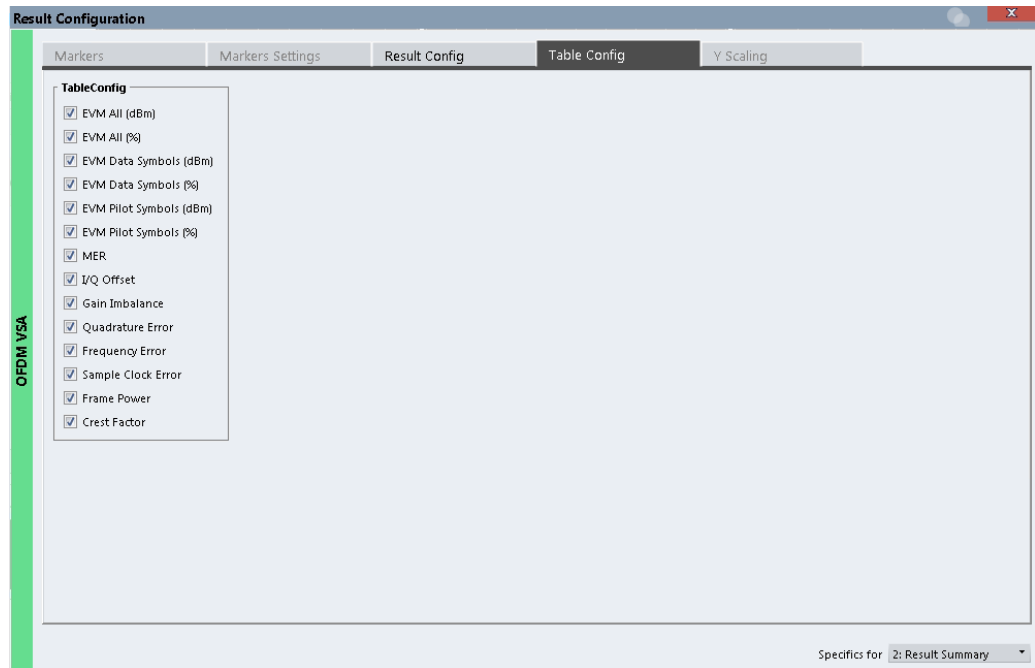
Defines the size of the individual points in a constellation diagram.

## 6.2 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 Result Summary table. For a description of the individual parameters, see [Chapter 2.1, "OFDM VSA parameters"](#), on page 9.



### Bitstream Format

For the Bitstream display, define the format of the symbols: hexadecimal (default), decimal, octal or binary.

Remote command:

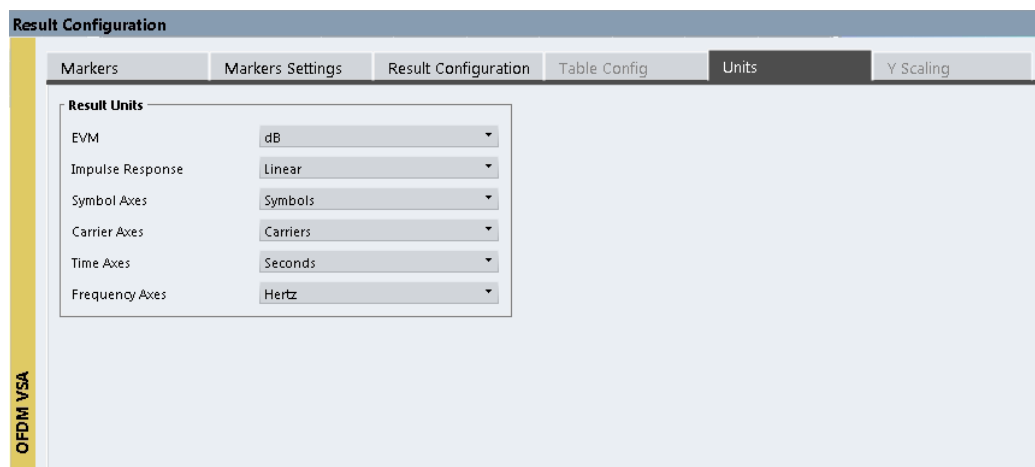
`CALCulate<n>:BITStream:FORMat` on page 203

## 6.3 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: EVM` on page 209

`UNIT: IRESponse` on page 210

`UNIT: SAXes` on page 210

`UNIT: CAXes` on page 208

`UNIT: TAXes` on page 210

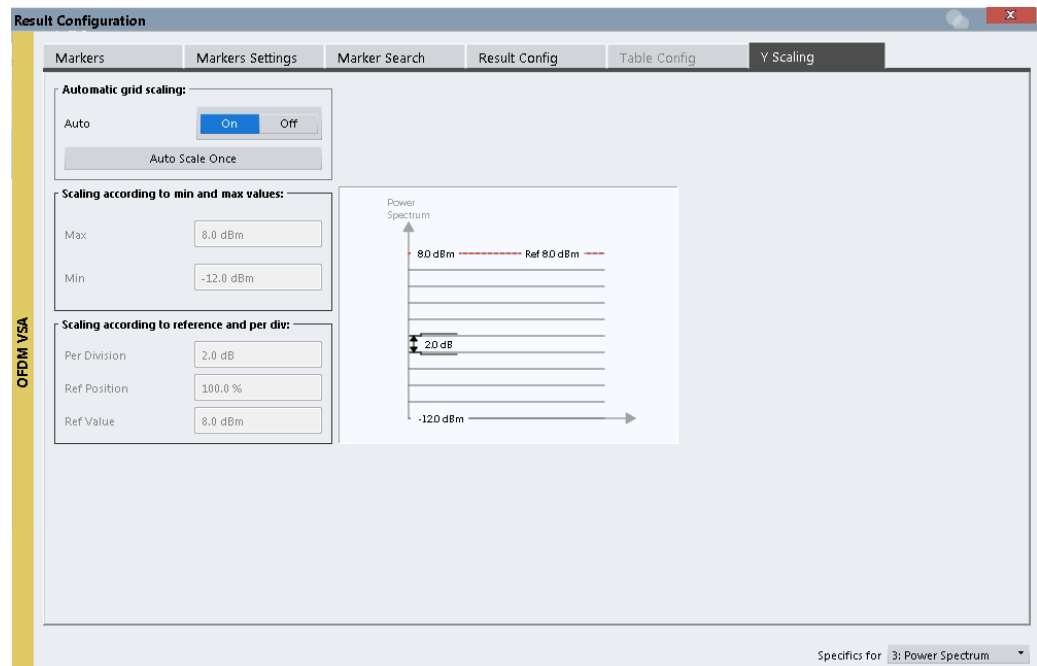
`UNIT: FAXes` on page 209

## 6.4 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.....	114
Auto Scale Once.....	114
Absolute Scaling (Min/Max Values).....	114
Relative Scaling (Reference/ per Division).....	114
L Per Division.....	114
L Ref Position.....	114
L Ref Value.....	114

**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>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`  
on page 206

**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>][:SUBWindow<n>]:TRACe<t>:Y[:SCALe]:AUTO`  
on page 206

**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 208  
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 208

**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>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:PDIVision`  
on page 206

**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>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition`  
on page 207

**Ref Value ← Relative Scaling (Reference/ per Division)**

Defines the reference value to be displayed at the specified reference position.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue`  
on page 207

## 6.5 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.

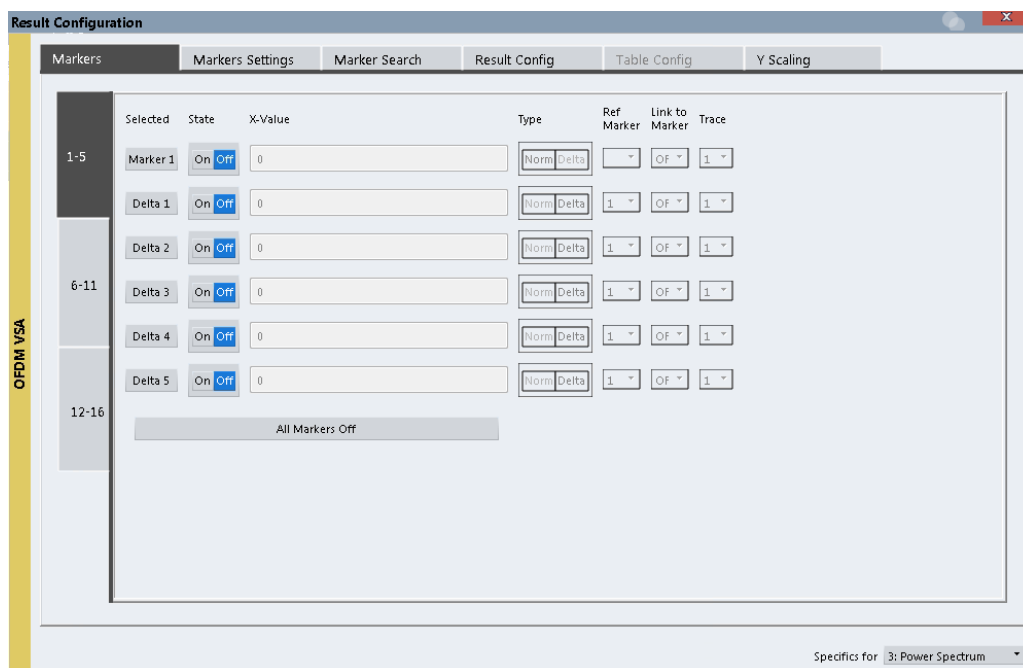
- [Individual marker settings](#)..... 115
- [General marker settings](#)..... 118
- [Marker positioning functions](#)..... 120

### 6.5.1 Individual marker settings

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

**Or:** "Marker" > "Marker"

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



- ▼ Place New Marker..... 116
- ML Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16..... 116
- Selected Marker..... 117
- Marker State..... 117
- X-value..... 117
- Y-value..... 117
- Marker Type..... 117
- Reference Marker..... 118
- Linking to Another Marker..... 118
- Assigning the Marker to a Trace..... 118
- All Markers Off..... 118

▼ Place New Marker

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

ML 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 214

[CALCulate<n>:MARKer<m>:X](#) on page 215

[CALCulate<n>:MARKer<m>:Y?](#) on page 248

[CALCulate<n>:DELTamarker<m>\[:STATe\]](#) on page 217

[CALCulate<n>:DELTamarker<m>:X](#) on page 218

[CALCulate<n>:MARKer<m>:Y?](#) on page 248

[CALCulate<n>:DELTamarker<m>:Y?](#) on page 246

### 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 214

[CALCulate<n>:DELTamarker<m>\[:STATe\]](#) on page 217

### 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 218

[CALCulate<n>:MARKer<m>:X](#) on page 215

### 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 246

[CALCulate<n>:MARKer<m>:Y?](#) on page 248

### 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 214

[CALCulate<n>:DELTamarker<m>\[:STATe\]](#) on page 217

### 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>:MREference](#) on page 216

### 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<ms>:LINK:TO:MARKer<md>](#) on page 213

[CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>](#) on page 216

[CALCulate<n>:DELTamarker<m>:LINK](#) on page 216

### 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 214

### All Markers Off



Deactivates all markers in one step.

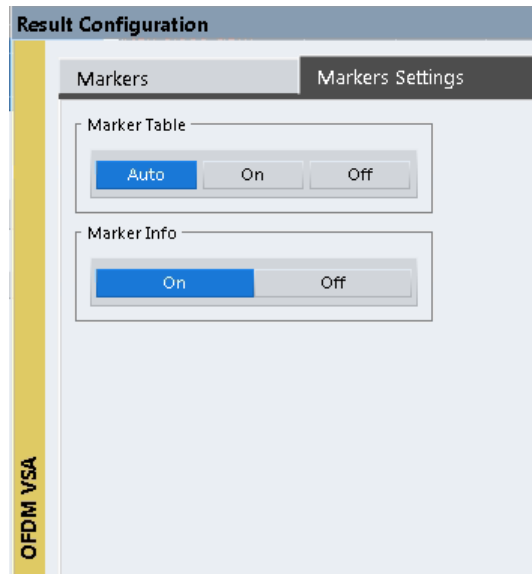
Remote command:

[CALCulate<n>:MARKer<m>:AOFF](#) on page 213

## 6.5.2 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.  
If **Marker Info** is active, the marker information is displayed within the diagram area.
- "Auto"                (Default) If more than two markers are active, the marker table is displayed automatically.  
If **Marker Info** is active, the marker information for up to two markers is displayed in the diagram area.

Remote command:

`DISPlay[:WINDow<n>]:MTABLE` on page 218

### Marker Info

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

1AP Clrw	
M1[1]	81.13 dB $\mu$ V 177.610 MHz
D2[1]	-22.18 dB -28.980 MHz

Remote command:

`DISPlay[:WINDow<n>]:MINFo[:STATe]` on page 218

### 6.5.3 Marker positioning functions

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

**Access:** "Marker" toolbar

Peak Search.....	120
Search Next Peak.....	120
Search Minimum.....	120
Search Next Minimum.....	120

#### 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 222

[CALCulate<n>:DELTamarker<m>:MAXimum\[:PEAK\]](#) on page 220

#### 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 222

[CALCulate<n>:MARKer<m>:MAXimum:RIGHT](#) on page 222

[CALCulate<n>:MARKer<m>:MAXimum:LEFT](#) on page 222

[CALCulate<n>:DELTamarker<m>:MAXimum:NEXT](#) on page 220

[CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT](#) on page 220

[CALCulate<n>:DELTamarker<m>:MAXimum:LEFT](#) on page 220

#### 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 223

[CALCulate<n>:DELTamarker<m>:MINimum\[:PEAK\]](#) on page 221

#### Search Next Minimum

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



Remote command:

[CALCulate<n>:MARKer<m>:MINimum:NEXT](#) on page 223

[CALCulate<n>:MARKer<m>:MINimum:LEFT](#) on page 223

[CALCulate<n>:MARKer<m>:MINimum:RIGHT](#) on page 223

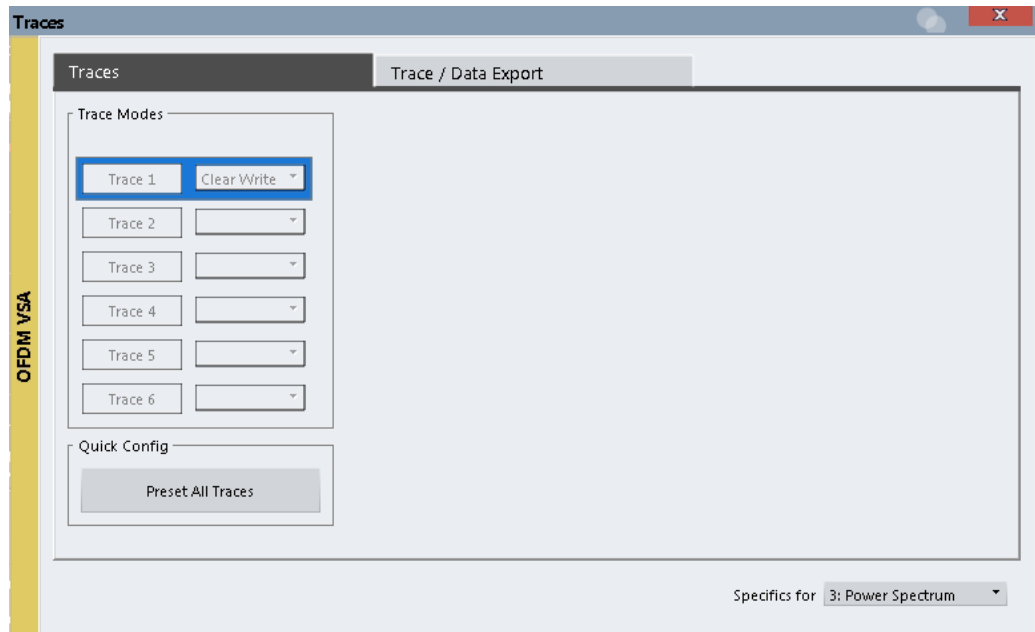
[CALCulate<n>:DELTamarker<m>:MINimum:NEXT](#) on page 221



[CALCulate<n>:DELTaMarker<m>:MINimum:LEFT](#) on page 221  
[CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT](#) on page 221

## 6.6 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 6 traces are available.



Trace data can also be exported to an ASCII file for further analysis. For details, see [Chapter 6.7, "Trace / data export configuration"](#), on page 123.

<a href="#">Trace 1/Trace 2/Trace 3</a> .....	121
<a href="#">Trace Mode</a> .....	121
<a href="#">Predefined Trace Settings - Quick Config</a> .....	122

### Trace 1/Trace 2/Trace 3

Selects the corresponding trace for configuration. The currently selected trace is high-lighted orange.

Remote command:

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>\[:STATe\]](#) on page 212

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. All available detectors can be selected.
"Max Hold"	The maximum value is determined over several measurements and displayed. The R&S VSE saves the measurement result in the trace memory only if the new value is greater than the previous one.
"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S VSE saves the measurement result 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. <b>Note:</b> If a trace is frozen, you can change the measurement settings, apart from scaling settings, without impact on the displayed trace. The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk * on the tab label. If you change any parameters that affect the scaling of the diagram axes, the R&S VSE automatically adapts the trace data to the changed display range. Thus, you can zoom into the diagram after the measurement to show details of the trace.
"Blank"	Removes the selected trace from the display.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:MODE` on page 212

### 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
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

## 6.7 Trace / data export configuration

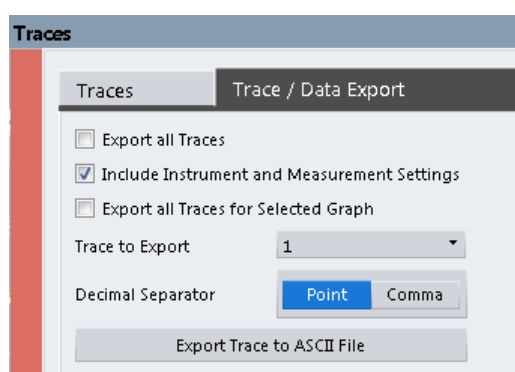
**Access:** "Edit" > "Trace Export"

Traces resulting from encrypted file input cannot be exported.



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

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



<a href="#">Export all Traces and all Table Results</a> .....	123
<a href="#">Include Instrument &amp; Measurement Settings</a> .....	123
<a href="#">Export All Traces for Selected Graph</a> .....	123
<a href="#">Trace to Export</a> .....	124
<a href="#">Decimal Separator</a> .....	124
<a href="#">Export Trace to ASCII File</a> .....	124

### 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 251

### 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 250

### 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 250

### **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 250

### **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 251

## 7 How to perform measurements in the R&S VSE OFDM VSA application

The following step-by-step instructions demonstrate how to perform measurements with the R&S VSE OFDM VSA application.




The R&S VSE OFDM VSA application provides sample data and sample configuration files in the

C:\ProgramData\Rohde-Schwarz\VSE\`<version_no>`\user\OFDM-VSA directory.

### To perform a OFDM VSA measurement

1. Open a new channel or replace an existing one and select the "OFDM VSA" application.
2. Configure the input source to be used as described in the R&S VSE Base Software User Manual.
3. Select the "Meas Setup > Overview" menu item to display the "Overview" for a OFDM VSA measurement.
4. Select the "Signal Description" button and configure the expected signal characteristics either manually or using a configuration file.
5. To use a configuration file:
  - a) If no configuration file is available yet, create one from the input signal as described in [Chapter 5, "Creating a configuration file using the wizard"](#), on page 81.
  - b) Select "Load Config. File"
  - c) Select the configuration file to use.The file is loaded and "Use Configuration File" is automatically set to "Yes".
6. Select the "Input/Frontend" button to define the input signal's center frequency, amplitude and other basic settings.
7. 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.
8. For bursted signals, select the "Burst Search" button and activate a burst search.
9. Select the "Data Acquisition" button and define how much and which data to capture:
  - "Capture Time" or "Capture length": the duration or number of samples to be captured

For non-triggered ("Free run") measurements, be sure to capture at least twice the number of samples per frame so you are sure to capture at least one entire frame.

- "Sample rate": the rate at which I/Q data is acquired (analysis bandwidth / 0.8); must also correspond to the OFDM system sample rate ( $\text{<subcarrier\_spacing> * <FFT\_size>$ , see also "[OFDM system sample rate](#)" on page 33)
10. Select the "Result Range" button and define how many OFDM symbols are to be interpreted as one frame.
  11. To optimize the synchronization process, if necessary, select the "Sync/Demod/Tracking" button and configure the synchronization and demodulation parameters. Which compensation and synchronization functions are allowed depends on the standard defining the tests.
  12. Select the  "Add Window" icon from the toolbar to add further result displays for the OFDM VSA.

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

## 8 Remote commands for OFDM VSA

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

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

### General R&S VSE Remote Commands

The application-independent remote commands for general tasks on the R&S VSE are also available for R&S VSE OFDM VSA application 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 on the R&S VSE, most commands refer to the currently active channel. Thus, always remember to activate a OFDM VSA channel before starting a remote program for a OFDM VSA measurement.

The following tasks specific to R&S VSE OFDM VSA application are described here:

• <a href="#">Introduction</a> .....	127
• <a href="#">Common suffixes</a> .....	132
• <a href="#">Activating OFDM VSA measurements</a> .....	132
• <a href="#">Configuring OFDM VSA</a> .....	133
• <a href="#">Analysis</a> .....	202
• <a href="#">Configuring the result display</a> .....	227
• <a href="#">Retrieving results</a> .....	237
• <a href="#">Status reporting system</a> .....	263
• <a href="#">Deprecated commands</a> .....	265
• <a href="#">Programming examples: OFDM vector signal analysis</a> .....	267

### 8.1 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, usually, 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, they are separated by a comma from one another.

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



### Remote command examples

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

## 8.1.1 Conventions used in descriptions

The following conventions are 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 VSE follow the SCPI syntax rules.
- **Asynchronous commands**  
A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (\*RST)**  
Default parameter values that are used directly after resetting the instrument (\*RST command) are indicated as **\*RST** values, if available.
- **Default unit**  
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.



### 8.1.2 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 uppercase 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`.

### 8.1.3 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 do not 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.

### 8.1.4 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.



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.

### 8.1.5 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`.

### 8.1.6 SCPI parameters

Many commands feature one or more parameters.

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

**Example:**

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

Parameters can have different forms of values.

- [Numeric values](#)..... 130
- [Boolean](#)..... 131
- [Character data](#)..... 131
- [Character strings](#)..... 132
- [Block data](#)..... 132

#### 8.1.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For 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. for 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. Sometimes, you can customize the step size with a corresponding command.

### Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for 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`

Sometimes, numeric values are 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 if errors occur.

### 8.1.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "ON" or the 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`

### 8.1.6.3 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 8.1.2, "Long and short form"](#), on page 129.

#### 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

**8.1.6.4 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'

**8.1.6.5 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. 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.

**8.2 Common suffixes**

In the R&S VSE OFDM VSA application, the following common suffixes are used in remote commands:

*Table 8-1: Common suffixes used in remote commands in the R&S VSE OFDM VSA application*

Suffix	Value range	Description
<m>	1 to 4	Marker
<n>	1 to x	Window (in the currently selected channel)
<t>	1 to 6	Trace
<li>	1 to 8	Limit line

**8.3 Activating OFDM VSA measurements**

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

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

## 8.4 Configuring OFDM VSA

• Restoring the default configuration (Preset).....	133
• Signal description.....	133
• Configuring data input.....	140
• Frontend settings.....	177
• Triggering measurements.....	183
• Configuring data acquisition.....	189
• Enabling a burst search.....	194
• Defining the result range.....	194
• Synchronization, tracking and demodulation.....	195
• Adjusting settings automatically.....	199

### 8.4.1 Restoring the default configuration (Preset)

<code>SYSTem:PRESet:CHANnel[:EXEC]</code> .....	133
-------------------------------------------------	-----

---

#### `SYSTem:PRESet:CHANnel[:EXEC]`

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:PRESet:CHAN:EXEC`  
                                   Restores the factory default settings to the "Spectrum2" channel.

**Usage:**                     Event

**Manual operation:**    See "[Preset Channel](#)" on page 47

### 8.4.2 Signal description

The signal description provides information on the expected input signal, which optimizes pattern and burst detection and the calculation of the ideal reference signal.

<code>CONFigure:PREAmble:BLENght</code> .....	134
<code>CONFigure:PREAmble:FOFFset</code> .....	134
<code>CONFigure:RFUC:FZERo:FREQuency</code> .....	134
<code>CONFigure:RFUC:FZERo:MODE</code> .....	135
<code>CONFigure:RFUC:STATe</code> .....	135
<code>CONFigure[:SYMBol]:GUARd:MODE</code> .....	136
<code>CONFigure[:SYMBol]:GUARd:NSYMBOLs&lt;cp&gt;</code> .....	136
<code>CONFigure[:SYMBol]:GUARd:PERiodic</code> .....	137
<code>CONFigure[:SYMBol]:NFFT</code> .....	137
<code>CONFigure[:SYMBol]:NGUard&lt;cp&gt;</code> .....	137
<code>CONFigure[:SYMBol]:NSUFix</code> .....	138
<code>CONFigure:SYSTem:CFILE</code> .....	138

<a href="#">CONFigure:TPReCoding</a> .....	139
<a href="#">CONFigure:TPReCoding:IGNore</a> .....	139
<a href="#">MMEMory:LOAD:CFGFile</a> .....	140

---

### CONFigure:PREamble:BLENght <BlockLength>

Defines the length of a block of repeating samples within a preamble symbol.

#### Parameters:

<BlockLength>      Range:      8 to 65636  
                          \*RST:        0  
                          Default unit: samples

**Example:**            `CONF:PRE:BLEN 32`  
 Defines a block length of 32 samples.

**Example:**            See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Preamble Symbol Characteristics: Block Length"](#) on page 51

---

### CONFigure:PREamble:FOFFset <FrameOffset>

Defines the frame offset, that is the start of the actual OFDM frame relative to the start of the first detected preamble block.

#### Parameters:

<FrameOffset>      Distance from the first preamble sample to the first sample of the frame.  
                          Range:        - <capture\_length> to +<capture\_length>  
                          \*RST:        0

**Example:**            `CONF:PRE:FOFF 0`  
 Defines a frame offset of 0 samples. Thus, the frame starts with the first sample of the preamble.

**Example:**            See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Frame Start Offset"](#) on page 51

---

### CONFigure:RFUC:FZERo:FREQuency <Frequency>

If phase compensation is enabled (see [CONFigure:RFUC:STATe](#) on page 135) and the phase shift frequency is defined manually (see [CONFigure:RFUC:FZERo:MODE](#) on page 135), this command defines the frequency for phase shift.

#### Parameters:

<Frequency>        numeric value  
                          Default unit: HZ

**Example:**

```
CONF:RFUC:STAT ON
CONF:RFUC:FZER:MODE MAN
CONF:RFUC:FZER:FREQ 10MHz
```

**Manual operation:** See "[RF Upconversion: Phase Compensation](#)" on page 50

### CONFigure:RFUC:FZERo:MODE <Mode>

If phase compensation is enabled (see [CONFigure:RFUC:STATe](#) on page 135), this command defines the frequency for phase shift.

#### Parameters:

<Mode> CF | MANual

#### CF

The phase shift frequency corresponds to the current center frequency.

#### MANual

The phase shift frequency is defined manually by the [CONFigure:RFUC:FZERo:FREQuency](#) command.

**Example:**

```
CONF:RFUC:STAT ON
CONF:RFUC:FZER:MODE MAN
CONF:RFUC:FZER:FREQ 10MHz
```

**Manual operation:** See "[RF Upconversion: Phase Compensation](#)" on page 50

### CONFigure:RFUC:STATe <State>

Enables or disables phase compensation during the upconversion of the baseband signal to the radio frequency.

#### Parameters:

<State> ON | OFF | 0 | 1

#### OFF | 0

Switches the function off. The R&S VSE OFDM VSA application assumes that the input signal is not phase-compensated.

#### ON | 1

Switches the function on. The R&S VSE OFDM VSA application assumes the input signal is phase-compensated for a specific frequency. Define the frequency using the [CONFigure:RFUC:FZERo:MODE](#) and [CONFigure:RFUC:FZERo:FREQuency](#) commands.

```
*RST: 0
```

**Example:**

```
CONF:RFUC:STAT ON
CONF:RFUC:FZER:MODE MAN
CONF:RFUC:FZER:FREQ 10MHz
```

**Manual operation:** See "[RF Upconversion: Phase Compensation](#)" on page 50

**CONFigure[:SYMBOL]:GUARd:MODE** <Mode>

Selects the type of cyclic prefix.

**Parameters:**

&lt;Mode&gt;

**CONV**

Conventional cyclic prefix mode.

**GU2**

Cyclic prefix with two different lengths.

\*RST: CONV

**Example:**

```
CONF:GUAR:MODE GU2
```

Selects a cyclic prefix with two different lengths.

```
CONF:GUAR:PER ON
```

Activates periodic cyclic prefix ranges.

```
CONF:GUAR1:NSYM 5
```

```
CONF:GUAR2:NSYM 10
```

Defines the number of symbols for both cyclic prefixes (5 and 10).

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:**

See ["Advanced Cyclic Prefix Configuration"](#) on page 51

See ["Cyclic prefix mode"](#) on page 99

**CONFigure[:SYMBOL]:GUARd:NSYMBOLS**<cp> <Symbols>

Defines the number of symbols for which the first and second non-conventional cyclic prefix is used.

For more information see:

- [CONFigure\[:SYMBOL\]:GUARd:MODE](#)
- [CONFigure\[:SYMBOL\]:GUARd:PERiodic](#) on page 137

**Suffix:**

&lt;cp&gt;

1 | 2

Selects the cyclic prefix for non-conventional, periodic cyclic prefix lengths.

For non-periodic non-conventional cyclic prefix lengths, the suffix must be 1 (range 2 is variable, till the end of the frame).

**Parameters:**

&lt;Symbols&gt;

unsigned integer

Number of symbols

Range: 1 to 1000

\*RST: 100

**Example:**

See [CONFigure\[:SYMBOL\]:GUARd:MODE](#) on page 136.

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267



**Manual operation:** See ["Cyclic prefix definition per range \(Symbols / Samples\)"](#) on page 52

---

### **CONFigure[:SYMBOL]:GUARd:PERiodic <State>**

Turns periodic cyclic prefix ranges on and off.

The command is available for non-conventional cyclic prefixes.

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

The cyclic prefix changes at a certain point in time and then stays constant till the end of the OFDM frame.

**ON | 1**

The cyclic prefix toggles between two different values periodically.

\*RST: 0

**Example:** See [CONFigure\[:SYMBOL\]:GUARd:MODE](#) on page 136.

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Different cyclic prefix lengths"](#) on page 51

---

### **CONFigure[:SYMBOL]:NFFT <NFFT>**

Defines the FFT length of an OFDM symbol. This command is only available if no configuration file has been loaded.

**Parameters:**

<NFFT> FFT length in samples.

Range: 8 to 65535

\*RST: 64

**Example:** `CONF:SYMB:NFFT 1024`  
Defines an FFT length of 1024 samples.

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["FFT Size"](#) on page 50

---

### **CONFigure[:SYMBOL]:NGUard<cp> <NGuard>**

Defines the cyclic prefix length.

**Suffix:**

&lt;cp&gt;

1 | 2

Selects the cyclic prefix for non-conventional, periodic cyclic prefix lengths.

For non-periodic non-conventional cyclic prefix lengths, the suffix must be 1 (range 2 is variable, till the end of the frame).

For conventional cyclic prefix lengths, the suffix is irrelevant.

**Parameters:**

&lt;NGuard&gt;

unsigned integer

Length of the cyclic prefix in samples.

Range: 4 to 65535

\*RST: 16

**Example:**

CONF:SYMB:NGU 128

Defines a guard length of 128 samples.

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:**

See ["Cyclic Prefix Length"](#) on page 50

See ["Cyclic prefix definition per range \(Symbols / Samples\)"](#) on page 52

**CONFigure[:SYMBol]:NSUffix <NSuffix>**

Defines the length of the cyclic suffix.

The cyclic suffix length must be smaller than or equal to the ["FFT Size"](#) on page 50.

**Parameters:**

&lt;NSuffix&gt;

unsigned integer

Length of the cyclic suffix in samples.

Range: 0 to FFT size

\*RST: 0

**Example:**

CONF:NSUF 16

**Manual operation:**

See ["Cyclic Suffix Length"](#) on page 50

**CONFigure:SYSTEM:CFILE <State>**

Determines whether the configuration from the currently loaded file is used for the measurement. Alternatively, you can configure the OFDM signal manually.

Note: when you load a configuration file using the [MMEMoRY:LOAD:CFGFile](#) command, the use of the file is automatically set to ON.

**Parameters:**

&lt;State&gt;

ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**\*RST:** 0**Example:**`M MEM:LOAD:CFGF 'C:\TEMP\K96Test.xml'`Loads the configuration stored in the file `K96Test.xml`.`CONF:SYST:MAN`

Switches to manual configuration.

`CONF:SYST:CFIL ON`

Uses the configuration in the loaded file.

**Manual operation:** See ["Use Configuration File"](#) on page 48**CONFigure:TPReCoding <State>**Enables or disables transform precoding. See ["DFT-s-OFDM / SC-FDMA:Transform Precoding"](#) on page 49.**Parameters:****<State>** ON | OFF | 0 | 1**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**\*RST:** 0**Example:**`CONF:TPR ON`**Manual operation:** See ["DFT-s-OFDM / SC-FDMA:Transform Precoding"](#) on page 49**CONFigure:TPReCoding:IGNore <State>**For [CONFigure:TPReCoding](#) ON, defines how to process OFDM symbols that contain "Don't Care" and pilot cells.**Parameters:****<State>** ON | OFF | 0 | 1**OFF | 0**

OFDM symbols that contain a pilot or a "Don't Care" cell are skipped and not decoded.

**ON | 1**

OFDM symbols that contain pilot or "Don't Care" cells are decoded, but these cells are ignored.

**\*RST:** 0**Example:**

Decode precoding for all symbols, even if they contain pilot or "Don't Care" cells.

`CONF:TPR ON``CONF:TPR:IGN 1`

**Manual operation:** See ["Ignore PILOT/DONTCARE"](#) on page 49

---

### MMEMory:LOAD:CFGFile <Filename>

Loads an OFDM configuration file and activates its use.

#### Parameters:

<Filename> String containing the path and name of the .xml file.

#### Example:

```
MMEM:LOAD:CFGF 'C:\TEMP\K96Test.xml'
```

Loads the configuration stored in the file K96Test.xml.

#### Example:

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Load Configuration File"](#) on page 49

## 8.4.3 Configuring data input

The following commands are required to configure data input.

- [RF input](#)..... 140
- [Configuring oscilloscope baseband input](#)..... 151
- [Using external mixers](#)..... 154
- [Remote commands for external frontend control](#)..... 162
- [Working with power sensors](#)..... 169

### 8.4.3.1 RF input

#### Remote commands exclusive to configuring RF input:

INPut<ip>:ATTenuation:PROTection[:STATe].....	141
INPut:ATTenuation:PROTection:RESet.....	141
INPut<ip>:COUPling<ant>.....	141
INPut<ip>:DPATH.....	142
INPut<ip>:FILE:ZPADing.....	142
INPut<ip>:FILTer:HPASs[:STATe].....	143
INPut<ip>:FILTer:YIG[:STATe].....	143
INPut<ip>:IMPedance<ant>.....	144
INPut<ip>:PRESelection:SET.....	144
INPut<ip>:PRESelection[:STATe].....	144
INPut<ip>:RF:CAPMode.....	145
INPut<ip>:RF:CAPMode:IQ:SRATe.....	145
INPut<ip>:RF:CAPMode:WAVeform:SRATe.....	146
INPut:SELect.....	146
INPut:TYPE.....	147
INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>.....	147
INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>:CONFig.....	147
INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>:TYPE.....	147
SYSTem:COMMunicate:RDEVice:OSCilloscope[:STATe].....	148

SYSTem:COMMunicate:RDEvice:OSCilloscope:TCPIp.....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:PSMode[:STATe].....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:SRATe.....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:VDEvice?.....	150
SYSTem:COMMunicate:RDEvice:OSCilloscope:VFIRmware?.....	150

---

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

Turns the availability of attenuation levels of 10 dB or less on and off.

#### Suffix:

<ip> 1..n

#### 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 instrument.

#### OFF | 0

Attenuation levels of 10 dB or less are not blocked. Provide appropriate protection for the RF input connector of the connected instrument yourself.

\*RST: 1

#### Example:

INP:ATT:PROT ON

Turns on the input protection.

---

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

Resets the attenuator and reconnects the RF input with the input mixer for the connected instrument 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.

#### Setting parameters:

<DeviceName> string

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

#### Example:

INP:ATT:PROT:RES 'MyDevice'

**Manual operation:** See "[10 dB Minimum Attenuation](#)" on page 57

---

### INPut<ip>:COUPling<ant> <CouplingType>

Selects the coupling type of the RF input.

**Suffix:**

<ip> 1 | 2  
irrelevant

<ant> [Input source](#) (for MIMO measurements only)

**Parameters:**

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

**Example:** INP:COUP DC

**Manual operation:** See "[Input Coupling](#)" on page 54

**INPut<ip>:DPATH <DirectPath>**

Enables or disables the use of the direct path for frequencies close to 0 Hz.

**Suffix:**

<ip> 1..n

**Parameters:**

<DirectPath> AUTO | OFF  
**AUTO | 1**  
(Default) the direct path is used automatically for frequencies close to 0 Hz.  
**OFF | 0**  
The analog mixer path is always used.

**Example:** INP:DPAT OFF

**Manual operation:** See "[Direct Path](#)" on page 55

**INPut<ip>:FILE:ZPADIg <State>**

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> 1..n

**Parameters:**

<State> 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 60**INPut<ip>:FILTer:HPASs[:STATe] <State>**

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the connected instrument to measure the harmonics for a DUT, for example.

Requires an additional high-pass filter hardware option.

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

**Suffix:**

&lt;ip&gt; 1..n

**Parameters:**

&lt;State&gt; ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**\*RST:** 0**Example:** INP:FILT:HPAS ON

Turns on the filter.

**Manual operation:** See ["High Pass Filter 1 to 3 GHz"](#) on page 55**INPut<ip>:FILTer:YIG[:STATe] <State>**

Enables or disables the YIG filter.

**Suffix:**<ip> 1 | 2  
irrelevant**Parameters:**

&lt;State&gt; ON | OFF | 0 | 1

**Example:** INP:FILT:YIG OFF

Deactivates the YIG-preselector.

**Manual operation:** See ["YIG-Preselector"](#) on page 56

---

**INPut<ip>:IMPedance<ant> <Impedance>**

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

**Suffix:**

<ip> 1 | 2  
irrelevant

<ant> [Input source](#) (for MIMO measurements only)

**Parameters:**

<Impedance> 50 | 75  
**numeric value**  
User-defined impedance from 50 Ohm to 100000000 Ohm (=100 MOhm)  
User-defined values are only available for the Spectrum application, the I/Q Analyzer, and some optional applications.  
\*RST: 50 Ω  
Default unit: OHM

**Example:** INP:IMP 75

**Manual operation:** See "[Impedance](#)" on page 55

---

**INPut<ip>:PRESelection:SET <Mode>**

Selects the preselector mode.

The command is available with the optional preselector.

**Suffix:**

<ip> 1..n

**Parameters:**

<Mode> **NARROW**  
Performs a measurement by automatically applying all available combinations of low and high pass filters consecutively. These combinations all have a narrow bandwidth.  
**WIDE**  
Performs a measurement by automatically applying all available bandpass filters consecutively. The bandpass filters have a wide bandwidth.

**Manual operation:** See "[Preselector Mode](#)" on page 57

---

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

Turns the preselector on and off.

**Suffix:**

<ip> 1 | 2  
irrelevant



**Manual operation:** See "[Preselector State](#)" on page 57

---

### INPut<ip>:RF:CAPMode <CAPMode>

Determines how data from an oscilloscope is input to the R&S VSE software.

Is only available for connected oscilloscopes.

**Suffix:**

<ip> 1..n

**Parameters:**

<CAPMode> AUTO | IQ | WAVeform

**IQ**

The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.

**WAVeform**

The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.

**AUTO**

Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement).

\*RST: IQ

**Example:** INP:RF:CAPM WAV

---

### INPut<ip>:RF:CAPMode:IQ:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for I/Q capture mode (see [INPut<ip>:RF:CAPMode](#) on page 145).

This setting is only available if an R&S oscilloscope is used to obtain the input data.

**Suffix:**

<ip> 1..n

**Parameters:**

<SamplingRate> 20 GHz | 40 GHz

No other sample rate values are allowed.

**20 GHz**

Achieves a higher decimation gain, but reduces the record length by half.

Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

**40 GHz**

Provides a maximum sample rate.

Only available for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet).

\*RST: 20 GHz  
Default unit: HZ

**Example:** INP:RF:CAPM IQ  
INP:RF:CAPM:IQ:SRAT 40 GHZ

### INPut<ip>:RF:CAPMode:WAVEform:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for waveform capture mode (see [INPut<ip>:RF:CAPMode](#) on page 145).

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

#### Suffix:

<ip> 1..n

#### Parameters:

<SamplingRate> 10 GHz | 20 GHz

No other sample rate values are allowed.

#### 10 GHz

Default ; provides maximum record length

#### 20 GHz

Achieves a higher decimation gain, but reduces the record length by half.

Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHz is always used.

\*RST: 10 GHz  
Default unit: HZ

**Example:** INP:RF:CAPM WAV  
INP:RF:CAPM:WAVE:SRAT 10000000

### INPut:SElect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

#### Parameters:

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

**FIQ**  
I/Q data file

**AIQ**  
Analog Baseband signal (only available with optional "Analog Baseband" interface)

\*RST: RF

**Manual operation:** See "[Input Type \(Instrument / File\)](#)" on page 54

---

**INPut:TYPE** <Input>

The command selects the input path for R&S FSW85 models.

**Parameters:**

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

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

**Manual operation:** See "[Input 1 / Input 2](#)" on page 54

---

**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
	<b>FILE</b> A loaded file is used for input.
	<b>DEViCe</b> A configured device provides input for the measurement
	<b>NONE</b> No input source defined.

**Manual operation:** See "[Input Type \(Instrument / File\)](#)" on page 54

---

**INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>:CONFig** <Port>

Configures the port to be used for input on the selected instrument.

Is only available if an oscilloscope is connected.

**Suffix:**

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

**Parameters:**

<Port>

---

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

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

Not all input sources are supported by all R&S VSE applications.

**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.)

**'Channels 1,3 (Waveform)'**  
Waveform data provided by oscilloscope input channels 1 and 3 (for oscilloscopes with 2 channels only)

**'Channels 2,4 (Waveform)'**  
Waveform data provided by oscilloscope input channels 2 and 4 (for oscilloscopes with 2 channels only)

**'Channels 1-4 (Waveform)'**  
Waveform data provided by oscilloscope input channels 1 to 4 (for oscilloscopes with 4 channels only)

\*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

---

**SYSTem:COMMunicate:RDEvice:OSCilloscope[:STATe] <State>**

Activates the optional 2 GHz bandwidth extension (R&S FSW-B2000).

**Note:** Manual operation on the connected oscilloscope, or remote operation other than by the R&S VSE, is not possible while the B2000 option is active.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
Switches the function off

**ON | 1**

Switches the function on

**Example:** `SYST:COMM:RDEV:OSC ON`**Manual operation:** See "[B2000 State](#)" on page 56**SYSTem:COMMunicate:RDEvice:OSCilloscope:TCPip <Address>**

Defines the TCPIP address or computer name of the oscilloscope connected to the R&amp;S VSE via LAN.

**Note:** The IP address is maintained after a [PRESET], and is transferred between applications.**Parameters:**

&lt;Address&gt; computer name or IP address

**Example:** `SYST:COMM:RDEV:OSC:TCP '192.0.2.0'`**Example:** `SYST:COMM:RDEV:OSC:TCP 'FSW43-12345'`**Manual operation:** See "[Oscilloscope IP Address](#)" on page 57**SYSTem:COMMunicate:RDEvice:OSCilloscope:PSMode[:STATe] <State>**

Activates the use of the power splitter inserted between the "IF 2 GHZ OUT" connector of the R&amp;S VSE and the "CH1" and "CH3" input connectors of the oscilloscope. Note that this mode requires an additional alignment with the power splitter.

For details see the R&amp;S FSW I/Q Analyzer and I/Q Input User Manual

**Parameters:**

&lt;State&gt; ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:** `SYST:COMM:RDEV:OSC:PSM ON`**Manual operation:** See "[Oscilloscope Splitter Mode](#)" on page 56**SYSTem:COMMunicate:RDEvice:OSCilloscope:SRATe <Rate>**

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHz mode achieves a higher decimation gain, but reduces the record length by half.

**Parameters:**

<Rate> 10 GHz | 20 GHz  
 No other sample rate values are allowed.  
 \*RST: 10 GHz  
 Default unit: HZ

**Example:**

```
TRAC:IQ:SRAT?
//Result: 100000000
TRAC:IQ:RLEN?
//Result: 3128
SYST:COMM:RDEV:OSC:SRAT 20GHZ
TRAC:IQ:SRAT?
//Result: 200000000
TRAC:IQ:RLEN?
//Result: 1564
```

**SYSTem:COMMunicate:RDEvice:OSCilloscope:VDEvice?**

Queries whether the connected instrument is supported by the 2 GHz bandwidth extension option(B2000).

**Return values:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:**

```
SYST:COMM:RDEV:OSC:VDEV?
```

**Usage:**

Query only

**SYSTem:COMMunicate:RDEvice:OSCilloscope:VFIRmware?**

Queries whether the firmware on the connected oscilloscope is supported by the 2 GHz bandwidth extension (B2000) option.

**Return values:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:**

```
SYST:COMM:RDEV:OSC:VFIR?
```

**Usage:**

Query only

### 8.4.3.2 Configuring oscilloscope baseband input

The following commands define settings for oscilloscope baseband input.



The commands for oscilloscope baseband input from an oscilloscope to the R&S VSE software are similar, but *not identical* to those used by an R&S FSW.

#### Remote commands exclusive to oscilloscope baseband input:

<code>INPut&lt;ip&gt;:IQ:OSC:FULLscale[:LEVel]</code> .....	151
<code>INPut&lt;ip&gt;:IQ:OSC:FULLscale:AUTO</code> .....	151
<code>INPut&lt;ip&gt;:IQ:OSC:SKEW:I</code> .....	152
<code>INPut&lt;ip&gt;:IQ:OSC:SKEW:I:INVerted</code> .....	152
<code>INPut&lt;ip&gt;:IQ:OSC:SKEW:Q</code> .....	152
<code>INPut&lt;ip&gt;:IQ:OSC:SKEW:Q:INVerted</code> .....	152
<code>INPut&lt;ip&gt;:IQ:OSC:TYPE</code> .....	153
<code>INSTRument:BLOCK:CHANnel[:SETTings]:SOURce&lt;si&gt;:TYPE</code> .....	153

---

#### `INPut<ip>:IQ:OSC:FULLscale[:LEVel] <Level>`

The full scale level defines the maximum power for baseband input possible without clipping the signal.

For manual input, this setting corresponds to the setting on the oscilloscope. Thus, possible scaling values of the oscilloscope are allowed.

##### Suffix:

<ip> 1..n

##### Parameters:

<Level> Default unit: V

**Example:** `INP:IQ:OSC:FULL:AUTO OFF`

**Example:** `INP:IQ:OSC:FULL:LEV 1.0`

---

#### `INPut<ip>:IQ:OSC:FULLscale:AUTO <State>`

If enabled, the full scale level is defined automatically according to the reference level.

For manual mode, define the level using `INPut<ip>:IQ:OSC:FULLscale[:LEVel]` on page 151.

##### Suffix:

<ip> 1..n

##### Parameters:

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

\*RST: 0

**Example:** INP:IQ:OSC:FULL:AUTO OFF

#### INPut<ip>:IQ:OSC:SKEW:I <Value>

Compensates for skewed values in the positive I path, e.g. due to different input cables.

**Suffix:**

<ip> 1..n

**Parameters:**

<Value> Default unit: S

**Example:** INP:IQ:OSC:SKEW:I 0.2

#### INPut<ip>:IQ:OSC:SKEW:I:INVerted <Value>

Compensates for skewed values in the negative I path, e.g. due to different input cables.

**Suffix:**

<ip> 1..n

**Parameters:**

<Value> Default unit: S

**Example:** INP:IQ:OSC:SKEW:I:INV 0.2

#### INPut<ip>:IQ:OSC:SKEW:Q <Value>

Compensates for skewed values in the positive Q path, e.g. due to different input cables.

**Suffix:**

<ip> 1..n

**Parameters:**

<Value> Default unit: S

**Example:** INP:IQ:OSC:SKEW:Q 0.2

#### INPut<ip>:IQ:OSC:SKEW:Q:INVerted <Value>

Compensates for skewed values in the negative Q path, e.g. due to different input cables.

**Suffix:**

<ip> 1..n

**Parameters:**

<Value> Default unit: S



**Example:** `INP:IQ:OSC:SKEW:Q:INV 0.2`

---

### **INPut<ip>:IQ:OSC:TYPE <Type>**

Defines the format of the input signal.

**Suffix:**

<ip> 1..n

**Parameters:**

<Type> IQ | I

**IQ**

Both components of the complex input signal (in-phase component, quadrature component) are filtered and resampled to the sample rate of the application.

The input signal is down-converted with the center frequency (**Low IF I**).

**I**

The input signal at the channel providing I data is resampled to the sample rate of the application.

The input signal is down-converted with the center frequency (**Low IF I**).

**Example:** `INP:IQ:OSC:TYPE I`

---

### **INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>:TYPE <Source>**

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

Not all input sources are supported by all R&S VSE applications.

**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.)

**'Channels 1,3 (Waveform)'**

Waveform data provided by oscilloscope input channels 1 and 3 (for oscilloscopes with 2 channels only)

**'Channels 2,4 (Waveform)'**

Waveform data provided by oscilloscope input channels 2 and 4 (for oscilloscopes with 2 channels only)

**'Channels 1-4 (Waveform)'**

Waveform data provided by oscilloscope input channels 1 to 4 (for oscilloscopes with 4 channels only)

\*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

**8.4.3.3 Using external mixers**

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the connected instrument to have an external mixer option installed and an external mixer to be connected to the connected instrument.

- [Basic settings](#)..... 154
- [Mixer settings](#)..... 156
- [Programming example: working with an external mixer](#)..... 161

**Basic settings**

The basic settings concern general usage of an external mixer.

<a href="#">[SENSe:]MIXer&lt;x&gt;[:STATe]</a> .....	154
<a href="#">[SENSe:]MIXer&lt;x&gt;:BIAS:HIGH</a> .....	155
<a href="#">[SENSe:]MIXer&lt;x&gt;:BIAS[:LOW]</a> .....	155
<a href="#">[SENSe:]MIXer&lt;x&gt;:LOPower</a> .....	155

**[SENSe:]MIXer<x>[:STATe] <State>**

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the optional External Mixer is installed and an external mixer is connected.

**Suffix:**

<x>	1..n
	irrelevant

**Parameters:**

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

**Example:** MIX ON

**[SENSe:]MIXer<x>:BIAS:HIGH <BiasSetting>**

Defines the bias current for the high (last) range.

Is only available if the external mixer is active (see [\[SENSe:\]MIXer<x>\[:STATe\]](#) on page 154).

**Suffix:**

<x> 1..n  
 irrelevant

**Parameters:**

<BiasSetting> \*RST: 0.0 A  
 Default unit: A

**[SENSe:]MIXer<x>:BIAS[:LOW] <BiasSetting>**

Defines the bias current for the low (first) range.

Is only available if the external mixer is active (see [\[SENSe:\]MIXer<x>\[:STATe\]](#) on page 154).

**Suffix:**

<x> 1..n  
 irrelevant

**Parameters:**

<BiasSetting> \*RST: 0.0 A  
 Default unit: A

**[SENSe:]MIXer<x>:LOPower <Level>**

Specifies the LO level of the external mixer's LO port.

**Suffix:**

<x> 1..n  
 irrelevant

**Parameters:**

<Level> Range: 13.0 dBm to 17.0 dBm  
 Increment: 0.1 dB  
 \*RST: 15.5 dBm  
 Default unit: DBM

**Example:** MIX:LOP 16.0dBm

## Mixer settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer<x>:FREQUency:HANdOver.....	156
[SENSe:]MIXer<x>:FREQUency:STARt.....	156
[SENSe:]MIXer<x>:FREQUency:STOP.....	157
[SENSe:]MIXer<x>:HARMonic:BAND:PRESet.....	157
[SENSe:]MIXer<x>:HARMonic:BAND.....	157
[SENSe:]MIXer<x>:HARMonic:HIGH:STATe.....	158
[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue].....	158
[SENSe:]MIXer<x>:HARMonic:TYPE.....	158
[SENSe:]MIXer<x>:HARMonic[:LOW].....	159
[SENSe:]MIXer<x>:IF?.....	159
[SENSe:]MIXer<x>:LOSS:HIGH.....	159
[SENSe:]MIXer<x>:LOSS:TABLE:HIGH.....	159
[SENSe:]MIXer<x>:LOSS:TABLE[:LOW].....	160
[SENSe:]MIXer<x>:LOSS[:LOW].....	160
[SENSe:]MIXer<x>:PORTs.....	160
[SENSe:]MIXer<x>:RFOVerrange[:STATe].....	161

---

### [SENSe:]MIXer<x>:FREQUency:HANdOver <Frequency>

Defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

Is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 154).

#### Suffix:

<x>	1..n
	irrelevant

#### Parameters:

<Frequency>	Default unit: HZ
-------------	------------------

#### Example:

```
MIX ON
Activates the external mixer.
MIX:FREQ:HAND 78.0299GHZ
Sets the handover frequency to 78.0299 GHz.
```

---

### [SENSe:]MIXer<x>:FREQUency:STARt

Sets or queries the frequency at which the external mixer band starts.

#### Suffix:

<x>	1..n
	irrelevant

#### Example:

```
MIX:FREQ:STAR?
Queries the start frequency of the band.
```

**[SENSe:]MIXer<x>:FREQuency:STOP**

Sets or queries the frequency at which the external mixer band stops.

**Suffix:**

<x>                    1..n  
                          irrelevant

**Example:**

MIX:FREQ:STOP?  
Queries the stop frequency of the band.

**[SENSe:]MIXer<x>:HARMonic:BAND:PRESet**

Restores the preset frequency ranges for the selected standard waveguide band.

**Note:** Changes to the band and mixer settings are maintained even after using the [PRESET] function. Use this command to restore the predefined band ranges.

**Suffix:**

<x>                    1..n  
                          irrelevant

**Example:**

MIX:HARM:BAND:PRESet  
Prests the selected waveguide band.

**[SENSe:]MIXer<x>:HARMonic:BAND <Band>**

Selects the external mixer band. The query returns the currently selected band.

Is only available if the external mixer is active (see [SENSe:]MIXer<x>[:STATe] on page 154).

**Suffix:**

<x>                    1..n  
                          irrelevant

**Parameters:**

<Band>                KA|Q|U|V|E|W|F|D|G|Y|J|USER  
                          Standard waveguide band or user-defined band.

**Table 8-2: Frequency ranges for pre-defined bands**

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0

\*) The band formerly referred to as "A" is now named "KA".

Band	Frequency start [GHz]	Frequency stop [GHz]
F	90.0	140.0
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)

\*) The band formerly referred to as "A" is now named "KA".

---

**[SENSe:]MIXer<x>:HARMonic:HIGH:STATe <State>**

Specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

**Suffix:**

<x> 1..n

**Parameters:**

<State> ON | OFF  
\*RST: ON

**Example:** MIX:HARM:HIGH:STAT ON

---

**[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue] <HarmOrder>**

Specifies the harmonic order to be used for the high (second) range.

**Suffix:**

<x> 1..n  
irrelevant

**Parameters:**

<HarmOrder> Range: 2 to 128 (USER band); for other bands: see band definition

**Example:** MIX:HARM:HIGH:STAT ON  
MIX:HARM:HIGH 3

---

**[SENSe:]MIXer<x>:HARMonic:TYPE <OddEven>**

Specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

**Suffix:**

<x> 1..n  
irrelevant

**Parameters:**

<OddEven>            ODD | EVEN | EODD  
**ODD | EVEN | EODD**  
 \*RST:                EVEN

**Example:**            MIX:HARM:TYPE ODD

**[SENSe:]MIXer<x>:HARMonic[:LOW] <HarmOrder>**

Specifies the harmonic order to be used for the low (first) range.

**Suffix:**

<x>                    1..n  
 irrelevant

**Example:**            MIX:HARM 3

**[SENSe:]MIXer<x>:IF?**

Queries the intermediate frequency currently used by the external mixer.

**Suffix:**

<x>                    1..n  
 irrelevant

**Example:**            MIX:IF?

**Example:**            See "[Programming example: working with an external mixer](#)"  
 on page 161.

**Usage:**                Query only

**[SENSe:]MIXer<x>:LOSS:HIGH <Average>**

Defines the average conversion loss to be used for the entire high (second) range.

**Suffix:**

<x>                    1..n

**Parameters:**

<Average>            Range:        0 to 100  
 \*RST:                24.0 dB  
 Default unit: dB

**Example:**            MIX:LOSS:HIGH 20dB

**[SENSe:]MIXer<x>:LOSS:TABLE:HIGH <FileName>**

Defines the conversion loss table to be used for the high (second) range.

**Suffix:**

<x>                    1..n

**Parameters:**

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (.ac1 file).

**[SENSe:]MIXer<x>:LOSS:TABLE[:LOW] <FileName>**

Defines the file name of the conversion loss table to be used for the low (first) range.

**Suffix:**

<x> 1..n

**Parameters:**

<FileName> String containing the path and name of the file, or the serial number of the external mixer whose file is required. The R&S VSE automatically selects the correct cvl file for the current IF. As an alternative, you can also select a user-defined conversion loss table (.ac1 file).

**Example:**

```
MIX:LOSS:TABLE '101567'
MIX:LOSS:TABLE?
//Result:
'101567_MAG_6_B5000_3G5.B5G'
```

**[SENSe:]MIXer<x>:LOSS[:LOW] <Average>**

Defines the average conversion loss to be used for the entire low (first) range.

**Suffix:**

<x> 1..n

**Parameters:**

<Average> Range: 0 to 100  
\*RST: 24.0 dB  
Default unit: dB

**Example:**

```
MIX:LOSS 20dB
```

**[SENSe:]MIXer<x>:PORTs <PortType>**

Selects the mixer type.

**Suffix:**

<x> 1..n  
irrelevant

**Parameters:**

<PortType> 2 | 3  
2  
Two-port mixer.



**3**  
 Three-port mixer.  
 \*RST: 2

**Example:** MIX:PORT 3

---

### [SENSe:]MIXer<x>:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

#### Suffix:

<x> 1..n  
 irrelevant

#### Parameters:

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

### Programming example: working with an external mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//-----Preparing the instrument -----
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----- Configuring basic mixer behavior -----
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----- Configuring the mixer and band settings -----
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
```

```

SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW 20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//----- Activating automatic signal identification functions -----
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//-----Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//-----Retrieving Results-----
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3

```

#### 8.4.3.4 Remote commands for external frontend control

The following commands are available and required only if the optional external frontend control is installed on the connected instrument.

Further commands for external frontend control described elsewhere:

- `INPut:SElect RF`; see `INPut:SElect` on page 146
- `[SENSe<ip>:]FREQuency:CENTer` on page 177
- `DISPlay[:WINDow<n>] [:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:RLEVel<ant>` on page 179
- `INPut<ip>:ATTenuation:AUTO` on page 181
- `INPut<ip>:ATTenuation` on page 180
- `Commands for initial configuration`..... 162

#### Commands for initial configuration

The following commands are required when you initially set up a measurement with an external frontend on the connected instrument. Note that some commands are not available for all connected instruments, or only as queries.

<code>[SENSe:]JEFRontend:ALIGnment&lt;ch&gt;:FILE</code> .....	163
<code>[SENSe:]JEFRontend:ALIGnment&lt;ch&gt;:STATe</code> .....	163
<code>[SENSe:]JEFRontend:CONNecTion[:STATe]</code> .....	164
<code>[SENSe:]JEFRontend:CONNecTion:CONFIg</code> .....	164
<code>[SENSe:]JEFRontend:CONNecTion:CSTate?</code> .....	165
<code>[SENSe:]JEFRontend:FREQuency:BAND:COUNT?</code> .....	165

[SENSe:]EFRontend:FREQUENCY:Band<b>:LOWer?	165
[SENSe:]EFRontend:FREQUENCY:Band<b>:UPPer?	166
[SENSe:]EFRontend:FREQUENCY:BCONfig:AUTO	166
[SENSe:]EFRontend:FREQUENCY:BCONfig:LIST?	166
[SENSe:]EFRontend:FREQUENCY:BCONfig:SElect	167
[SENSe:]EFRontend:FREQUENCY:IFrequency:SIDeband?	167
[SENSe:]EFRontend:FREQUENCY:IFrequency[.VALue]?	168
[SENSe:]EFRontend:FREQUENCY:REFerence	168
[SENSe:]EFRontend:FREQUENCY:REFerence:LIST?	168
[SENSe:]EFRontend:IDN?	168
[SENSe:]EFRontend[:STATe]	169

---

### [SENSe:]EFRontend:ALIGNment<ch>:FILE <File>

Selects or queries the touchstone file that contains correction data to compensate for signal losses in the cable occurring at different IF signal frequencies.

**Suffix:**

<ch>                    1..n  
 Currently irrelevant

**Parameters:**

<File>                    string in double quotes  
 Path and file name of the correction data file. The file must be in s2p format.  
 If the specified file is not found or does not have the correct format, an error message is returned (-256, "File name not found", -150, "String data error").

**Example:**                EFR:ALIG:FILE "FE44S.s2p"

---

### [SENSe:]EFRontend:ALIGNment<ch>:STATe <State>

Activates correction of the IF signal due to cable loss from the frontend to the analyzer. Specify the file with correction data using [SENSe:]EFRontend:ALIGNment<ch>:FILE on page 163.

**Suffix:**

<ch>                    1..n  
 Currently irrelevant

**Parameters:**

<State>                    ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on  
 \*RST:                    0

---

**[SENSe:]EFRontend:CONNection[:STATe] <State>**

Queries the external frontend connection state in the firmware.

Note: to query the physical connection state of the external frontend, use [\[SENSe:\]EFRontend:CONNection:CSTate?](#) on page 165.

**Parameters:**

<State>                    ON | OFF | 0 | 1

**OFF | 0**  
The connection to the frontend is deactivated temporarily. The frontend is thus available for use elsewhere, for example by a signal generator. The measurement settings on the R&S VSE remain untouched.

**ON | 1**  
Frontend connection enabled.  
The frontend is reserved for exclusive use by the R&S VSE.

\*RST:                    0

**Example:**

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S", "123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

---

**[SENSe:]EFRontend:CONNection:CONFIg <Type>, <IPAddress>[, <DeviceID>, <SymbolicName>]**

Configures the connection to the external frontend.

**Parameters:**

<Type>                    String in double quotes containing the type of frontend to be connected.

<IPAddress>                string in double quotes  
The IP address or computer name of the frontend connected to the R&S VSE via LAN. The IP address and computer name are indicated on the electronic ink display on the side panel of the frontend.

<DeviceID>                string in double quotes  
Unique device ID consisting of <type>-<serialnumber>  
Not required or relevant for the R&S VSE.

<SymbolicName>            string in double quotes  
Symbolic name of the external frontend.  
Not required or relevant for the R&S VSE.

**Example:**

```
//Global activation of external frontend
EFR ON
//Configure frontend
EFR:CONN:CONF "FE44S","123.456.789"
//Activate exclusive use of frontend by
R&S VSE.
EFR:CONN ON
```

### [SENSe:]EFRontend:CONNECTION:CState?

Queries the status of the physical connection to the external frontend.

**Return values:**

<State>                    ON | OFF | 0 | 1  
                               **OFF | 0**  
                               Frontend not connected; connection error  
                               **ON | 1**  
                               Frontend connected

**Usage:**                    Query only

### [SENSe:]EFRontend:FREQUENCY:BAND:COUNT?

Queries the number of frequency bands provided by the selected frontend.

**Return values:**

<NoBands>                 integer  
                               Number of frequency bands

**Example:**

```
//Query number of frequency bands
EFR:FREQ:BAND:COUN?
//Result: 2
```

**Usage:**                    Query only

### [SENSe:]EFRontend:FREQUENCY:BAND<b>:LOWer?

Queries the start of the frequency range supported by the selected frontend frequency band.

**Suffix:**

<b>                            1..n  
                               Band for multi-band frontends  
                               Use [\[SENSe:\]EFRontend:FREQUENCY:BAND:COUNT?](#)  
                               on page 165 to determine the number of available bands.

**Return values:**

<StartFreq>                Start frequency of the specified band

**Example:**

```
//Query start frequency of second band
EFR:FREQ:BAND2:LOW?
//Result: 24000000000
```

**Usage:** Query only

---

**[SENSe:]EFRontend:FREQUENCY:BAND<b>:UPPer?**

Queries the end of the frequency range supported by the selected frontend frequency band.

**Suffix:**

<b> 1..n  
Band for multi-band frontends  
Use [SENSe:]EFRontend:FREQUENCY:BAND:COUNT?  
on page 165 to determine the number of available bands.

**Return values:**

<StopFreq> End frequency of the specified band

**Example:** //Query end frequency of second band  
EFR:FREQ:BAND2:UPP?  
//Result: 44000000000

**Usage:** Query only

---

**[SENSe:]EFRontend:FREQUENCY:BCONfig:AUTO <State>**

Determines whether the frequency band of the external frontend is configured automatically or manually.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
Uses the frequency band configured by [SENSe:]EFRontend:FREQUENCY:BCONfig:SElect on page 167.  
**ON | 1**  
Configures the frequency band automatically  
\*RST: 1

**Example:** //Configures the use of the IF high band manually.  
EFR:FREQ:BCON:AUTO 0  
EFR:FREQ:BCON:SEL "IF HIGH"

---

**[SENSe:]EFRontend:FREQUENCY:BCONfig:LIST?**

Returns the intermediate frequency (output) range of the external frontend.

**Return values:**

<BandConfigs> string  
**"IF LOW"**  
A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the R&S VSE.

**"IF HIGH"**

A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the R&S VSE.

**Example:**

```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

**Usage:**

Query only

**[SENSe:]EFRontend:FREQuency:BCONfig:SElect <BandConfig>**

Defines the intermediate frequency (output) range of the external frontend.

**Parameters:**

<BandConfig>

**"IF HIGH"**

(R&S FE44S/ R&S FE50DTR)

A higher intermediate frequency is used on the external frontend, resulting in a higher input frequency at the connected instrument.

**"IF LOW"**

(R&S FE44S/ R&S FE50DTR)

A lower intermediate frequency is used on the external frontend, resulting in a lower input frequency at the connected instrument.

**"Spur Optimized"**

(R&S FE170SR/R&S FE110SR only)

The selected IF range avoids unwanted spurious effects.

**"EVM Optimized"**

(R&S FE170SR/R&S FE110SR only)

The selected IF range provides an optimal EVM result.

**"Shared LO"**

(R&S FE170SR/R&S FE110SR only)

Ensures that multiple external frontends (R&S FE170SR/ R&S FE170ST or R&S FE110SR/R&S FE110ST) use the same LO frequencies for upconversion and downconversion.

**Example:**

```
EFR:FREQ:BCON:LIST?
//Result: "IF HIGH", "IF LOW"
EFR:FREQ:BCON:SEL "IF HIGH"
```

**[SENSe:]EFRontend:FREQuency:IFRequency:SIDeband?**

Queries the currently used sideband for frequency conversion.

**Return values:**

<Sideband>

"USB" | "LSB"

**"USB"**

Upper sideband

**"LSB"**

Lower sideband

**Example:**           EFR:FREQ:IFR?  
                  EFR:FREQ:IFR:SID?

**Usage:**            Query only

#### [SENSe:]EFRontend:FREQUENCY:IFrequency[:VALue]?

Queries the currently used intermediate frequency (IF) for frequency conversion.

**Return values:**  
<IFFrequency>        numeric

**Example:**           EFR:FREQ:IFR?

**Usage:**            Query only

#### [SENSe:]EFRontend:FREQUENCY:REFerence <Frequency>

Sets the reference frequency that is used for frequency conversion on the frontend. Depending on the connected type of frontend, different values are available. To determine which reference levels are available, use [\[SENSe:\]EFRontend:FREQUENCY:REFerence:LIST?](#) on page 168.

**Parameters:**  
<Frequency>         Default unit: HZ

**Example:**           //Query the available reference levels  
                  EFR:FREQ:REF:LIST?  
                  //Result: 10000000,640000000,1000000000  
                  //Use 640 MHz reference  
                  EFR:FREQ:REF 640000000

#### [SENSe:]EFRontend:FREQUENCY:REFerence:LIST?

Queries the available reference signals for the connected frontend type.

**Return values:**  
<References>         10000000 | 640000000 | 1000000000

**Example:**           //Query the available reference levels  
                  EFR:FREQ:REF:LIST?  
                  //Result: 10000000,640000000,1000000000  
                  //Use 640 MHz reference  
                  EFR:FREQ:REF 640000000

**Usage:**            Query only

#### [SENSe:]EFRontend:IDN?

Queries the device identification information (\*IDN?) of the frontend.



**Return values:**

<DevInfo> string without quotes  
 Rohde&Schwarz,<device type>,<part number>/<serial number>,<firmware version>

**Example:**

```
EFR:IDN?
//Result: Rohde&Schwarz,FE44S,
1234.5678K00/123456,0.8.0
```

**Usage:**

Query only

**[SENSe:]EFRontend[:STATe] <State>**

Enables or disables the general use of an external frontend for the application.

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
 The frontend is disconnected. The application adapts the measurement settings to the common settings supported by the R&S VSE.  
**ON | 1**  
 The R&S VSE allows you to configure and connect an external frontend for the application. The application adapts the available measurement settings to the connected frontend. The channel bar indicates "Inp: ExtFe".  
 \*RST: 0

**Example:**

```
EFR ON
```

**8.4.3.5 Working with power sensors**

The following commands describe how to work with power sensors.

These commands require the use of a Rohde & Schwarz power sensor. For a list of supported sensors, see the data sheet.

- [Configuring power sensors](#)..... 169
- [Configuring power sensor measurements](#)..... 171

**Configuring power sensors**

[SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO\[:STATe\]](#)..... 169  
[SYSTem:COMMunicate:RDEvice:PMETer<p>:COUNT?](#)..... 170  
[SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine](#)..... 170

**SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO[:STATe] <State>**

Turns automatic assignment of a power sensor to the power sensor index on and off.

**Suffix:**

<p> Power sensor index

**Parameters:**

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

**Example:**

```
SYST:COMM:RDEV:PMET:CONF:AUTO OFF
```

**SYSTem:COMMunicate:RDEVice:PMETer<p>:COUNT?**

Queries the number of power sensors currently connected to the R&S VSE.

**Suffix:**

<p> Power sensor index

**Return values:**

<NumberSensors> Number of connected power sensors.

**Example:**

```
SYST:COMM:RDEV:PMET:COUN?
```

**Usage:**

Query only

**SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>**

Assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

**Suffix:**

<p> Power sensor index

**Parameters:**

<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

**Example:**

```
SYST:COMM:RDEV:PMET2:DEF ' ', 'NRP-Z81', ' ', '123456'
```

Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".

```
SYST:COMM:RDEV:PMET2:DEF?
```

Queries the sensor assigned to "Power Sensor 2".

Result:

```
' ', 'NRP-Z81', 'USB', '123456'
```

The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

**Configuring power sensor measurements**

CALibration:PMETer<p>:ZERO:AUTO ONCE.....	171
CALCulate<n>:PMETer<p>:RELative[:MAGNitude].....	171
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE.....	172
CALCulate<n>:PMETer<p>:RELative:STATe.....	172
FETCh:PMETer<p>?.....	172
READ:PMETer<p>?.....	172
[SENSe:]PMETer<p>:DCYClE[:STATe].....	173
[SENSe:]PMETer<p>:DCYClE:VALue.....	173
[SENSe:]PMETer<p>:FREQuency.....	173
[SENSe:]PMETer<p>:FREQuency:LINK.....	174
[SENSe:]PMETer<p>:MTIME.....	174
[SENSe:]PMETer<p>:MTIME:AVERAge:COUNT.....	174
[SENSe:]PMETer<p>:MTIME:AVERAge[:STATe].....	175
[SENSe:]PMETer<p>:ROFFset[:STATe].....	175
[SENSe:]PMETer<p>:SOFFset.....	175
[SENSe:]PMETer<p>[:STATe].....	176
[SENSe:]PMETer<p>:UPDate[:STATe].....	176
UNIT<n>:PMETer<p>:POWer.....	176
UNIT<n>:PMETer<p>:POWer:RATio.....	177

**CALibration:PMETer<p>:ZERO:AUTO ONCE**

Zeroes the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

**Suffix:**

<p> Power sensor index

**Example:**

CAL:PMET2:ZERO:AUTO ONCE;\*WAI

Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

**Usage:**

Event

**CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>**

Defines the reference value for relative measurements.

**Suffix:**

<n> [Window](#)

<p> Power sensor index

**Parameters:**

<RefValue> Range: -200 dBm to 200 dBm  
 \*RST: 0  
 Default unit: DBM

**Example:** `CALC:PMET2:REL -30`  
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

---

#### **CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE**

Sets the current measurement result as the reference level for relative measurements.

**Suffix:**

<n> [Window](#)

<p> Power sensor index

**Example:** `CALC:PMET2:REL:AUTO ONCE`  
Takes the current measurement value as reference value for relative measurements for power sensor 2.

**Usage:** Event

---

#### **CALCulate<n>:PMETer<p>:RELative:STATe <State>**

Turns relative power sensor measurements on and off.

**Suffix:**

<n> [Window](#)

<p> Power sensor index

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:** `CALC:PMET2:REL:STAT ON`  
Activates the relative display of the measured value for power sensor 2.

---

#### **FETCH:PMETer<p>?**

Queries the results of power sensor measurements.

**Suffix:**

<p> Power sensor index

**Usage:** Query only

---

#### **READ:PMETer<p>?**

Initiates a power sensor measurement and queries the results.

**Suffix:**  
 <p> Power sensor index

**Usage:** Query only

**[SENSe:]PMETer<p>:DCYClE[:STATe] <State>**

Turns the duty cycle correction on and off.

**Suffix:**  
 <p> Power sensor index

**Parameters:**  
 <State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:** PMET2:DCYC:STAT ON

**[SENSe:]PMETer<p>:DCYClE:VALue <Percentage>**

Defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

**Suffix:**  
 <p> Power sensor

**Parameters:**  
 <Percentage> Range: 0.001 to 99.999  
 \*RST: 99.999  
 Default unit: %

**Example:** PMET2:DCYC:STAT ON  
 Activates the duty cycle correction.  
 PMET2:DCYC:VAL 0.5  
 Sets the correction value to 0.5%.

**[SENSe:]PMETer<p>:FREQUency <Frequency>**

Defines the frequency of the power sensor.

**Suffix:**  
 <p> Power sensor index

**Parameters:**  
 <Frequency> The available value range is specified in the data sheet of the power sensor in use.  
 \*RST: 50 MHz  
 Default unit: HZ

**Example:** `PMET2:FREQ 1GHZ`  
Sets the frequency of the power sensor to 1 GHz.

---

**[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>**

Selects the frequency coupling for power sensor measurements.

**Suffix:**  
<p> Power sensor index

**Parameters:**  
<Coupling> **CENTer**  
Couples the frequency to the center frequency of the analyzer  
**MARKer1**  
Couples the frequency to the position of marker 1  
**OFF**  
Switches the frequency coupling off  
**\*RST: CENTer**

**Example:** `PMET2:FREQ:LINK CENT`  
Couples the frequency to the center frequency of the analyzer

---

**[SENSe:]PMETer<p>:MTIME <Duration>**

Selects the duration of power sensor measurements.

**Suffix:**  
<p> Power sensor index

**Parameters:**  
<Duration> **SHORt | NORMAl | LONG**  
**\*RST: NORMAl**

**Example:** `PMET2:MTIM SHOR`  
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

---

**[SENSe:]PMETer<p>:MTIME:AVERAge:COUNT <NumberReadings>**

Sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

**Suffix:**  
<p> Power sensor index

**Parameters:**

<NumberReadings> An average count of 0 or 1 performs one power reading.

Range: 0 to 256

Increment: binary steps (1, 2, 4, 8, ...)

**Example:**

```
PMET2:MTIM:AVER ON
```

Activates manual averaging.

```
PMET2:MTIM:AVER:COUN 8
```

Sets the number of readings to 8.

**[SENSe:]PMETer<p>:MTIMe:AVERAge[:STATe] <State>**

Turns averaging for power sensor measurements on and off.

**Suffix:**

<p> Power sensor index

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:**

```
PMET2:MTIM:AVER ON
```

Activates manual averaging.

**[SENSe:]PMETer<p>:ROFFset[:STATe] <State>**

Includes or excludes the reference level offset of the analyzer for power sensor measurements.

**Suffix:**

<p> Power sensor index

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:**

```
PMET2:ROFF OFF
```

Takes no offset into account for the measured power.

**[SENSe:]PMETer<p>:SOFFset <SensorOffset>**

Takes the specified offset into account for the measured power. Only available if [\[SENSe:\]PMETer<p>:ROFFset\[:STATe\]](#) is disabled.

**Suffix:**  
 <p> Power sensor index

**Parameters:**  
 <SensorOffset> Default unit: DB

**Example:** PMET2:SOFF 0.001

**[SENSe:]PMETer<p>[:STATe] <State>**

Turns a power sensor on and off.

**Suffix:**  
 <p> Power sensor index

**Parameters:**  
 <State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:** PMET1 ON  
 Switches the power sensor measurements on.

**[SENSe:]PMETer<p>:UPDate[:STATe] <State>**

Turns continuous update of power sensor measurements on and off.

If on, the results are updated even if a single sweep is complete.

**Suffix:**  
 <p> Power sensor index

**Parameters:**  
 <State> ON | OFF | 0 | 1  
**OFF | 0**  
 Switches the function off  
**ON | 1**  
 Switches the function on

**Example:** PMET1:UPD ON  
 The data from power sensor 1 is updated continuously.

**UNIT<n>:PMETer<p>:POWer <Unit>**

Selects the unit for absolute power sensor measurements.

**Suffix:**  
 <n> irrelevant  
 <p> Power sensor index



**Parameters:**

<Unit> DBM | WATT | W | DB | PCT  
 \*RST: DBM

**Example:**

UNIT:PMET:POW DBM

**UNIT<n>:PMETer<p>:POWer:RATio <Unit>**

Selects the unit for relative power sensor measurements.

**Suffix:**

<n> irrelevant  
 <p> Power sensor index

**Parameters:**

<Unit> DB | PCT  
 \*RST: DB

**Example:**

UNIT:PMET:POW:RAT DB

## 8.4.4 Frontend settings

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

- [Frequency](#)..... 177
- [Amplitude settings](#)..... 179
- [Attenuation](#)..... 180
- [Configuring a preamplifier](#)..... 182

### 8.4.4.1 Frequency

<a href="#">[SENSe&lt;ip&gt;:]FREQUENCY:CENTer</a> .....	177
<a href="#">[SENSe:]FREQUENCY:CENTer:STEP</a> .....	178
<a href="#">[SENSe:]FREQUENCY:CENTer:STEP:AUTO</a> .....	178
<a href="#">[SENSe&lt;ip&gt;:]FREQUENCY:OFFSet</a> .....	178

**[SENSe<ip>:]FREQUENCY:CENTer <Frequency>**

Defines the center frequency.

**Suffix:**

<ip> 1..n

**Parameters:**

<Frequency> The allowed range and  $f_{\max}$  is specified in the data sheet.  
 \*RST:  $f_{\max}/2$   
 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 60

**[SENSe:]FREQuency:CENTer:STEP <StepSize>**

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 61

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

Defines the step width of the center frequency.

**Parameters:**

<State> **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 178).

**Manual operation:** See "[Center Frequency Stepsize](#)" on page 61

**[SENSe<ip>:]FREQuency:OFFSet <Offset>**

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.

**Suffix:**

<ip> 1..n

**Parameters:**

<Offset>                   Range:     -1 THz to 1 THz  
                               \*RST:       0 Hz  
                               Default unit: HZ

**Example:**                FREQ:OFFS 1GHZ

**Manual operation:**    See "[Frequency Offset](#)" on page 61

**8.4.4.2 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:

- [INPut<ip>:COUPling<ant>](#) on page 141
- [\[SENSe<ip>:\]ADJust:LEVel](#) on page 202

**Remote commands exclusive to amplitude settings:**

[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALe\]:RLEVel<ant>](#)..... 179  
[DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALe\]:RLEVel<ant>:OFFSet](#)..... 180

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>**  
 <ReferenceLevel>

Defines the reference level (for all traces in all windows).

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

**Suffix:**

<n>                        irrelevant  
 <w>                        subwindow  
                               Not supported by all applications  
 <t>                        irrelevant  
 <ant>                     [Input source](#) (for MIMO measurements only)

**Parameters:**

<ReferenceLevel>        The unit is variable.  
                               Range:        see datasheet  
                               \*RST:        0 dBm  
                               Default unit: DBM

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

**Manual operation:**    See "[Reference Level](#)" on page 63

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:  
OFFSet <Offset>**

Defines a reference level offset (for all traces in all windows).

**Suffix:**

<n>	irrelevant
<w>	subwindow Not supported by all applications
<t>	irrelevant
<ant>	<a href="#">Input source</a> (for MIMO measurements only)

**Parameters:**

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

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

**Manual operation:** See "[Shifting the Display \(Offset\)](#)" on page 63

### 8.4.4.3 Attenuation

<a href="#">INPut&lt;ip&gt;:ATTenuation</a> .....	180
<a href="#">INPut&lt;ip&gt;:ATTenuation:AUTO</a> .....	181
<a href="#">INPut:EATT</a> .....	181
<a href="#">INPut:EATT:AUTO</a> .....	181
<a href="#">INPut:EATT:STATe</a> .....	182

---

**INPut<ip>:ATTenuation <Attenuation>**

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..n
------	------

**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 63

**INPut<ip>:ATTenuation:AUTO <State>**

Couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S VSE determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

**Suffix:**

<ip> 1..n

**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 63

**INPut:EATT <Attenuation>**

Defines an electronic attenuation manually. Automatic mode must be switched off (INP:EATT:AUTO OFF, see [INPut:EATT:AUTO](#) on page 181).

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

**Parameters:**

<Attenuation> 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

**Manual operation:** See "[Using Electronic Attenuation](#)" on page 64

**INPut:EATT:AUTO <State>**

Turns automatic selection of the electronic attenuation on and off.

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

**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

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 64

---

#### INPut:EATT:STATe <State>

Turns the electronic attenuator on and off.

##### 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.

**Manual operation:** See ["Using Electronic Attenuation"](#) on page 64

#### 8.4.4.4 Configuring a preamplifier

INPut<ip>:GAIN<ant>:STATe.....	182
INPut<ip>:GAIN<ant>[:VALue].....	183

---

#### INPut<ip>:GAIN<ant>:STATe <State>

Turns the internal preamplifier on the connected instrument on and off. It requires the additional preamplifier hardware option on the connected instrument.

##### Suffix:

<ip>                        1 | 2  
 irrelevant  
 <ant>                    [Input source](#) (for MIMO measurements only)

##### 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  
 INP:GAIN:VAL 15  
 Switches on 15 dB preamplification.

**Manual operation:** See ["Preamplifier"](#) on page 64

**INPut<ip>:GAIN<ant>[:VALue] <Gain>**

Selects the "gain" if the preamplifier is activated (INP:GAIN:STAT ON, see INPut<ip>:GAIN<ant>:STATe on page 182).

The command requires the additional preamplifier hardware option.

**Suffix:**

<ip> 1 | 2  
irrelevant

<ant> [Input source](#) (for MIMO measurements only)

**Parameters:**

<Gain> 15 dB and 30 dB  
All other values are rounded to the nearest of these two.  
30 dB  
Default unit: DB

**Example:**

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

**Manual operation:** See "[Preamplifier](#)" on page 64

## 8.4.5 Triggering measurements

The trigger commands define the beginning of a measurement.

TRIGger[:SEQuence]:DTIME.....	183
TRIGger[:SEQuence]:HOLDoff[:TIME].....	184
TRIGger[:SEQuence]:IFPower:HOLDoff.....	184
TRIGger[:SEQuence]:IFPower:HYSteresis.....	184
TRIGger[:SEQuence]:LEVel:BBPower.....	185
TRIGger[:SEQuence]:LEVel[:EXternal<port>].....	185
TRIGger[:SEQuence]:LEVel:IFPower.....	185
TRIGger[:SEQuence]:LEVel:IQPower.....	186
TRIGger[:SEQuence]:LEVel:MAPower.....	186
TRIGger[:SEQuence]:MAPower:HOLDoff.....	186
TRIGger[:SEQuence]:MAPower:HYSteresis.....	186
TRIGger[:SEQuence]:SLOPe.....	187
TRIGger[:SEQuence]:SOURce.....	187
TRIGger[:SEQuence]:TIME:RINTerval.....	188

**TRIGger[:SEQuence]:DTIME <DropoutTime>**

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

For input from the "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

**Parameters:**

<DropoutTime> Dropout time of the trigger.  
 Range: 0 s to 10.0 s  
 \*RST: 0 s  
 Default unit: S

**Manual operation:** See "[Drop-Out Time](#)" on page 68

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

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

**Parameters:**

<Offset> \*RST: 0 s  
 Default unit: S

**Example:** TRIG:HOLD 500us

**Manual operation:** See "[Trigger Offset](#)" on page 68

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

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  
 Default unit: 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 68

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

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

**Parameters:**

<Hysteresis> Range: 3 dB to 50 dB  
 \*RST: 3 dB  
 Default unit: 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 68

---

### TRIGger[:SEquence]:LEVel:BBPower <Level>

Sets the level of the baseband power trigger.

Is available for the optional "Analog Baseband" interface.

**Parameters:**

<Level>                    Range:        -50 dBm to +20 dBm  
                               \*RST:        -20 dBm  
                               Default unit: DBM

**Example:**                TRIG:LEV:BBP -30DBM

**Manual operation:** See ["Trigger Level"](#) on page 67

---

### TRIGger[:SEquence]:LEVel[:EXTernal<port>] <TriggerLevel>

Defines the level the external signal must exceed to cause a trigger event.

**Suffix:**

<port>                    Selects the trigger port.  
                               1 = trigger port 1 (TRIGGER INPUT connector on front panel)  
                               2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)  
                               3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

**Parameters:**

<TriggerLevel>           Range:        0.5 V to 3.5 V  
                               \*RST:        1.4 V  
                               Default unit: V

**Example:**                TRIG:LEV 2V

**Manual operation:** See ["Trigger Level"](#) on page 67

---

### TRIGger[:SEquence]:LEVel:IFPower <TriggerLevel>

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

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

For compatibility reasons, this command is also available for the "Baseband Power" trigger source when using the "Analog Baseband" interface.

**Parameters:**

<TriggerLevel>           For details on available trigger levels and trigger bandwidths, see the data sheet.  
                               \*RST:        -20 dBm  
                               Default unit: DBM

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

---

### **TRIGger[:SEQuence]:LEVel:IQPower** <TriggerLevel>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

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

#### **Parameters:**

<TriggerLevel>      Range:      -130 dBm to 30 dBm  
                          \*RST:      -20 dBm  
                          Default unit: DBM

**Example:** `TRIG:LEV:IQP -30DBM`

---

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

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.  
                          Default unit: DBM

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

---

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

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  
                          Default unit: 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 68

---

### **TRIGger[:SEQuence]:MAPower:HYSteresis** <Hysteresis>

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  
                              Default unit: 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 68

**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 68

**TRIGger[:SEQUence]:SOURce <Source>**

Selects the trigger source.

Note that the availability of trigger sources depends on the connected instrument.

**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 that this situation is avoided in your remote control programs.

**Parameters:**

<Source>                    **IMMediate**  
                                  Free Run  
                                  **EXTernal**  
                                  Trigger signal from the "Trigger Input" connector.  
                                  If power splitter mode is active, this parameter activates the  
                                  "EXT TRIGGER INPUT" connector on the oscilloscope. Then  
                                  the R&S VSE triggers when the signal fed into the "EXT TRIG-  
                                  GER INPUT" connector on the oscilloscope meets or exceeds  
                                  the specified trigger level.

**EXT | EXT2 | EXT3 | EXT4**

Trigger signal from the corresponding "TRIGGER INPUT/ OUTPUT" connector on the connected instrument, or the oscilloscope's corresponding input channel (if not used as an input source).

For details on the connectors see the instrument's Getting Started manual.

**BBPower**

Baseband power

For input from the optional "Analog Baseband" interface.

**MAGNitude**

For (offline) input from a file, rather than an instrument.

The trigger level is specified by `TRIGger[:SEquence]:LEVel:MAPower`.

**MAIT**

For trigger information stored as markers in an .iqx file.

**MANual**

Only available for a connected R&S RTP:

Any trigger settings in the R&S VSE software are ignored; only trigger settings defined on the connected instrument are considered. Thus, you can use the more complex trigger settings available on an R&S RTP.

\*RST: IMMEDIATE

**Example:**

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

**Manual operation:**

See "Trigger Source" on page 66

See "Free Run" on page 66

See "External Trigger / Trigger Channel X" on page 66

See "External Analog" on page 66

See "RF Power" on page 66

See "Time" on page 67

See "Magnitude (Offline)" on page 67

See "Manual" on page 67

**TRIGger[:SEquence]:TIME:RINTerval <Interval>**

Defines the repetition interval for the time trigger.

**Parameters:**

<Interval>

numeric value

Range: 2 ms to 5000 s

\*RST: 1.0 s

Default unit: S

**Example:**

```
TRIG:SOUR TIME
```

Selects the time trigger input for triggering.

```
TRIG:TIME:RINT 5
```

The measurement starts every 5 s.

**Manual operation:** See ["Repetition Interval"](#) on page 67

## 8.4.6 Configuring data acquisition

<a href="#">INITiate:REFResh</a> .....	189
<a href="#">INPut:FILTer:CHANnel:HPASs:FDBBw?</a> .....	189
<a href="#">INPut:FILTer:CHANnel:HPASs:SDBBw</a> .....	189
<a href="#">INPut:FILTer:CHANnel:HPASs[:STATe]</a> .....	190
<a href="#">INPut:FILTer:CHANnel[:LPASs]:FDBBw</a> .....	190
<a href="#">INPut:FILTer:CHANnel[:LPASs]:SDBBw</a> .....	190
<a href="#">INPut:FILTer:CHANnel[:LPASs][:STATe]</a> .....	191
<a href="#">[SENSe:]CAPTuRe:OVERsampling</a> .....	191
<a href="#">[SENSe:]SWAPiq</a> .....	191
<a href="#">[SENSe:]SWEep:COUNT</a> .....	192
<a href="#">[SENSe:]SWEep:LENGTh</a> .....	192
<a href="#">[SENSe:]SWEep:TIME</a> .....	193
<a href="#">TRACe:IQ:BWIDTh</a> .....	193
<a href="#">TRACe:IQ:SRATe</a> .....	193
<a href="#">TRACe:IQ:WBANd[:STATe]</a> .....	193
<a href="#">TRACe:IQ:WBANd:MBWidth</a> .....	194

---

### INITiate:REFResh

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 72

---

### INPut:FILTer:CHANnel:HPASs:FDBBw?

**Return values:**  
<Frequency>                Default unit: HZ

**Usage:**                    Query only

**Manual operation:** See ["50-dB Bandwidth"](#) on page 72

---

### INPut: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.

**Parameters:**

&lt;Frequency&gt; Default unit: HZ

**Example:**

INP: FILT: CHAN: HPAS: SDBB 30 MHZ

**Manual operation:**See ["6-dB Bandwidth"](#) on page 72**INPut: FILTer: CHANnel: HPASs[:STATe]** <State>

Activates an additional internal highpass filter.

**Parameters:**

&lt;State&gt; 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 72**INPut: 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: FILTer: CHANnel\[:LPASs\]: SDBBw](#) on page 190).

**Parameters:**

&lt;Frequency&gt; Default unit: HZ

**Example:**

INP: FILT: CHAN: FDBB 40MHZ

**Example:**See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267**Manual operation:**See ["50-dB Bandwidth"](#) on page 72**INPut: 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: FILTer: CHANnel\[:LPASs\]: FDBBw](#) on page 190).

**Parameters:**

&lt;Frequency&gt; Default unit: HZ

**Example:**

INP: FILT: CHAN: SDBB 30MHZ

**Example:**See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["6-dB Bandwidth"](#) on page 71

---

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

Turns an adjustable (lowpass) channel filter in the signal path on and off.

You can define its characteristics with

- [INPut:FILTer:CHANnel\[:LPASs\]:SDBBw](#) on page 190
- [INPut:FILTer:CHANnel\[:LPASs\]:FDBBw](#) on page 190

**Parameters:**

<State> ON | OFF  
 \*RST: OFF

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

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Filter State"](#) on page 71

---

**[SENSe:]CAPTure:OVERsampling** <OversamplingValue>  
**[SENSe:]CAPTure:OVERsampling?** <OversamplingValue>

Enables or disables a capture oversampling factor.

**Parameters for setting and query:**

<OversamplingValue> 1 | 2

**1**

Capture oversampling is disabled (capture sample rate = system sample rate)

**2**

Oversampling factor 2 is enabled (capture sampling rate = 2\*system sample rate)

**Example:** TRACe:IQ:SRATe = 2 MHz  
 SENSe:CAPTure:OVERsampling 2  
 Capture sample rate = 4 MHz

**Manual operation:** See ["Oversampling / Capture Sample Rate"](#) on page 70

---

**[SENSe:]SWAPiq** <State>

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 VSE 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 71

**[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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See "[Capture Length](#)" on page 69



---

**[SENSe:]SWEep:TIME <Time>**

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

**Manual operation:** See "[Capture Time](#)" on page 69

---

**TRACe:IQ:BWIDth <Bandwidth>**

Queries the bandwidth in Hz of the resampling filter ("Usable I/Q Bandwidth").

**Parameters:**

<Bandwidth> Usable I/Q bandwidth  
Default unit: Hz

**Example:** TRAC1:IQ:BWID?

---

**TRACe:IQ:SRATe <SampleRate>**

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 VSE.

**Parameters:**

<SampleRate> The valid sample rates depend on the connected instrument. Refer to the instrument's documentation.  
\*RST: 32 MHz  
Default unit: HZ

**Manual operation:** See "[Sample Rate](#)" on page 70

---

**TRACe:IQ:WBAND[:STATe] <State>**

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

**Parameters:**

<State> ON | OFF | 0 | 1  
**OFF | 0**  
Switches the function off  
**ON | 1**  
Switches the function on

**Manual operation:** See "[Maximum Bandwidth](#)" on page 70

---

**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 instrument and the installed bandwidth extension options.

**Manual operation:** See ["Maximum Bandwidth"](#) on page 70

**8.4.7 Enabling a burst search****[SENSe:]DEMod:FORMat:BURSt <State>**

Turns a search for bursted OFDM signals on and off.

**Parameters:**

<State> ON | OFF  
\*RST: ON

**Example:** DEM:FORM:BURS ON  
Turns on the burst search.

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Burst Search State"](#) on page 73

**8.4.8 Defining the result range**

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

<a href="#">[SENSe:]DEMod:FORMat:MAXFrames.....</a>	194
<a href="#">[SENSe:]DEMod:FORMat:NOFSymbols.....</a>	195

**[SENSe:]DEMod:FORMat:MAXFrames <NFrames>**

Defines the maximum number of frames to be demodulated.

**Parameters:**

<NFrames> Numeric value.  
\*RST: 1

**Example:** DEM:FORM:MAXF 10  
Defines a maximum of 10 frames to be demodulated.

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Max No of Frames to Analyze"](#) on page 73

---

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

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See "[Result Length](#)" on page 74

## 8.4.9 Synchronization, tracking and demodulation

<a href="#">[SENSe:]COMPensate:CHANnel.....</a>	195
<a href="#">[SENSe:]DEMod:CDD.....</a>	195
<a href="#">[SENSe:]DEMod:COFFset.....</a>	196
<a href="#">[SENSe:]DEMod:FFTShift.....</a>	196
<a href="#">[SENSe:]DEMod:FSYNc.....</a>	196
<a href="#">[SENSe:]DEMod:MDETect.....</a>	197
<a href="#">[SENSe:]DEMod:THReshold:TIME.....</a>	197
<a href="#">[SENSe:]DEMod:THReshold:FRAME.....</a>	198
<a href="#">[SENSe:]DEMod:TSYNc.....</a>	198
<a href="#">SENSe:TRACking:LEVel.....</a>	198
<a href="#">SENSe:TRACking:PHASe.....</a>	199
<a href="#">SENSe:TRACking:TIME.....</a>	199

---

**[SENSe:]COMPensate:CHANnel <State>**

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See "[Channel Compensation](#)" on page 77

---

**[SENSe:]DEMod:CDD <IQSamplingRate>**

Defines the cyclic delay.

**Parameters:**

<IQSamplingRate> Cyclic delay in samples.  
 Range: –<CP length> to +<CP length>  
 \*RST: 0

**Example:**

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

**Manual operation:** See "[Cyclic Delay](#)" on page 78

**[SENSe:]DEMod:COFFset <IQSamplingRate>**

Defines the maximum allowed carrier offset for frame synchronization.

**Parameters:**

<IQSamplingRate> Frequency offset in terms of (sub)carriers.  
 \*RST: 0

**Example:**

SENS:DEMod:COFF 2  
 Defines a frequency offset of two subcarriers.

**Manual operation:** See "[Maximum Carrier Offset](#)" on page 78

**[SENSe:]DEMod:FFTShift <IQSamplingRate>**

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.  
 If a cyclic suffix is used, the FFT shift can be a negative value,  
 down to  
 $-1 * (\text{cyclic suffix length} / \text{cyclic prefix length})$   
 \*RST: 0.5

**Example:**

DEM:FFTS 0.6  
 Defines an FFT shift of 0.6.

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See "[FFT Shift relative to Cyclic Prefix Length](#)" on page 77

**[SENSe:]DEMod:FSYNc <Mode>**

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 75

**[SENSe:]DEMod:MDETect <Mode>**

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.

**SYMB**

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 75

**[SENSe:]DEMod:THReshold:TIME <Reliability>**

Sets and queries the reliability threshold for time synchronisation.

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.

**Parameters:**

<Reliability>

Range:     0 to 1

\*RST:     0.5

**Example:**

SENS:DEM:THR:TIME 0.5

**Manual operation:** See "[Minimum Time Sync Metric](#)" on page 76

**[SENSe:]DEMod:THReshold:FRAMe <Reliability>**

Sets and queries the reliability threshold for frame synchronisation.

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.

**Parameters:**

<Reliability>            Range:     0 to 1  
                              \*RST:     0.5

**Example:**                SENS : DEM : THR : FRAM 0 . 5

**Manual operation:**    See "[Minimum Frame Sync Metric](#)" on page 76

**[SENSe:]DEMod:TSYNc <Mode>**

Selects the time synchronization mode.

**Parameters:**

<Mode>                    **CP**  
                              Performs time synchronization by correlating the cyclic prefix.

**PREamble**  
                              Performs time synchronization by correlating the recurring pre-  
                              amble structure.

                              \*RST:     CP

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

**Example:**                See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:**    See "[Time Synchronization](#)" on page 75

**SENSe:TRACking:LEVel <State>**

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Level Tracking"](#) on page 77

#### SENSe:TRACking:PHASe <State>

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Phase Tracking"](#) on page 76

#### SENSe:TRACking:TIME <State>

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Timing Tracking"](#) on page 77

### 8.4.10 Adjusting settings automatically

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

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation.....	200
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE.....	200
[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:LOWer.....	201
[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:UPPer.....	201
[SENSe<ip>:]ADJust:CONFigure:TRIGger.....	201
[SENSe<ip>:]ADJust:LEVel.....	202

---

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

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command defines the length of the measurement if

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE is set to MANual.

#### Suffix:

<ip> 1..n

#### Parameters:

<Duration> Numeric value in seconds  
 Range: 0.001 to 16000.0  
 \*RST: 0.001  
 Default unit: s

#### Example:

ADJ:CONF:DUR:MODE MAN  
 Selects manual definition of the measurement length.  
 ADJ:CONF:LEV:DUR 5ms  
 Length of the measurement is 5 ms.

**Manual operation:** See "[Automatic Measurement Time Mode and Value](#)" on page 79

---

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

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command selects the way the R&S VSE determines the length of the measurement .

#### Suffix:

<ip> 1..n

#### Parameters:

<Mode> **AUTO**  
 The R&S VSE determines the measurement length automatically according to the current input data.  
**MANual**  
 The R&S VSE uses the measurement length defined by [SENSe<ip>:]ADJust:CONFigure:LEVel:DURation on page 200.  
 \*RST: AUTO

**Manual operation:** See "[Automatic Measurement Time Mode and Value](#)" on page 79



---

**[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>****Suffix:**

&lt;ip&gt; 1..n

**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 is only adjusted when the signal level falls below 18 dBm.

**Manual operation:** See "[Lower Level Hysteresis](#)" on page 80

---

**[SENSe<ip>:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>****Suffix:**

&lt;ip&gt; 1..n

**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 is only adjusted when the signal level rises above 22 dBm.

**Manual operation:** See "[Upper Level Hysteresis](#)" on page 79

---

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

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

**Suffix:**

&lt;ip&gt; 1..n

**Parameters:**

&lt;State&gt; ON | OFF | 0 | 1

**OFF | 0**

(default:) The measurement for adjustment waits for the next trigger.

**ON | 1**

The measurement for adjustment is performed without waiting for a trigger (corresponds to "Continue" in manual operation).

\*RST: 0

**Example:**

```
//Use default ref level at 0.00 dBm.
//Define an RF power trigger at -20 dBm
:TRIG:SEQ:SOUR RFP
:TRIG:SEQ:LEV:RFP -20
//Perform adjustment measurement without waiting for trigger
SENS:ADJ:CONF:TRIG ON
//Perform auto level adjustment
:SENS:ADJ:LEV;*WAI
```

---

### [SENSe<ip>:]ADJust:LEVel

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. Thus, the settings of the RF attenuation and the reference level are optimized for the signal level. The R&S VSE is not overloaded and the dynamic range is not limited by an S/N ratio that is too small.

#### Suffix:

<ip> 1..n

#### Example:

ADJ:LEV

**Manual operation:** See ["Setting the Reference Level Automatically \(Auto Level\)"](#) on page 63

## 8.5 Analysis

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

- [Result configuration](#)..... 202
- [Scaling](#)..... 205
- [Units for results](#)..... 208
- [Configuring traces](#)..... 211
- [Working with markers](#)..... 213
- [Zooming into the display](#)..... 224

### 8.5.1 Result configuration

<a href="#">[SENSe:]DEMod:EVMCalc:FAverage</a> .....	203
<a href="#">[SENSe:]DEMod:EVMCalc:NORMALize</a> .....	203
<a href="#">CALCulate&lt;n&gt;:BITStream:FORMat</a> .....	203
<a href="#">CONFigure:FILTer&lt;n&gt;:CARRier</a> .....	204
<a href="#">CONFigure:FILTer&lt;n&gt;:MODulation</a> .....	204
<a href="#">CONFigure:FILTer&lt;n&gt;:MODulation:TYPE</a> .....	204
<a href="#">CONFigure:FILTer&lt;n&gt;:SYMBOL</a> .....	205

---

**[SENSe:]DEMod:EVMCalc:FAverage <Type>**

Selects the averaging method for the mean EVM over multiple frames.

**Parameters:**

&lt;Type&gt;

**MSQ**

Mean EVM is based on squared EVM values.

**RMS**

Mean EVM is directly based on the EVM values.

\*RST: MS

**Example:**

DEMod:EVMCalc:FAverage MS

Selects EVM averaging based on squared EVM values.

**Manual operation:** See ["Frame Averaging"](#) on page 110

---

**[SENSe:]DEMod:EVMCalc:NORMALize <Method>**

Selects the normalization method for EVM results.

**Parameters:**

&lt;Method&gt;

**NONE**

Normalization is turned off.

**PDAT**

EVM normalized to the peak value of the data cells.

**PPD**

EVM normalized to the peak value of the pilot and data cells.

**PPIL**

EVM normalized to the peak value of the pilot cells.

**RMSD**

EVM values normalized to the RMS value of the data cells.

**RPD**

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

**RMSP**

EVM values normalized to the RMS value of the pilot cells.

\*RST: RPD

**Example:**

DEMod:EVMCalc:NORMALize RMSD

Selects normalization to the RMS value of the data cells.

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:** See ["Normalize EVM to"](#) on page 110

---

**CALCulate<n>:BITStream:FORMat <Mode>**

Defines the format of the symbols for the Bitstream display.

**Suffix:**

&lt;n&gt; 1..n

**Parameters:**<Mode> BINary | OCTal | DECimal | HEXadecimal  
\*RST: HEXadecimal**Example:**

CALC2:BITS:FORM DEC

Sets the bitstream display on window 2 to use decimal format.

**Manual operation:** See "[Bitstream Format](#)" on page 112**CONFigure:FILTer<n>:CARRier <CarrierNo>**

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

The range of valid carrier numbers is:

[- [FFT Size/2](#), +[FFT Size/2](#)]**Suffix:**<n> 1..n  
[Window](#)**Parameters:**

&lt;CarrierNo&gt; ALL | integer

**Example:**

CONF:FILT:CARR -2

**Manual operation:** See "[Constellation Display - Carrier](#)" on page 111**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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267**Manual operation:** See "[Constellation Display - Modulation](#)" on page 110**CONFigure:FILTer<n>:MODulation:TYPE <ModType>**

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

**Suffix:**

<n> 1..n  
[Window](#)

**Parameters:**

<ModType> PDATa | PILots | DATA  
**PDATa**  
 Pilot and data cells  
**PILots**  
 Pilot cells only  
**DATA**  
 Data cells only

**Example:**

CONF:FILT:MOD:TYPE DATA  
 Only data cells are displayed.

**Example:**

See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Manual operation:**

See "[Constellation Display - Modulation Type](#)" on page 110

**CONFigure:FILTer<n>:SYMBol <SymbolNo>**

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

**Suffix:**

<n> 1..n  
[Window](#)

**Parameters:**

<SymbolNo> ALL | integer

**Example:**

CONF:FILT:SYMB 2

**Manual operation:**

See "[Constellation Display - Symbol](#)" on page 111

## 8.5.2 Scaling

<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:AUTO ONCE</a> .....	205
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:AUTO</a> .....	206
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]</a> .....	206
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:PDIVision</a> .....	206
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RPOSition</a> .....	207
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:RVALue</a> .....	207
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:MAXimum</a> .....	208
<a href="#">DISPlay[:WINDow&lt;n&gt;]:TRACe&lt;t&gt;:Y[:SCALe]:MINimum</a> .....	208

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

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

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

**Parameters for setting and query:**

<State>	<b>OFF</b> Switch the function off
	<b>ON</b> Switch the function on
	*RST: ON

**Manual operation:** See ["Automatic Grid Scaling"](#) on page 114  
See ["Auto Scale Once"](#) on page 114

---

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

Defines the display range of the y-axis (for all traces).

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications
<t>	irrelevant

**Example:** DISP:TRAC:Y 110dB

---

**DISPlay[:WINDow<n>][:SUBWindow<w>]: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
<w>	subwindow Not supported by all applications

<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

Default unit: DBM

**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 114

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition**  
<Position>

Defines the vertical position of the reference level on the display grid (for all traces).

The R&S VSE adjusts the scaling of the y-axis accordingly.

**Suffix:**

<n> [Window](#)

<w> subwindow  
Not supported by all applications

<t> irrelevant

**Example:**

DISP:TRAC:Y:RPOS 50PCT

**Manual operation:** See "[Ref Position](#)" on page 114

**DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue** <Value>

Defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

**Suffix:**

<n> [Window](#)

<w> subwindow

<t> irrelevant

**Parameters:**

<Value> Default unit: DB

**Example:**

DISP:TRAC:Y:RVAL 0

Sets the value assigned to the reference position to 0 Hz

**Manual operation:** See "[Ref Value](#)" on page 114

---

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

Defines the maximum value on the y-axis in the specified window.

**Suffix:**

<n> [Window](#)

<t> irrelevant

**Parameters:**

<Max> numeric value

**Example:** `DISP:WIND2:TRAC:Y:SCAL:MAX 10`

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 114

---

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

Defines the minimum value on the y-axis in the specified window.

**Suffix:**

<n> [Window](#)

<t> irrelevant

**Parameters:**

<Min> numeric value

**Example:** `DISP:WIND2:TRAC:Y:SCAL:MIN -90`

**Manual operation:** See "[Absolute Scaling \(Min/Max Values\)](#)" on page 114

### 8.5.3 Units for results

<a href="#">UNIT:CAXes</a> .....	208
<a href="#">UNIT:EVM</a> .....	209
<a href="#">UNIT:FAXes</a> .....	209
<a href="#">UNIT:IREsponse</a> .....	210
<a href="#">UNIT:SAXes</a> .....	210
<a href="#">UNIT:TAXes</a> .....	210

---

**UNIT:CAXes <Unit>**

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 14  
See ["Constellation vs Carrier"](#) on page 16  
See ["EVM vs Carrier"](#) on page 18  
See ["EVM vs Symbol vs Carrier"](#) on page 20  
See ["Group Delay"](#) on page 21  
See ["Power vs Carrier"](#) on page 24  
See ["Power vs Symbol vs Carrier"](#) on page 26

**UNIT:EVM <Unit>**

Selects the unit for EVM results.

**Parameters:**

- <Unit>
- DB**  
Returns EVM results in dB.
- PCT**  
Returns EVM results in %.
- \*RST: dB

**Example:** UNIT:EVM PCT  
Selects '%' as the unit of EVM results.

**Manual operation:** See ["EVM vs Carrier"](#) on page 18  
See ["EVM vs Symbol"](#) on page 19  
See ["EVM vs Symbol vs Carrier"](#) on page 20

**UNIT:FAXes <Unit>**

Selects the unit for result displays that show results over the frequency, for example the Power Spectrum.

**Parameters:**

- <Unit>
- HZ**  
Frequency axis represents Hz.
- CARRIER**  
Frequency axis represents carrier number.
- \*RST: Hz

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

**Manual operation:** See ["Power Spectrum"](#) on page 27

---

**UNIT:IRESpone** <Unit>

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 22

---

**UNIT:SAXes** <Unit>

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

**Parameters:**

<Unit>                    SYMBol | SECond

**SYMBol**  
Symbol axis represents symbols.

**SECond**  
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 11  
See ["Constellation vs Symbol"](#) on page 17  
See ["EVM vs Symbol"](#) on page 19  
See ["EVM vs Symbol vs Carrier"](#) on page 20  
See ["Power vs Symbol"](#) on page 25  
See ["Power vs Symbol vs Carrier"](#) on page 26

---

**UNIT:TAXes** <Unit>

Selects the unit for result displays that show results over time, for example the Magnitude Capture display.

**Parameters:**

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

**SAMPlE**  
Time axis represents samples.

**SYMBOL**

Time axis represents symbols.

This setting is not available if 2 different cyclic prefix lengths are used (see [CONFIGure\[:SYMBOL\]:GUARd:MODE](#) on page 136).

\*RST: SEC

**Example:**

UNIT:TAX SEC

Selects 'seconds' as the unit of the time axis.

**Manual operation:** See "[Magnitude Capture](#)" on page 23

### 8.5.4 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 8.7.3, "Retrieving trace data and marker values"](#), on page 246.

**Useful commands for trace configuration described elsewhere:**

- [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:Y\[:SCALE\]](#) on page 206

**Remote commands exclusive to trace configuration:**

<a href="#">CALCulate&lt;n&gt;:TRACe&lt;t&gt;[:VALue]</a> .....	211
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;:MODE</a> .....	212
<a href="#">DISPlay[:WINDow&lt;n&gt;][:SUBWindow&lt;w&gt;]:TRACe&lt;t&gt;[:STATE]</a> .....	212

---

**CALCulate<n>:TRACe<t>[:VALue] <TraceRefType>**

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

For [DISPlay\[:WINDow<n>\]\[:SUBWindow<w>\]:TRACe<t>:MODE](#) View, the data source to be evaluated cannot be changed. It remains set to the value that was most recently set.

**Suffix:**

<n> Window

<t> Trace

**Parameters:**

<TraceRefType> MEAS | REF | ERRor | TCAP

**MEAS**

Measurement signal

**REF**

Reference signal

**ERR**

Error

**TCAP**

Capture buffer

\*RST: Depends on the current measurement.

---

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

Selects the trace mode. If necessary, the selected trace is also activated.

**Suffix:**

<n> [Window](#)

<w> subwindow  
Not supported by all applications

<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 121

---

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

Turns a trace on and off.

The measurement continues in the background.

**Suffix:**

<n> [Window](#)

<w> subwindow  
Not supported by all applications

<t> [Trace](#)

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**  
Switches the function off

**ON | 1**  
Switches the function on

**Example:** DISP:TRAC3 ON**Manual operation:** See "[Trace 1/Trace 2/Trace 3](#)" on page 121

## 8.5.5 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.

- [Individual marker settings](#)..... 213
- [General marker settings](#).....218
- [Marker positioning settings](#)..... 219

### 8.5.5.1 Individual marker settings

In OFDM VSA 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 248
- [CALCulate<n>:DELTamarker<m>:Y?](#) on page 246

#### Remote commands exclusive to individual markers

<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:AOFF</a> .....	213
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;ms&gt;:LINK:TO:MARKer&lt;md&gt;</a> .....	213
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;[:STATe]</a> .....	214
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:TRACe</a> .....	214
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:X</a> .....	215
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:AOFF</a> .....	215
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:LINK</a> .....	216
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;ms&gt;:LINK:TO:MARKer&lt;md&gt;</a> .....	216
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MREFerence</a> .....	216
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;[:STATe]</a> .....	217
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:TRACe</a> .....	217
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:X</a> .....	218

---

#### **CALCulate<n>:MARKer<m>:AOFF**

Turns off all markers.

##### **Suffix:**

<n>                      [Window](#)

<m>                      [Marker](#)

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

**Manual operation:** See "[All Markers Off](#)" on page 118

---

#### **CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md> <State>**

Links the normal source marker <ms> to any active destination marker <md> (normal or delta marker).

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

**Suffix:**

<n>	<a href="#">Window</a>
<ms>	source marker, see <a href="#">Marker</a>
<md>	destination marker, see <a href="#">Marker</a>

**Parameters:**

<State>	ON   OFF   0   1
	<b>OFF   0</b>
	Switches the function off
	<b>ON   1</b>
	Switches the function on

**Example:**

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

**Manual operation:** See "[Linking to Another Marker](#)" on page 118

**CALCulate<n>:MARKer<m>[:STATE] <State>**

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>	<a href="#">Window</a>
<m>	<a href="#">Marker</a>

**Parameters:**

<State>	ON   OFF   0   1
	<b>OFF   0</b>
	Switches the function off
	<b>ON   1</b>
	Switches the function on

**Example:**

CALC:MARK3 ON  
Switches on marker 3.

**Manual operation:** See "[Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16](#)" on page 116  
See "[Marker State](#)" on page 117  
See "[Marker Type](#)" on page 117

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

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:**

&lt;Trace&gt;

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

**Manual operation:** See "[Assigning the Marker to a Trace](#)" on page 118

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

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 24  
 See "[Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16](#)" on page 116  
 See "[X-value](#)" on page 117

**CALCulate<n>:DELTamarker<m>:AOFF**

Turns off *all* delta markers.

**Suffix:**<n> [Window](#)

&lt;m&gt; irrelevant

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

---

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

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 | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**Example:** `CALC:DELT2:LINK ON`

**Manual operation:** See "[Linking to Another Marker](#)" on page 118

---

**CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md> <State>**

Links the delta source marker <ms> to any active destination marker <md> (normal or delta marker).

**Suffix:**

<n> [Window](#)

<ms> source marker, see [Marker](#)

<md> destination marker, see [Marker](#)

**Parameters:**

<State> ON | OFF | 0 | 1

**OFF | 0**

Switches the function off

**ON | 1**

Switches the function on

**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 118

---

**CALCulate<n>:DELTamarker<m>:MREFerence <Reference>**

Selects a reference marker for a delta marker other than marker 1.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)



**Parameters:**

<Reference>           **D1**  
Selects the deltamarker 1 as the 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 118

**CALCulate<n>:DELTamarker<m>[:STATe] <State>**

Turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTmarker turns on delta marker 1.

**Suffix:**

<n>                    [Window](#)

<m>                    [Marker](#)

**Parameters:**

<State>               ON | OFF | 0 | 1  
**OFF | 0**  
Switches the function off  
**ON | 1**  
Switches the function on

**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 116  
See "[Marker State](#)" on page 117  
See "[Marker Type](#)" on page 117

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

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>**

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:**

<n> [Window](#)

<m> [Marker](#)

**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 116  
See "[X-value](#)" on page 117

**8.5.5.2 General marker settings**

<a href="#">DISPlay[:WINDow&lt;n&gt;]:MINFo[:STATe]</a> .....	218
<a href="#">DISPlay[:WINDow&lt;n&gt;]:MTABLE</a> .....	218

**DISPlay[:WINDow<n>]:MINFo[:STATe] <State>**

Turns the marker information in all diagrams on and off.

**Suffix:**

<n> irrelevant

**Parameters:**

<State> **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 119

**DISPlay[:WINDow<n>]:MTABLE <DisplayMode>**

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 119**8.5.5.3 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 214
- [CALCulate<n>:DELTamarker<m>:TRACe](#) on page 217

**Remote commands exclusive to positioning markers:**

<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum:APEak</a> .....	219
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum:LEFT</a> .....	220
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum:NEXT</a> .....	220
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum[:PEAK]</a> .....	220
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MAXimum:RIGHT</a> .....	220
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MINimum:LEFT</a> .....	221
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MINimum:NEXT</a> .....	221
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MINimum[:PEAK]</a> .....	221
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:MINimum:RIGHT</a> .....	221
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum:APEak</a> .....	221
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum:LEFT</a> .....	222
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum:NEXT</a> .....	222
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum:RIGHT</a> .....	222
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MAXimum[:PEAK]</a> .....	222
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MINimum:LEFT</a> .....	223
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MINimum:NEXT</a> .....	223
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MINimum:RIGHT</a> .....	223
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:MINimum[:PEAK]</a> .....	223
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:SEARCh</a> .....	224

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

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**

Moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See ["Search Next Peak"](#) on page 120

---

**CALCulate<n>:DELTaMarker<m>:MAXimum:NEXT**

Moves a marker to the next positive peak value.

**Suffix:**

<n> 1..n  
[Window](#)

<m> 1..n  
[Marker](#)

**Manual operation:** See ["Search Next Peak"](#) on page 120

---

**CALCulate<n>:DELTaMarker<m>:MAXimum[:PEAK]**

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](#)

**Manual operation:** See ["Peak Search"](#) on page 120

---

**CALCulate<n>:DELTaMarker<m>:MAXimum:RIGHT**

Moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See ["Search Next Peak"](#) on page 120

---

**CALCulate<n>:DELTaMarker<m>:MINimum:LEFT**

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See "[Search Next Minimum](#)" on page 120

---

**CALCulate<n>:DELTaMarker<m>:MINimum:NEXT**

Moves a marker to the next minimum peak value.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See "[Search Next Minimum](#)" on page 120

---

**CALCulate<n>:DELTaMarker<m>:MINimum[:PEAK]**

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](#)

**Manual operation:** See "[Search Minimum](#)" on page 120

---

**CALCulate<n>:DELTaMarker<m>:MINimum:RIGHT**

Moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See "[Search Next Minimum](#)" on page 120

---

**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**

Moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

**Suffix:**  
 <n>                    Window  
 <m>                    Marker

**Manual operation:** See "[Search Next Peak](#)" on page 120

---

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

Moves a marker to the next positive peak.

**Suffix:**  
 <n>                    Window  
 <m>                    Marker

**Manual operation:** See "[Search Next Peak](#)" on page 120

---

#### **CALCulate<n>:MARKer<m>:MAXimum:RIGHT**

Moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

**Suffix:**  
 <n>                    Window  
 <m>                    Marker

**Manual operation:** See "[Search Next Peak](#)" on page 120

---

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

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

**Manual operation:** See ["Peak Search"](#) on page 120

---

#### **CALCulate<n>:MARKer<m>:MINimum:LEFT**

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See ["Search Next Minimum"](#) on page 120

---

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

Moves a marker to the next minimum peak value.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See ["Search Next Minimum"](#) on page 120

---

#### **CALCulate<n>:MARKer<m>:MINimum:RIGHT**

Moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

**Suffix:**

<n> [Window](#)

<m> [Marker](#)

**Manual operation:** See ["Search Next Minimum"](#) on page 120

---

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

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](#)

**Manual operation:** See ["Search Minimum"](#) on page 120

**CALCulate<n>:MARKer<m>:SEARch <MarkReallmag>**

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

**Suffix:**

<n> 1..n  
Window

<m> 1..4  
Marker

**Parameters:**

<MarkReallmag> REAL | IMAG  
\*RST: REAL

## 8.5.6 Zooming into the display

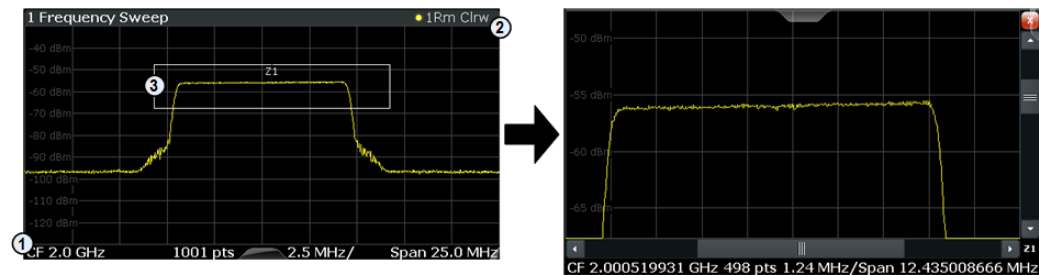
### 8.5.6.1 Using the single zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA..... 224  
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATE]..... 225

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

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

<w> subwindow  
Not supported by all applications



**Parameters:**

<x1>	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
<y1>	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
<x2>	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
<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>][:SUBWindow<w>]:ZOOM[:STATe] <State>**

Turns the zoom on and off.

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications

**Parameters:**

<State>	ON   OFF   0   1 <b>OFF   0</b> Switches the function off <b>ON   1</b> Switches the function on
---------	--------------------------------------------------------------------------------------------------------------

**Example:**

DISP:ZOOM ON  
Activates the zoom mode.

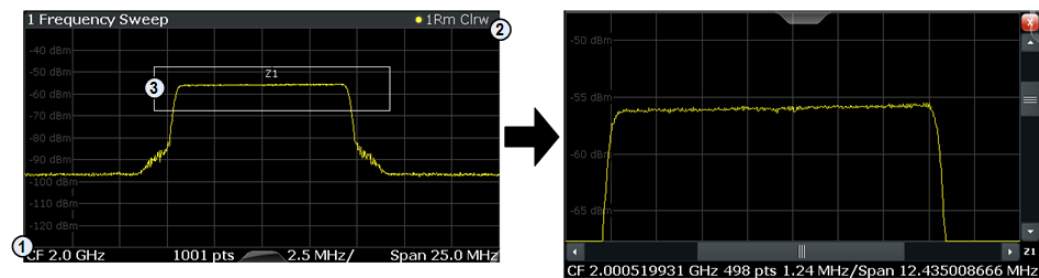
### 8.5.6.2 Using the multiple zoom

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA.....	226
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATE].....	227

**DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA**  
 <x1>,<y1>,<x2>,<y2>

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
<w>	subwindow Not supported by all applications
<zn>	Selects the zoom window.

#### Parameters:

<x1>	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
<y1>	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

<x2>	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
<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>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>**

Turns the multiple zoom on and off.

**Suffix:**

<n>	Window
<w>	subwindow Not supported by all applications
<zn>	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   0   1 <b>OFF   0</b> Switches the function off <b>ON   1</b> Switches the function on
---------	--------------------------------------------------------------------------------------------------------------

## 8.6 Configuring the result display

The commands required to configure the screen display in a remote environment are described here.

- [Global layout commands](#).....227
- [Working with windows in the display](#).....230

### 8.6.1 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 8.6.2, "Working with windows in the display"](#), on page 230 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

<a href="#">LAYout:GLOBal:ADD[:WINDow]?</a> .....	228
<a href="#">LAYout:GLOBal:CATalog[:WINDow]?</a> .....	229
<a href="#">LAYout:GLOBal:IDENtify[:WINDow]?</a> .....	229
<a href="#">LAYout:GLOBal:REMOve[:WINDow]</a> .....	230
<a href="#">LAYout:GLOBal:REPLace[:WINDow]</a> .....	230

---

### **LAYout:GLOBal:ADD[:WINDow]?**

<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

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 <a href="#">LAYout:GLOBal:IDENtify[:WINDow]?</a> query.
<Direction>	LEFT   RIGHT   ABOVE   BELOW   TAB Direction the new window is added relative to the existing window. <b>TAB</b> 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]?**

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>

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>

**Setting parameters:**

<ChannelName>

<WindowName>

**Usage:** Setting only

**LAYout:GLOBal:REPLace[:WINDow]** <ExChannelName>, <WindowName>, <NewChannelName>, <WindowType>

**Setting parameters:**

<ExChannelName>

<WindowName>

<NewChannelName>

<WindowType>

**Usage:** Setting only

## 8.6.2 Working with windows in the display

Note that the suffix <n> always refers to the window *in the currently selected channel*.

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 8.6.1, "Global layout commands"](#), on page 227.

<a href="#">LAYout:ADD[:WINDow]?</a> .....	231
<a href="#">LAYout:CATalog[:WINDow]?</a> .....	233
<a href="#">LAYout:IDENtify[:WINDow]?</a> .....	233
<a href="#">LAYout:MOVE[:WINDow]</a> .....	234
<a href="#">LAYout:REMove[:WINDow]</a> .....	234
<a href="#">LAYout:REPLace[:WINDow]</a> .....	234
<a href="#">LAYout:WINDow&lt;n&gt;:ADD?</a> .....	235
<a href="#">LAYout:WINDow&lt;n&gt;:IDENtify?</a> .....	236
<a href="#">LAYout:WINDow&lt;n&gt;:REMove</a> .....	236
<a href="#">LAYout:WINDow&lt;n&gt;:REPLace</a> .....	236
<a href="#">LAYout:WINDow&lt;n&gt;:TYPE</a> .....	237

---

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

Adds a window to the display in the active channel.

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 <a href="#">LAYout:CATalog[:WINDow]?</a> 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 <a href="#">LAYout:GLOBal:REPLace[:WINDow]</a> 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 11
  - See "Bitstream" on page 12
  - See "CCDF" on page 13
  - See "Channel Flatness" on page 14
  - See "Constellation Diagram" on page 14
  - See "Constellation vs Carrier" on page 16
  - See "Constellation vs Symbol" on page 17
  - See "EVM vs Carrier" on page 18
  - See "EVM vs Symbol" on page 19
  - See "EVM vs Symbol vs Carrier" on page 20
  - See "Group Delay" on page 21
  - See "Impulse Response" on page 22
  - See "Magnitude Capture" on page 23
  - See "Marker Table" on page 24
  - See "Power vs Carrier" on page 24
  - See "Power vs Symbol" on page 25
  - See "Power vs Symbol vs Carrier" on page 26
  - See "Power Spectrum" on page 27
  - See "Result Summary" on page 28
  - See "Signal Flow" on page 29
  - See "Trigger to Sync" on page 29

**Table 8-3: <WindowType> parameter values for OFDM VSA application**

Parameter value	Window type
AMATrix	"Allocation Matrix"
BITStream	"Bitstream"
CCARrier	"Constellation vs Carrier"
CCDF	"CCDF"
CHFLatness	"Channel Flatness"
CONStell	"Constellation Diagram"
CSYMBOL	"Constellation vs Symbol"
EVCarrier	"EVM vs Carrier"
EVSYMBOL	"EVM vs Symbol"
EVSC	"EVM vs Symbol vs Carrier"
GDElay	"Group Delay"
IRESpOse	"Impulse Response"
MCAPture	"Magnitude Capture"
MTABLE	"Marker Table"
PCARrier	"Power vs Carrier"
PSC	"Power vs Symbol vs Carrier"
PSPectrum	"Power Spectrum"
PSYMBOL	"Power vs Symbol"



Parameter value	Window type
RSUMmary	"Result Summary"
SFLow	"Signal Flow"
TRIGger	"Trigger to Sync"

---

### LAYout:CATalog[:WINDow]?

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>

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:IDEN:WIND? '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>

Removes a window from the display in the active channel.

**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:** Setting only

---

**LAYout:REPLace[:WINDow]** <WindowName>, <WindowType>

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 231 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>**

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. Unlike `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.

Is always used as a query so that you immediately obtain the name of the new window as a result.

**Suffix:**

<n> [Window](#)

**Query parameters:**

- <Direction> LEFT | RIGHT | ABOVE | BELOW
- <WindowType> Type of measurement window you want to add.  
See `LAYout:ADD[:WINDow]?` on page 231 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?**

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**

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>**

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 231 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

**LAYout:WINDow<n>:TYPE <WindowType>**

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see [LAYout:ADD\[:WINDow\]?](#) on page 231.

Note that this command is not available in all applications and measurements.

**Suffix:**

<n> 1..n  
[Window](#)

**Parameters:**

<WindowType>

**Example:**

```
LAY:WIND2:TYPE?
```

## 8.7 Retrieving results

The following commands are required to retrieve the calculated OFDM VSA parameters.

- [Retrieving numerical results](#).....237
- [Retrieving signal flow results](#).....242
- [Retrieving trace data and marker values](#)..... 246
- [Using the TRACe\[:DATA\] command](#)..... 255

### 8.7.1 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

<a href="#">FETCH:BURSt:COUNT?</a> .....	239
<a href="#">FETCH:BURSt:LENGthS?</a> .....	239
<a href="#">FETCH:BURSt:STARtS?</a> .....	239
<a href="#">FETCH:SUMMArY[:ALL]?</a> .....	239

FETCh:SUMMary:CRESt:MAXimum?	240
FETCh:SUMMary:CRESt:MINimum?	240
FETCh:SUMMary:CRESt[:AVERage]?	240
FETCh:SUMMary:EVM:DATA:MAXimum?	240
FETCh:SUMMary:EVM:DATA:MINimum?	240
FETCh:SUMMary:EVM:DATA[:AVERage]?	240
FETCh:SUMMary:EVM:DATA:PCT:MAXimum?	240
FETCh:SUMMary:EVM:DATA:PCT:MINimum?	240
FETCh:SUMMary:EVM:DATA:PCT[:AVERage]?	240
FETCh:SUMMary:EVM:PILot:MAXimum?	240
FETCh:SUMMary:EVM:PILot:MINimum?	240
FETCh:SUMMary:EVM:PILot[:AVERage]?	240
FETCh:SUMMary:EVM:PILot:PCT:MAXimum?	241
FETCh:SUMMary:EVM:PILot:PCT:MINimum?	241
FETCh:SUMMary:EVM:PILot:PCT[:AVERage]?	241
FETCh:SUMMary:EVM[:ALL]:MAXimum?	241
FETCh:SUMMary:EVM[:ALL]:MINimum?	241
FETCh:SUMMary:EVM[:ALL][:AVERage]?	241
FETCh:SUMMary:EVM[:ALL]:PCT:MAXimum?	241
FETCh:SUMMary:EVM[:ALL]:PCT:MINimum?	241
FETCh:SUMMary:EVM[:ALL]:PCT[:AVERage]?	241
FETCh:SUMMary:FERRor:MAXimum?	241
FETCh:SUMMary:FERRor:MINimum?	241
FETCh:SUMMary:FERRor[:AVERage]?	241
FETCh:SUMMary:GIMBalance:MAXimum?	241
FETCh:SUMMary:GIMBalance:MINimum?	241
FETCh:SUMMary:GIMBalance[:AVERage]?	241
FETCh:SUMMary:IQOFset:MAXimum?	241
FETCh:SUMMary:IQOFset:MINimum?	241
FETCh:SUMMary:IQOFset[:AVERage]?	241
FETCh:SUMMary:MER[:ALL]:MAXimum?	241
FETCh:SUMMary:MER[:ALL]:MINimum?	241
FETCh:SUMMary:MER[:ALL][:AVERage]?	241
FETCh:SUMMary:MER:DATA:MAXimum?	241
FETCh:SUMMary:MER:DATA:MINimum?	241
FETCh:SUMMary:MER:PILot:MAXimum?	241
FETCh:SUMMary:MER:PILot:MINimum?	241
FETCh:SUMMary:POWer:MAXimum?	241
FETCh:SUMMary:POWer:MINimum?	241
FETCh:SUMMary:POWer[:AVERage]?	241
FETCh:SUMMary:QUADerror:MAXimum?	241
FETCh:SUMMary:QUADerror:MINimum?	241
FETCh:SUMMary:QUADerror[:AVERage]?	241
FETCh:SUMMary:SERRor:MAXimum?	241
FETCh:SUMMary:SERRor:MINimum?	241
FETCh:SUMMary:SERRor[:AVERage]?	241
FETCh:SUMM:<parameter>:<statistic>	241
FETCh:TFRame?	241

---

**FETCH:BURSt:COUNT?**

Returns the number of analyzed bursts from the current capture buffer.

**Return values:**

<Value>

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Usage:** Query only

---

**FETCH:BURSt:LENGthS?**

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Usage:** Query only

---

**FETCH:BURSt:STARtS?**

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:**

```
FETCH:BURSt:STARtS?  
//Result:  
//6.04e-05
```

**Usage:** Query only

---

**FETCH:SUMMery[:ALL]?**

Returns all values in the result summary, in the same order as in the display

(See ["Result Summary"](#) on page 28.)

For details on the individual parameters, see [Chapter 2.1, "OFDM VSA parameters"](#), on page 9.

**Return values:**

<Result> <EVMAIIdB\_Min>,<EVMAIIdB\_Avg>,<EVMAIIdB\_Max>,  
 <EVMAIIPCT\_Min>,<EVMAIIPCT\_Avg>,<EVMAIIPCT\_Max>  
 , <EVMDData\_dB\_Min>,<EVMDData\_dB\_Avg>,<EVM-  
 Data\_dB\_Max>,<EVMDData\_PCT\_Min>,<EVM-  
 Data\_PCT\_Avg>,<EVMDData\_PCT\_Max>,<EVMPi-  
 lot\_dB\_Min>,<EVMPilot\_dB\_Avg>,<EVMPilot\_dB\_Max>,<EVM-  
 Pilot\_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>,<Gain-  
 Imbalance\_Avg>,<GainImbalance\_Max>,<QuadEr-  
 ror\_Min>,<QuadError\_Avg>,<QuadError\_Max>,<Fre-  
 qErr\_Min>,<FreqErr\_Avg>,<FreqErr\_Max>,<SampleClock-  
 Err\_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 28

---

```
FETCh:SUMMary:CRESt:MAXimum?
FETCh:SUMMary:CRESt:MINimum?
FETCh:SUMMary:CRESt[:AVERage]?
FETCh:SUMMary:EVM:DATA:MAXimum?
FETCh:SUMMary:EVM:DATA:MINimum?
FETCh:SUMMary:EVM:DATA[:AVERage]?
FETCh:SUMMary:EVM:DATA:PCT:MAXimum?
FETCh:SUMMary:EVM:DATA:PCT:MINimum?
FETCh:SUMMary:EVM:DATA:PCT[:AVERage]?
FETCh:SUMMary:EVM:PILot:MAXimum?
FETCh:SUMMary:EVM:PILot:MINimum?
FETCh:SUMMary:EVM:PILot[:AVERage]?
```



```

FETCh:SUMMary:EVM:PILot:PCT:MAXimum?
FETCh:SUMMary:EVM:PILot:PCT:MINimum?
FETCh:SUMMary:EVM:PILot:PCT[:AVERage]?
FETCh:SUMMary:EVM[:ALL]:MAXimum?
FETCh:SUMMary:EVM[:ALL]:MINimum?
FETCh:SUMMary:EVM[:ALL][:AVERage]?
FETCh:SUMMary:EVM[:ALL]:PCT:MAXimum?
FETCh:SUMMary:EVM[:ALL]:PCT:MINimum?
FETCh:SUMMary:EVM[:ALL]:PCT[:AVERage]?
FETCh:SUMMary:FERRor:MAXimum?
FETCh:SUMMary:FERRor:MINimum?
FETCh:SUMMary:FERRor[:AVERage]?
FETCh:SUMMary:GIMBalance:MAXimum?
FETCh:SUMMary:GIMBalance:MINimum?
FETCh:SUMMary:GIMBalance[:AVERage]?
FETCh:SUMMary:IQOFfset:MAXimum?
FETCh:SUMMary:IQOFfset:MINimum?
FETCh:SUMMary:IQOFfset[:AVERage]?
FETCh:SUMMary:MER[:ALL]:MAXimum?
FETCh:SUMMary:MER[:ALL]:MINimum?
FETCh:SUMMary:MER[:ALL][:AVERage]?
FETCh:SUMMary:MER:DATA:MAXimum?
FETCh:SUMMary:MER:DATA:MINimum?
FETCh:SUMMary:MER:PILot:MAXimum?
FETCh:SUMMary:MER:PILot:MINimum?
FETCh:SUMMary:POWEr:MAXimum?
FETCh:SUMMary:POWEr:MINimum?
FETCh:SUMMary:POWEr[:AVERage]?
FETCh:SUMMary:QUADerror:MAXimum?
FETCh:SUMMary:QUADerror:MINimum?
FETCh:SUMMary:QUADerror[:AVERage]?
FETCh:SUMMary:SERRor:MAXimum?
FETCh:SUMMary:SERRor:MINimum?
FETCh:SUMMary:SERRor[:AVERage]?
FETCh:SUMM:<parameter>:<statistic>

```

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 [Chapter 2.1, "OFDM VSA parameters"](#), on page 9.

---

#### **FETCh:TTFRame?**

Retrieves the time offset between the trigger event and the start of the first OFDM frame.

#### **Return values:**

<Time>

**Example:**                    FETC:TTFR?

**Usage:** Query only  
**Manual operation:** See "Trigger to Sync" on page 29

## 8.7.2 Retrieving signal flow results

The following commands are required to retrieve the results of the signal flow stages.

See also "Signal Flow" on page 29

FETCh:SFLow:FSYNc?	242
FETCh:SFLow:STATe:ALL?	242
FETCh:SFLow:STATe:BDetection?	243
FETCh:SFLow:STATe:COMPensate?	243
FETCh:SFLow:STATe:DESTimation?	244
FETCh:SFLow:STATe:EVMMeas?	244
FETCh:SFLow:STATe:FSYNc?	244
FETCh:SFLow:STATe:MDetection?	245
FETCh:SFLow:STATe:PESTimation?	245
FETCh:SFLow:STATe:TSYNc?	245
FETCh:SFLow:TSYNc?	246

---

### FETCh:SFLow:FSYNc?

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>

**FAIL**

Not successful

**PASS**

Successful

**WARN**

Warning occurred

**DISabled**

Inactive

**Example:** `FETC:SFL:STAT:ALL?`**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267**Usage:** Query only**FETCh:SFLow:STATe:BDetection?**

Returns the state of the burst detection stage of the signal flow.

**Return values:**

&lt;Value&gt;

**FAIL**

Not successful

**PASS**

Successful

**WARN**

Warning occurred

**DISabled**

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:**

&lt;Value&gt;

**FAIL**

Not successful

**PASS**

Successful

**WARN**

Warning occurred

**DISabled**

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>	<b>FAIL</b> Not successful
	<b>PASS</b> Successful
	<b>WARN</b> Warning occurred
	<b>DISabled</b> 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>	<b>FAIL</b> Not successful
	<b>PASS</b> Successful
	<b>WARN</b> Warning occurred
	<b>DISabled</b> 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>	<b>FAIL</b> Not successful
	<b>PASS</b> Successful
	<b>WARN</b> Warning occurred
	<b>DISabled</b> 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>           **FAIL**  
                      Not successful  
  
                      **PASS**  
                      Successful  
  
                      **WARN**  
                      Warning occurred  
  
                      **DISabled**  
                      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>           **FAIL**  
                      Not successful  
  
                      **PASS**  
                      Successful  
  
                      **WARN**  
                      Warning occurred  
  
                      **DISabled**  
                      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>           **FAIL**  
                      Not successful  
  
                      **PASS**  
                      Successful  
  
                      **WARN**  
                      Warning occurred

**DISabled**

Inactive

**Example:** FETC:SFL:STAT:TSYN?**Usage:** Query only**FETCh:SFLow:TSYNc?**

Returns the Time Synchronisation value.

**Return values:**

&lt;Value&gt;

**Example:** FETC:SFL:TSYN?**Usage:** Query only

### 8.7.3 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 215

**Remote commands exclusive to retrieving trace data and marker values:**

<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Y?</a> .....	246
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Y:RELative?</a> .....	247
<a href="#">CALCulate&lt;n&gt;:DELTamarker&lt;m&gt;:Z</a> .....	247
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Y?</a> .....	248
<a href="#">CALCulate&lt;n&gt;:MARKer&lt;m&gt;:Z</a> .....	248
<a href="#">FORMat[:DATA]</a> .....	249
<a href="#">FORMat:DEXPort:DSEParator</a> .....	250
<a href="#">FORMat:DEXPort:GRAPh</a> .....	250
<a href="#">FORMat:DEXPort:HEADer</a> .....	250
<a href="#">FORMat:DEXPort:TRACes</a> .....	251
<a href="#">MMEMory:STORe&lt;n&gt;:TRACe</a> .....	251
<a href="#">TRACe&lt;n&gt;[:DATA]?</a> .....	251
<a href="#">TRACe&lt;n&gt;[:DATA]:X?</a> .....	252
<a href="#">TRACe&lt;n&gt;[:DATA]:Y?</a> .....	252
<a href="#">TRACe:IQ:DATA?</a> .....	253
<a href="#">TRACe:IQ:DATA:FORMat</a> .....	254
<a href="#">TRACe:IQ:DATA:MEMory?</a> .....	254

**CALCulate<n>:DELTamarker<m>:Y?**

Queries the result at the position of the specified delta marker.

**Suffix:**

&lt;n&gt; 1..n

<m> 1..n

**Return values:**

<Result> Result at the position of the delta marker.  
The unit is variable and depends on the one you have currently set.  
Default unit: DBM

**Usage:** Query only

**Manual operation:** See "[Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16](#)" on page 116  
See "[Y-value](#)" on page 117

**CALCulate<n>:DELTamarker<m>:Y:RELative?**

Queries the relative position of a delta marker of a 3D trace on the y-axis. If necessary, the command activates the delta marker first.

**Suffix:**

<n> 1..n  
[Window](#)

<m> 1..n  
[Marker](#)

**Return values:**

<XValue> Default unit: HZ

**Example:** CALC:DELT3:Y:REL?

**Usage:** Query only

**CALCulate<n>:DELTamarker<m>:Z <Result>**

Sets a delta marker's current position on the z-axis or queries its result in a 3-dimensional diagram.

**Suffix:**

<n> 1..n  
[Window](#)

<m> 1..n  
[Marker](#)

**Parameters:**

<Result> Result at the position of the delta marker.  
For 3-dimensional constellation diagrams (Constellation vs carrier/symbol), this parameter defines the carrier or symbol, respectively, to place the marker at.  
The unit depends on the type of data displayed on the z-axis.

**Example:**

```
//Define a power vs. symbol vs. carrier display
LAY:ADD? '1',RIGH,PSC
//Set delta marker 2 at carrier 2
CALC2:DELT2:Y 2
//Query the delta marker result for carrier 2
CALC2:DELT2:Z?
```

**Example:**

```
//Define constellation vs. symbol display
LAY:ADD? '1',RIGH,CSYM
//Set delta marker 2 at carrier 1
CALC2:DELT2:Z 1
//Query the delta marker result for carrier 1.
CAL2:DELT2:Y?
```

---

### CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

**Suffix:**

<n> 1..n

<m> 1..n

**Return values:**

<Result> Default unit: DBM

**Usage:** Query only

**Manual operation:** See ["Marker Table"](#) on page 24  
 See ["MI Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16"](#) on page 116  
 See ["Y-value"](#) on page 117

---

### CALCulate<n>:MARKer<m>:Z <Result>

Sets a marker's current position on the z-axis or queries its result in a 3-dimensional diagram.

**Suffix:**

<n> 1..n  
[Window](#)

<m> 1..n  
[Marker](#)

**Parameters:**

<Result> Result at the position of the marker.  
 For 3-dimensional constellation diagrams (Constellation vs carrier/symbol), this parameter defines the carrier or symbol, respectively, to place the marker at.  
 The unit depends on the type of data displayed on the z-axis.



**Example:**           //Define a power vs. symbol vs. carrier display  
LAY:ADD? '1',RIGH,PSC  
//Set marker 2 at carrier 2  
CALC2:MARK2:Y 2  
//Query the marker result for carrier 2  
CALC2:MARK2:Z?

**Example:**           //Define constellation vs. carrier display  
LAY:ADD? '1',RIGH,CCAR  
//Set marker 2 at symbol 3  
CALC2:MARK2:Z 3  
//Query the marker result for symbol 3.  
CAL2:MARK2:Y?

**Manual operation:** See ["Constellation Diagram"](#) on page 14  
See ["Constellation vs Carrier"](#) on page 16  
See ["Constellation vs Symbol"](#) on page 17  
See ["EVM vs Symbol vs Carrier"](#) on page 20  
See ["Power vs Symbol vs Carrier"](#) on page 26

---

#### **FORMat[:DATA] <Format>[, <BitLength>]**

Selects the data format that is used for transmission of trace data from the R&S VSE to the controlling computer.

Note that the command has no effect for data that you send to the R&S VSE. The R&S VSE automatically recognizes the data it receives, regardless of the format.

#### **Parameters:**

<Format>

##### **ASCII**

ASCII format, separated by commas.

This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

##### **REAL**

Floating-point numbers (according to IEEE 754) in the "definite length block format".

<BitLength>

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>

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 124

---

**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 123

---

**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 123

**FORMat:DEXPort:TRACes** <Selection>

Selects the data to be included in a data export file (see [MMEMory:STORe<n>:TRACe](#) on page 251).

Trace data resulting from encrypted file input cannot be queried.

**Parameters:**

&lt;Selection&gt;

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 123

**MMEMory:STORe<n>:TRACe** <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

You cannot query trace data resulting from encrypted file input.

For details on the order of the trace results depending on the display type, see [Chapter 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255.

**Suffix:**

&lt;n&gt;

[Window](#)**Parameters:**

&lt;Trace&gt;

Number of the trace to be stored

&lt;FileName&gt;

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 124

**TRACe<n>[:DATA]? <Trace>**

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 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255.

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Usage:**

Query only

**Manual operation:** See ["Allocation Matrix"](#) on page 11

**TRACe<n>[:DATA]:X? [<Trace>]**

Returns the x-values for the trace data in the selected result display.

For information on how many values are returned see [Chapter 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255.

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 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Usage:**

Query only

**Manual operation:** See ["Allocation Matrix"](#) on page 11  
 See ["CCDF"](#) on page 13  
 See ["Channel Flatness"](#) on page 14  
 See ["EVM vs Carrier"](#) on page 18  
 See ["EVM vs Symbol"](#) on page 19  
 See ["EVM vs Symbol vs Carrier"](#) on page 20  
 See ["Group Delay"](#) on page 21  
 See ["Impulse Response"](#) on page 22  
 See ["Magnitude Capture"](#) on page 23  
 See ["Power vs Carrier"](#) on page 24  
 See ["Power vs Symbol"](#) on page 25  
 See ["Power vs Symbol vs Carrier"](#) on page 26

**TRACe<n>[:DATA]:Y? [<Trace>]**

Returns the y-values for 3-dimensional trace data in the selected result display.

For information on how many values are returned see [Chapter 8.7.4, "Using the TRACe\[:DATA\] command"](#), on page 255.

Trace data resulting from encrypted file input cannot be queried.

**Suffix:**

<n> 1..n  
[Window](#)

**Query parameters:**

<Trace>

**Example:** TRAC2:DATA:Y?

**Example:** See [Chapter 8.10.1, "Example 1: analysis using a predefined configuration file"](#), on page 267

**Usage:** Query only

**Manual operation:** See ["Allocation Matrix"](#) on page 11  
 See ["EVM vs Symbol vs Carrier"](#) on page 20  
 See ["Power vs Symbol vs Carrier"](#) on page 26

### TRACe:IQ:DATA?

Initiates a measurement with the current settings and returns the captured data from I/Q measurements.

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>

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>]

Queries the I/Q data currently stored in the capture buffer of the R&S VSE.

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 [TRACe: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>

**Query 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

<b>&lt;NoOfSamples&gt;</b>	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>
<b>Return values:</b>	
<b>&lt;IQData&gt;</b>	Measured value pair (I,Q) for each sample that has been recorded. The data format of the individual values depends on <a href="#">FORMat [ : DATA ]</a> on page 249. Default unit: V
<b>Example:</b>	<pre>// 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</pre>
<b>Usage:</b>	Query only

### 8.7.4 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<n> [ : 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 specify them 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 set with [FORMat \[ : DATA \]](#) on page 249.

Following this detailed description, you find a short summary of the most important functions of the TRACe<n> [ : DATA ] ? command.

- [Allocation matrix](#).....256
- [Bitstream](#).....256
- [CCDF](#).....256

• Channel flatness.....	257
• Constellation diagram.....	257
• Constellation vs carrier.....	259
• Constellation vs symbol.....	259
• EVM vs carrier.....	260
• EVM vs symbol.....	260
• EVM vs symbol vs carrier.....	260
• Group delay.....	261
• Impulse response.....	261
• Magnitude capture.....	261
• Power vs carrier.....	262
• Power vs symbol.....	262
• Power vs symbol vs carrier.....	262
• Power spectrum.....	263

#### 8.7.4.1 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 252.

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 252.

#### 8.7.4.2 Bitstream

The command returns a demodulated data stream for the symbols in the currently analyzed result ranges in decimal format. Non-data cells, including the guard carriers, are indicated as "-1".

#### 8.7.4.3 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 252.



#### 8.7.4.4 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.

#### 8.7.4.5 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[F0][Sym0][Carr0], <Q[F0][Sym0][Carr0], ..., <I[F0][Sym0][Carrn], <Q[F0][Sym0][Carrn],
<I[F0][Sym1][Carr0], <Q[F0][Sym1][Carr0], ..., <I[F0][Sym1][Carrn], <Q[F0][Sym1][Carrn],
...
<I[F0][Symn][Carr0], <Q[F0][Symn][Carr0], ..., <I[F0][Symn][Carrn], <Q[F0][Symn][Carrn],
<I[F1][Sym0][Carr0], <Q[F1][Sym0][Carr0], ..., <I[F1][Sym0][Carrn], <Q[F1][Sym0][Carrn],
<I[F1][Sym1][Carr0], <Q[F1][Sym1][Carr0], ..., <I[F1][Sym1][Carrn], <Q[F1][Sym1][Carrn],
...
<I[Fn][Symn][Carr0], <Q[Fn][Symn][Carr0], ..., <I[Fn][Symn][Carrn], <Q[Fn][Symn][Carrn>
```

Where:

- F = frame
- Sym = symbol of that subframe
- Carr = subcarrier in that symbol

The I and Q values have no unit.

The `TRACe<n>[:DATA]?` command evaluates *all* cells in the Constellation diagram, including non-allocated cells, for example in guard carriers. Any specific selection by `CONFigure:FILTer<n>:MODulation` or `CONFigure:FILTer<n>:MODulation:TYPE` is ignored.



### Results for trace export (MMEM:STOR:TRAC)

Note that for the trace export feature, the results are different to the `TRACe<n>[:DATA]?` results (see `MMEMoRY:STORe<n>:TRACe` on page 251):

- Only the constellation activated in the Constellation diagram is exported (see `CONFiGure:FILTer<n>:MODulation` and `CONFiGure:FILTer<n>:MODulation:TYPE`). Non-allocated cells are not included.
- The order of the trace data is as follows:
  - One modulation type after the next (see `CONFiGure:FILTer<n>:MODulation:TYPE` on page 204)
  - Within one modulation type: carriers in ascending order of their number (from negative to positive)
  - For each carrier: measured symbols in ascending order, starting with 0
  - For each symbol: First Q, then I

### Example: Trace export results

Assume you measure 2 frames with 4 carriers and 4 symbols each.

Frame 0				Frame 1				Carrier number
Symbol								
0	1	2	3	4	5	6	7	
U	U	U	U	U	U	U	U	+1
P1	B1	Q1	Q3	P3	B3	Q5	Q7	0
P0	B0	Q0	Q2	P2	B2	Q4	Q6	-1
U	U	U	U	U	U	U	U	-2

Where:

- P: pilots
- B: BPSK data cells
- Q: QAM data cells
- U: unallocated guard carriers

Then the trace export results for `MMEM:STOR:TRAC?` depending on the constellation is:

- For all modulation types:  
P0 P2 P1 P3 B0 B2 B1 B3 Q0 Q2 Q4 Q6 Q1 Q3 Q5 Q7
- For pilots only:  
P0 P2 P1 P3
- For QAM modulation only:  
Q0 Q2 Q4 Q6 Q1 Q3 Q5 Q7

#### 8.7.4.6 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 8-4: Results for TRACe1:DATA? TRACe1**

```
<I[F0][Carr0][Sym0]>, <I[F0][Carr0][Sym1]>, ..., <I[F0][Carr0][Symn]>,
<I[F0][Carr1][Sym0]>, <I[F0][Carr1][Sym1]>, ..., <I[F0][Carr1][Symn]>,
...
<I[F0][Carrn][Sym0]>, <I[F0][Carrn][Sym1]>, ..., <I[F0][Carrn][Symn]>,
<I[F1][Carr0][Sym0]>, <I[F1][Carr0][Sym1]>, ..., <I[F1][Carr0][Symn]>,
<I[F1][Carr1][Sym0]>, <I[F1][Carr1][Sym1]>, ..., <I[F1][Carr1][Symn]>,
...
<I[Fn][Carrn][Sym0]>, <I[Fn][Carrn][Sym1]>, ..., <I[Fn][Carrn][Symn]>
```

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 252.

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

#### 8.7.4.7 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 Constellation vs. Carrier 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 252.

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

#### 8.7.4.8 EVM vs carrier

The command returns one value for each carrier that has been analyzed.

The following parameters are supported.

- TRACE1  
Returns the average EVM over all symbols.
- TRACE2  
Returns the minimum EVM found over all symbols.
- TRACE3  
Returns the maximum EVM found over all symbols.

#### 8.7.4.9 EVM vs symbol

The command returns one value for each OFDM symbol that has been analyzed.

The following parameters are supported.

- TRACE1  
Returns the average EVM over all carriers.
- TRACE2  
Returns the minimum EVM found over all carriers.
- TRACE3  
Returns the maximum EVM found over all carriers.

#### 8.7.4.10 EVM 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 EVM 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 252.

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 252.

#### 8.7.4.11 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.

#### 8.7.4.12 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.

#### 8.7.4.13 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

#### 8.7.4.14 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.

#### 8.7.4.15 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.

#### 8.7.4.16 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 252.

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 252.

#### 8.7.4.17 Power spectrum

The command returns one value for each trace point.

`<power>, ...`

The unit is always dBm/Hz.

The following parameters are supported.

- TRACE1

## 8.8 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 VSE OFDM VSA application 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 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 VSE OFDM VSA application.



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 OFDM VSA channel. It can be queried with commands `STATus:QUEStionable:SYNC:CONDition?` on page 264 and `STATus:QUEStionable:SYNC[:EVENT]?` on page 264.

**Table 8-5: Status error bits in STATus:QUEStionable:SYNC register for the R&S VSE OFDM VSA application**

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.

<code>STATus:QUEStionable:SYNC:CONDition?</code> .....	264
<code>STATus:QUEStionable:SYNC[:EVENT]?</code> .....	264
<code>STATus:QUEStionable:SYNC:ENABle</code> .....	264
<code>STATus:QUEStionable:SYNC:NTRansition</code> .....	265
<code>STATus:QUEStionable:SYNC:PTRansition</code> .....	265

---

#### **STATus:QUEStionable:SYNC:CONDition?** <ChannelName>

Reads out the CONDition section of the status register.

The command does not delete the contents of the EVENT section.

#### **Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

---

#### **STATus:QUEStionable:SYNC[:EVENT]?** <ChannelName>

Reads out the EVENT section of the status register.

The command also deletes the contents of the EVENT section.

#### **Query parameters:**

<ChannelName> String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**Usage:** Query only

---

#### **STATus:QUEStionable:SYNC:ENABle** <BitDefinition>, <ChannelName>

Controls the ENABle part of a register.



The ENABLE part allows true conditions in the EVENT part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

**Parameters:**

<BitDefinition>      Range:      0 to 65535

<ChannelName>      String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**STATus:QUESTIONable:SYNC:NTRansition** <BitDefinition>[,<ChannelName>]

Controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

**Parameters:**

<BitDefinition>      Range:      0 to 65535

<ChannelName>      String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

**STATus:QUESTIONable:SYNC:PTRansition** <BitDefinition>[,<ChannelName>]

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENT register.

**Parameters:**

<BitDefinition>      Range:      0 to 65535

<ChannelName>      String containing the name of the channel.  
The parameter is optional. If you omit it, the command works for the currently active channel.

## 8.9 Deprecated commands

Note that the following commands are maintained for compatibility reasons only. Use the specified alternative commands for new remote control programs.

Note that this command is maintained for compatibility reasons only. Use the LAYout commands for new remote control programs (see [Chapter 8.6.2, "Working with windows in the display"](#), on page 230).

**CALCulate<n>:FEED** <ResultDisplay>

This command selects the result display.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see [Chapter 8.6.2, "Working with windows in the display"](#), on page 230).

**Suffix:**

<n> [Window](#)

**Parameters for setting and query:**

<ResultDisplay> String containing a short form of the result display.

**'POW:PVSC'**

(Power vs Symbol X Carrier)

**'POW:PVCA'**

(Power vs Carrier)

**'POW:PVSY'**

(Power vs Symbol)

**'POW:CBUF'**

(Capture Buffer)

**'POW:PSPE'**

(Power Spectrum)

**'EVM:EVSC'**

(EVM vs Symbol X Carrier)

**'EVM:EVCA'**

(EVM vs Carrier)

**'EVM:EVSY'**

(EVM vs Symbol)

**'EVM:FERR'**

(Frequency Error)

**'EVM:PERR'**

(Phase Error)

**'CHAN:FLAT'**

(Channel Flatness)

**'CHAN:GDEL'**

(Group Delay)

**'CHAN:IRES'**

(Impulse Response)

**'CONS:CONS'**

(Constellation Diagram)

**'CONS:CVCA'**

(Constellation vs Carrier)

**'CONS:CVSY'**

(Constellation vs Symbol)

**'STAT:CCDF'**

(CCDF)

### 'STAT:SFLO' (Signal Flow)

**Example:**            `CALC2:FEED 'POW:CBUF'`  
Selects the Capture Buffer result display for screen B.

## 8.10 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 VSE 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.

### 8.10.1 Example 1: analysis using a predefined configuration file

This example uses input from the demo file `WlanA_64QAM.iq.tar` and the configuration file `WlanA_64QAM.xml`, which are both provided in the directory:

`C:\ProgramData\Rohde-Schwarz\VSE\<version_no>\user\OFDM-VSA\.`

**Note:** You must insert the correct path for your installation before executing this script.

```
//-----Preparing the measurement channel -----
//Reset the software
*RST
DEVIce:DELeTe:ALL

//Create OFDM VSA channel as replacement for default I/Q Analyzer channel
INST:CRE:REPL 'IQ Analyzer',OFDMVSA,'MyOFDMVSA'

//Load I/Q data file for input
//Assign the file as input source for channel 1
INST:BLOC:CHAN:SETT:SOUR FILE

//Select file to load - insert correct path! Analysis bandwidth = 16 MHz
INST:BLOC:CHAN:SETT:FILE:IQT 'WlanA_64QAM.iq.tar', 16000000

//-----Configuring the OFDM signal -----
//Use the provided sample file - insert correct path!
MMEM:LOAD:CFGF 'WlanA_64QAM.xml'

//-----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
```

## Programming examples: OFDM vector signal analysis

```

//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. EVM of data symbols
FETC:SUMM:EVM: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? TRACel

```

```

TRAC3:DATA:Y? TRACe1
TRAC3:DATA? TRACe1

//Retrieve trace data for filtered constellation diagram
TRAC4:DATA? TRACE1

```

### 8.10.2 Example 2: analysis with manual signal description

This signal uses input from the demo file `WLANac_64QAM_20MHz_ShortCP.iq.tar`.

**Note:** You must insert the correct path for your installation before executing this script.

```

//-----Preparing the measurement channel -----
//Reset the software
*RST
DEVIce:DELeTe:ALL

//Create a second OFDM VSA channel
INST:CRE:NEW OFDMVSA,'ManualOFDMVSA'

//Load I/Q data file for input
//Assign the file as input source for channel 'ManualOFDMVSA'
INST:SEL 'ManualOFDMVSA'
INST:BLOC:CHAN:SETT:SOUR FILE

//Select file to load - insert correct path! Analysis bandwidth = 16 MHz
INST:BLOC:CHAN:SETT:FILE:IQT 'WLANac_64QAM_20MHz_ShortCP.iq.tar', 16000000

//-----Configuring the OFDM signal -----
//Define 64 subcarriers
CONF:SYMB:NFFT 64
//Non-conventional, non-periodic cyclic prefixes;
//Range 1 (10 symbols): 16 samples
//Range 2 (all other symbols): 8 samples
CONF:GUAR:MODE GU2
CONF:GUAR:PER OFF
CONF:GUAR1:NSYM 10
CONF:SYMB:NGU1 16
CONF:SYMB:NGU2 8
//Preamble of 16 samples; frame starts at -560 samples
CONF:PRE:BLen 16
CONF:PRE:FOFF -560

//-----Configuring data acquisition-----
//Capture 43680 samples with a sample rate of 20 MHz
SWE:LENG 43680
TRAC:IQ:SRAT 20000000
//Apply a channel filter with 6-dB bw = 15 MHz, 50-dB bw = 20 MHz
INP:FILT:CHAN ON
INP:FILT:CHAN:SDBB 15000000

```

```
INP:FILT:CHAN:FDBB 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 Results
// Default displays:
//1: Magnitude Capture 3: Power Spectrum
//2: Result Summary 4: Constellation

//-----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 the state of the individual signal flow stages
FETC:SFL:STAT:ALL?

//Retrieve trace data for capture buffer
TRAC1:DATA:X? TRACe1
TRAC1:DATA? TRACe1
```



After the signal has been demodulated correctly, you can use the configuration to create a new configuration file with the interactive wizard. See [Chapter 5, "Creating a configuration file using the wizard"](#), on page 81.

## Annex

<b>A</b>	<b>Menu reference.....</b>	<b>273</b>
<b>B</b>	<b>Reference of toolbar functions.....</b>	<b>278</b>
<b>C</b>	<b>Formulae.....</b>	<b>282</b>
<b>D</b>	<b>Reference: IQW format specification for user-defined constellation points.....</b>	<b>284</b>





# A Menu reference

Most functions in the R&S VSE are available from the menus.

- [Common R&S VSE menus](#)..... 273
- [OFDM vector signal analysis menus](#).....275

## A.1 Common R&S VSE menus



The following menus provide **basic functions for all applications**:

- [File menu](#)..... 273
- [Window menu](#)..... 274
- [Help menu](#).....275

### A.1.1 File menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE base software user manual.


Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> 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.

Menu item	Corresponding icon in toolbar	Description
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE 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 VSE
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

### 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

Menu item	Corresponding icon in toolbar	Description
New Window >		Inserts a new result display window for the selected measurement channel
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	-	Opens the Rohde & Schwarz support page ( <a href="http://www.rohde-schwarz.com/support">http://www.rohde-schwarz.com/support</a> ) in a browser 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 OFDM vector signal analysis menus

The following menus are only available if a OFDM Vector Signal Analysis channel is selected.

• <a href="#">Edit menu</a> .....	275
• <a href="#">Input &amp; output menu</a> .....	276
• <a href="#">Meas setup menu</a> .....	276
• <a href="#">Trace menu</a> .....	277
• <a href="#">Marker menu</a> .....	277
• <a href="#">Limits menu</a> .....	277

### 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 <a href="#">Chapter 6.7, "Trace / data export configuration"</a> , on page 123.
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 OFDM Vector Signal Analysis**

Menu item	Description
Amplitude	<a href="#">Chapter 4.3.3, "Amplitude settings"</a> , on page 61
Scale	<a href="#">Chapter 6.4, "Y-Scaling"</a> , on page 113
Frequency	<a href="#">Chapter 4.3.2, "Frequency settings"</a> , on page 60
Trigger	<a href="#">Chapter 4.4, "Trigger settings"</a> , on page 65
Input Source	<a href="#">Chapter 4.3, "Input and frontend settings"</a> , on page 52
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 OFDM Vector Signal Analysis**

Menu item	Description
Signal Description	<a href="#">Chapter 4.2, "Signal description"</a> , on page 47
Input/Frontend	<a href="#">Chapter 4.3, "Input and frontend settings"</a> , on page 52
Data Acquisition	<a href="#">Chapter 4.5, "Data acquisition"</a> , on page 69
Burst Search	<a href="#">Chapter 4.6, "Burst search"</a> , on page 72
Result Range	<a href="#">Chapter 4.7, "Result ranges"</a> , on page 73
Sync/Demod/Tracking	<a href="#">Chapter 4.8, "Synchronization, demodulation and tracking"</a> , on page 74

Menu item	Description
Result Configuration	<a href="#">Chapter 6.1, "Result configuration"</a> , on page 109
Overview	<a href="#">Chapter 4.1, "Configuration overview"</a> , on page 45

## A.2.4 Trace menu

The "Trace" menu provides access to trace-specific functions.

See [Chapter 6.6, "Trace settings"](#), on page 121

This menu is application-specific.

**Table A-3: "Trace" menu items for OFDM Vector 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 OFDM Vector Signal Analysis**

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		" <input type="text" value="ML"/> Marker 1/ Delta Marker 1/ Delta Marker 2/ Delta Marker 16" on page 116
Marker to Trace	-	" <a href="#">Assigning the Marker to a Trace</a> " on page 118
All Markers Off		" <a href="#">All Markers Off</a> " on page 118
Marker		<a href="#">Chapter 6.5.1, "Individual marker settings"</a> , on page 115
Search		<a href="#">Chapter 6.5.2, "General marker settings"</a> , on page 118

## A.2.6 Limits menu

The "Limits" menu is not used by the R&S VSE OFDM VSA 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

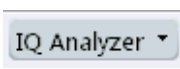






The following functions are generally available for all applications:

#### "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
 1:1	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 VSE VSA and OFDM VSA applications only)
	Auto level
	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

## C Formulae

### C.1 Error vector magnitude (EVM)

The EVM of a cell (symbol number  $l$ , carrier number  $k$ ) is defined as

$$EVM_{l,k} = \sqrt{\frac{|r_{l,k} - a_{l,k}|^2}{P_{norm}}}$$

where

- $r_{l,k}$  is the received symbol point in the complex plane of symbol number  $l$  and carrier number  $k$ .  
The received symbol point is compensated by phase and clock errors as well as channel transfer function according to the user settings.
- $a_{l,k}$  is the ideal symbol point in the complex plane of symbol number  $l$  and carrier number  $k$ .  
 $P_{norm}$  is a normalization value that can be set in four different ways

Normalize EVM to	$P_{norm}$
RMS Pilots & Data	$\frac{1}{N_{pilot} + N_{data}} \sum_{l,k \in Pilot, Data}  a_{l,k} ^2$
RMS Data	$\frac{1}{N_{data}} \sum_{l,k \in Data}  a_{l,k} ^2$
RMS Pilots	$\frac{1}{N_{pilot}} \sum_{l,k \in Pilot}  a_{l,k} ^2$
Peak Pilots & Data	$\max_{l,k \in Pilot, Data}  a_{l,k} ^2$
Peak Data	$\max_{l,k \in Data}  a_{l,k} ^2$
Peak Pilots	$\max_{l,k \in Pilot}  a_{l,k} ^2$
None	1.0

- $N_{pilot}$  is the number of pilot cells
- $N_{data}$  is the number of data cells

## C.2 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.

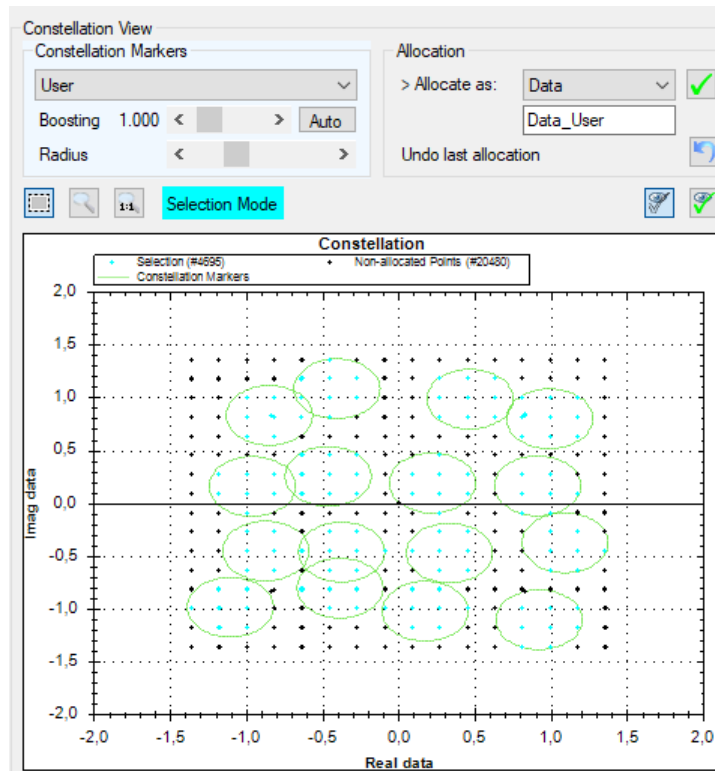
Variable	Meaning	Definition from Transmitter Model
$G_I$	Gain I-branch	1
$G_Q$	Gain Q-branch	$1 + \Delta Q$ (complex)

$$\text{Gain-Imbalance} = 20 \log \left( \frac{|G_Q|}{|G_I|} \right) \text{ dB}$$

$$\text{Quadrature-Error} = \arctan \left( \frac{\text{Im}\{G_Q\}}{\text{Re}\{G_Q\}} \right) \cdot 180^\circ / \pi$$

## D Reference: IQW format specification for user-defined constellation points

For a user-specific, unusual constellation of a signal component, you can configure the constellation in an IQW file in advance. Then load the file to the wizard instead of selecting a predefined modulation for a specific signal component. See [Step 3: Synchronizing the measured data, step 3](#).



**Figure D-1: Example for user-defined constellation points**

Create the constellation file using a python or Matlab script, for example.

Consider the following prerequisites:

- The file must contain the ideal complex values for the N constellation points.
- Define the symbols in the correct order (symbol number 0, 1, 2, 3.., N-1). Otherwise, the bitstream results are incorrect.
- The number of points must be between 2 and  $64 \cdot 1024$ .
- For each constellation point, define the real component first, than the imaginary component. One point after the next. ( $Re_0, Im_0, Re_1, Im_1, \dots, Re_n, Im_n$ )
- Define each value in binary, single-precision float format.
- Do not include any header or length information, only the values themselves.

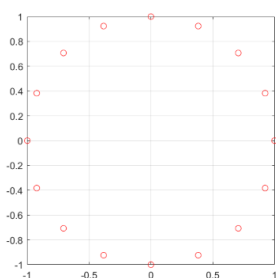
### Sample script to configure 16 constellation points in Matlab

The following script can be used to configure the 16 points on the unit circle (16-PSK) as shown in [Figure D-2](#).

```
sFilename = '16PSK.iqw';
iN = 16
vfcVector = exp(1j*2*pi/iN*[0:iN-1])

fileID = fopen(sFilename, 'w');
if -1==fileID
    error('file open failed')
end
for iK = 1:length(vfcVector)
    fwrite(fileID, real(vfcVector(iK)) , 'single', 'ieee-le');
    fwrite(fileID, imag(vfcVector(iK)) , 'single', 'ieee-le');
end
fclose(fileID);
```

As a result, the following constellation points are configured:



**Figure D-2: 16-PSK ideal constellation points**

```
1.00 +j*0.00 //corresponds to symbol number 0
0.92 +j*0.38
0.71 +j*0.71
0.38 +j*0.92
0.00 +j*1.00
-0.38 +j*0.92
-0.71 +j*0.71
-0.92 +j*0.38
-1.00 +j*0.00
-0.92 +j*-0.38
-0.71 +j*-0.71
-0.38 +j*-0.92
-0.00 +j*-1.00
0.38 +j*-0.92
0.71 +j*-0.71
0.92 +j*-0.38 //corresponds to symbol number 15
```

## List of commands (OFDM VSA)

[SENSe:]CAPtUre:OVERsampling.....	191
[SENSe:]COMPensate:CHANnel.....	195
[SENSe:]DEMod:CDD.....	195
[SENSe:]DEMod:COFFset.....	196
[SENSe:]DEMod:EVMCalc:FAverage.....	203
[SENSe:]DEMod:EVMCalc:NORMalize.....	203
[SENSe:]DEMod:FFTShift.....	196
[SENSe:]DEMod:FORMat:BURSt.....	194
[SENSe:]DEMod:FORMat:MAXFrames.....	194
[SENSe:]DEMod:FORMat:NOFSymbols.....	195
[SENSe:]DEMod:FSYnc.....	196
[SENSe:]DEMod:MDETect.....	197
[SENSe:]DEMod:THReshold:FRAME.....	198
[SENSe:]DEMod:THReshold:TIME.....	197
[SENSe:]DEMod:TSYnc.....	198
[SENSe:]EFRontend:ALIGNment<ch>:FILE.....	163
[SENSe:]EFRontend:ALIGNment<ch>:STATe.....	163
[SENSe:]EFRontend:CONNecTion:CONFig.....	164
[SENSe:]EFRontend:CONNecTion:CSTATe?.....	165
[SENSe:]EFRontend:CONNecTion[:STATe].....	164
[SENSe:]EFRontend:FREQuency:BAND:COUNT?.....	165
[SENSe:]EFRontend:FREQuency:BAND<b>:LOWer?.....	165
[SENSe:]EFRontend:FREQuency:BAND<b>:UPPer?.....	166
[SENSe:]EFRontend:FREQuency:BCONfig:AUTO.....	166
[SENSe:]EFRontend:FREQuency:BCONfig:LIST?.....	166
[SENSe:]EFRontend:FREQuency:BCONfig:SElect.....	167
[SENSe:]EFRontend:FREQuency:IFREquency:SIDeband?.....	167
[SENSe:]EFRontend:FREQuency:IFREquency[:VALue]?.....	168
[SENSe:]EFRontend:FREQuency:REFerence.....	168
[SENSe:]EFRontend:FREQuency:REFerence:LIST?.....	168
[SENSe:]EFRontend:IDN?.....	168
[SENSe:]EFRontend[:STATe].....	169
[SENSe:]FREQuency:CENTer:STEP.....	178
[SENSe:]FREQuency:CENTer:STEP:AUTO.....	178
[SENSe:]MIXer<x>:BIAS:HIGH.....	155
[SENSe:]MIXer<x>:BIAS[:LOW].....	155
[SENSe:]MIXer<x>:FREQuency:HANDover.....	156
[SENSe:]MIXer<x>:FREQuency:STARt.....	156
[SENSe:]MIXer<x>:FREQuency:STOP.....	157
[SENSe:]MIXer<x>:HARMonic:BAND.....	157
[SENSe:]MIXer<x>:HARMonic:BAND:PRESet.....	157
[SENSe:]MIXer<x>:HARMonic:HIGH:STATe.....	158
[SENSe:]MIXer<x>:HARMonic:HIGH[:VALue].....	158
[SENSe:]MIXer<x>:HARMonic:TYPE.....	158
[SENSe:]MIXer<x>:HARMonic[:LOW].....	159
[SENSe:]MIXer<x>:IF?.....	159
[SENSe:]MIXer<x>:LOPower.....	155

[SENSe:]MIXer<x>:LOSS:HIGH.....	159
[SENSe:]MIXer<x>:LOSS:TABLE:HIGH.....	159
[SENSe:]MIXer<x>:LOSS:TABLE[:LOW].....	160
[SENSe:]MIXer<x>:LOSS[:LOW].....	160
[SENSe:]MIXer<x>:PORTs.....	160
[SENSe:]MIXer<x>:RFOVerrange[:STATe].....	161
[SENSe:]MIXer<x>[:STATe].....	154
[SENSe:]PMETer<p>:DCYClE:VALue.....	173
[SENSe:]PMETer<p>:DCYClE[:STATe].....	173
[SENSe:]PMETer<p>:FREQUency.....	173
[SENSe:]PMETer<p>:FREQUency:LINK.....	174
[SENSe:]PMETer<p>:MTIME.....	174
[SENSe:]PMETer<p>:MTIME:AVERAge:COUNT.....	174
[SENSe:]PMETer<p>:MTIME:AVERAge[:STATe].....	175
[SENSe:]PMETer<p>:ROFFset[:STATe].....	175
[SENSe:]PMETer<p>:SOFFset.....	175
[SENSe:]PMETer<p>:UPDate[:STATe].....	176
[SENSe:]PMETer<p>[:STATe].....	176
[SENSe:]SWAPiq.....	191
[SENSe:]SWEep:COUNT.....	192
[SENSe:]SWEep:LENGth.....	192
[SENSe:]SWEep:TIME.....	193
[SENSe<ip>:]ADJust:CONFigure:HYSTerEsis:LOWer.....	201
[SENSe<ip>:]ADJust:CONFigure:HYSTerEsis:UPPer.....	201
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation.....	200
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE.....	200
[SENSe<ip>:]ADJust:CONFigure:TRIGger.....	201
[SENSe<ip>:]ADJust:LEVel.....	202
[SENSe<ip>:]FREQUency:CENTer.....	177
[SENSe<ip>:]FREQUency:OFFSet.....	178
CALCulate<n>:BITStream:FORMat.....	203
CALCulate<n>:DELTamarker<m>:AOFF.....	215
CALCulate<n>:DELTamarker<m>:LINK.....	216
CALCulate<n>:DELTamarker<m>:MAXimum:APEak.....	219
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT.....	220
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT.....	220
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHT.....	220
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK].....	220
CALCulate<n>:DELTamarker<m>:MINimum:LEFT.....	221
CALCulate<n>:DELTamarker<m>:MINimum:NEXT.....	221
CALCulate<n>:DELTamarker<m>:MINimum:RIGHT.....	221
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK].....	221
CALCulate<n>:DELTamarker<m>:MREFerence.....	216
CALCulate<n>:DELTamarker<m>:TRACe.....	217
CALCulate<n>:DELTamarker<m>:X.....	218
CALCulate<n>:DELTamarker<m>:Y:RELative?.....	247
CALCulate<n>:DELTamarker<m>:Y?.....	246
CALCulate<n>:DELTamarker<m>:Z.....	247
CALCulate<n>:DELTamarker<m>[:STATe].....	217
CALCulate<n>:DELTamarker<ms>:LINK:TO:MARKer<md>.....	216

CALCulate<n>:FEED.....	266
CALCulate<n>:MARKer<m>:AOFF.....	213
CALCulate<n>:MARKer<m>:MAXimum:APEak.....	221
CALCulate<n>:MARKer<m>:MAXimum:LEFT.....	222
CALCulate<n>:MARKer<m>:MAXimum:NEXT.....	222
CALCulate<n>:MARKer<m>:MAXimum:RIGHT.....	222
CALCulate<n>:MARKer<m>:MAXimum[:PEAK].....	222
CALCulate<n>:MARKer<m>:MINimum:LEFT.....	223
CALCulate<n>:MARKer<m>:MINimum:NEXT.....	223
CALCulate<n>:MARKer<m>:MINimum:RIGHT.....	223
CALCulate<n>:MARKer<m>:MINimum[:PEAK].....	223
CALCulate<n>:MARKer<m>:SEARCh.....	224
CALCulate<n>:MARKer<m>:TRACe.....	214
CALCulate<n>:MARKer<m>:X.....	215
CALCulate<n>:MARKer<m>:Y?.....	248
CALCulate<n>:MARKer<m>:Z.....	248
CALCulate<n>:MARKer<m>[:STATe].....	214
CALCulate<n>:MARKer<ms>:LINK:TO:MARKer<md>.....	213
CALCulate<n>:PMETer<p>:RELative:STATe.....	172
CALCulate<n>:PMETer<p>:RELative[:MAGNitude].....	171
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE.....	172
CALCulate<n>:TRACe<t>[:VALue].....	211
CALibration:PMETer<p>:ZERO:AUTO ONCE.....	171
CONFigure:FILTer<n>:CARRier.....	204
CONFigure:FILTer<n>:MODulation.....	204
CONFigure:FILTer<n>:MODulation:TYPE.....	204
CONFigure:FILTer<n>:SYMBol.....	205
CONFigure:PREamble:BLENght.....	134
CONFigure:PREamble:FOFFset.....	134
CONFigure:RFUC:FZERo:FREQuency.....	134
CONFigure:RFUC:FZERo:MODE.....	135
CONFigure:RFUC:STATe.....	135
CONFigure:SYSTem:CFILE.....	138
CONFigure:TPRecoding.....	139
CONFigure:TPRecoding:IGNore.....	139
CONFigure[:SYMBol]:GUARd:MODE.....	136
CONFigure[:SYMBol]:GUARd:NSYMBOLs<cp>.....	136
CONFigure[:SYMBol]:GUARd:PERiodic.....	137
CONFigure[:SYMBol]:NFFT.....	137
CONFigure[:SYMBol]:NGUard<cp>.....	137
CONFigure[:SYMBol]:NSUffix.....	138
DISPlay[:WINDow<n>]:MINFo[:STATe].....	218
DISPlay[:WINDow<n>]:MTABLE.....	218
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:MAXimum.....	208
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALE]:MINimum.....	208
DISPlay[:WINDow<n>][:SUBWIndow<n>]:TRACe<t>:Y[:SCALE]:AUTO.....	206
DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:MODE.....	212
DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE].....	206
DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:AUTO ONCE.....	205
DISPlay[:WINDow<n>][:SUBWIndow<w>]:TRACe<t>:Y[:SCALE]:PDIVision.....	206



DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>.....	179
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet.....	180
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition.....	207
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue.....	207
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe].....	212
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA.....	224
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA.....	226
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe].....	227
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe].....	225
FETCh:BURSt:COUNT?.....	239
FETCh:BURSt:LENGths?.....	239
FETCh:BURSt:STARts?.....	239
FETCh:PMETer<p>?.....	172
FETCh:SFLow:FSYNc?.....	242
FETCh:SFLow:STATe:ALL?.....	242
FETCh:SFLow:STATe:BDETection?.....	243
FETCh:SFLow:STATe:COMPensate?.....	243
FETCh:SFLow:STATe:DESTimation?.....	244
FETCh:SFLow:STATe:EVMMeas?.....	244
FETCh:SFLow:STATe:FSYNc?.....	244
FETCh:SFLow:STATe:MDETection?.....	245
FETCh:SFLow:STATe:PESTimation?.....	245
FETCh:SFLow:STATe:TSYNc?.....	245
FETCh:SFLow:TSYNc?.....	246
FETCh:SUMM:<parameter>:<statistic>.....	241
FETCh:SUMMary:CRESt:MAXimum?.....	240
FETCh:SUMMary:CRESt:MINimum?.....	240
FETCh:SUMMary:CRESt[:AVERAge]?.....	240
FETCh:SUMMary:EVM:DATA:MAXimum?.....	240
FETCh:SUMMary:EVM:DATA:MINimum?.....	240
FETCh:SUMMary:EVM:DATA:PCT:MAXimum?.....	240
FETCh:SUMMary:EVM:DATA:PCT:MINimum?.....	240
FETCh:SUMMary:EVM:DATA:PCT[:AVERAge]?.....	240
FETCh:SUMMary:EVM:DATA[:AVERAge]?.....	240
FETCh:SUMMary:EVM:PILot:MAXimum?.....	240
FETCh:SUMMary:EVM:PILot:MINimum?.....	240
FETCh:SUMMary:EVM:PILot:PCT:MAXimum?.....	241
FETCh:SUMMary:EVM:PILot:PCT:MINimum?.....	241
FETCh:SUMMary:EVM:PILot:PCT[:AVERAge]?.....	241
FETCh:SUMMary:EVM:PILot[:AVERAge]?.....	240
FETCh:SUMMary:EVM[:ALL]:MAXimum?.....	241
FETCh:SUMMary:EVM[:ALL]:MINimum?.....	241
FETCh:SUMMary:EVM[:ALL]:PCT:MAXimum?.....	241
FETCh:SUMMary:EVM[:ALL]:PCT:MINimum?.....	241
FETCh:SUMMary:EVM[:ALL]:PCT[:AVERAge]?.....	241
FETCh:SUMMary:EVM[:ALL][:AVERAge]?.....	241
FETCh:SUMMary:FERRor:MAXimum?.....	241
FETCh:SUMMary:FERRor:MINimum?.....	241
FETCh:SUMMary:FERRor[:AVERAge]?.....	241
FETCh:SUMMary:GIMBalance:MAXimum?.....	241

FETCh:SUMMary:GIMBalance:MINimum?	241
FETCh:SUMMary:GIMBalance[:AVERage]?	241
FETCh:SUMMary:IQOFfset:MAXimum?	241
FETCh:SUMMary:IQOFfset:MINimum?	241
FETCh:SUMMary:IQOFfset[:AVERage]?	241
FETCh:SUMMary:MER:DATA:MAXimum?	241
FETCh:SUMMary:MER:DATA:MINimum?	241
FETCh:SUMMary:MER:PILot:MAXimum?	241
FETCh:SUMMary:MER:PILot:MINimum?	241
FETCh:SUMMary:MER[:ALL]:MAXimum?	241
FETCh:SUMMary:MER[:ALL]:MINimum?	241
FETCh:SUMMary:MER[:ALL][:AVERage]?	241
FETCh:SUMMary:POWer:MAXimum?	241
FETCh:SUMMary:POWer:MINimum?	241
FETCh:SUMMary:POWer[:AVERage]?	241
FETCh:SUMMary:QUADerror:MAXimum?	241
FETCh:SUMMary:QUADerror:MINimum?	241
FETCh:SUMMary:QUADerror[:AVERage]?	241
FETCh:SUMMary:SERRor:MAXimum?	241
FETCh:SUMMary:SERRor:MINimum?	241
FETCh:SUMMary:SERRor[:AVERage]?	241
FETCh:SUMMary[:ALL]?	239
FETCh:TTFRame?	241
FORMat:DEXPort:DSEParator	250
FORMat:DEXPort:GRAPh	250
FORMat:DEXPort:HEADer	250
FORMat:DEXPort:TRACes	251
FORMat[:DATA]	249
INITiate:REFResh	189
INPut:ATTenuation:PROTection:RESet	141
INPut:EATT	181
INPut:EATT:AUTO	181
INPut:EATT:STATe	182
INPut:FILTer:CHANnel:HPASs:FDBBw?	189
INPut:FILTer:CHANnel:HPASs:SDBBw	189
INPut:FILTer:CHANnel:HPASs[:STATe]	190
INPut:FILTer:CHANnel[:LPASs]:FDBBw	190
INPut:FILTer:CHANnel[:LPASs]:SDBBw	190
INPut:FILTer:CHANnel[:LPASs][:STATe]	191
INPut:SElect	146
INPut:TYPE	147
INPut<ip>:ATTenuation	180
INPut<ip>:ATTenuation:AUTO	181
INPut<ip>:ATTenuation:PROTection[:STATe]	141
INPut<ip>:COUPling<ant>	141
INPut<ip>:DPATH	142
INPut<ip>:FILE:ZPADing	142
INPut<ip>:FILTer:HPASs[:STATe]	143
INPut<ip>:FILTer:YIG[:STATe]	143
INPut<ip>:GAIN<ant>:STATe	182

INPut<ip>:GAIN<ant>[:VALue].....	183
INPut<ip>:IMPedance<ant>.....	144
INPut<ip>:IQ:OSC:FULLScale:AUTO.....	151
INPut<ip>:IQ:OSC:FULLScale[:LEVel].....	151
INPut<ip>:IQ:OSC:SKEW:I.....	152
INPut<ip>:IQ:OSC:SKEW:I:INVerted.....	152
INPut<ip>:IQ:OSC:SKEW:Q.....	152
INPut<ip>:IQ:OSC:SKEW:Q:INVerted.....	152
INPut<ip>:IQ:OSC:TYPE.....	153
INPut<ip>:PRESelection:SET.....	144
INPut<ip>:PRESelection[:STATe].....	144
INPut<ip>:RF:CAPMode.....	145
INPut<ip>:RF:CAPMode:IQ:SRATe.....	145
INPut<ip>:RF:CAPMode:WAVEform:SRATe.....	146
INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>.....	147
INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>:CONFig.....	147
INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>:TYPE.....	147
INSTRument:BLOCK:CHANnel[:SETTings]:SOURce<si>:TYPE.....	153
LAYout:ADD[:WINDow]?.....	231
LAYout:CATalog[:WINDow]?.....	233
LAYout:GLOBal:ADD[:WINDow]?.....	228
LAYout:GLOBal:CATalog[:WINDow]?.....	229
LAYout:GLOBal:IDENtify[:WINDow]?.....	229
LAYout:GLOBal:REMove[:WINDow].....	230
LAYout:GLOBal:REPLace[:WINDow].....	230
LAYout:IDENtify[:WINDow]?.....	233
LAYout:MOVE[:WINDow].....	234
LAYout:REMove[:WINDow].....	234
LAYout:REPLace[:WINDow].....	234
LAYout:WINDow<n>:ADD?.....	235
LAYout:WINDow<n>:IDENtify?.....	236
LAYout:WINDow<n>:REMove.....	236
LAYout:WINDow<n>:REPLace.....	236
LAYout:WINDow<n>:TYPE.....	237
MMEMory:LOAD:CFGFile.....	140
MMEMory:STORe<n>:TRACe.....	251
READ:PMETer<p>?.....	172
SENSe:TRACking:LEVel.....	198
SENSe:TRACking:PHASe.....	199
SENSe:TRACking:TIME.....	199
STATus:QUEStionable:SYNC:CONDition?.....	264
STATus:QUEStionable:SYNC:ENABLe.....	264
STATus:QUEStionable:SYNC:NTRansition.....	265
STATus:QUEStionable:SYNC:PTRansition.....	265
STATus:QUEStionable:SYNC[:EVENT]?.....	264
SYSTem:COMMunicate:RDEvice:OSCilloscope:PSMMode[:STATe].....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:SRATe.....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:TCPip.....	149
SYSTem:COMMunicate:RDEvice:OSCilloscope:VDEvice?.....	150
SYSTem:COMMunicate:RDEvice:OSCilloscope:VFIRmware?.....	150

SYSTem:COMMunicate:RDEvice:OSCilloscope[:STATe].....	148
SYSTem:COMMunicate:RDEvice:PMETer<p>:CONFigure:AUTO[:STATe].....	169
SYSTem:COMMunicate:RDEvice:PMETer<p>:COUNT?.....	170
SYSTem:COMMunicate:RDEvice:PMETer<p>:DEFine.....	170
SYSTem:PRESet:CHANnel[:EXEC].....	133
TRACe:IQ:BWIDth.....	193
TRACe:IQ:DATA:FORMat.....	254
TRACe:IQ:DATA:MEMory?.....	254
TRACe:IQ:DATA?.....	253
TRACe:IQ:SRATe.....	193
TRACe:IQ:WBANd:MBWidth.....	194
TRACe:IQ:WBANd[:STATe].....	193
TRACe<n>[:DATA]:X?.....	252
TRACe<n>[:DATA]:Y?.....	252
TRACe<n>[:DATA]?.....	251
TRIGger[:SEQuence]:DTIME.....	183
TRIGger[:SEQuence]:HOLDoff[:TIME].....	184
TRIGger[:SEQuence]:IFPower:HOLDoff.....	184
TRIGger[:SEQuence]:IFPower:HYSTeresis.....	184
TRIGger[:SEQuence]:LEVel:BBPower.....	185
TRIGger[:SEQuence]:LEVel:IFPower.....	185
TRIGger[:SEQuence]:LEVel:IQPower.....	186
TRIGger[:SEQuence]:LEVel:MAPower.....	186
TRIGger[:SEQuence]:LEVel[:EXTeRnal<port>].....	185
TRIGger[:SEQuence]:MAPower:HOLDoff.....	186
TRIGger[:SEQuence]:MAPower:HYSTeresis.....	186
TRIGger[:SEQuence]:SLOPe.....	187
TRIGger[:SEQuence]:SOURce.....	187
TRIGger[:SEQuence]:TIME:RINTerval.....	188
UNIT:CAXes.....	208
UNIT:EVM.....	209
UNIT:FAXes.....	209
UNIT:IRESpOse.....	210
UNIT:SAXes.....	210
UNIT:TAXes.....	210
UNIT<n>:PMETer<p>:POWer.....	176
UNIT<n>:PMETer<p>:POWer:RATIo.....	177

# Index

## A

AC/DC coupling .....	54
Activating	
OFDM VSA measurements (remote) .....	132
Allocation Matrix	
Markers .....	115
Amplitude	
Configuration .....	61
Configuration (remote) .....	179
Settings .....	61
Analysis	
Bandwidth, definition .....	41
Button .....	109
Attenuation	
Auto .....	63
Configuration (remote) .....	180
Electronic .....	64
Manual .....	63
Option .....	64
Protective (remote) .....	141
Auto adjustment	
Triggered measurement .....	201
Auto level	
Hysteresis .....	79, 80
Reference level .....	63, 79
Auto settings	
Meastime mode .....	79
Automatic	
Configuration (remote) .....	199

## B

B2000	
State .....	56
Band	
External Mixer (remote) .....	157
Bandwidth	
Maximum usable .....	41, 70
Bias	
External Mixer (remote) .....	155

## C

Capture time .....	69
see also Measurement time .....	193
Carrier Offset .....	78
CDA	
Configuring .....	45
Center frequency .....	60
Step size .....	61
Closing	
Windows (remote) .....	236
Configuration	
Procedure .....	46
Configuration file	
Wizard .....	81
Constellation diagram	
Markers .....	115
Conventions	
SCPI commands .....	128
Conversion loss	
External Mixer (remote) .....	159, 160

Conversion loss tables	
External Mixer (remote) .....	159, 160
Cyclic Delay Diversity .....	78

## D

Data format	
Remote .....	250, 251
Data source	
Display .....	8
Decimal separator	
Trace export .....	124
Delta markers .....	118
Defining .....	117
Diagram footer information .....	8
Direct path	
Input configuration .....	55
Display	
Information .....	7
Refreshing .....	72
Drop-out time	
Trigger .....	68

## E

Electronic input attenuation .....	63, 64
Errors	
IF OVLD .....	63
Evaluation methods	
Remote .....	228, 231
WLAN .....	10
EVM .....	282
Exporting	
I/Q data .....	123
Measurement settings .....	123
Traces .....	123, 124
External Mixer	
Activating (remote) .....	154
Band .....	156, 157
Programming example .....	161
RF overrange .....	161
Type .....	160
External trigger .....	66
Level (remote) .....	185

## F

FFT Shift .....	77
Filters	
High-pass (RF input) .....	55, 72
YIG (remote) .....	143
Format	
Data (remote) .....	250, 251
Free Run	
Trigger .....	66
Frequency	
Configuration .....	60
Configuration (remote) .....	177
Offset .....	61
Frontend	
Configuration .....	52
Configuration (remote) .....	177

**G**

Gating	
Source .....	66

**H**

Handover frequency	
External Mixer (remote) .....	156
Harmonics	
External Mixer (remote) .....	158, 159
High-pass filter	
RF input .....	55, 72
Hysteresis	
Lower (Auto level) .....	80
Trigger .....	68
Upper (Auto level) .....	79

**I**

I/Q data	
Exporting .....	123
Maximum bandwidth .....	41
Sample rate .....	41
I/Q Power	
Trigger level (remote) .....	186
IF Power	
Trigger level (remote) .....	185
Impedance	
Setting .....	55
Input	
B2000 .....	56
Configuration .....	52
Configuration (remote) .....	177
Coupling .....	54
Overload (remote) .....	141
Settings .....	64
Input sample rate (ISR)	
Definition .....	41
Input sources	
Channels .....	54, 59
Instrument .....	54
Radio frequency (RF) .....	53
Instruments	
Input source .....	54

**L**

Linking	
Markers .....	118
LO feedthrough .....	55
Lower Level Hysteresis .....	80

**M**

Marker table	
Configuring .....	118
Evaluation method .....	24
Marker to Trace .....	118
Markers	
Allocation Matrix .....	115
Assigned trace .....	118
Configuring .....	115
Constellation diagram .....	115
Deactivating .....	118
Delta markers .....	117
General settings (remote) .....	219

Linking .....	118
Minimum .....	120
Next minimum .....	120
Next peak .....	120
Peak .....	120
Positioning .....	120
Retrieving values (remote) .....	246
Settings (remote) .....	213
State .....	117
Table .....	119
Table (evaluation method) .....	24
Type .....	117
X-value .....	117
Y-value .....	117

**Measurement**

Allocation matrix .....	11
Capture Buffer .....	23
Channel Flatness .....	14
Channel Impulse Response .....	22
Complementary Cumulative Distribution Function (CCDF) .....	13
Constellation Diagram .....	14
Constellation vs Carrier .....	16
Constellation vs Symbol .....	17
EVM vs. Carrier .....	18
EVM vs. Symbol .....	19
EVM vs. Symbol vs Carrier .....	20
Group Delay .....	21
Power Spectrum .....	27
Power vs Carrier vs Symbol .....	26
Power vs. Carrier .....	24
Power vs. Symbol .....	25
Signal flow .....	29
Measurement channels	
Input source .....	54, 59
Measurement time	
Auto settings .....	79
Remote .....	193
Minimum .....	120
Marker positioning .....	120
Next .....	120
Minimum attenuation .....	57
Modulation	
Inverted (I/Q, remote) .....	191
Inverted (I/Q) .....	71

**N**

Next Minimum .....	120
Marker positioning .....	120
Next Peak .....	120
Marker positioning .....	120

**O**

OFDM VSA	
Performing .....	125
Offset	
Frequency .....	61
Reference level .....	63
Options	
Electronic attenuation .....	64
High-pass filter .....	55, 72
Preamplifier .....	64
Oscilloscope	
Address .....	57

- Output
  - Sample rate, definition ..... 41
- Overload
  - RF input (remote) ..... 141
- Overview
  - Configuration OFDM VSA ..... 45
- P**
- Parameter tables
  - Configuration ..... 111
- Peaks
  - Marker positioning ..... 120
  - Next ..... 120
- Performing
  - OFDM VSA measurement ..... 125
- Ports
  - External Mixer (remote) ..... 160
- Power splitter mode ..... 56, 149
- Preamplifier
  - Setting ..... 64
  - Softkey ..... 64
- Preselector ..... 57
- Preset
  - Bands (External Mixer, remote) ..... 157
- Presetting
  - Channels ..... 47
- Pretrigger ..... 68
- Programming examples
  - External Mixer ..... 161
- Protection
  - RF input (remote) ..... 141
- Q**
- Quick Config
  - Traces ..... 122
- R**
- Record length
  - Definition ..... 41
- Reference level ..... 63
  - Auto level ..... 63, 79
  - Offset ..... 63
  - Unit ..... 63
  - Value ..... 63
- Reference marker ..... 118
- Refresh
  - Display ..... 72
- Remote commands
  - Basics on syntax ..... 127
  - Boolean values ..... 131
  - Capitalization ..... 129
  - Character data ..... 131
  - Data blocks ..... 132
  - Numeric values ..... 130
  - Optional keywords ..... 129
  - Parameters ..... 130
  - Strings ..... 132
  - Suffixes ..... 129
- Repetition interval ..... 67
- Resetting
  - RF input protection ..... 141
- Restoring
  - Channel settings ..... 47
- Result displays
  - Bitstream ..... 12
  - Marker table ..... 24
  - Result Summary ..... 28
  - Trigger to Sync ..... 29
  - WLAN ..... 10
- Result range
  - Remote ..... 194
- Result type
  - Display ..... 8
- Results
  - Data format (remote) ..... 250, 251
  - Exporting ..... 123
  - Retrieving (remote) ..... 237
- RF attenuation
  - Auto ..... 63
  - Manual ..... 63
- RF input ..... 53
  - Overload protection (remote) ..... 141
  - Remote ..... 140
- RF overrange
  - External Mixer ..... 161
- RF Power
  - Trigger ..... 66
- S**
- Sample rate
  - Definition ..... 41
  - I/Q data ..... 70
  - Maximum ..... 41
  - Remote ..... 193
- Scaling
  - Automatic ..... 114
  - Automatically ..... 114
  - Y-axis ..... 113, 114
- Settings
  - Overview ..... 45
- Signal capturing
  - Duration ..... 69
  - Duration (remote) ..... 193
- Signal description
  - Configuration (remote) ..... 133
- Slope
  - Trigger ..... 68, 187
- Softkeys
  - Preamp ..... 64
  - Ref Level ..... 63
  - Ref Level Offset ..... 63
  - Trigger Offset ..... 68
- Specifics for
  - Configuration ..... 47
- Standard WLAN measurements ..... 9
- Statistics
  - Configuration ..... 111
  - Results ..... 10
- Status registers
  - Description ..... 263
  - STAT:QUES:POW ..... 141
- Status reporting system ..... 263
- Suffixes
  - Common ..... 132
  - Remote commands ..... 129
- Swap I/Q ..... 71
  - Remote ..... 191
- Sweep
  - Time (remote) ..... 193

**T**

Time trigger	
Repetition interval .....	67
Toolbars	
AutoSet .....	281
Control .....	279
Functions .....	278
Help .....	279
Main .....	278
Marker .....	280
Overview .....	278
Zoom .....	279
Traces	
Configuration .....	121
Configuring (remote control) .....	211
Export format .....	124
Exporting .....	123, 124
Mode .....	121
Mode (remote) .....	212
Retrieving data (remote) .....	246
Selecting .....	121
Settings (remote control) .....	211
Settings, predefined .....	122
Trigger	
Drop-out time .....	68
External (remote) .....	187
Holdoff .....	68
Hysteresis .....	68
Offset .....	68
Remote control .....	183
Slope .....	68, 187
Trigger level .....	67
External trigger (remote) .....	185
I/Q Power (remote) .....	186
IF Power (remote) .....	185
Trigger source .....	66
External .....	66
External Analog .....	66
Free Run .....	66
Magnitude .....	67
RF Power .....	66
Time .....	67
Troubleshooting	
Input overload .....	141

**U**

Units .....	112
Reference level .....	63
Upper Level Hysteresis .....	79
Usable I/Q bandwidth	
Definition .....	41
User sample rate	
Definition .....	41

**W**

Window title bar information .....	8
Windows	
Adding (remote) .....	228, 231
Closing (remote) .....	236
Configuring .....	47
Querying (remote) .....	229, 233
Replacing (remote) .....	234
Types (remote) .....	228, 231

**X**

X-axis	
Scaling, auto .....	114
X-value	
Marker .....	117

**Y**

Y-axis	
Scaling .....	114
Scaling, auto .....	114
Y-Scaling .....	113
Y-value	
Marker .....	117
YIG-preselector	
Activating/Deactivating .....	56
Activating/Deactivating (remote) .....	143

**Z**

Zooming	
Activating (remote) .....	225
Area (Multiple mode, remote) .....	226
Area (remote) .....	224
Multiple mode (remote) .....	226, 227
Remote .....	224
Single mode (remote) .....	224