R&S® FSV-K91/91n Firmware Option WLAN TX Measurements

Operating Manual

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Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This manual describes the following R&S®FSV options:

- analyzer-K91 (1310.8903.02)
- analyzer-K91n (1310.9468.02)

This manual is applicable for the following analyzer models with firmware version 1.55:

- R&S®FSV 3 (1307.9002K03)
- R&S®FSV 7 (1307.9002K07)
- R&S®FSV 13 (1307.9002K13)
- R&S®FSV 30 (1307.9002K30)
- R&S®FSV 40 (1307.9002K40)
- R&S®FSVR 7 (1311.0006K7)
- R&S®FSVR 13 (1311.0006K13)
- R&S®FSVR 30 (1311.0006K30)

The firmware of the instrument makes use of several valuable open source software packages. The most important of them are listed below together with their corresponding open source license. The verbatim license texts are provided on the user documentation CD-ROM (included in delivery).

Package	**Link**	**License**
OpenSSL	http://www.openssl.org	OpenSSL/SSLeavy
Xitami	http://www.xitami.com	2.5b6
PHP	http://www.php.net	PHP v.3
DOJO-AJAX	http://www.dojotoolkit.org	Academic Free License (BSD)
ResizableLib	http://www.geocities.com/ppescher	Artistic License
BOOST Library	http://www.boost.org	Boost Software v.1
ONC/RPC	http://www.plt.rwth-aachen.de/ index.php?id=258	SUN

The product Open SSL includes cryptographic software written by Eric Young (eay@cryptsoft.com) and software written by Tim Hudson (tjh@cryptsoft.com).

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

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The following abbreviations are used throughout this manual: R&S®FSV is abbreviated as R&S FSV.

Contents

1 Documentation Overview

The user documentation for the analyzer is divided as follows:

- Quick Start Guide
- Operating Manuals for base unit and options
- Service Manual
- Online Help
- Release Notes

Quick Start Guide

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and basic measurements are described. Also a brief introduction to remote control is given. The manual includes general information (e.g. Safety Instructions) and the following chapters:

Chapters 1-3	Introduction, General information
Chapter 4	Front and Rear Panel
Chapter 5	Preparing for Use
Chapter 6	Firmware Update and Installation of Firmware Options
Chapter 7	Basic Operations
Chapter 8	Basic Measurement Examples
Chapter 9	Brief Introduction to Remote Control
Appendix 1	Printer Interface
Appendix 2	LAN Interface

Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

The Operating Manual for the base unit provides basic information on operating the analyzer in general, and the "Spectrum" mode in particular. Furthermore, the software options that enhance the basic functionality for various measurement modes are described here. The set of measurement examples in the Quick Start Guide is expanded by more advanced measurement examples. In addition to the brief introduction to remote control in the Quick Start Guide, a description of the basic analyzer commands and programming examples is given. Information on maintenance, instrument interfaces and error messages is also provided.

In the individual option manuals, the specific instrument functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the analyzer is not included in the option manuals.

The following Operating Manuals are available for the analyzer:

- R&S FSV base unit; in addition:
  - R&S FSV-K9 Power Sensor Support
  - R&S FSV-K14 Spectrogram Measurement
- R&S FSV-K7 Analog Demodulation and R&S FSV-K7S FM Stereo Measurements
- R&S FSV-K10 GSM/EDGE Measurement
- R&S FSV-K30 Noise Figure Measurement
- R&S FSV-K40 Phase Noise Measurement
- R&S FSV-K70 Vector Signal Analysis
- R&S FSV-K72 3GPP FDD BTS Analysis
- R&S FSV-K73 3GPP FDD UE Analysis
- R&S FSV-K76/77 3GPP TD-SCDMA BTS/UE Measurement
- R&S FSV-K82/83 CDMA2000 BTS/MS Analysis
- R&S FSV-K84/85 1xEV-DO BTS/MS Analysis
- R&S FSV-K91 WLAN IEEE 802.11a/b/g/j/n
- R&S FSV-K93 WiMAX IEEE 802.16 OFDM/OFDMA Analysis
- R&S FSV-K100/K104 EUTRA / LTE Downlink Measurement Application

These manuals are available in PDF format on the CD delivered with the instrument. The printed manual can be ordered from Rohde & Schwarz GmbH & Co. KG.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the analyzer by replacing modules. The manual includes the following chapters:

Chapter 1	Performance Test
Chapter 2	Adjustment
Chapter 3	Repair
Chapter 4	Software Update / Installing Options
Chapter 5	Documents

Online Help

The online help contains context-specific help on operating the analyzer and all available options. It describes both manual and remote operation. The online help is installed on the analyzer by default, and is also available as an executable .chm file on the CD delivered with the instrument.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

2 Conventions Used in the Documentation

2.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

2.2 Conventions for Procedure Descriptions

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

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

3 How to Use the Help System

Calling context-sensitive and general help

► To display the general help dialog box, press the HELP key on the front panel.

The help dialog box "View" tab is displayed. A topic containing information about the current menu or the currently opened dialog box and its function is displayed.

For standard Windows dialog boxes (e.g. File Properties, Print dialog etc.), no context-sensitive help is available.

► If the help is already displayed, press the softkey for which you want to display help.

A topic containing information about the softkey and its function is displayed.

If a softkey opens a submenu and you press the softkey a second time, the submenu of the softkey is displayed.

Contents of the help dialog box

The help dialog box contains four tabs:

- "Contents" - contains a table of help contents
- "View" - contains a specific help topic
- "Index" - contains index entries to search for help topics
- "Zoom" - contains zoom functions for the help display

To change between these tabs, press the tab on the touchscreen.

Navigating in the table of contents

- To move through the displayed contents entries, use the UP ARROW and DOWN ARROW keys. Entries that contain further entries are marked with a plus sign.
- To display a help topic, press the ENTER key. The "View" tab with the corresponding help topic is displayed.
- To change to the next tab, press the tab on the touchscreen.

Navigating in the help topics

- To scroll through a page, use the rotary knob or the UP ARROW and DOWN ARROW keys.
- To jump to the linked topic, press the link text on the touchscreen.

Searching for a topic

1. Change to the "Index" tab.

2. Enter the first characters of the topic you are interested in. The entries starting with these characters are displayed.
3. Change the focus by pressing the ENTER key.
4. Select the suitable keyword by using the UP ARROW or DOWN ARROW keys or the rotary knob.
5. Press the ENTER key to display the help topic.

   The "View" tab with the corresponding help topic is displayed.

Changing the zoom

1. Change to the "Zoom" tab.
2. Set the zoom using the rotary knob. Four settings are available: 1-4. The smallest size is selected by number 1, the largest size is selected by number 4.

Closing the help window

► Press the ESC key or a function key on the front panel.

4 WLAN TX Measurements Option R&S FSV-K91/91n

Overview of Firmware Option R&S FSV-K91/91n

This section contains all information required for operation of an analyzer equipped with Application Firmware R&S FSV-K91/91n. It covers operation via menus and the remote control commands for analog demodulation measurements.

This part of the documentation consists of the following chapters:

- chapter 4.1.1, "Basic Measurement Examples", on page 13
  Describes the measurement setup for WLAN TX measurements.
- chapter 4.2, "Instrument Functions WLAN TX Measurements (R&S FSV-K91/91n)", on page 34
  Describes the overall instrument functions and provides further information
- chapter 4.2.2, "Softkeys of the WLAN TX Menu (R&S FSV-K91/91n)", on page 44
  Shows all softkeys available in the "WLAN" menu. This chapter also refers to the remote control commands associated with each softkey function.
- chapter 4.3, "Remote Commands for WLAN TX Measurements (R&S FSV-K91/91n)", on page 85
  Describes all remote control commands defined for the power meter measurement.

This part of the documentation includes only functions of the Application Firmware R&S FSV-K91/91n. For all other descriptions, please refer to the description of the base unit at the beginning of the documentation.

4.1 WLAN TX Measurements (R&S FSV-K91/91n)

The R&S FSV-K91/91n application extends the functionality of the analyzer signal analyzer to enable wireless LAN TX measurements in accordance with IEEE standards 802.11 a b, g, j & n (R&S FSV-K91/91n).

The following measurements are described in this section:

- chapter 4.1.1, "Basic Measurement Examples", on page 13
- chapter 4.1.2, "Signal Processing of the IEEE 802.11a Application", on page 15
- chapter 4.1.3, "Signal Processing of the IEEE 802.11b Application", on page 22
- chapter 4.1.4, "802.11b RF Carrier Suppression", on page 28
- chapter 4.1.5, "IQ Impairments", on page 28

4.1.1 Basic Measurement Examples

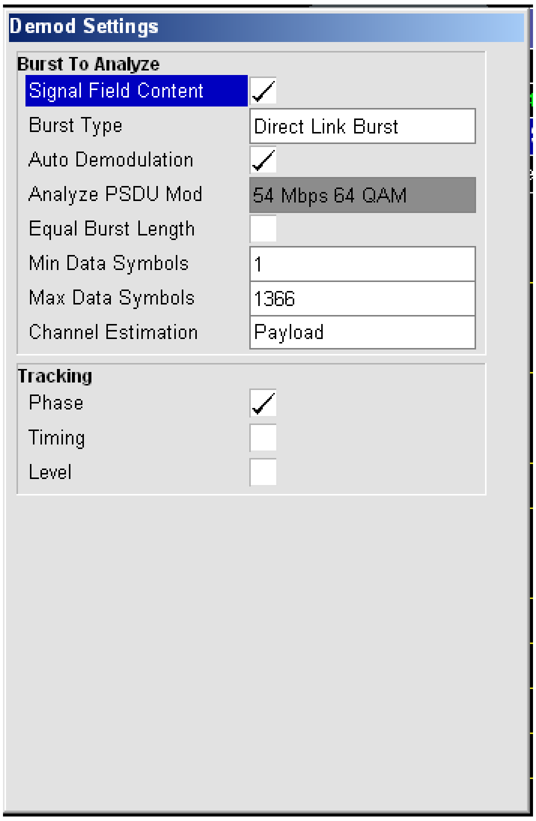
This section provides step-by-step instruction for working through an ordinary measurement. The following steps are described:

1. chapter 4.1.1.1, "Setting Up the Measurement", on page 14
2. chapter 4.1.1.2, "Performing the Main Measurement", on page 14

In this example, a DUT using IEEE 802.11a is be used. The DUT is connected to the analyzer using the RF input of the analyzer. The DUT generates a signal modulated using 16QAM.

4.1.1.1 Setting Up the Measurement

1. Activate the "WLAN" mode using the MODE > "WLAN" keys.
2. Press the "FREQ" key once to select and open the Demod Settings Dialog Box (K91) and to activate the frequency input field.



3. Activate "Auto Demodulation" (see "Auto Demodulation" on page 77) to use the content of the signal inherent field to detect the modulation type automatically.

4.1.1.2 Performing the Main Measurement

- Select single sweep measurements by pressing the RUN SINGLE hardkey.
- Select continuous measurements by pressing the RUN CONT hardkey.
  During the measurement, the status message "Running" is displayed.
  Leveling is done automatically.

Measurement results are updated once the measurement has completed. The results are displayed in graphical form. The display can be toggled to a tabular list of measurement points by pressing the "Display" softkey (in the "WLAN" menu or "Trace" menu).

4.1.2 Signal Processing of the IEEE 802.11a Application

This description gives a rough view of the IEEE 802.11a application signal processing. Details are disregarded in order to get a concept overview.

- chapter 4.1.2.1, "Understanding Signal Processing of the IEEE 802.11a Application", on page 15
- chapter 4.1.2.2, "Literature to the IEEE 802.11a Application", on page 21

Abbreviations

$a_{l,k}$	symbol at symbol l of subcarrier k
EVM_k	error vector magnitude of subcarrier k
EVM	error vector magnitude of current packet
g	signal gain
Δf	frequency deviation between TX and RX
l	symbol index l = [1, nof_Symbols]
nof_symbols	number of symbols of payload
H_k	channel transfer function of subcarrier k
k	channel index k = [–31,32]
K_{mod}	modulation-dependent normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	subcarrier of symbol l

4.1.2.1 Understanding Signal Processing of the IEEE 802.11a Application

A diagram of the interesting blocks is shown in figure 4-1. First the RF signal is down converted to the IF frequency f_{IF} = 96 MHz. The resulting IF signal $r_{IF}(t)$ is shown on the left-hand side of the figure. After bandpass filtering, the signal is sampled by an Analog to Digital Converter (ADC) at a sampling rate of f_{s1} = 128 MHz. This digital sequence is resampled. Thus the sampling rate of the down sampled sequence r(i) is the Nyquist rate of f_{s3} = 20 MHz. Up to this point the digital part is implemented in an ASIC.

In the lower part of the figure the subsequent digital signal processing is shown. In the first block the packet search is performed. This block detects the Long Symbol (LS) and recovers the timing. The coarse timing is detected first. This search is implemented in the time domain. The algorithm is based on cyclic repetition within the LS after N = 64 samples. Numerous treatises exist on this subject, e.g. [1] to [3].

Furthermore a coarse estimate $\Delta\hat{f}_{coarse}$ of the Rx-Tx frequency offset Δf is derived from the metric in [6]. (The hat generally indicates an estimate, e.g. $\hat{x}$ is the estimate of x.) This can easily be understood because the phase of r(i) Δ r* (i + N) is determined by the frequency offset. As the frequency deviation Δf can exceed half a bin (distance between neighboring sub-carriers) the preceding Short Symbol (SS) is also analyzed in order to detect the ambiguity.

After the coarse timing calculation the time estimate is improved by the fine timing calculation. This is achieved by first estimating the coarse frequency response $\hat{H}^{(LS)}{}_{k}$, with k = [–26, 26] denoting the channel index of the occupied sub-carriers.

First the FFT of the LS is calculated. After the FFT calculation the known symbol information of the LS sub-carriers is removed by dividing by the symbols. The result is a coarse estimate $\hat{H}_k$ of the channel transfer function.

In the next step the complex channel impulse response is computed by an IFFT. Next the energy of the windowed impulse response (the window size is equal to the guard period) is calculated for every trial time. Afterwards the trail time of the maximum energy is detected. This trial time is used to adjust the timing.

Now the position of the LS is known and the starting point of the useful part of the first payload symbol can be derived. In the next block this calculated time instant is used to position the payload window. Only the payload part is windowed. This is sufficient because the payload is the only subject of the subsequent measurements.

In the next block the windowed sequence is compensated by the coarse frequency estimate $\Delta\hat{f}_{course}$. This is necessary because otherwise inter channel interference (ICI) would occur in the frequency domain.

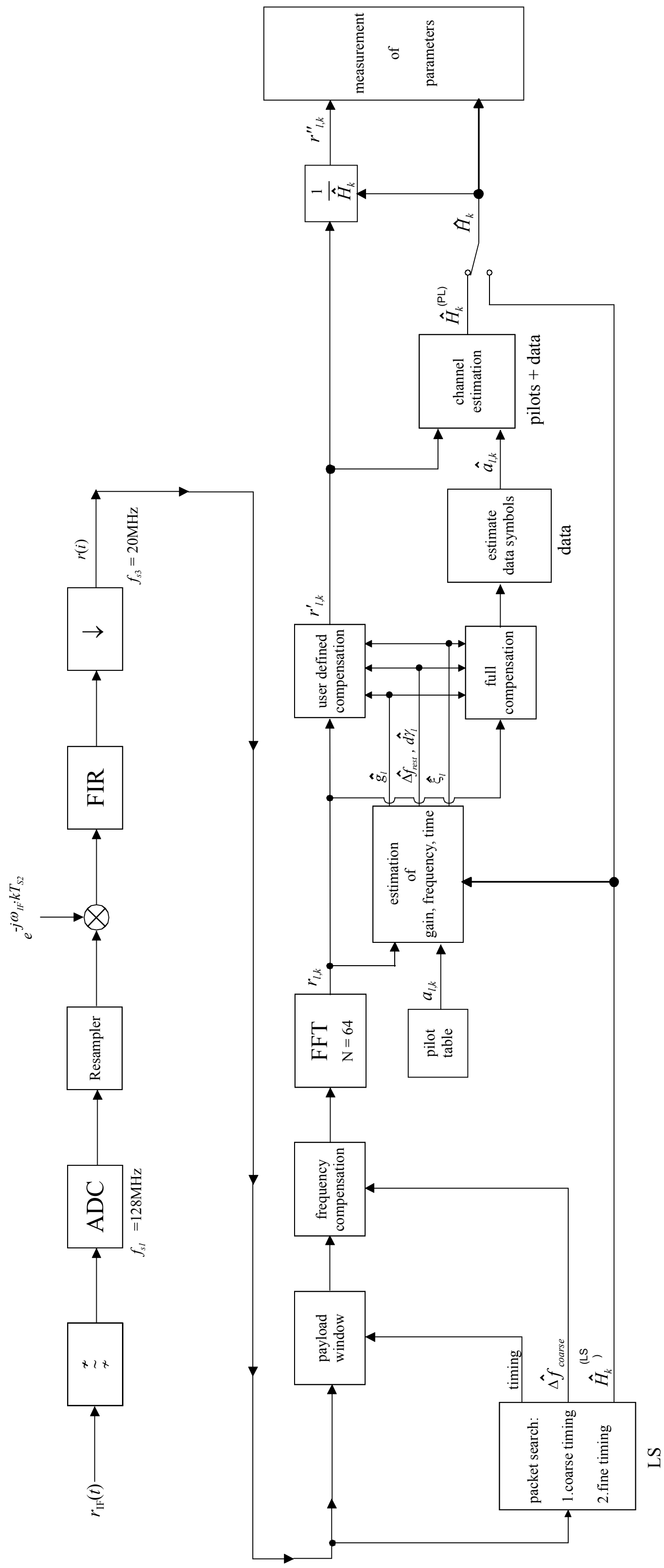


Fig. 4-1: Signal processing of the IEEE 802.11a application

The transition to the frequency domain is achieved by an FFT of length 64. The FFT is performed symbol-wise for every of the "nof_symbols" symbols of the payload. The calculated FFTs are described by $r_{l,k}$ with:

- l = [1, nof_symbols] as the symbol index
- k = [–31, 32] as the channel index

In case of an additive white Gaussian noise (AWGN) channel the FFT is described by [4], [5]

$$r_{l,k} = K_{\text{mod}} \times a_{l,k} \times g_l \times H_k \times e^{j(phase_l^{(common)} + phase_{l,k}^{(\text{timing})})} + n_{l,k}$$

with:

- k_{mod}: the modulation-dependant normalization factor
- $a_{l,k}$: the symbol of sub-carrier k at symbol l
- g_l: the gain at the symbol l in relation to the reference gain g = 1 at the long symbol (LS)
- H_k: the channel frequency response at the long symbol (LS)
- ${}_l^{(common)}$: the common phase drift phase of all sub-carriers at symbol l (see)
- $phase_{l,k}^{(timing)}$: the phase of sub-carrier k at symbol l caused by the timing drift (see)
- $n_{l,k}$: the independent Gaussian distributed noise samples

The common phase drift in is given by:

$$phase_l^{(common)} = 2\pi \times N_s / N \times \Delta f_{rest} T \times l + dy_l$$

with

- N_s = 80: the number of Nyquist samples of the symbol period
- N = 64: the number of Nyquist samples of the useful part of the symbol
- Δf_{rest}: the (not yet compensated) frequency deviation
- $d\gamma_l$: the phase jitter at the symbol l

In general, the coarse frequency estimate $\Delta \hat{f}_{coarse}$ (see) Signal processing of the IEEE 802.11a application) is not error-free. Therefore the remaining frequency error Δf_{rest} represents the frequency deviation in $r_{l,k}$ not yet compensated. Consequently, the overall frequency deviation of the device under test (DUT) is calculated by:

$\Delta f = \Delta \hat{f}_{coarse} + \Delta f_{rest}$

The only motivation for dividing the common phase drift in into two parts is to be able to calculate the overall frequency deviation of the DUT.

The reason for the phase jitter $d\gamma_l$ in may be different. The nonlinear part of the phase jitter may be caused by the phase noise of the DUT oscillator. Another reason for nonlinear phase jitter may be the increase of the DUT amplifier temperature at the beginning of the burst. Note that besides the nonlinear part the phase jitter, $d\gamma_l$ also contains a constant part. This constant part is caused by the frequency deviation Δf_{rest} not yet compensated. To understand this, keep in mind that the measurement of the phase starts at the first symbol l = 1 of the payload. In contrast the channel frequency response H_k in represents the channel at the long symbol of the preamble. Consequently, the frequency deviation Δf_{rest} not yet compensated produces a phase drift between the long symbol and the first symbol of the payload. Therefore, this phase drift appears as a constant value ("DC value") in $d\gamma_l$.

Referring to the IEEE 802.11a measurement standard Chapter 17.3.9.7 "Transmit modulation accuracy test" [6], the common phase drift $phase_l^{(command)}$ must be estimated and compensated from the pilots. Therefore this "symbol-wise phase tracking" (Tracking Phase) is activated as the default setting of the R&S FSV-K91/91n.

Furthermore, the timing drift in is given by:

$$phase_{l,k}^{(\text{timing})} = 2\pi \times N_s / N \times \xi \times k \times l$$

with ξ: the relative clock deviation of the reference oscillator

Normally, a symbol-wise timing jitter is negligible and thus not modeled in . However, there may be situations where the timing drift has to be taken into account. This is illustrated by an example: In accordance to [6] the allowed clock deviation of the DUT is up to ξ_{max} = 20 ppm. Furthermore, a long packet with 400 symbols is assumed. The result of and , is that the phase drift of the highest sub-carrier k = 26 in the last symbol l = NOF_SYMBOLS is 93 degrees. Even in the noise-free case, this would lead to symbol errors. The example shows that it is actually necessary to estimate and compensate the clock deviation, which is accomplished in the next block.

Referring to the IEEE 802.11a measurement standard [6], the timing drift $phase^{(timing)}_{l,k}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSV-K91/91n. The time tracking option should rather be seen as a powerful analyzing option.

In addition, the tracking of the gain g_l in is supported for each symbol in relation to the reference gain g = 1 at the time instant of the long symbol (LS). At this time the coarse channel transfer function $\hat{H}^{(LS)}_k$ is calculated.

This makes sense since the sequence r' is compensated by the coarse channel transfer function $\hat{H}^{(LS)}_k$ before estimating the symbols. Consequently, a potential change of the gain at the symbol l (caused, for example, by the increase of the DUT amplifier temperature) may lead to symbol errors especially for a large symbol alphabet M of the MQAM transmission. In this case the estimation and the subsequent compensation of the gain are useful.

Referring to the IEEE 802.11a measurement standard [6], the compensation of the gain g_l is not part of the requirements. Therefore the "gain tracking"' (Tracking Gain) is not activated as the default setting of the R&S FSV-K91/91n.

How can the parameters above be calculated? In this application the optimum maximum likelihood algorithm is used. In the first estimation step the symbol-independent parameters Δf_{rest} and ξ are estimated. The symbol dependent parameters can be neglected in this step, i.e. the parameters are set to $g_l = 1$ and $d\gamma = 0$. Referring to , the log likelihood function L must be calculated as a function of the trial parameters $\Delta\tilde{f}_{rest}$ and $\tilde{\xi}$. (The tilde generally describes a trial parameter. Example: $\tilde{x}$ is the trial parameter of x.)

$$L_1(\Delta\tilde{f}_{rest}, \tilde{\xi}) = \sum_{l=1}^{nof\_symbols} \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \times \hat{H}_k^{(LS)} \times e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2$$

$$with$$

$$\tilde{p}hase_l^{(common)} = 2\pi \times N_s / N \times \Delta\tilde{f}_{rest} T \times l$$

$$\tilde{p}hase_l^{(timing)} = 2\pi \times N_s / N \times \tilde{\xi} \times k \times l$$

The trial parameters leading to the minimum of the log likelihood function are used as estimates $\Delta\hat{f}_{rest}$ and $\hat{\xi}$. In the known pilot symbols $a_{l,k}$ are read from a table.

In the second step, the log likelihood function is calculated for every symbol l as a function of the trial parameters $\tilde{g}_l$ and $d\tilde{\gamma}_l$:

$$L_2(\tilde{g}_l, d\tilde{\gamma}_l) = \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \times \tilde{g}_l \times \hat{H}_k^{(LS)} \times e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2$$

$$with$$

$$\tilde{p}hase_l^{(common)} = 2\pi \times N_s / N \times \Delta\hat{f}_{rest} T \times l + d\tilde{\gamma}_l$$

$$\tilde{p}hase_l^{(timing)} = 2\pi \times N_s / N \times \hat{\xi} \times k \times l$$

Finally, the trial parameters leading to the minimum of the log likelihood function are used as estimates $\hat{g}_l$ and $d\hat{\gamma}_l$.

This robust algorithm works well even at low signal to noise ratios with the Cramer Rao Bound being reached.

After estimation of the parameters, the sequence $r_{l,k}$ is compensated in the compensation blocks.

In the upper analyzing branch the compensation is user-defined i.e. the user determines which of the parameters are compensated. This is useful in order to extract the influence of these parameters. The resulting output sequence is described by: $\gamma'_{\delta,k}$.

In the lower compensation branch the full compensation is always performed. This separate compensation is necessary in order to avoid symbol errors. After the full compensation the secure estimation of the data symbols $\hat{a}_{l,k}$ is performed. From it is clear that first the channel transfer function H_k must be removed. This is achieved by dividing the known coarse channel estimate $\hat{H}^{(LS)}_k$ calculated from the LS. Usually an error free estimation of the data symbols can be assumed.

In the next block a better channel estimate $\hat{H}^{(PL)}_k$ of the data and pilot sub-carriers is calculated by using all nof_symbols symbols of the payload (PL). This can be accomplished at this point because the phase is compensated and the data symbols are known. The long observation interval of nof_symbols symbols (compared to the short interval of 2 symbols for the estimation of $\hat{H}^{(LS)}_k$) leads to a nearly error-free channel estimate.

In the following equalizer block $\hat{H}^{(LS)}_k$ is compensated by the channel estimate. The resulting channel-compensated sequence is described by $\gamma_{\delta,k}''$. The user may either choose the coarse channel estimate $\hat{H}^{(LS)}_k$ (from the long symbol) or the nearly error-free channel estimate $\hat{H}^{(PL)}_k$ (from the payload) for equalization. If the improved estimate $\hat{H}^{(LS)}_k$ is used, a 2 dB reduction of the subsequent EVM measurement can be expected.

According to the IEEE 802.11a measurement standard [6], the coarse channel estimation $\hat{H}^{(LS)}_k$ (from the long symbol) has to be used for equalization. Therefore the default setting of the R&S FSV-K91/91n is equalization from the coarse channel estimate derived from the long symbol.

In the last block the measurement variables are calculated. The most important variable is the error vector magnitude of the sub-carrier "k" of the current packet:

$$\overline{EVM} = \sqrt{\frac{1}{nof\_packets} \sum_{counter=1}^{nof\_packets} EVM^2(counter)}$$

Furthermore, the packet error vector magnitude is derived by averaging the squared EVM_k versus k:

$$EVM = \sqrt{\frac{1}{52} \sum_{k=-26(k\neq 0)}^{26} EVM_k^2}$$

Finally, the average error vector magnitude is calculated by averaging the packet EVM of all nof_symbols detected packets:

$$EVM_k = \sqrt{\frac{1}{nof\_symbols} \sum_{l=1}^{nof\_symbols} \left| r''_{l,k} - K_{\text{mod}} \times a_{l,k} \right|^2}$$

This parameter is equivalent to the so-called "RMS average of all errors": $Error_{RMS}$ of the IEEE 802.11a measurement commandment (see [6],).

4.1.2.2 Literature to the IEEE 802.11a Application

[1]	Speth, Classen, Meyr: "Frame synchronization of OFDM systems in frequency selective fading channels", VTC '97, pp. 1807-1811
[2]	Schmidl, Cox: "Robust Frequency and Timing Synchronization of OFDM", IEEE Trans. on Comm., Dec. 1997, pp. 1613-621
[3]	Minn, Zeng, Bhargava: "On Timing Offset Estimation for OFDM", IEEE Communication Letters, July 2000, pp. 242-244
[4]	Speth, Fechtel, Fock, Meyr: "Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part I", IEEE Trans. On Comm. VOL. 47, NO 11, Nov. 1999

[5]	Speth, Fechtel, Fock, Meyr: "Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part II", IEEE Trans. On Comm. VOL. 49, NO 4, April. 2001
[6]	IEEE 802.11a, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

4.1.3 Signal Processing of the IEEE 802.11b Application

This description gives a rough overview of the signal processing concept of the IEEE 802.11b application.

- chapter 4.1.3.1, "Understanding Signal Processing of the IEEE 802.11b Application", on page 22
- chapter 4.1.3.2, "Literature of the IEEE 802.11b Application", on page 27

Abbreviations

ε	timing offset
Δ"f"	frequency offset
ΔΦ	phase offset
ARG{...}	calculation of the angle of a complex value
EVM	error vector magnitude
$\hat{g}_I$	estimate of the gain factor in the I-branch
$\hat{g}_Q$	estimate of the gain factor in the Q-branch
$\Delta\hat{g}_Q$	accurate estimate of the crosstalk factor of the Q-branch in the I-branch
$\hat{h}_s(v)$	estimated baseband filter of the transmitter
$\hat{h}_r(v)$	estimated baseband filter of the receiver
$\hat{o}_I$	estimate of the IQ-offset in the I-branch
$\hat{o}_Q$	estimate of the IQ-offset in the I-branch
r(v)	measurement signal
$\hat{s}(v)$	estimate of the reference signal
$\hat{s}_n(v)$	estimate of the power normalized and undisturbed reference signal
REAL{...}	calculation of the real part of a complex value
IMAG{...}	calculation of the imaginary part of a complex value

4.1.3.1 Understanding Signal Processing of the IEEE 802.11b Application

A block diagram of the measurement application is shown below in figure 4-2. The baseband signal of an IEEE 802.11b wireless LAN system transmitter is sampled with a sampling rate of 44 MHz.

The first task of the measurement application is to detect the position of the bursts within the measurement signal $r_1(v)$. The detection algorithm is able to find the positions of the beginning of short and long bursts and can distinguish between them. The algorithm also detects the initial state of the scrambler. This is required if IEEE 802.11 signals should be analyzed, because this standard does not specify the initial state of the scrambler.

With the knowledge of the start position of the burst, the header of the burst can be demodulated. The bits transmitted in the header provide information about the length of the burst and the modulation type used in the PSDU.

After the start position and the burst length is fully known, better estimates of timing offset, timing drift, frequency offset and phase offset can be calculated using the entire data of the burst.

At this point of the signal processing a demodulation can be performed without decision error. After demodulation the normalized and undisturbed reference signal s(v) is available.

If the frequency offset is not constant and varies with time, the frequency- and phase offset in several partitions of the burst must be estimated and corrected. Additionally, timing offset, timing drift and gain factor can be estimated and corrected in several partitions of the burst. These corrections can be separately switched off in the "Demod Settings" menu.

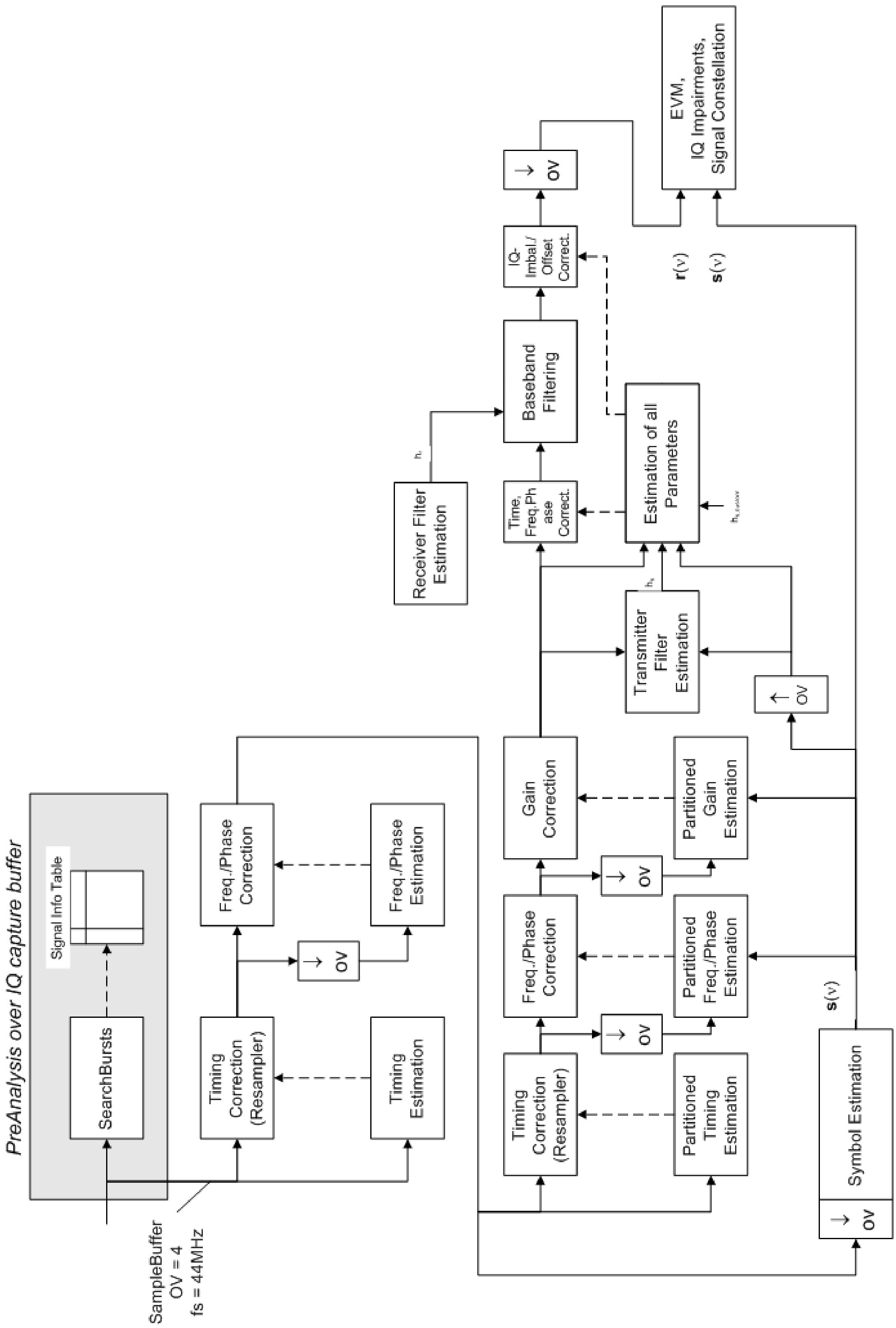


Fig. 4-2: Signal processing of the IEEE 802.11b application

Knowing the normalized power and undisturbed reference signal, the transmitter baseband filter is estimated by minimizing the cost function of a maximum-likelihood-based estimator:

$$L_1 = \sum_{\nu=0}^{N-1} \left| r(\nu) \times e^{-j2\pi\Delta\tilde{f}\nu} \times e^{-j\Delta\tilde{\phi}} - \sum_{i=-L}^{+L} \tilde{h}_s(i) \times \hat{s}_n(\nu - i) - \tilde{o}_I - j\tilde{o}_Q \right|^2$$

where:

r(v): the oversampled measurement signal

ŝ: the normalized oversampled power

$_n$(v): the undisturbed reference signal

N: the observation length

L: the filter length

$\Delta\tilde{f}$: the variation parameters of the frequency offset

$\Delta\tilde{\phi}$: the variation parameters of the phase offset

$\tilde{o}_I$, $\tilde{o}_Q$: the variation parameters of the IQ-offset

$\tilde{h}_s(\nu)$: the coefficients of the transmitter filter

The frequency-, the phase- and the IQ-offset are estimated jointly with the coefficients of the transmitter filter to increase the estimation quality.

Once the transmitter filter is known, all other unknown signal parameters are estimated with a maximum-likelihood-based estimation, which minimizes the cost function:

$$L_2 = \sum_{\nu=0}^{N-1} \left| r(\nu - \tilde{\varepsilon}) \times e^{-j2\pi\tilde{f}\nu} \times e^{-j\Delta\tilde{\phi}} - \tilde{g}_I \times s_I(\nu) - j\tilde{g}_Q \times s_Q(\nu) + \Delta\tilde{g}_Q \times s_Q(\nu) - \tilde{o}_I - j\tilde{o}_Q \right|^2$$

where:

$\tilde{g}_I$, $\tilde{g}_Q$: the variation parameters of the gain used in the I/Q-branch

$\Delta\tilde{g}_Q$: the crosstalk factor of the Q-branch into the I-branch

s_I(v), s_Q(v): the filtered reference signal of the I/Q-branch.

The unknown signal parameters are estimated in a joint estimation process to increase the accuracy of the estimates.

The accurate estimates of the frequency offset, the IQ-imbalance, the quadrature-mismatch and the normalized IQ-offset are displayed by the measurement software. The IQ-imbalance is the quotient of the estimates of the gain factor of the Q-branch, the crosstalk factor and the gain factor of the I-branch:

$$IQ - Imbalance = \left| \frac{\hat{g}_Q + \Delta\hat{g}_Q}{\hat{g}_I} \right|$$

The quadrature-mismatch is a measure for the crosstalk of the Q-branch into the I-branch:

$$Quadrature-Mismatch = ARG\{\tilde{g}_Q + j \times \Delta\tilde{g}_Q\}$$

The normalized IQ-offset is defined as the magnitude of the IQ-offset normalized by the magnitude of the reference signal:

$$IQ-Offset = \frac{\sqrt{\hat{o}_I^2 + \hat{o}_Q^2}}{\sqrt{\frac{1}{2} \cdot \left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}}$$

At this point of the signal processing all unknown signal parameters such as timing-, frequency-, phase-, IQ-offset and IQ-imbalance have been evaluated and the measurement signal can be corrected accordingly.

Using the corrected measurement signal r(v) and the estimated reference signal □(v), the modulation quality parameters can be calculated. The mean error vector magnitude (EVM) is the quotient of the root-mean-square values of the error signal power and the reference signal power:

$$EVM = \frac{\sqrt{\sum_{v=0}^{N-1} |r(v) - \hat{s}(v)|^2}}{\sqrt{\sum_{v=0}^{N-1} |\hat{s}(v)|^2}}$$

Whereas the instant error vector magnitude is the momentary error signal magnitude normalized by the root mean square value of the reference signal power:

$$EVM(v) = \frac{|r(v) - \hat{s}(v)|}{\sqrt{\sum_{v=0}^{N-1} |\hat{s}(v)|^2}}$$

In [2] a different algorithm is proposed to calculate the error vector magnitude. In a first step the IQ-offset in the I-branch and the IQ-offset of the Q-branch are estimated separately:

$$\hat{o}_I = \frac{1}{N} \sum_{v=0}^{N-1} \mathrm{REAL}\{r(v)\}$$

$$\hat{o}_Q = \frac{1}{N} \sum_{v=0}^{N-1} \mathrm{IMAG}\{r(v)\}$$

where r(v) is the measurement signal which has been corrected with the estimates of the timing-, frequency- and phase offset, but not with the estimates of the IQ-imbalance and IQ-offset

With these values the IQ-imbalance of the I-branch and the IQ-imbalance of the Q-branch are estimated in a non-linear estimation in a second step:

$$\hat{g}_I = \frac{1}{N}\sum_{v=0}^{N-1}\left|\text{REAL}\left\{r(v) - \hat{o}_I\right\}\right|$$

$$\hat{g}_Q = \frac{1}{N}\sum_{v=0}^{N-1}\left|\text{IMAG}\left\{r(v) - \hat{o}_Q\right\}\right|$$

Finally, the mean error vector magnitude can be calculated with a non-data-aided calculation:

$$V_{err}(v) = \frac{\sqrt{\frac{1}{2}\sum_{v=0}^{N-1}\left[\left|\text{REAL}\left\{r(v)\right\} - \hat{o}_I\right| - \hat{g}_I\right]^2 + \frac{1}{2}\sum_{v=0}^{N-1}\left[\left|\text{IMAG}\left\{r(v)\right\} - \hat{o}_Q\right| - \hat{g}_Q\right]^2}}{\sqrt{\frac{1}{2}\cdot\left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}}$$

The instant error vector magnitude is the error signal magnitude normalized by the root mean square value of the estimate of the measurement signal power:

$$V_{err}(v) = \frac{\sqrt{\frac{1}{2}\left[\left|\text{REAL}\left\{r(v)\right\} - \hat{o}_I\right| - \hat{g}_I\right]^2 + \frac{1}{2}\left[\left|\text{IMAG}\left\{r(v)\right\} - \hat{o}_Q\right| - \hat{g}_Q\right]^2}}{\sqrt{\frac{1}{2}\cdot\left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}}$$

The advantage of this method is that no estimate of the reference signal is needed, but the IQ-offset and IQ-imbalance values are not estimated in a joint estimation procedure. Therefore, each estimation parameter is disturbing the estimation of the other parameter and the accuracy of the estimates is lower than the accuracy of the estimations achieved by . If the EVM value is dominated by Gaussian noise this method yields similar results as .

4.1.3.2 Literature of the IEEE 802.11b Application

[1]	Institute of Electrical and Electronic Engineers, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, IEEE Std 802.11-1999, Institute of Electrical and Electronic Engineers, Inc., 1999.
[2]	Institute of Electrical and Electronic Engineers, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher-Speed Physical Layer Extensions in the 2.4 GHz Band, IEEE Std 802.11b-1999, Institute of Electrical and Electronic Engineers, Inc., 1999.

4.1.4 802.11b RF Carrier Suppression

Definition

The RF carrier suppression, measured at the channel center frequency, shall be at least 15 dB below the peak SIN(x)/x power spectrum. The RF carrier suppression shall be measured while transmitting a repetitive 01 data sequence with the scrambler disabled using DQPSK modulation. A 100 kHz resolution bandwidth shall be used to perform this measurement.

Comparison to IQ offset measurement in R&S FSV-K91/91n list mode

The IQ offset measurement in R&S FSV-K91/91n returns the actual carrier feed through normalized to the mean power at the symbol timings. This measurement doesn't need a special test signal and is independent of the transmit filter shape.

The RF carrier suppression measured according to the standard is inversely proportional to the IQ offset measured in R&S FSV-K91/91n list mode. The difference (in dB) between the two values depends on the transmit filter shape and should be determined with one reference measurement.

The following table lists exemplary the difference for three transmit filter shapes (±0.5 db):

Transmit filter	– IQ-Offset [dB] – RF-Carrier-Suppression [dB]
Rectangular	11 dB
Root raised cosine, "□" = 0.3	10 dB
Gaussian, "□" = 0.3	9 dB

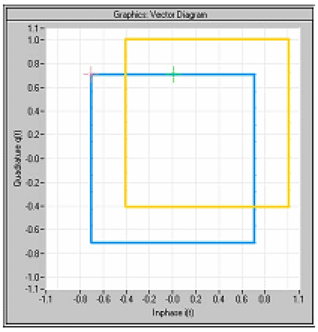
4.1.5 IQ Impairments

This chapter provides an overview over the I/Q impairments for the R&S FSV-K91/91n.

- chapter 4.1.5.1, "IQ Offset", on page 28
- chapter 4.1.5.2, "Gain Imbalance", on page 29
- chapter 4.1.5.3, "Quadrature Error", on page 30

4.1.5.1 IQ Offset

An IQ-Offset indicates a carrier offset with fixed amplitude. This results in a constant shift of the IQ axes. The offset is normalized by the mean symbol power and displayed in dB.



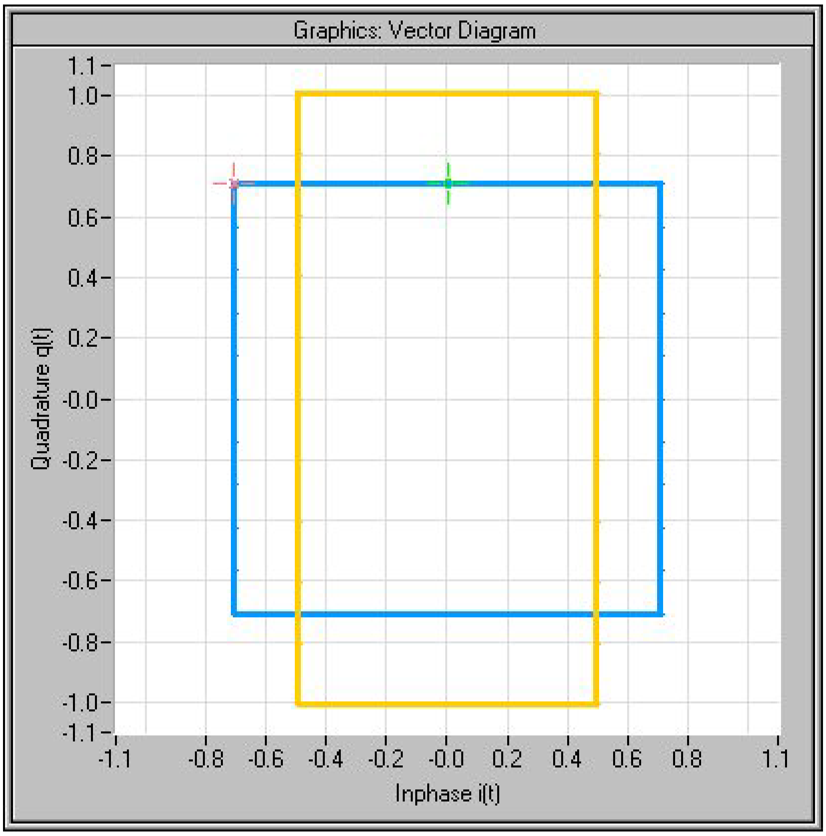
4.1.5.2 Gain Imbalance

An ideal I/Q modulator amplifies the I and Q signal path by exactly the same degree. The imbalance corresponds to the difference in amplification of the I and Q channel and therefore to the difference in amplitude of the signal components. In the vector diagram, the length of the I vector changes relative to the length of the Q vector.

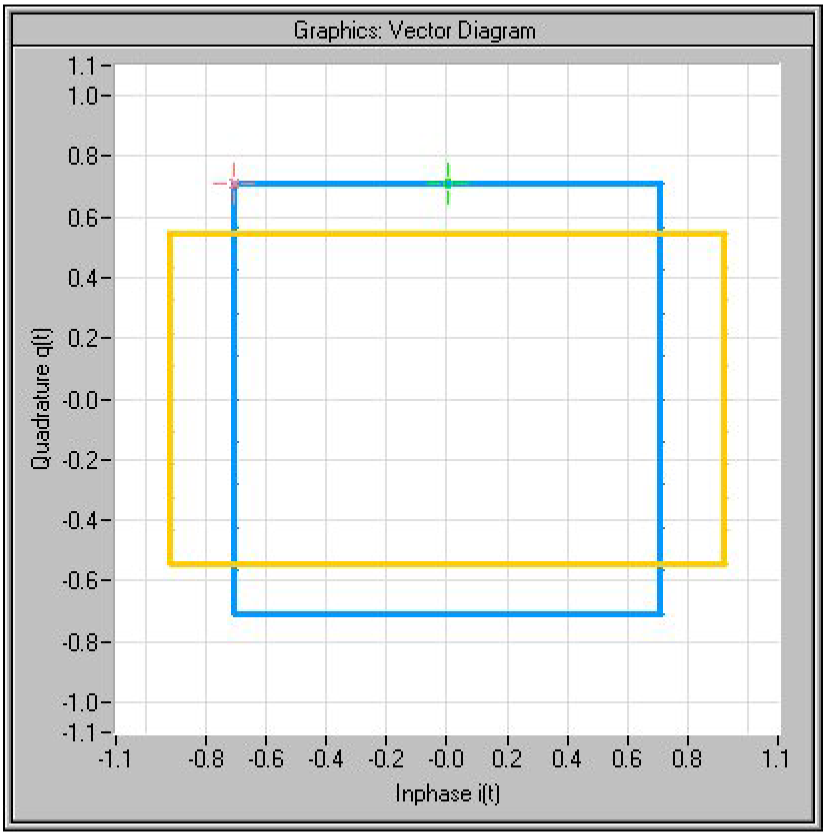
The entry is displayed in dB and %, where 1 dB offset is roughly 12 % according to the following:

Imbalance [dB] = 20log (| GainQ |/| GainI |)

Positive values mean that the Q vector is amplified more than the I vector by the corresponding percentage:



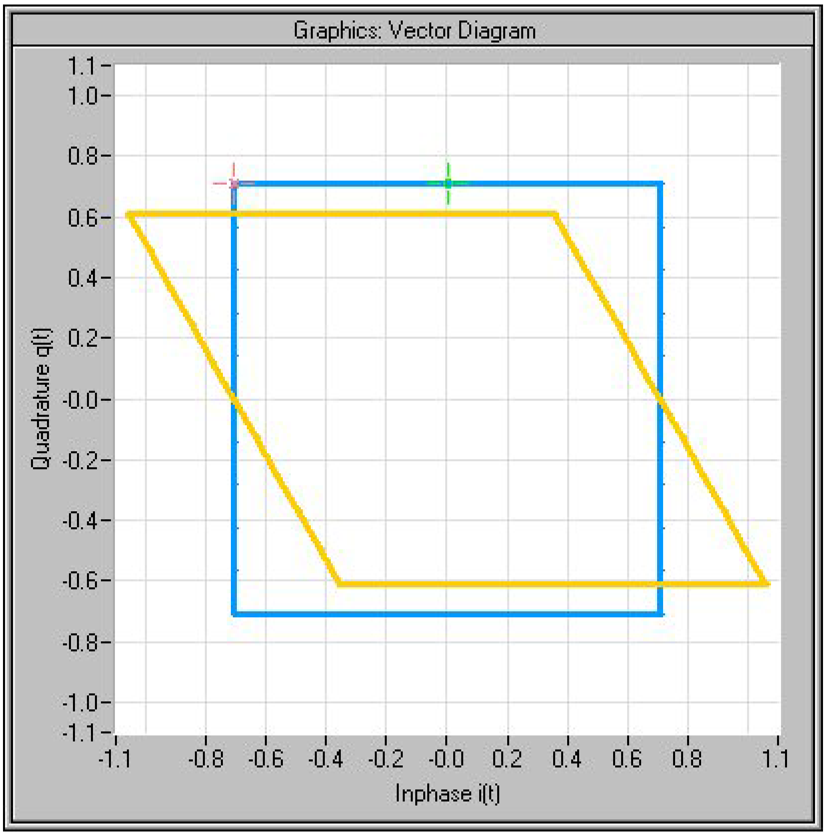
Negative values mean that the I vector is amplified more than the Q vector by the corresponding percentage:



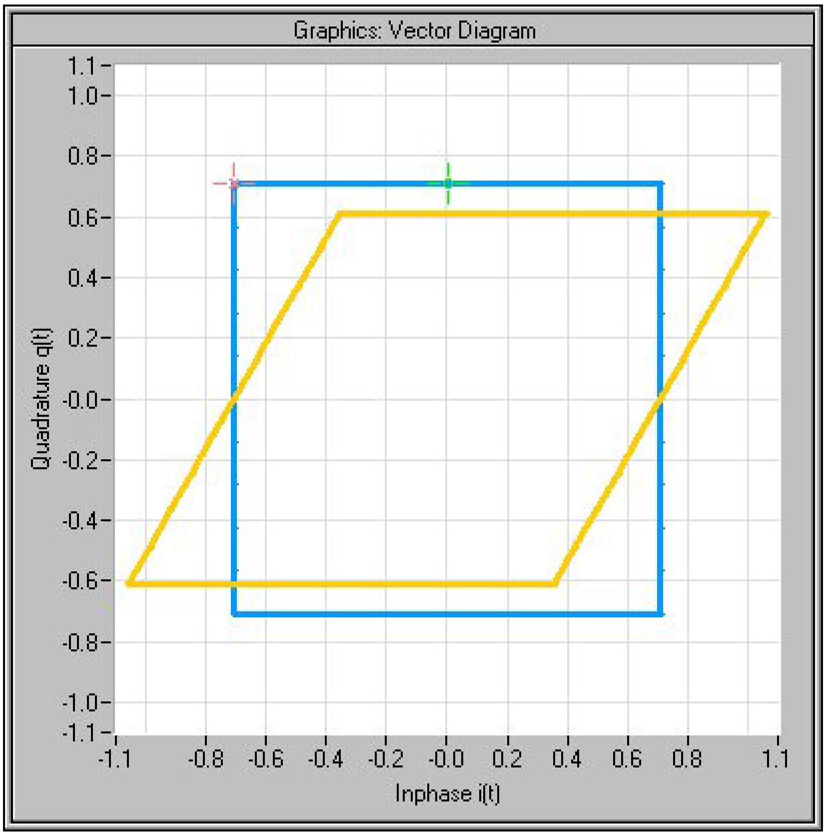
4.1.5.3 Quadrature Error

An ideal I/Q modulator sets the phase angle to exactly 90 degrees. With a quadrature error, the phase angle between the I and Q vector deviates from the ideal 90 degrees, the amplitudes of both components are of the same size. In the vector diagram, the quadrature error causes the coordinate system to shift.

A positive quadrature error means a phase angle greater than 90 degrees:



A negative quadrature error means a phase angle less than 90 degrees:



4.1.6 EVM Measurement

The R&S FSV-K91 option provides two different types of EVM calculation.

Peak EVM (IEEE)

Peak EVM (IEEE) evaluates the EVM as defined in section 18.4.7.8 "Transmit modulation accuracy" of the IEEE 802.11b standard. The measurement signal is corrected in respect of frequency error and clock deviation before EVM calculation. Additionally the specified calculation removes the dc offset of the measurement signal.

The standard does not specify a normalization factor for the error vector magnitude. To get a level independent EVM value, the R&S FSV-K91 normalizes the EVM values, so that an EVM of 100% indicates that the error power on the I- or Q-channels equals the mean power on the I- or Q-channels respectively.

The Peak EVM is the maximum EVM over all chips of one burst. If more than one burst is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count), the Min / Mean / Max columns show the minimum, mean or maximum Peak EVM of all analyzed bursts.

The IEEE 802.11b standard allows a Peak EVM of less than 35%. In contrary to the specification, the R&S FSV-K91 does not limit the measurement to 1000 chips length, but searches the maximum over the whole burst.

Burst EVM (Direct)

Burst EVM (Direct) evaluates the root mean square EVM over one burst. That is the square root of the averaged error power normalized by the averaged reference power:

$$\mathrm{EVM} = \sqrt{\frac{\sum_{n=0}^{N-1}\left|x_{\mathrm{meas}}(n) - x_{\mathrm{ref}}(n)\right|^2}{\sum_{n=0}^{N-1}\left|x_{\mathrm{ref}}(n)\right|^2}} = \sqrt{\frac{\sum_{n=0}^{N-1}\left|e(n)\right|^2}{\sum_{n=0}^{N-1}\left|x_{\mathrm{ref}}(n)\right|^2}}$$

Before calculation of the EVM, the measurement signal is corrected in respect of frequency error, clock deviation and IQ impairments.

If more than one burst is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count), the Min / Mean / Max columns show the minimum, mean or maximum Burst EVM of all analyzed bursts.

Burst EVM is not part of the IEEE standard and no limit check is specified. Nevertheless, this commonly used EVM calculation can give some insight in modulation quality and allows comparisons to other modulation standards.

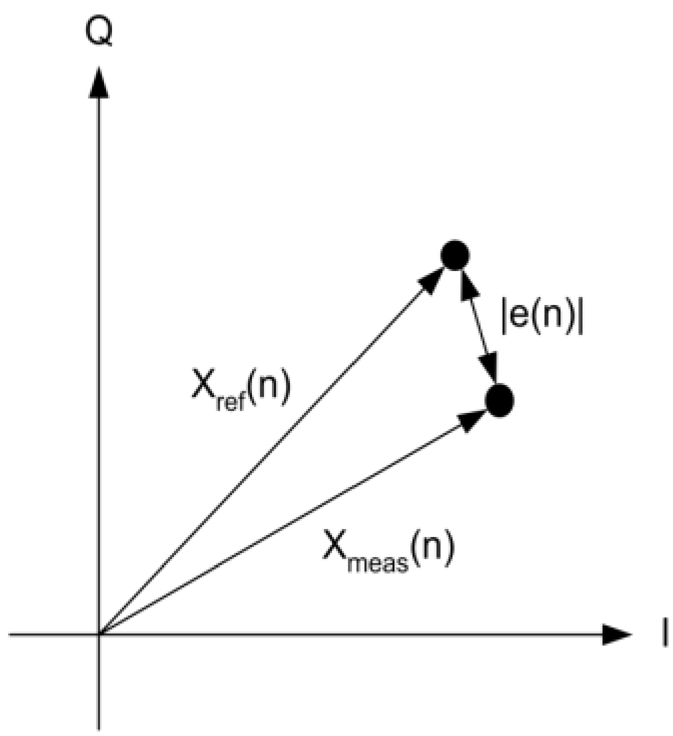


Fig. 4-3: IQ diagram for EVM calculation

4.2 Instrument Functions WLAN TX Measurements (R&S FSV-K91/91n)

The WLAN TX Measurements option extends the functionality of the analyzer signal analyzer to enable Wireless LAN TX measurements according to the standards specified for the device:

- Modulation formats:
  - IEEE 802.11a, j & g (OFDM)
  - BPSK
  - QPSK
  - 16QAM
  - 64QAM
- IEEE 802.11b & g (single carrier mode)
  - DBPSK
  - DQPSK
  - CCK (5.5 & 11 Mbps)
  - PBCC (5.5, 11 & 22 Mbps)
- IEEE 802.11n (OFDM)
  - BPSK (6.5 & 7.2 Mbps)
  - QPSK (13, 14.4, 19.5 & 21.7 Mbps)
  - 16QAM(26, 28.9, 39 & 43.3 Mbps)
  - 64QAM(52, 57.8, 58.5, 65 & 72.2 Mbps)
- Modulation measurements:
  - Constellation diagram
  - Constellation diagram per OFDM carrier
  - I/Q offset and I/Q imbalance
  - Carrier and symbol frequency errors
  - Modulation error (EVM) per OFDM carrier or symbol
  - Amplitude response and group-delay distortion (spectral flatness)
- Amplitude statistics (CCDF) and crest factor
- Transmit spectrum mask
- FFT, also over a selected part of the signal, e.g. preamble
- Payload bit information
- Capture time selectable (dependent on selected standard), multiple sweeps possible for large number of bursts
- Freq/Phase Err vs. Preamble

To open the WLAN menu

- If the "WLAN" mode is not the active measurement mode, press the MODE key and select the "WLAN" softkey

To exit the "WLAN" measurement mode, select another option.

Menu and softkey description

- chapter 4.2.2, "Softkeys of the WLAN TX Menu (R&S FSV-K91/91n)", on page 44
- chapter 4.2.5, "Softkeys of the Sweep Menu – SWEEP key (R&S FSV-K91/91n)", on page 80
- chapter 4.2.7, "Softkeys of the Marker Menu – MKR key (R&S FSV-K91/91n)", on page 81
- chapter 4.2.8, "Softkeys of the Marker To Menu – MKR-> key (R&S FSV-K91/91n)", on page 82
- chapter 4.2.9, "Softkeys of the Lines Menu – LINES key (R&S FSV-K91/91n)", on page 83
- chapter 4.2.6, "Softkeys of the Trace Menu – TRAC key (R&S FSV-K91/91n)", on page 81
- chapter 4.2.10, "Softkeys of the Input/Output Menu for WLAN Measurements", on page 83

The "Span", "Bandwidth", "Marker Function", and "Auto Set" menus are not available in the WLAN mode.

The FREQ, AMPT, and TRIG keys open the "General Settings" or the "Demod Settings" dialog box. For details refer to the "Settings General/Demod" on page 46 softkey description ("WLAN" menu).

To display help to a softkey, press the HELP key and then the softkey for which you want to display help. To close the help window, press the ESC key. For further information refer to chapter 3, "How to Use the Help System", on page 11.

Further information

This chapter provides further information about the measurements and result displays for R&S FSV-K91/91n application.

- chapter 4.2.1, "Measurement and Result Displays", on page 36
- chapter 4.2.1.2, "Result Summary List", on page 38
- chapter 4.2.1.3, "Result Display Graph", on page 42
- chapter 4.2.1.1, "Measurement Settings", on page 37
- chapter 4.2.1.2, "Result Summary List", on page 38
- chapter 4.2.1.3, "Result Display Graph", on page 42
- chapter 4.2.1.4, "Rise/Fall Time Measurement", on page 43
- chapter 4.2.1.5, "Title Bar Information", on page 44
- chapter 4.2.1.6, "Status Bar Information", on page 44

4.2.1 Measurement and Result Displays

The WLAN option provides two main measurement types:

IQ measurements (based on captured IQ data):

- Power vs Time (see "PVT" on page 46)
- EVM vs Symbol, EVM vs Carrier (see "EVM vs Symbol/Carrier" on page 51 softkey)
- Phase vs Preamble, Frequency vs Preamble (see "Error Frequency/Phase" on page 53 softkey)
- Spectrum Flatness (see "Spectrum Flatness (IEEE 802.11a, g, j, n – OFDM)" on page 59 softkey)
- Spectrum FFT (see "Spectrum FFT" on page 61 softkey)
- Constellation vs Symbol, Constellation vs Carrier (see "Constell vs Symbol/Carrier" on page 55 softkey)
- Conditional Cumulative Distribution Function (see "CCDF" on page 66 softkey)
- Bit Stream (see "Bitstream" on page 66 softkey)
- Signal Field (see "Signal Field (IEEE 802.11a, g, j & n – OFDM)/ PLCP Header (IEEE 802.11b, g – Single Carrier)" on page 68 softkey)

Frequency sweep measurements:

- Spectrum mask (see "Spectrum Mask (IEEE 802.11b, g – Single Carrier)/ Spectrum IEEE/ETSI (IEEE 802.11a, g, j & n – OFDM) " on page 60 softkey)
- Spectrum ACP/ACPR (see "Spectrum ACPR (IEEE 802.11a, g, n, OFDM Turbo Mode)/ Spectrum ACP (IEEE 802.11b)/ ACP Rel/Abs (IEEE 802.11j)" on page 62

The measurement result display is divided into two panes:

- chapter 4.2.1.1, "Measurement Settings", on page 37
- Result displays

The results can be displayed in form of a list or a graph (see also "Display List/Graph" on page 46 softkey).

- chapter 4.2.1.2, "Result Summary List", on page 38
- chapter 4.2.1.3, "Result Display Graph", on page 42

4.2.1.1 Measurement Settings

The overall measurement settings used to obtain the current measurement results are displayed below the title bar (see figure 4-4). The following settings are listed:

Setting	Description	Restrictions
Frequency	The frequency of the measured input signal.	
Burst Type	The type of burst being analyzed.	IEEE 802.11a, g (OFDM), j, n and Turbo Mode only
Preamble Type	The type of preamble of analyzed bursts.	IEEE 802.11b & g (Single Carrier) only
Signal Level	The expected mean signal level for the input signal.	IEEE 802.11a, g (OFDM), j, n and Turbo Mode only
Ref Level	The reference level used for the input signal.	IEEE 802.11b, g (Single Carrier) only
Modulation	Shows the active setting selected in the "Demod Settings" dialog box: "Demodulator" or "PSDU Modulation to Analyze".	
External Att	The attenuation (positive values) or gain (negative values) applied to the signal externally (i.e. before the RF or IQ connector of the signal analyzer), e.g.: External Att = 10 dB means that before the RF connector of the analyzer a 10 dB attenuator is used External Att = -20 dB means that before the RF connector of the analyzer a amplifier with 20 dB gain is used	
Data Symbols	Shows the minimum and maximum number of data symbols that a burst may have if it is to be considered in results analysis.	IEEE 802.11a, g (OFDM), j and Turbo Mode only
PSDU Data Length	Shows the minimum and maximum number of data bytes that a burst may have if it is to be considered in results analysis.	IEEE 802.11b, g (Single Carrier) only

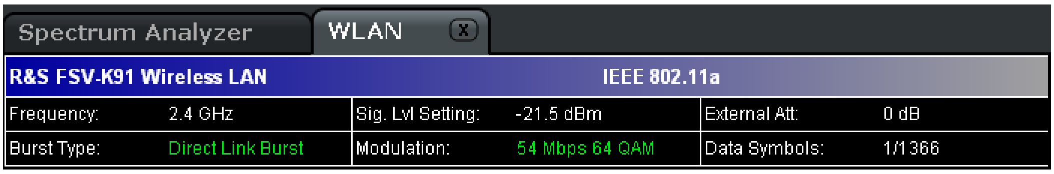
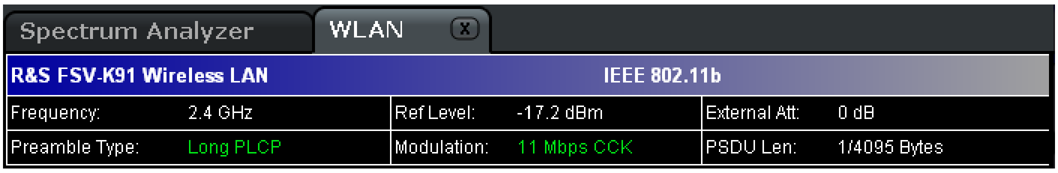


Fig. 4-4: Measurement settings (example)



4.2.1.2 Result Summary List

The result summary list shows the overall measurement results and provides limit checking for result values in accordance with the selected standard. Result values which are within the limit as specified by the standard are displayed in green. Result values which are outside of the limits specified by the standard are displayed in red with a '*' to the left. Results which have no limits specified by the standard are displayed in white. Limit values are displayed in white (not bold) and can be modified, if focused, via the keypad. To reset the limit values to the values specified in the standard, use the "Lines" menu (chapter 4.2.9, "Softkeys of the Lines Menu – LINES key (R&S FSV-K91/91n)", on page 83).

The results displayed in this list are for the entire measurement. If a specific number of bursts have been requested which requires more than one sweep, the result summary list is updated at the end of each sweep. The number of bursts measured and the number of bursts requested are displayed to show the progress through the measurement. The Min/Mean/Max columns show the minimum, mean or maximum values of the burst results.

Result display for measurements on OFDM signals

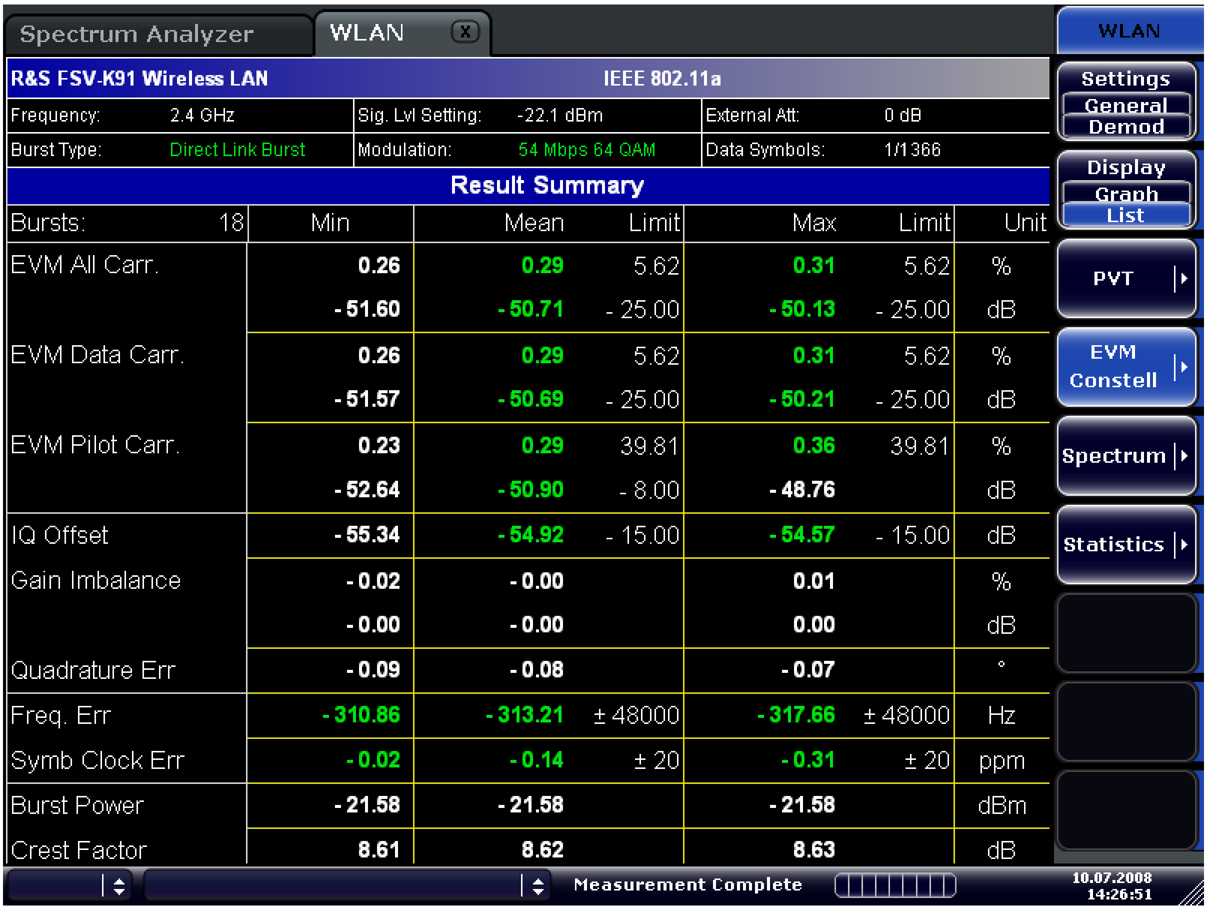


Fig. 4-5: Result summary list for measurements on OFDM signals

- **EVM All Carr, IEEE802.11a, j, g**
  Shows the EVM (Error Vector Magnitude) over all carriers of the payload symbols in % and in dB. For better orientation, the table also shows the corresponding limits specified in the standard.
- **EVM Data Carr, IEEE802.11a, j, g**
  Shows the EVM (Error Vector Magnitude) over all data carriers of the payload symbols in % and in dB. For better orientation, the table also shows the corresponding limits specified in the standard.
- **EVM Pilot Carr, IEEE802.11a, j, g**
  Shows the EVM (Error Vector Magnitude) over all pilot carriers of the payload symbols in % and in dB. For better orientation, the table also shows the corresponding limits specified in the standard.
- **IQ Offset, IEEE802.11a, j, g**
  Shows the IQ offset of the signal in dB. This is the transmitter center frequency leakage relative to overall transmitted power. For better orientation, the table also shows the corresponding limits specified in the standard.
- **Gain Imbalance, IEEE802.11a, j, g**
  Shows the gain imbalance of the signal in % as well as dB. This is the amplification of the quadrature phase component of the signal relative to the in-phase component.

- **Quadrature Error, IEEE802.11a, j, g**
  Shows the quadrature error of the signal in degree. This is the deviation of the quadrature phase angle from the ideal 90°.
- **Frequency Error, IEEE802.11a, j, g**
  Shows the frequency error between the signal and the current center frequency of the R&S analyzer. The absolute frequency error is the sum of the frequency error of the R&S analyzer and that of the DUT. If possible, the transmitter and the receiver should be synchronized.
  For better orientation, the table also shows the corresponding limits specified in the standard.
- **Symbol Clock Error, IEEE802.11a, j, g**
  Shows the clock error between the signal and the sample clock of the R&S analyzer in parts per million (ppm). For better orientation, the table also shows the corresponding limits specified in the standard.
- **Burst Power, IEEE802.11a, j, g**
  Shows the mean burst power in dBm.
- **Crest Factor, IEEE802.11a, j, g**
  Shows the crest factor in dB. The crest factor is the ratio of the peak power to the mean power of the signal (also called Peak to Average Power Ratio, PAPR).

Result display for measurements on DSSS / CCK / PBCC signals

Fig. 4-6: Result summary list for measurements on DSSS/CCK/PBCC signals

- **Peak Vector Err, IEEE802.11b, g**
  Shows the peak vector error over the complete burst including the preamble in % and in dB. The vector error is calculated according to the IEEE 802.11b definition of the normalized error vector magnitude. For better orientation, the table also shows the corresponding limits specified in the standard.
- **Burst EVM, IEEE802.11b, g**
  Shows the EVM (Error Vector Magnitude) over the complete burst including the preamble in % and dB.
- **IQ Offset**
  Shows the IQ offset of the signal in dB. This is the IQ offset magnitude relative to the RMS magnitude at the chip timing.
- **Gain Imbalance**
  see "Result display for measurements on OFDM signals", on page 39
- **Quadrature Error**
  see "Result display for measurements on OFDM signals", on page 39
- **Center Frequency Error**
  see "Result display for measurements on OFDM signals", on page 39
- **Chip Clock Error, IEEE802.11b, g**

see Symbol Clock Error in "Result display for measurements on OFDM signals", on page 39

- **Rise Time, IEEE802.11b, g**
  Shows the rise time of the pulsed signal in µs. This is the time period the signal needs to increase its power level from 10% to 90% of the maximum resp. the average power depending on the reference power setting. For better orientation, the table also shows the corresponding limits specified in the standard.
- **Fall Time, IEEE802.11b, g**
  Shows the fall time of the pulsed signal in µs. This is the time period the signal needs to decrease its power level from 90% to 10% of the maximum resp. the average power depending on the reference power setting. For better orientation, the table also shows the corresponding limits specified in the standard.
- **Mean Power, IEEE802.11b, g**
  Shows the mean burst power in dBm.
- **Peak Power, IEEE802.11b, g**
  Shows the maximum burst power in dBm.
- **Crest Factor**
- **Rise Time, IEEE802.11b, g**
  Shows the rise time of the pulsed signal in µs. This is the time period the signal needs to increase its power level from 10% to 90% of the maximum resp. the average power depending on the reference power setting. For better orientation, the table also shows the corresponding limits specified in the standard.

All parameters and their calculations are described in detail in chapter 1 of this manual, 'Advanced Measurement Examples'

4.2.1.3 Result Display Graph

Additionally to the selected graphical result display, the Magnitude Capture Buffer display is provided for all IQ measurements. The different result displays are described with the corresponding softkey.

The Magnitude Capture Buffer display shows the complete range of captured data for the last sweep. All analyzed bursts are identified with a green bar at the bottom of the Magnitude Capture Buffer display. If, in the "Demod Settings" dialog box, the "Signal Field Content" option is activated, only bursts that match the required criteria are marked with a green bar (see "Signal Field Content (IEEE 802.11a, g (OFDM), j & n)" on page 75).

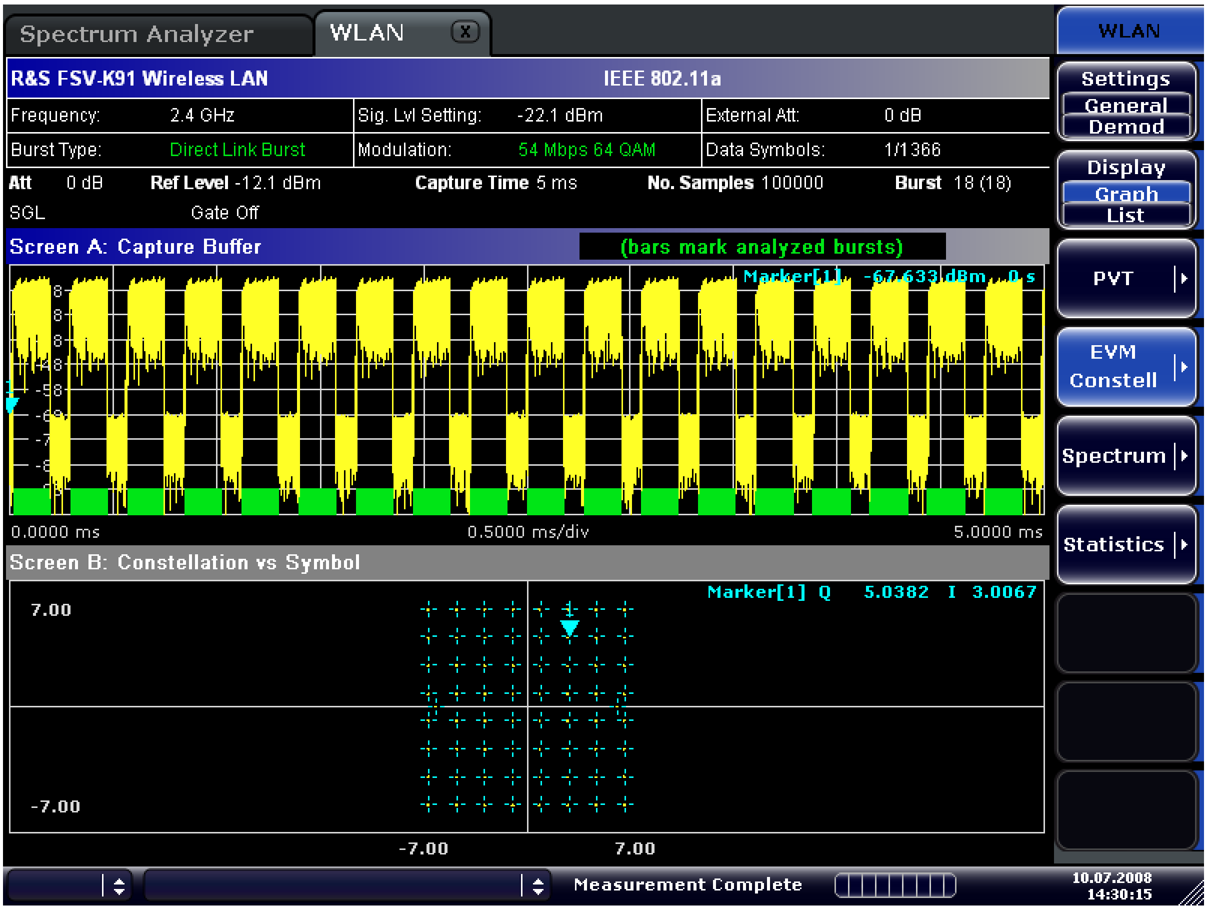


Fig. 4-7: Magnitude capture buffer results (example)

- IQ measurements
  All IQ measurements process the same signal data and as such all IQ measurement results are available after a single IQ measurement execution.
  IQ measurements can be run in split screen mode (allowing both the Magnitude Capture Buffer display and the selected IQ measurement results to be displayed simultaneously) or in full screen mode (with either the Magnitude Capture Buffer display or the selected IQ measurement results displayed).
- Frequency sweep measurements
  The frequency sweep measurements use different signal data to IQ measurements and as such it is not possible to run an IQ measurement and then view the results in the frequency sweep measurements and vice-versa. Also because each of the frequency sweep measurements uses different settings to obtain signal data it is not possible to run a frequency sweep measurement and view the results of another frequency sweep measurement.
  All frequency sweep measurements are run in full screen mode.

4.2.1.4 Rise/Fall Time Measurement

The rise/fall time is calculated according to the following algorithm:

- Apply a moving average filter over the burst power (adjustable average length)

- If "Ref Pow Max" is set: Search maximum power Pmax over the whole burst. Set Pref=Pmax
- If "Ref Pow Mean" is set: Calculate mean power Pmean of the whole burst. Set Pref=Pmean
- Rise time
  – Search the first crossing of 0.5xPref from the left.
  – Search backwards for the 10 % crossing 0.1xPref and note t10.
  – Search forward for the 90 % crossing 0.9xPref and note t90.
  – Return Trise=t90-t10.
- Fall time
  – Search the first crossing of 0.5xPref from the right.
  – Search forwards for the 10 % crossing 0.1xPref and note t10.
  – Search backwards for the 90 % crossing 0.9xPref and note t90.
  – Return Tfall=t10-t90.

Since the single carrier modes of 802.11b, g use linear modulation formats like BPSK or QPSK, the transmit signal power varies between symbol sampling times. These power variations are determined by the transmit filter, which is not defined in the standard. The R&S FSV-K91/91n allows fine tuning of the PVT measurements on signals with high crest factors by an adjustable moving average filter and two different reference power settings.

The reference power equals the 100 % setting for the rise/fall time calculation. Either the maximum burst power or the mean burst power can be chosen as reference power. Using the mean burst power, rarely power peaks within the burst does not influence the rise/fall time measurement.

The moving average filter smoothes the power trace and thus eliminates the modulation. While a long average length leads to more stable measurement results, it naturally increases the rise/fall times compared to no averaging.

4.2.1.5 Title Bar Information

The title bar displays the following information:

- wireless LAN standard applicable to the current measurement.

4.2.1.6 Status Bar Information

- The status bar displays the same information as the base device (see the "Quick Start Guide").

4.2.2 Softkeys of the WLAN TX Menu (R&S FSV-K91/91n)

The following table shows all softkeys available in the "WLAN" menu. It is possible that your instrument configuration does not provide all softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Settings General/Demod

Opens the "General Settings" or the "Demod Settings" dialog box. For details see chapter 4.2.3, "General Settings Dialog Box (K91)", on page 70 or chapter 4.2.4, "Demod Settings Dialog Box (K91)", on page 75.

Alternatively, the "General Settings" dialog box is opened as follows:

- FREQ key, with focus on the "Frequency" field
- AMPT key, with focus on the "Signal Level" ("RF") field
- TRIG key, with focus on the "Trigger Mode" field

Display List/Graph

Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:

`DISPlay[:WINDow<n>]:TABLe` on page 126

For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

PVT

Opens the PVT submenu to select the Power vs Time measurement results.

The PVT result displays show the minimum, average and maximum levels measured over the full range of the measured input data, or over complete bursts displayed within the gating lines if gating is switched on. The results are displayed as a single burst. Using screen B in full screen provides additional power information during this measurement.

For IEEE 802.11b and g (single carrier), the PVT results are displayed as percentage values of the reference power. The reference can be set to either the max or mean power of the burst. For both rising and falling edges two time lines are displayed, which mark the points 10 % and 90 % of the reference power. The time between these two points is compared against the limits specified for the rising and falling edges.

For further details see also chapter 4.2.1.4, "Rise/Fall Time Measurement", on page 43

SCPI command:

`CONFigure:BURSt:PVT[:IMMediate]` on page 120

Settings General/Demod ← PVT

Opens the "General Settings" or the "Demod Settings" dialog box. For details see chapter 4.2.3, "General Settings Dialog Box (K91)", on page 70 or chapter 4.2.4, "Demod Settings Dialog Box (K91)", on page 75.

Alternatively, the "General Settings" dialog box is opened as follows:

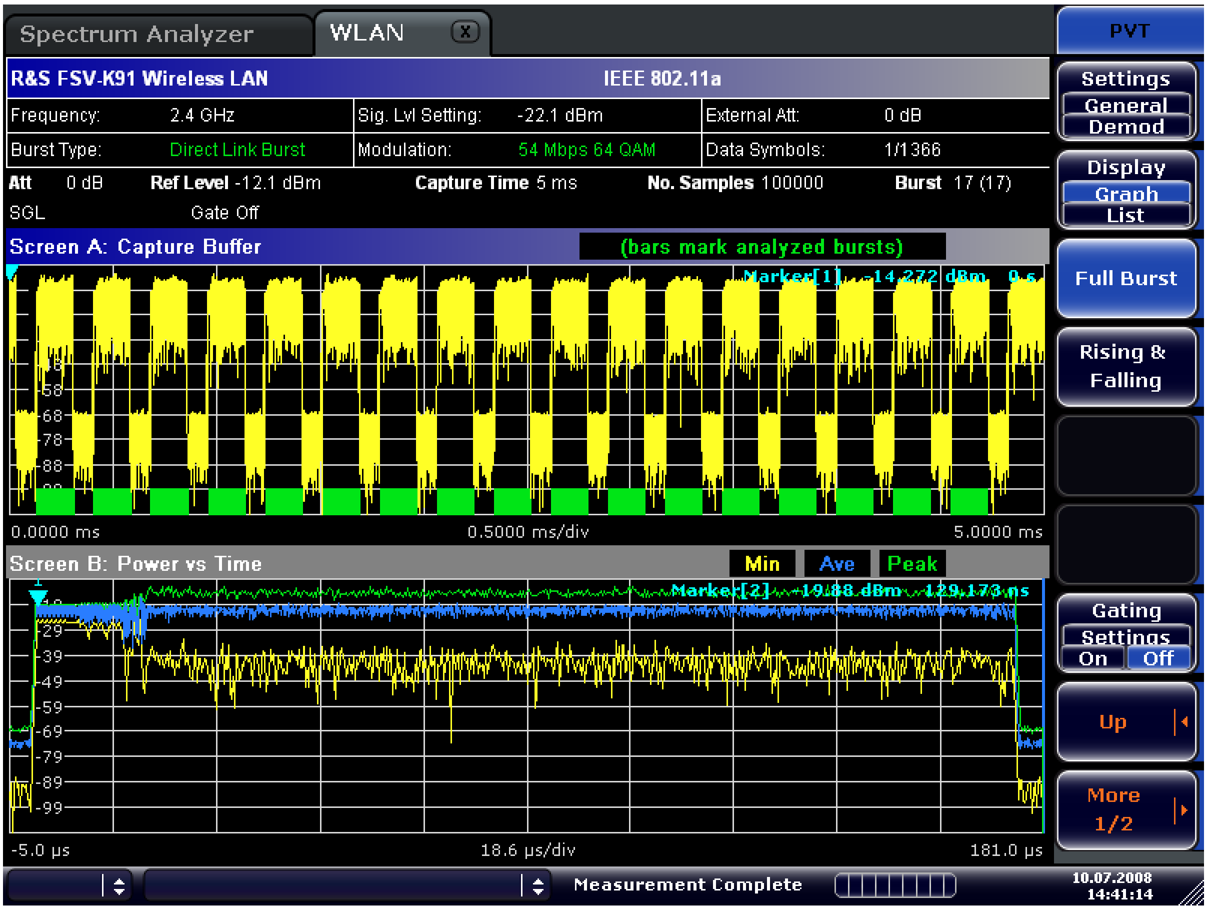
- FREQ key, with focus on the "Frequency" field
- AMPT key, with focus on the "Signal Level" ("RF") field
- TRIG key, with focus on the "Trigger Mode" field

Display List/Graph ← PVT
Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:
`DISPlay[:WINDow<n>]:TABLe` on page 126

For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

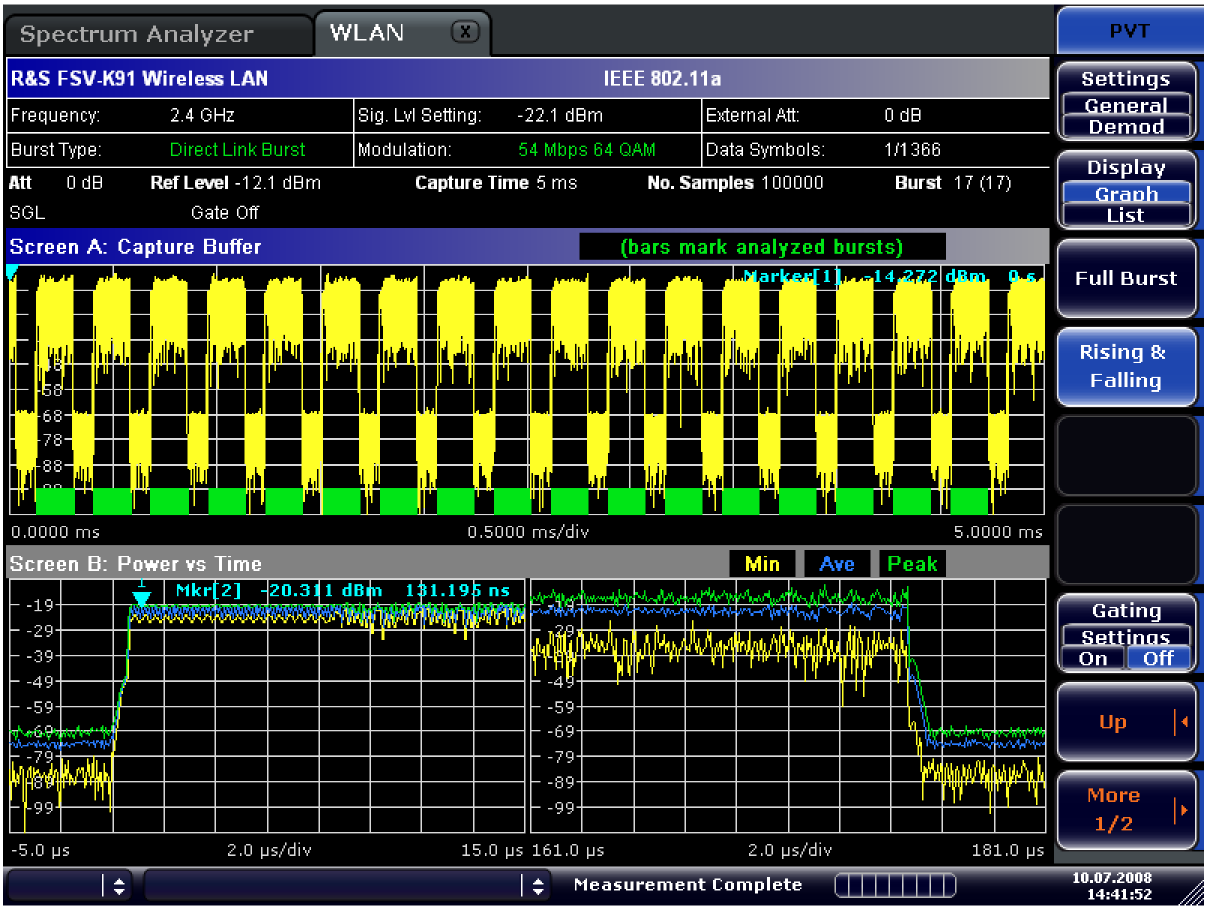
Full Burst (IEEE 802.11a, g, j &n – OFDM) ← PVT
Displays the PVT results in a single graph with all burst data being displayed.



For further details refer to the "PVT" on page 46 softkey.

SCPI command:
`CONFigure:BURSt:PVT:SELect` on page 120

Rising & Falling (IEEE 802.11a, g, j, n – OFDM) ← PVT
Displays the PVT results in two separate graphs, the left hand side showing the rising edge and the right hand side showing the falling edge.



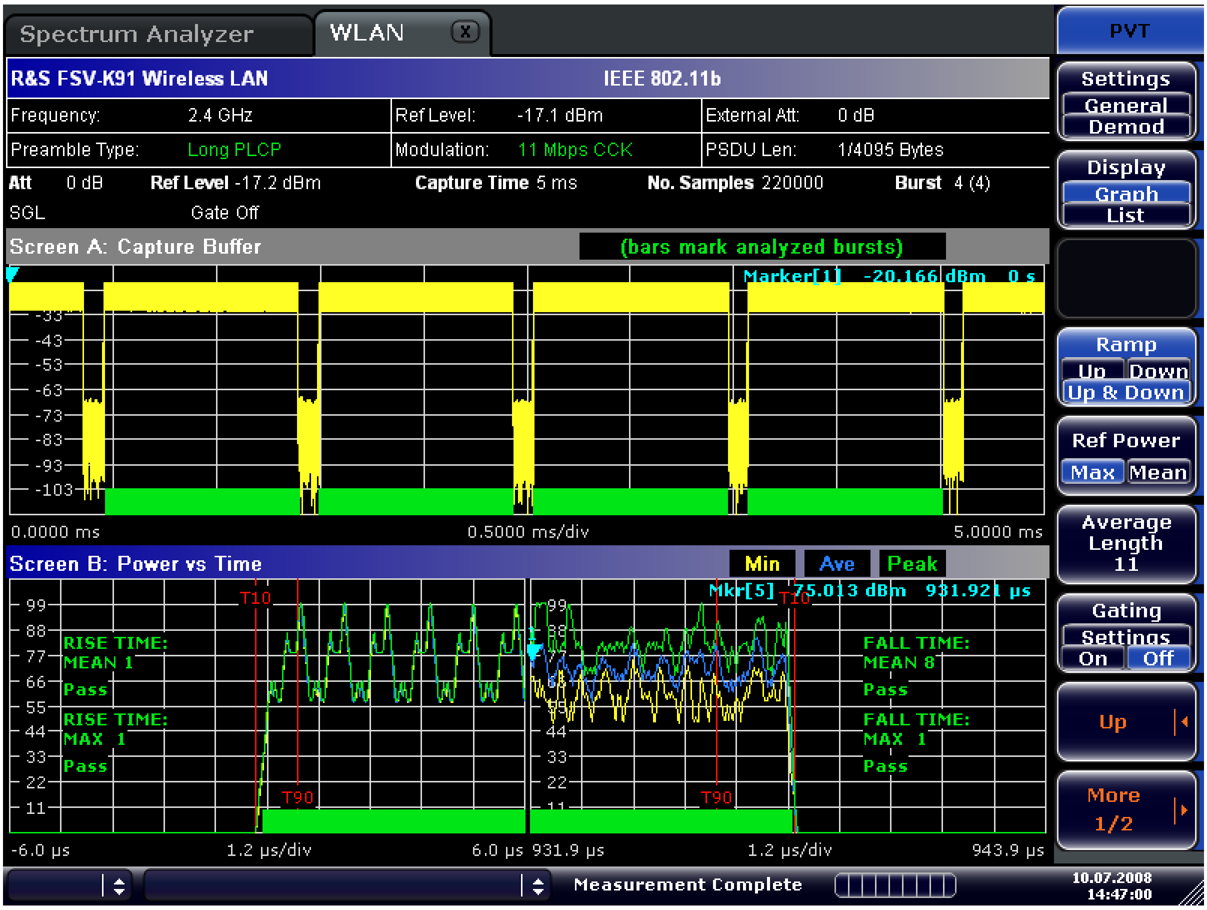
SCPI command:

`CONFigure:BURSt:PVT:SELect` on page 120

Ramp Up/Down/Up & Down (IEEE 802.11b, g – Single Carrier) ← PVT

Sets the display of the rising/falling edge graph:

Up	Displays the rising edge graph.
Down	Displays the falling edge graph.
Up & Down	Displays the rising and falling edge graph.



For further details refer to the "PVT" on page 46 softkey.

SCPI command:

`CONFigure:BURSt:PVT:SELect` on page 120

Ref Pow Max/Mean (IEEE 802.11b, g – Single Carrier) ← PVT

Sets the reference for the rise and fall time calculation to the maximum or mean burst power.

For further details refer to the "PVT" on page 46 softkey.

SCPI command:

`CONFigure:BURSt:PVT:RPOWer` on page 120

Average Length (IEEE 802.11b, g – Single Carrier) ← PVT

Opens an edit dialog box to enter the number of samples in order to adjust the length of the smoothing filter.

For further details refer to the "PVT" on page 46 softkey.

SCPI command:

`CONFigure:BURSt:PVT:AVERage` on page 120

Gating Settings On/Off ← PVT

Activates or deactivates gating, and opens the "Gate Settings" dialog box to specify range of captured data used in results calculation.

On	Uses only the specified range of captured data in results calculation. In the Magnitude Capture Buffer trace, two vertical lines mark the specified range.
Off	Uses all the captured data in results calculation.

In the "Gate Settings" dialog box, the following parameters are set:

Delay	Start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data in time or samples. If the delay is specified in time, the number of samples is updated accordingly, and vice versa.
Length	Amount of captured data to be used in results calculation. If the length is specified in time, the number of samples is updated accordingly, and vice versa.
Link Gate and Mark	If activated, the position of the marker and the gate lines are linked. The marker is positioned half way between gate start and end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

The gate settings are defined for following measurements: PVT, Spectrum FFT, CCDF, Spectrum Mask, Spectrum ACPR.

If a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the result display is switched to the Magnitude Capture Buffer display in order to allow the gate to be set the correct part of the sweep.

SCPI command:
`SWE:EGAT ON`
`SWE:EGAT:HOLD 125us, SWE:EGAT:HOLD:SAMP 2500` (Delay)
`SWE:EGAT:LENG 20ms, SWE:EGAT:LENG:SAMP 200000` (Length)
`SWE:EGAT:LINK ON` (Link Gate and Mark), see `[SENSe:]SWEep:EGATe:LINK` on page 153

Import ← PVT
Opens the "Choose the file to import" dialog box.

Select the IQ data file you want to import and press ENTER. The extension of data files is *.iqw.

SCPI command:
`MMEMory:LOAD:IQ:STATe 1,` on page 140

Export ← PVT
Opens the "Choose the file to export" dialog box.

Enter the path and the name of the IQ data file you want to export and press ENTER. The extension of data files is *.iqw. If the file cannot be created or there is no valid IQ data to export an error message is displayed.

SCPI command:
`MMEMory:STORe:IQ:STATe 1,` on page 140

R&S Support ← PVT
Stores useful information for troubleshooting in case of errors.

This data is stored in the `C:\R_S\Instr\user\Support` directory on the instrument.

If you contact the Rohde&Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

EVM Constell

Opens a submenu to select the error vector magnitude (EVM) or the constellation result displays.

Settings General/Demod ← EVM Constell

Opens the "General Settings" or the "Demod Settings" dialog box. For details see chapter 4.2.3, "General Settings Dialog Box (K91)", on page 70 or chapter 4.2.4, "Demod Settings Dialog Box (K91)", on page 75.

Alternatively, the "General Settings" dialog box is opened as follows:

- FREQ key, with focus on the "Frequency" field
- AMPT key, with focus on the "Signal Level" ("RF") field
- TRIG key, with focus on the "Trigger Mode" field

Display List/Graph ← EVM Constell

Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:

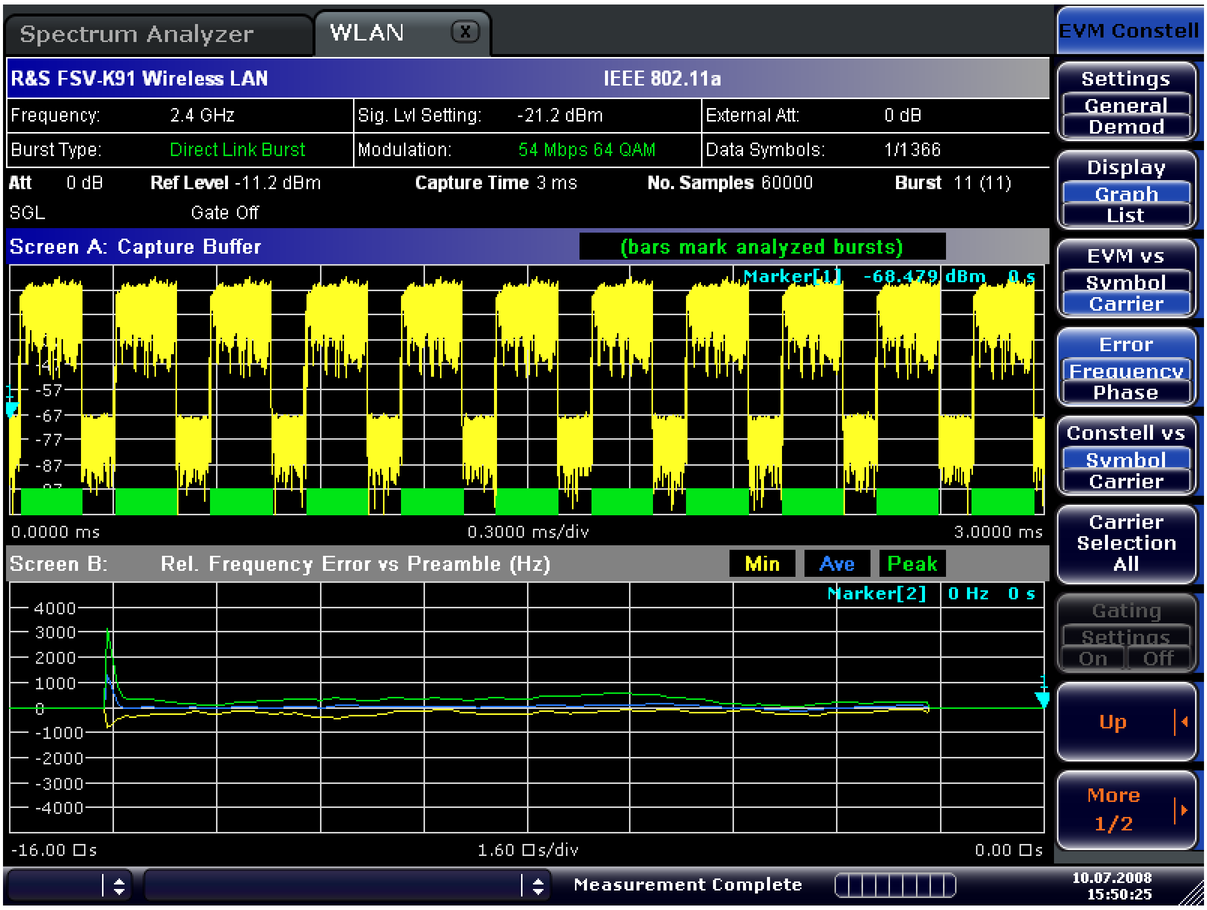
`DISPlay[:WINDow<n>]:TABLe` on page 126

For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

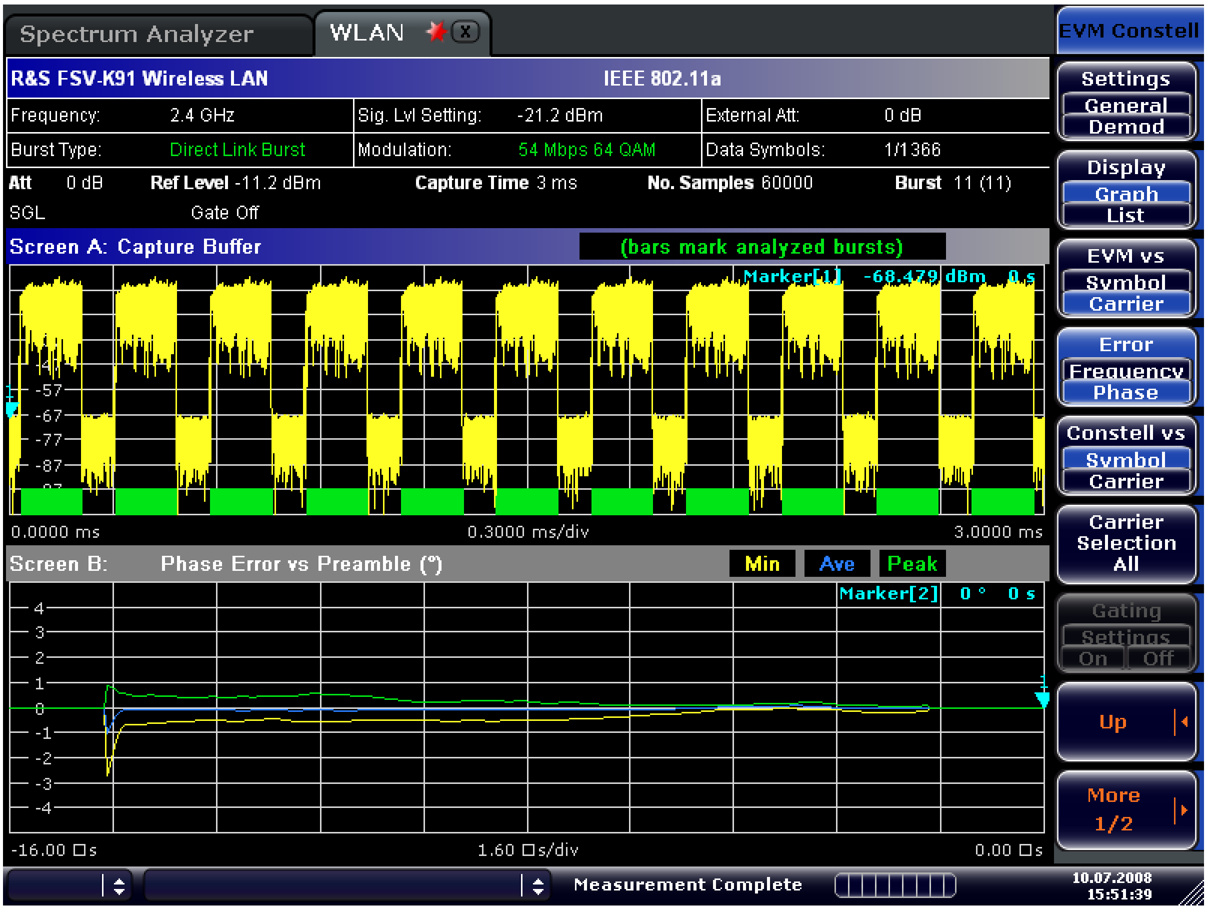
EVM vs Symbol/Carrier ← EVM Constell

Selects the EVM vs Symbol or EVM vs Carrier result displays.

- EVM vs Symbol
  This result display shows the EVM measured over the full range of the measured input data. The results are displayed on a per-symbol basis, with blue vertical lines marking the boundaries of each burst. Note that burst boundary lines are only displayed if the number of analyzed bursts is less than 250.
  For IEEE 802.11a, j, g (OFDM) & n the minimum, average, and maximum traces are displayed.
  For IEEE 802.11b, g (Single Carrier) two EVM traces are displayed. The trace labeled with VEC ERR IEEE shows the error vector magnitude as defined in the IEEE 802.11b, g standards. For the trace labeled with EVM a commonly used EVM definition is applied, which is the square root of the momentary error power normalized by the averaged reference power.



- EVM vs Carrier (IEEE 802.11a, g, j – OFDM) & n
  This result display shows all EVM values recorded on a per-carrier basis over the full set of measured data. An average trace is also displayed.



SCPI command:

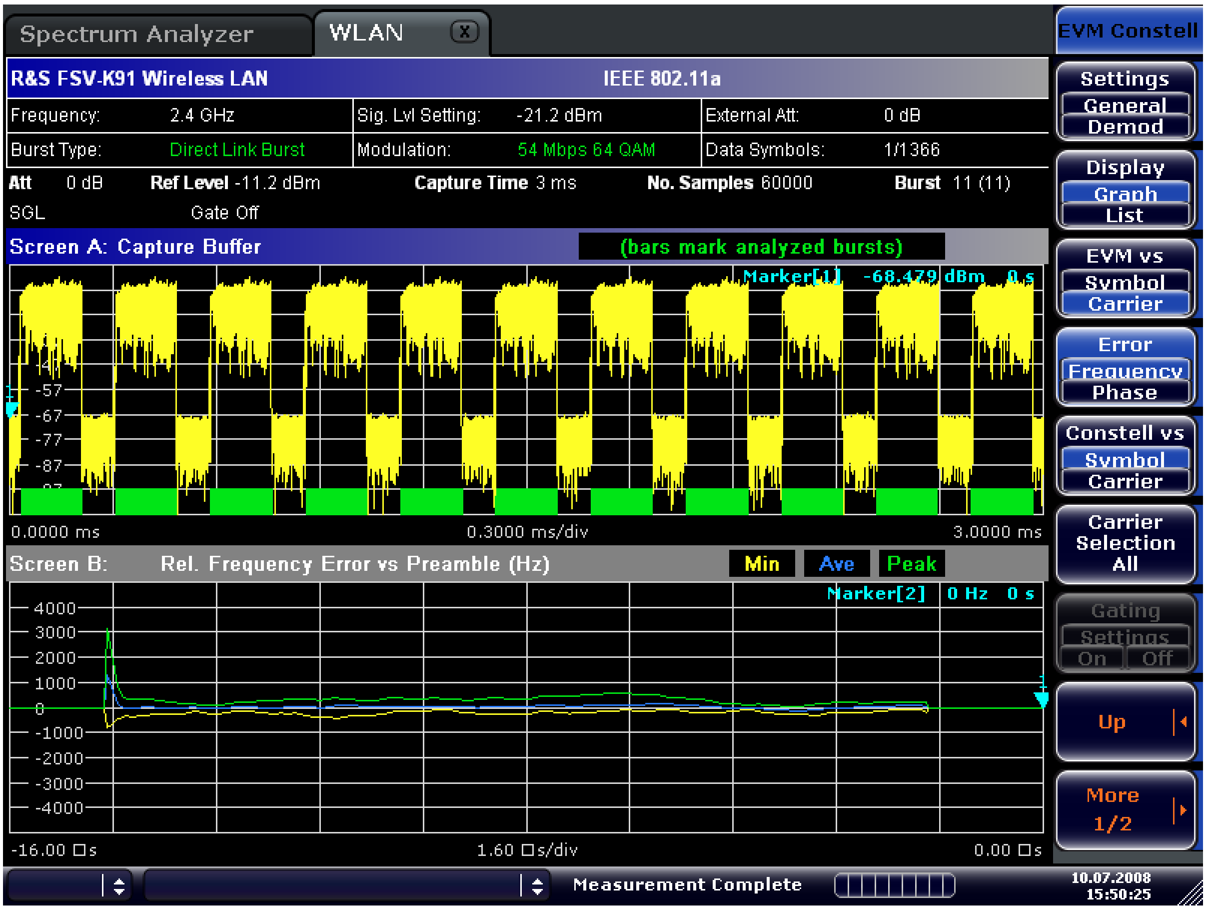
CONFigure:BURSt:EVM:ESYMbol[:IMMediate] on page 119

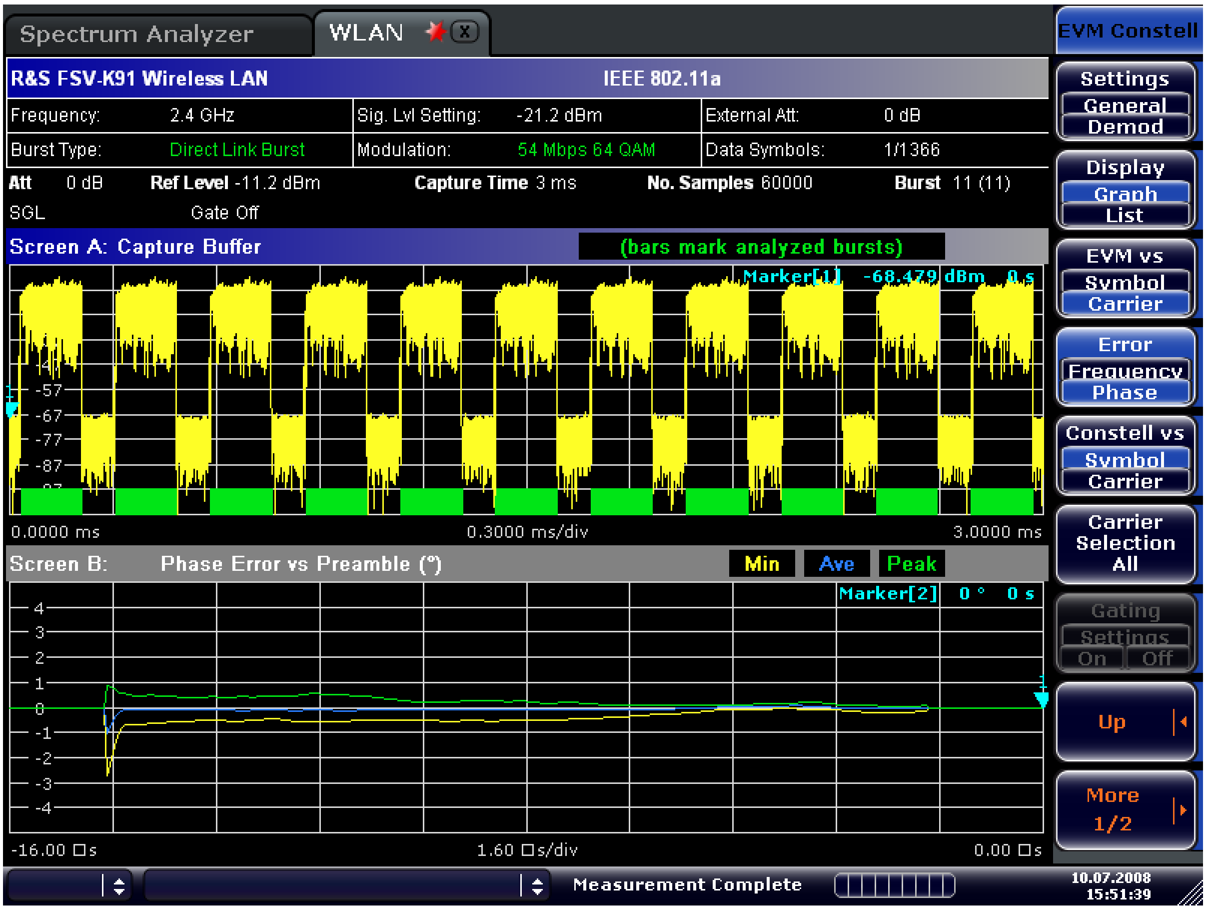
CONFigure:BURSt:EVM:ECARrier[:IMMediate] on page 119

Error Frequency/Phase ← EVM Constell

Selects the Rel. Frequency Error vs Preamble or the Phase Error vs Preamble result displays.

These result displays show the error values recorded over the preamble part of the burst. A minimum, average and maximum trace are displayed. The results display either relative frequency error or phase error.


Spectrum Analyzer
WLAN
R&S FSV-K91 Wireless LAN
IEEE 802.11a
Frequency: 2.4 GHz
Sig. Lvl Setting: -21.2 dBm
External Att: 0 dB
Burst Type: Direct Link Burst
Modulation: 54 Mbps 64 QAM
Data Symbols: 1/1366
Att 0 dB
Ref Level -11.2 dBm
Capture Time 3 ms
No. Samples 60000
Burst 11 (11)
SGL
Gate Off
Screen A: Capture Buffer
(bars mark analyzed bursts)
Marker[1] -68.479 dBm 0 s
0.0000 ms
0.3000 ms/div
3.0000 ms
Screen B: Rel. Frequency Error vs Preamble (Hz)
Min
Ave
Peak
Marker[2] 0 Hz 0 s
-16.00 µs
1.60 µs/div
0.00 µs
Measurement Complete
10.07.2008
15:50:25
EVM Constell
Settings
General
Demod
Display
Graph
List
EVM vs
Symbol
Carrier
Error
Frequency
Phase
Constell vs
Symbol
Carrier
Carrier
Selection
All
Gating
Settings
On
Off
Up
More
1/2



SCPI command:

`CONFigure:BURSt:PREamble[:IMMediate]` on page 119

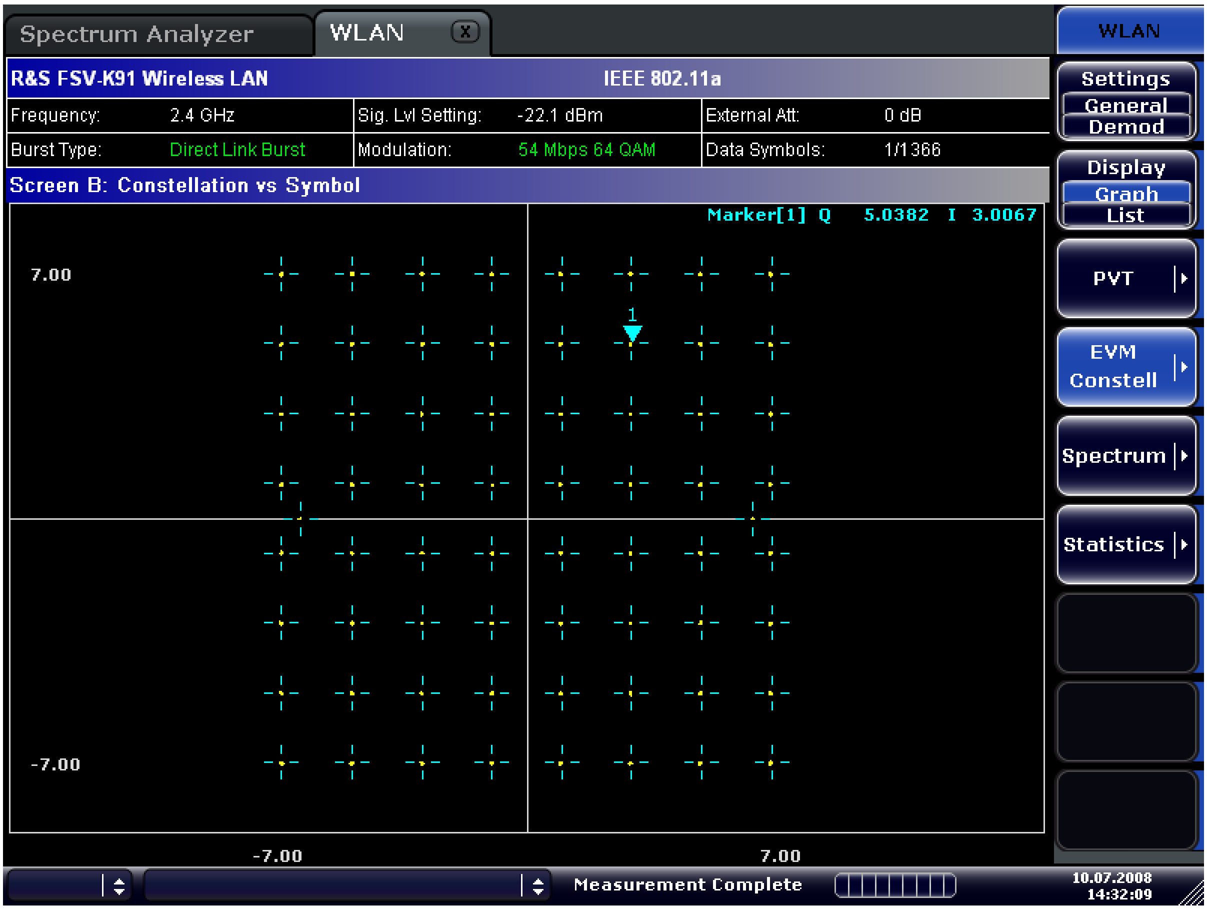
`CONFigure:BURSt:PREamble:SELect` on page 119

`CONFigure:BURSt:PREamble:SELect` on page 119

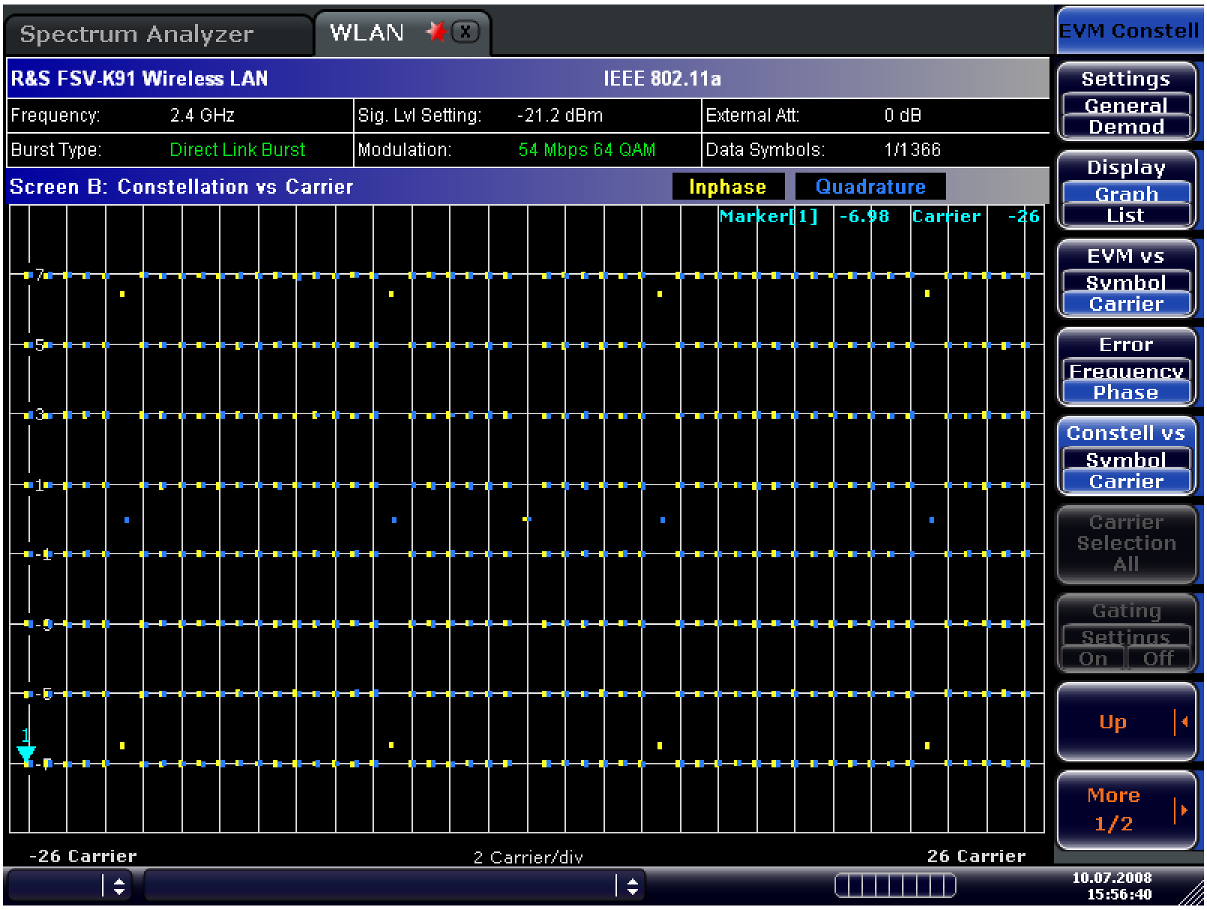
Constell vs Symbol/Carrier ← EVM Constell

Selects the Constallation vs Symbol or the Constellation vs Carrier result displays.

- Constellation vs Symbol (all standards)
  This result display shows the in-phase and quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.
  The amount of data displayed in the Constellation result display can be reduced by selecting the carrier or carriers for which data is to be displayed ("Carrier Selection (IEEE 802.11a, g, j, n – OFDM)" on page 57 softkey).



- Constellation vs Carrier (IEEE 802.11a, g, j – OFDM) & n
  This result display shows the in-phase and quadrature phase results over the full range of the measured input data plotted on a per-carrier basis. The magnitude of the in-phase and quadrature part is shown on the y-axis, both are displayed as separate traces (I-> trace 1, Q-> trace 2).



SCPI command:

CONFigure:BURSt:CONStellation:CSYMbol[:IMMediate] on page 118

CONFigure:BURSt:CONStellation:CCARrier[:IMMediate] on page 118

Carrier Selection (IEEE 802.11a, g, j, n – OFDM) ← EVM Constell

Opens a dialog box to select the carrier for data display. Either a specific carrier number, pilots only or all carriers can be selected.

SCPI command:

CONFigure:BURSt:CONStellation:CARRier:SELect on page 118

Gating Settings On/Off ← EVM Constell

Activates or deactivates gating, and opens the "Gate Settings" dialog box to specify range of captured data used in results calculation.

On	Uses only the specified range of captured data in results calculation. In the Magnitude Capture Buffer trace, two vertical lines mark the specified range.
Off	Uses all the captured data in results calculation.

In the "Gate Settings" dialog box, the following parameters are set:

Delay	Start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data in time or samples. If the delay is specified in time, the number of samples is updated accordingly, and vice versa.
Length	Amount of captured data to be used in results calculation. If the length is specified in time, the number of samples is updated accordingly, and vice versa.
Link Gate and Mark	If activated, the position of the marker and the gate lines are linked. The marker is positioned half way between gate start and end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

The gate settings are defined for following measurements: PVT, Spectrum FFT, CCDF, Spectrum Mask, Spectrum ACPR.

If a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the result display is switched to the Magnitude Capture Buffer display in order to allow the gate to be set the correct part of the sweep.

SCPI command:
`SWE:EGAT ON`
`SWE:EGAT:HOLD 125us, SWE:EGAT:HOLD:SAMP 2500` (Delay)
`SWE:EGAT:LENG 20ms, SWE:EGAT:LENG:SAMP 200000` (Length)
`SWE:EGAT:LINK ON` (Link Gate and Mark), see `[SENSe:]SWEep:EGATe:LINK` on page 153

Import ← EVM Constell
Opens the "Choose the file to import" dialog box.

Select the IQ data file you want to import and press ENTER. The extension of data files is *.iqw.

SCPI command:
`MMEMory:LOAD:IQ:STATe 1,` on page 140

Export ← EVM Constell
Opens the "Choose the file to export" dialog box.

Enter the path and the name of the IQ data file you want to export and press ENTER. The extension of data files is *.iqw. If the file cannot be created or there is no valid IQ data to export an error message is displayed.

SCPI command:
`MMEMory:STORe:IQ:STATe 1,` on page 140

Y-Axis/Div ← EVM Constell
Opens a dialog box to modify the y-axis settings:

Auto Scaling	If activated, the scaling of the y-axis is calculated automatically.
Per Division	Specifies the scaling to be used if Auto Scaling is deactivated.
Unit	Specifies the y-axis unit. With the unit is dB, Auto Scaling is always activated.

SCPI command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 126
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 127

R&S Support ← EVM Constell
Stores useful information for troubleshooting in case of errors.

This data is stored in the `C:\R_S\Instr\user\Support` directory on the instrument.

If you contact the Rohde&Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

Spectrum
Opens a submenu for frequency measurements.

Settings General/Demod ← Spectrum
Opens the "General Settings" or the "Demod Settings" dialog box. For details see chapter 4.2.3, "General Settings Dialog Box (K91)", on page 70 or chapter 4.2.4, "Demod Settings Dialog Box (K91)", on page 75.

Alternatively, the "General Settings" dialog box is opened as follows:

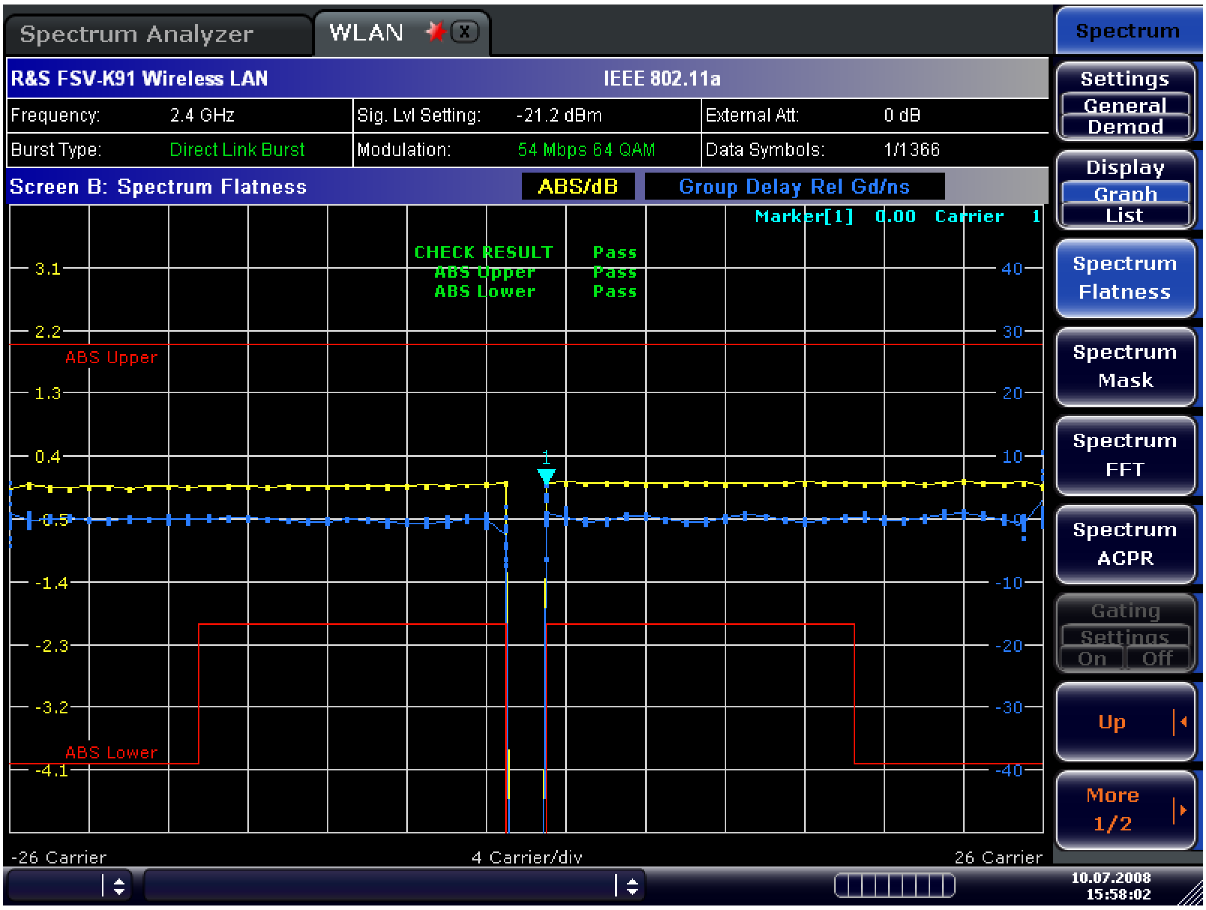
- FREQ key, with focus on the "Frequency" field
- AMPT key, with focus on the "Signal Level" ("RF") field
- TRIG key, with focus on the "Trigger Mode" field

Display List/Graph ← Spectrum
Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:
`DISPlay[:WINDow<n>]:TABLe` on page 126
For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

Spectrum Flatness (IEEE 802.11a, g, j, n – OFDM) ← Spectrum
Sets the Spectrum Flatness result display.

This result display shows the spectrum flatness and group delay values recorded on a per-carrier basis over the full set of measured data. An average trace is also displayed for each of the result types. An upper and lower limit line representing the limits specified for the selected standard are displayed and an overall pass/fail status is displayed for the obtained (average) results against these limit lines.



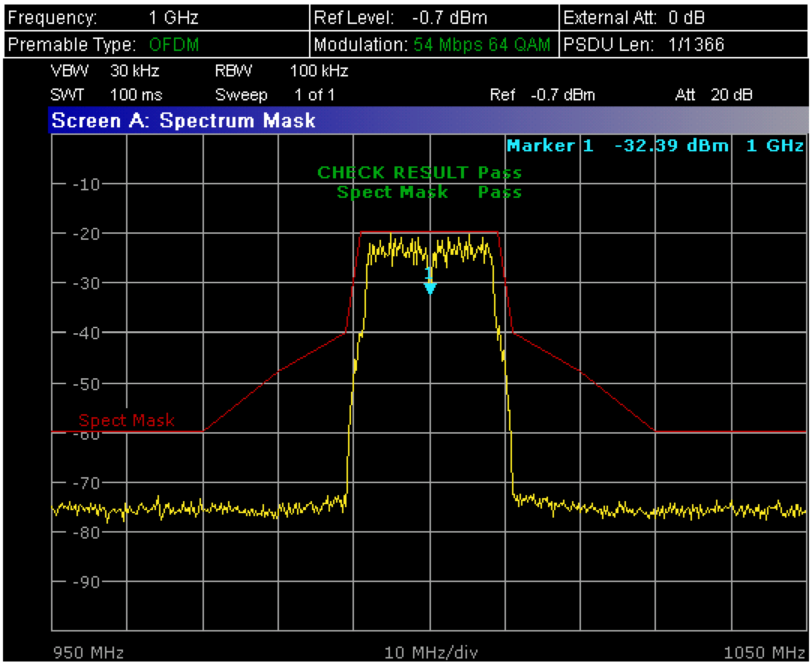
SCPI command:
CONFigure:BURSt:SPECtrum:FLATness[:IMMediate] on page 121

Spectrum Mask (IEEE 802.11b, g – Single Carrier)/ Spectrum IEEE/ETSI (IEEE 802.11a, g, j & n – OFDM) ← **Spectrum**

Sets the Spectrum Mask result display.

This result display shows power against frequency. The span of the results is 100 MHz for IEEE and 500 MHz for ETSI around the specified measurement frequency. A limit line representing the spectrum mask specified for the selected standard is displayed and an overall pass/fail status is displayed for the obtained results against this limit line.

The number of sweeps is set in the General Settings dialog box, Sweep Count field. If the measurement is performed over multiple sweeps both a max hold trace and an average trace are displayed.



SCPI command:

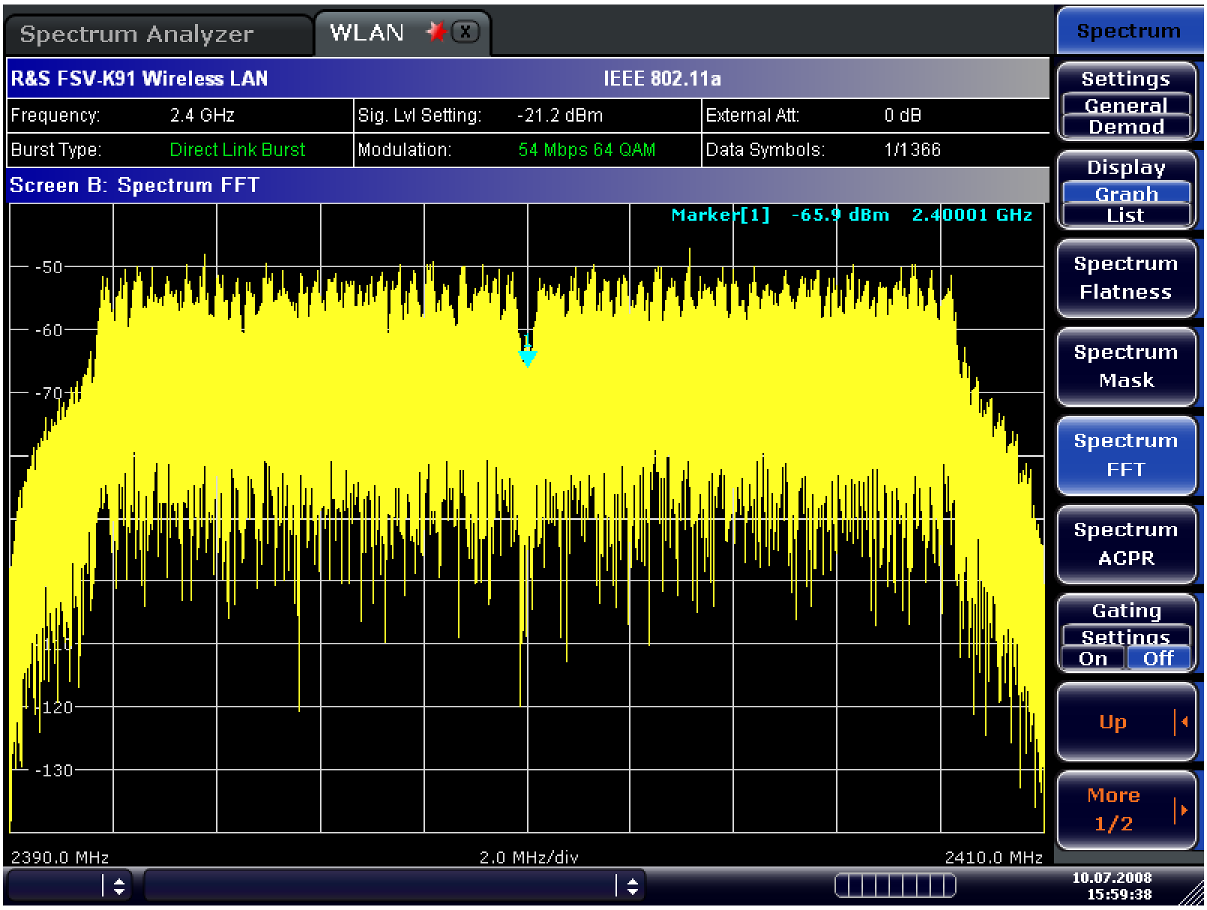
`CONFigure:BURSt:SPECtrum:MASK[:IMMediate]` on page 121

`CONFigure:BURSt:SPECtrum:MASK:SELect` on page 122

Spectrum FFT ← Spectrum

Sets the Spectrum FFT result display.

This result display shows the Power vs Frequency results obtained from a FFT performed over the range of data in the Magnitude Capture Buffer which lies within the gate lines.



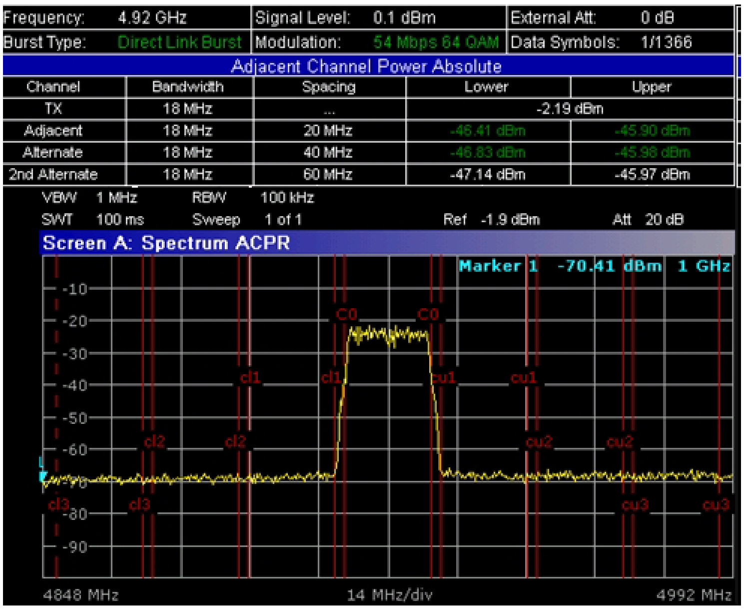
SCPI command:
`CONFigure:BURSt:SPECtrum:FFT[:IMMediate]` on page 121

Spectrum ACPR (IEEE 802.11a, g, n, OFDM Turbo Mode)/ Spectrum ACP (IEEE 802.11b)/ ACP Rel/Abs (IEEE 802.11j) ← Spectrum

Sets the ACP (Adjacent Channel Power) result display.

This result display is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the absolute or relative power measured in the three nearest channels either side of the measured channel. This measurement is the same as the adjacent channel power measurement provided by the signal analyzer.

The number of sweeps is set in the General Settings dialog box, Sweep Count field. If the measurement is performed over multiple sweeps both a max hold trace and an average trace are displayed.



SCPI command:

`CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]` on page 121

`CALCulate<n>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]` on page 116

`CALCulate<n>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold` on page 116

Gating Settings On/Off ← Spectrum

Activates or deactivates gating, and opens the "Gate Settings" dialog box to specify range of captured data used in results calculation.

On	Uses only the specified range of captured data in results calculation. In the Magnitude Capture Buffer trace, two vertical lines mark the specified range.
Off	Uses all the captured data in results calculation.

In the "Gate Settings" dialog box, the following parameters are set:

Delay	Start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data in time or samples. If the delay is specified in time, the number of samples is updated accordingly, and vice versa.
Length	Amount of captured data to be used in results calculation. If the length is specified in time, the number of samples is updated accordingly, and vice versa.
Link Gate and Mark	If activated, the position of the marker and the gate lines are linked. The marker is positioned half way between gate start and end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

The gate settings are defined for following measurements: PVT, Spectrum FFT, CCDF, Spectrum Mask, Spectrum ACPR.

If a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the result display is switched to the Magnitude Capture Buffer display in order to allow the gate to be set the correct part of the sweep.

SCPI command:
`SWE:EGAT ON`
`SWE:EGAT:HOLD 125us, SWE:EGAT:HOLD:SAMP 2500` (Delay)
`SWE:EGAT:LENG 20ms, SWE:EGAT:LENG:SAMP 200000` (Length)
`SWE:EGAT:LINK ON` (Link Gate and Mark), see `[SENSe:]SWEep:EGATe:LINK` on page 153

SEM Settings ← Spectrum
Displays the "SEM Settings" view that contains the following editable settings:

SEM according to ← SEM Settings ← Spectrum
Specifies how the Spectrum Emission Mask settings and limits are applied. This parameter provides the following settings:

"ETSI"	Settings and limits are as specified in the standard
"IEEE"	Settings and limits are as specified in the standard
"User"	Settings and limits are configured via an XML file

SCPI command:
`[SENSe:]POWer:SEM` on page 151

File Name ← SEM Settings ← Spectrum
When "SEM according to":"User" settings are specified, "File Name" shows the name of the loaded XML file. Clicking the arrow switches to the File Manager to locate an XML file, and automatically selects "SEM according to":"User".

When using "ETSI" or "IEEE" standards, "File Name" indicates the name of the built-in configuration.

Link Direction ← SEM Settings ← Spectrum
Sets the link direction:

"UL"	uplink
"DL"	downlink

Link Direction ← SEM Settings ← Spectrum
Sets the link direction:

"UL"	uplink
"DL"	downlink

Power Class ← SEM Settings ← Spectrum
Sets the power class

"Auto"	automatic selection
"(-INF, 23) dBm, (23, INF) dBm"	power class values for uplink

"(-INF, 29) dBm,power class values for downlink
(29, 40) dBm,
(40, INF) dBm"

SCPI command:
`[SENSe:]POWer:SEM:CLASs` on page 151

SEM Configuration ← SEM Settings ← Spectrum
The table shows the settings and limits applied over specified frequency ranges around the TX channel. The displayed settings depend on the selected Power Class and Link Direction

Import ← Spectrum
Opens the "Choose the file to import" dialog box.

Select the IQ data file you want to import and press ENTER. The extension of data files is *.iqw.

SCPI command:
`MMEMory:LOAD:IQ:STATe 1,` on page 140

Export ← Spectrum
Opens the "Choose the file to export" dialog box.

Enter the path and the name of the IQ data file you want to export and press ENTER. The extension of data files is *.iqw. If the file cannot be created or there is no valid IQ data to export an error message is displayed.

SCPI command:
`MMEMory:STORe:IQ:STATe 1,` on page 140

R&S Support ← Spectrum
Stores useful information for troubleshooting in case of errors.

This data is stored in the `C:\R_S\Instr\user\Support` directory on the instrument.

If you contact the Rohde&Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

Statistics
Opens a submenu to display statistics measurement results.

Settings General/Demod ← Statistics
Opens the "General Settings" or the "Demod Settings" dialog box. For details see chapter 4.2.3, "General Settings Dialog Box (K91)", on page 70 or chapter 4.2.4, "Demod Settings Dialog Box (K91)", on page 75.

Alternatively, the "General Settings" dialog box is opened as follows:

- FREQ key, with focus on the "Frequency" field
- AMPT key, with focus on the "Signal Level" ("RF") field
- TRIG key, with focus on the "Trigger Mode" field

Display List/Graph ← Statistics
Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:
`DISPlay[:WINDow<n>]:TABLe` on page 126
For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

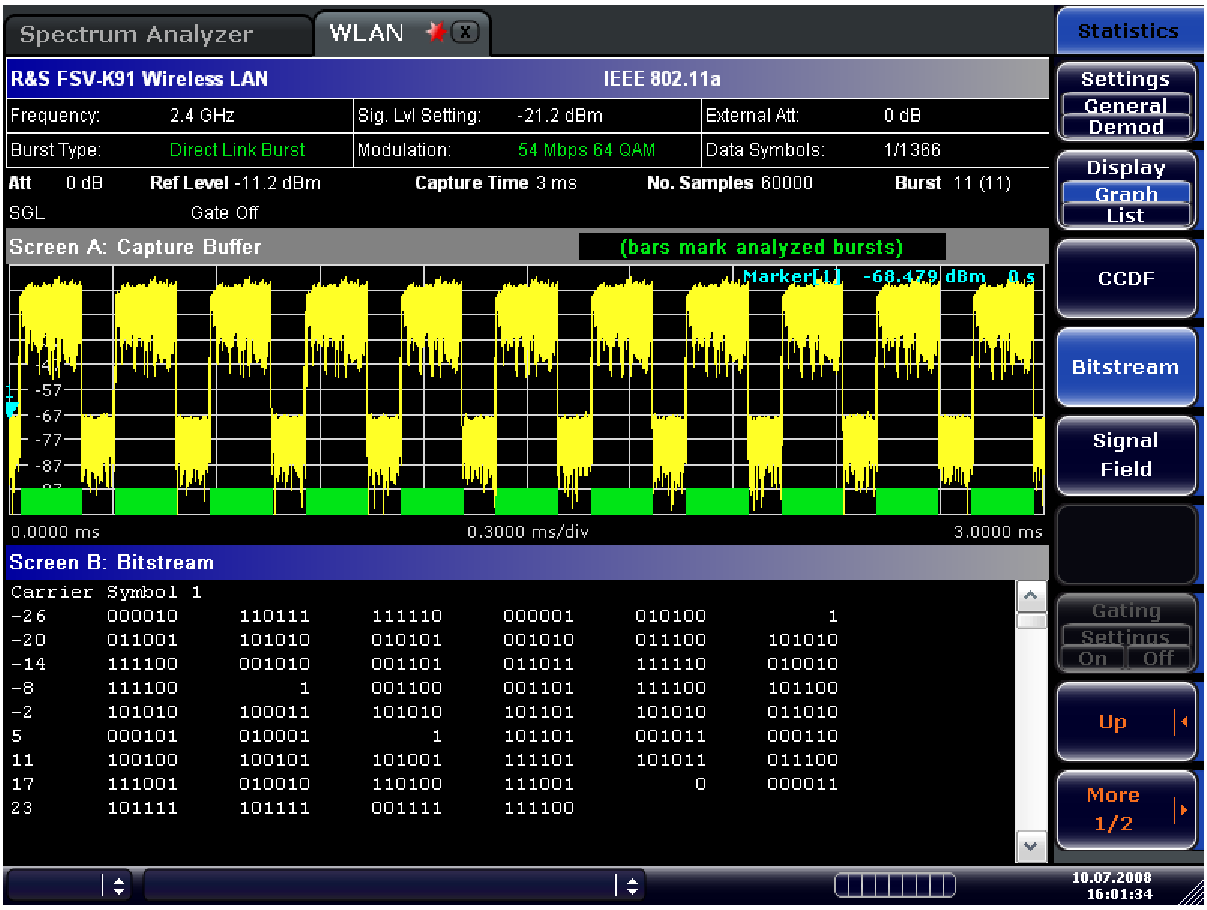
CCDF ← Statistics
Sets the CCDF result display.

This result display shows the probability of an amplitude within the gating lines exceeding the mean power measured between the gating lines. The x-axis displays power relative to the measured mean power.

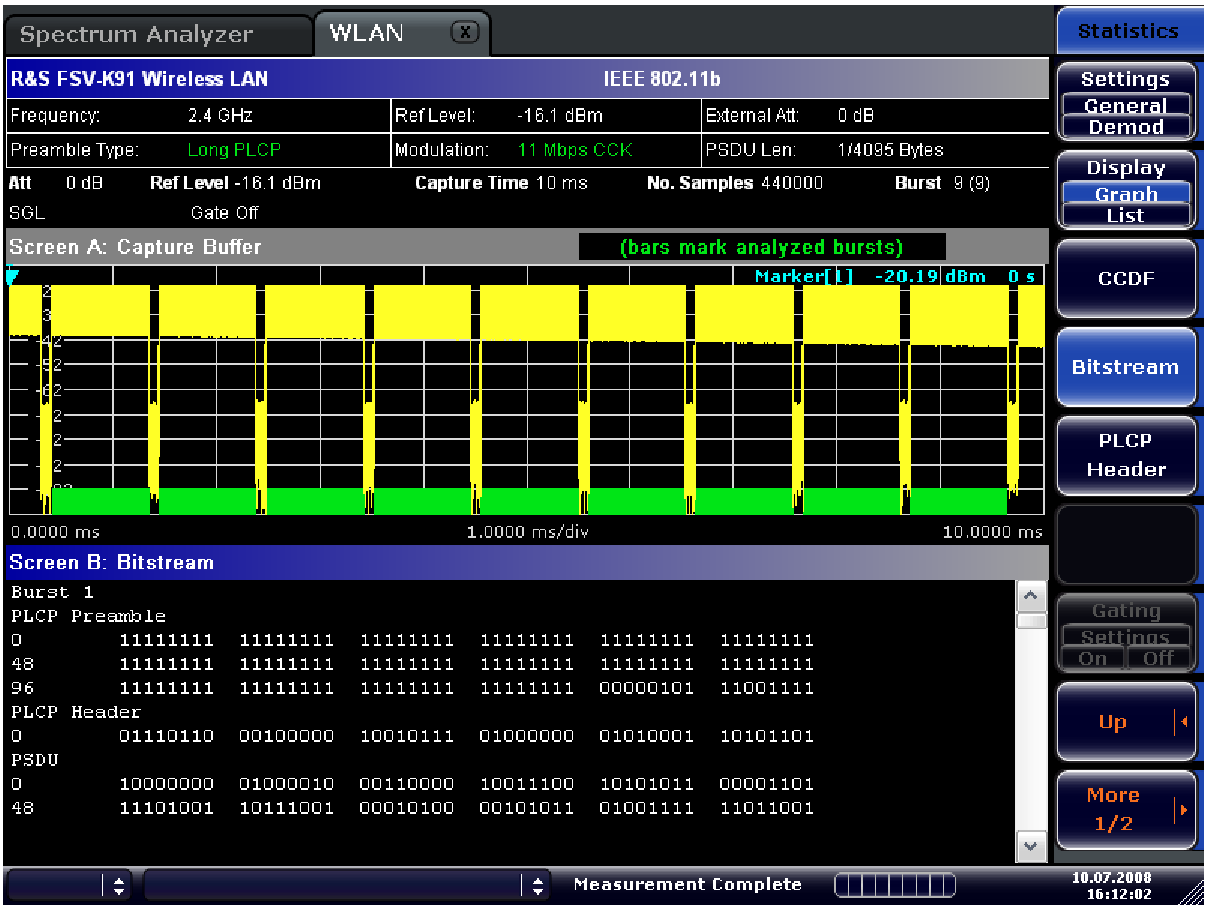
SCPI command:
`CONFigure:BURSt:STATistics:CCDF[:IMMediate]` on page 122

Bitstream ← Statistics
Sets the Bitstream result display. This result display shows the demodulated data stream.

- IEEE 802.11a, j, g (OFDM) & n:
  The results are grouped by symbol and carrier.



- IEEE 802.11b or g (Single Carrier)
  The results are grouped by burst.



SCPI command:

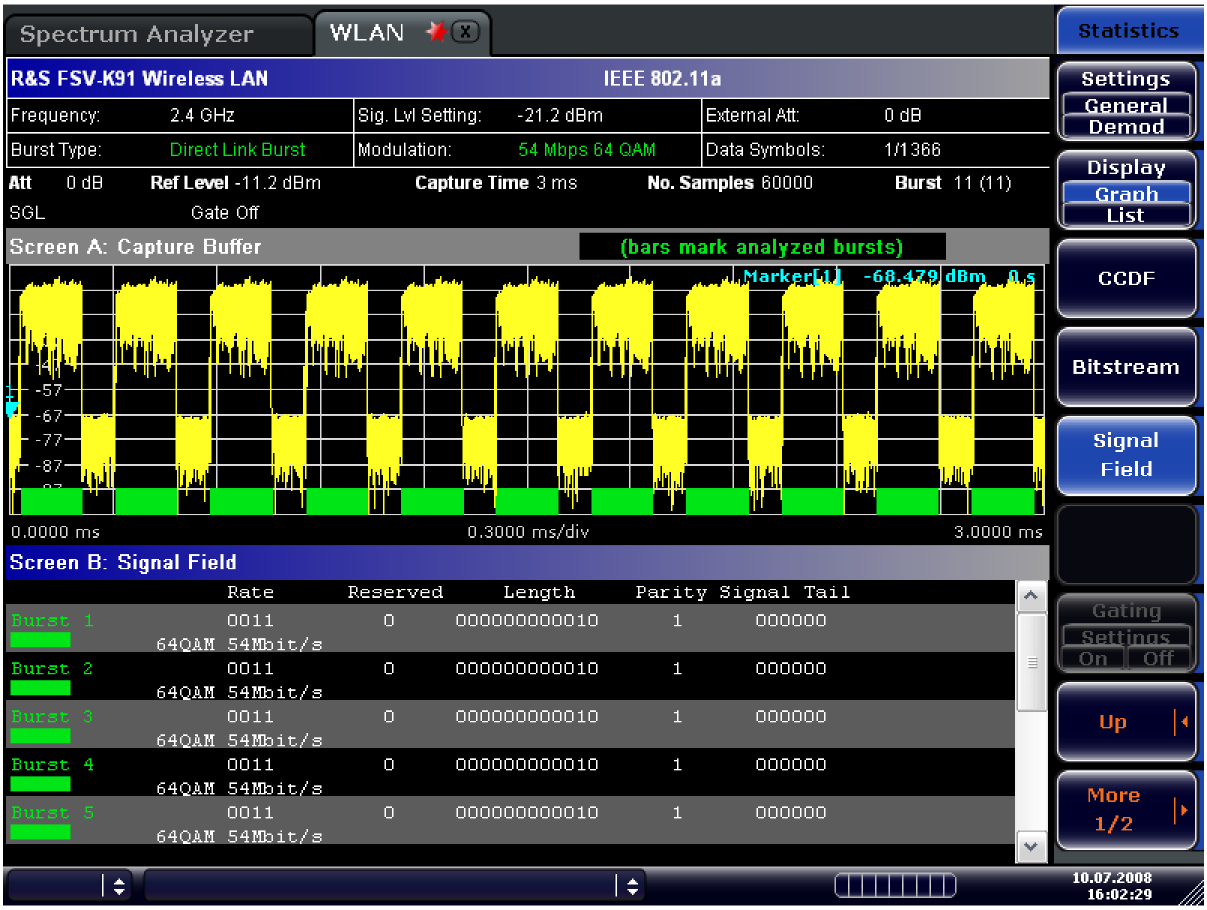
CONFigure:BURSt:STATistics:BSTReam[:IMMediate] on page 122

Signal Field (IEEE 802.11a, g, j & n – OFDM)/ PLCP Header (IEEE 802.11b, g – Single Carrier) ← Statistics

Sets the "Signal Field" result display or the "PLCP Header" result display, depending on the selected standard.

Signal Field

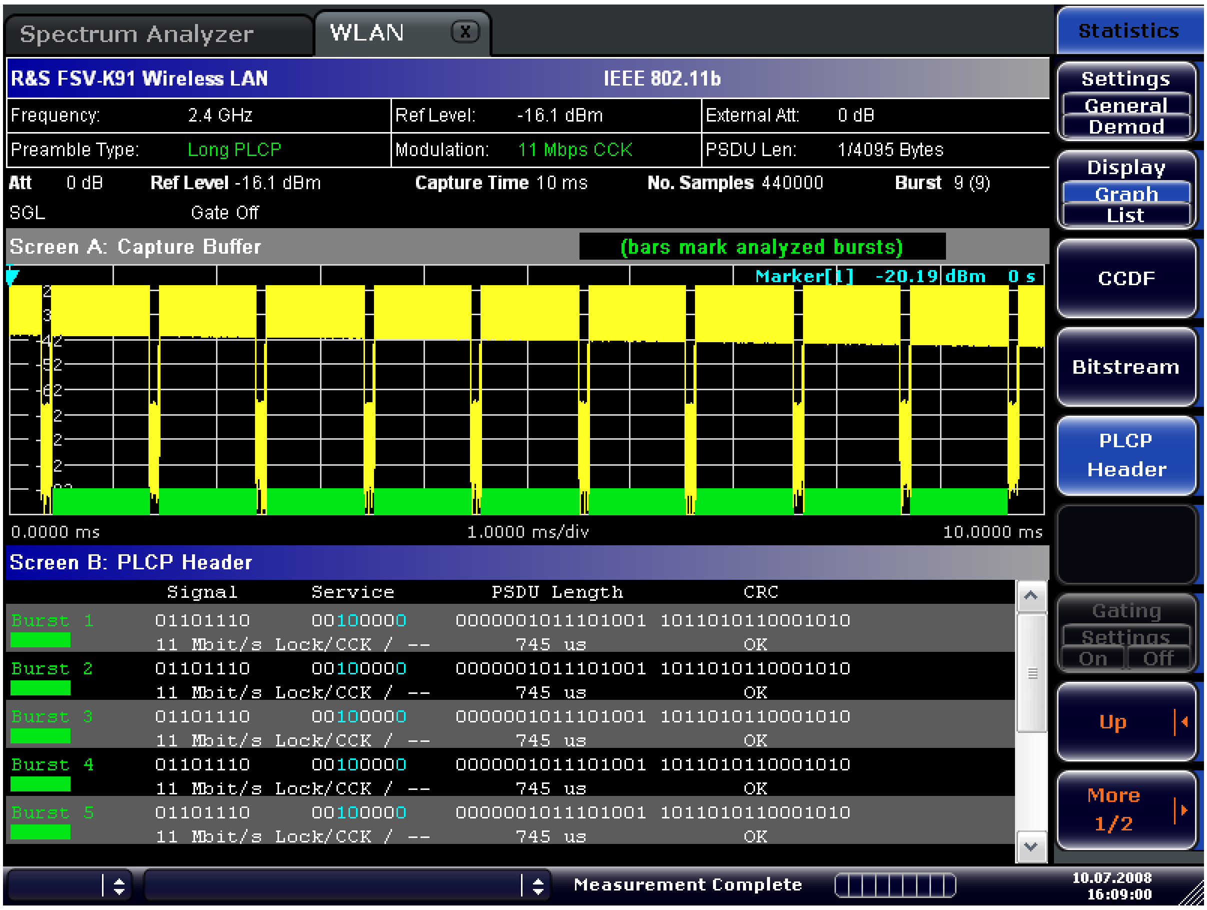
This result display shows the decoded data from the signal field of the burst. Therefore it is only available, if, in the Demod Settings dialog box, the Signal Field Content option is activated.



PLCP Header

This result display shows the decoded data from the PLCP header of the burst. The following details are listed:

Column header	Description	Example
Burst	number of the decoded burst A colored block indicates that the burst was successfully decoded.	Burst 1
Signal	signal field The decoded data rate is shown below.	00010100 2 MBits/s
Service	service field The currently used bits are highlighted. The text below explains the decoded meaning of these bits.	00000000 --/--/--
PSDU Length	length field The decoded time to transmit the PSDU is shown below.	0000000001111000 120 µs
CRC	CRC field The result is displayed below (OK for passed or Failed).	1110100111001110 OK



SCPI command:

CONFigure:BURSt:STATistics:SFIeld[:IMMediate] on page 122

4.2.3 General Settings Dialog Box (K91)

In the **General Settings** dialog box, all settings related to the overall measurement can be modified. The right pane with the advanced settings is only displayed if the "Advanced Settings" option is activated. The "General Settings" dialog box contains the following elements:

Standard

Displays a list of all installed standards to select the wireless LAN standard. This is necessary to ensure that the measurements are performed according to the specified standard with the correct limit values and limit lines.

SCPI command:

`CONFigure:STANdard` on page 124

Frequency

Specifies the center frequency of the signal to be measured. If the frequency is modified, the "Channel No" field is updated accordingly.

SCPI command:

`[SENSe:]FREQuency:CENTer` on page 150

Channel No

Specifies the channel to be measured. If the "Channel No" field is modified, the frequency is updated accordingly.

SCPI command:

`CONFigure:CHANnel` on page 122

Signal Level

Specifies the expected mean level of the RF input signal. If an automatic level detection measurement has been executed the signal level (RF) is updated.

For all standards other than IEEE 802.11b & g (Single Carrier), the reference level is set 10 dB higher than the signal level (RF) because of the expected crest factor of the signal. For standards IEEE 802.11b & g (Single Carrier), the reference level is set to the signal level (RF).

SCPI command:

`CONFigure:POWer:EXPected:RF` on page 123

Auto Lvl

Activates or deactivates the automatic setting of the reference level for measurements.

"ON" The reference level is measured automatically at the start of each measurement sweep. This ensures that the reference level is always set at the optimal level for obtaining accurate results but will result in slightly increased measurement times.

"OFF" The reference level is defined manually in the "Signal Level " on page 71 field.

SCPI command:
CONFigure:POWer:AUTO on page 123
CONFigure:POWer:AUTO:SWEep:TIME on page 123

Ext Att
Specifies the external attenuation or gain applied to the RF signal. A positive value indicates attenuation, a negative value indicates gain. All displayed power level values are shifted by this value.

SCPI command:
INPut:ATTenuation on page 137

Capture Time
Specifies the time (and therefore the amount of data) to be captured in a single measurement sweep.

SCPI command:
[SENSe:]SWEep:TIME on page 154

Burst Count
Activates or deactivates a specified number of bursts for capture and analysis.

On	The data analysis is performed over a number of consecutive sweeps until the required number of bursts has been captured and analyzed.
Off	The data analysis is performed on a single measurement sweep.

SCPI command:
[SENSe:]BURSt:COUNt:STATe on page 143

Analyze Bursts
Specifies the number of bursts to be measured, if the "Burst Count" option is activated.

SCPI command:
[SENSe:]BURSt:COUNt on page 143

Sweep Count
Specifies the number of sweeps to be performed for Spectrum ACP/ACPR and Spectrum Mask measurements.

SCPI command:
[SENSe:]SWEep:COUNt on page 152

Trigger Mode
Sets the source of the trigger for the measurement sweep.

Free Run	The measurement sweep starts immediately.
External	Triggering via a TTL signal at the input connector EXT TRIGGER/GATE IN on the rear panel.
Power	The measurement sweep starts when the signal power meets or exceeds the specified power trigger level. This trigger mode is not available for Spectrum Mask measurements in ETSI standard. If it is set and then the Spectrum Mask measurement in ETSI standard is selected, it automatically changes to "Free Run".

SCPI command:
`TRIGger[:SEQuence]:MODE` on page 163

Trigger Offset
Specifies the time offset between the trigger signal and the start of the sweep. A negative value indicates a pre-trigger. This field is not available in the "Free Run" trigger mode.

SCPI command:
`TRIGger[:SEQuence]:HOLDoff` on page 162

Ext. Trigger Lvl
Specifies the external trigger level if trigger mode "External" is used.

SCPI command:
`TRIGger<n>[:SEQuence]:LEVel[:EXTernal]` on page 162

Power Level
Specifies the trigger level if the "Power" trigger mode is set.

SCPI command:
`TRIGger[:SEQuence]:LEVel:POWer` on page 163

Auto Lvl
Activates or deactivates the automatic measurement of the power trigger level.

"ON" The power trigger level is measured automatically at the start of each measurement sweep. This ensures that the power trigger level is always set at the optimal level for obtaining accurate results but will result in a slightly increased measurement times.

"OFF" The power trigger level is defined manually in the "Power Level " on page 73 field.

SCPI command:
`TRIGger[:SEQuence]:LEVel:POWer:AUTO` on page 163

Input
The following signal sources are supported:

- RF Input
- Baseband Digital (only with Digital Baseband Interface, R&S FSV-B17)

SCPI command:
`INPut:SELect` on page 139

Swap IQ
Activates or deactivates the inverted I/Q modulation.

On	I and Q signals are interchanged.
Off	Normal I/Q modulation.

SCPI command:
[SENSe:]SWAPiq on page 151

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

SCPI command:
INPut:DIQ:SRATe on page 138

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

The level is defined in Volts.

SCPI command:
INPut:DIQ:RANGe[:UPPer] on page 138

Auto Level Time
Specifies the sweep time used for the automatic level measurements.

SCPI command:
CONFigure:POWer:AUTO:SWEep:TIME on page 123

Ref Level
Specifies the reference level to use for measurements. If the reference level is modified, the signal level is updated accordingly (depending on the currently selected standard and measurement type). This field is only editable if the "Auto Lvl" is deactivated.

SCPI command:
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel on page 127

Attenuation
Specifies the settings for the attenuator. This field is only editable if the "Auto Lvl" option is deactivated. If the "Auto Lvl" option is activated, the RF attenuator setting is coupled to the reference level setting.

SCPI command:
INPut:ATTenuation on page 137

Sample Rate
Specifies the sample rate used for IQ measurements.

SCPI command:
TRACe:IQ:SRATe on page 156

4.2.4 Demod Settings Dialog Box (K91)

In the "**Demod Settings**" dialog box, the settings associated with the signal modulation can be modified. The settings under "Burst to Analyze" specify the characteristics of the bursts to be considered in the measurement results. Only the bursts which meet the criteria specified in this group will be included in measurement analysis if the "Use Header Content" option is activated. The tracking settings allow various errors in measurement results to be compensated for.

The "Demod Settings" dialog box contains the following elements. If an element is only available for certain standards, the corresponding standards are listed.

Signal Field Content (IEEE 802.11a, g (OFDM), j & n)
Activates or deactivates the decoding of the captured burst data.

"ON" Only the bursts are included in the results analysis whose modulation format specified in the signal symbol field matches the modulation format specified in the "Analyze PSDU Mod" on page 77 field.

"OFF" The data is demodulated according to the modulation scheme specified in the "Demodulator" on page 77 field. If any of the analyzed data has a modulation different to that specified the results will be of limited use.

SCPI command:
`[SENSe:]DEMod:FORMat:SIGSymbol` on page 150

Use Header Content (IEEE 802.11b, g – Single Carrier)
Activates or deactivates the PLCP header field decoding of the captured burst data.

"ON" Only the bursts are included in the results analysis whose modulation format specified in the signal symbol field matches the modulation format specified in the "Analyze PSDU Mod" on page 77 field.

"OFF" The data is demodulated according to the modulation scheme specified in the "Demodulator" on page 77 field. If any of the analyzed data has a modulation different to that specified the results will be of limited use.

SCPI command:
`[SENSe:]DEMod:FORMat:SIGSymbol` on page 150

Burst Type (IEEE 802.11a, g (OFDM, Single Carrier), j & n)
Specifies the type of burst to be included in measurement analysis. Only one burst type can be selected for the measurement results. The following burst types are supported:

"Direct Link Burst"	IEEE 802.11a, j, n
"OFDM"	IEEE 802.11g
"Long DSSS"-"OFDM"	IEEE 802.11g
"Short DSSS"-"OFDM"	IEEE 802.11g
"Long PLCP"	IEEE 802.11g
"Short PLCP"	IEEE 802.11g

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:BTYPe` on page 145

Preamble Type (IEEE 802.11b)
Specifies the type of burst which should be included in measurement analysis. The following burst types are supported: Short PLCP, Long PLCP.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:BTYPe` on page 145

PPDU Frame Format (IEEE 802.11b)
Specifies the type of PHY Protocol Data Unit (PPDU) which should be included in measurement analysis. The following PPDU formats are supported:

- Mixed 20MHz
- Green Field 20MHz
- Mixed 40MHz
- Green Field 40MHz

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:BTYPe` on page 145

Auto Demodulation
Activates or deactivates the automatic detection of the modulation. If activated, the modulation applied to the input data is determined from the modulation type of the first complete burst within the captured data. This option automatically activates the "Signal Field Content" option.

SCPI command:
[SENSe:]DEMod:FORMat[:BCONtent]:AUTO on page 149

Analyze PSDU Mod
Specifies the modulation of the bursts to be analyzed. Only bursts using the selected modulation are considered in measurement analysis. This option is only available if the "Signal Field Content" or the "Use Header Content" option is activated.

SCPI command:
[SENSe:]DEMod:FORMat:BANalyze on page 144

Demodulator
Specifies the modulation to be applied to the measured data. If the captured data uses a different modulation scheme than specified by this field the results will be of limited use. This field is only available if the "Signal Field Content" or the "Use Header Content" option is deactivated.

SCPI command:
[SENSe:]DEMod:FORMat:BANalyze on page 144

Auto Guard Interval (IEEE 802.11n)
Specifies whether the Guard interval of the measured data should be automatically detected or not

When Auto Guard Interval is set to ON then the Guard Interval is detected from the input signal.

When Use Auto Guard Interval is set to OFF then guard interval of the input signal can be specified with the Guard Interval parameter.

SCPI command:
CONFigure:WLAN:GTIMe:AUTO on page 124

Guard Interval (IEEE 802.11n)
Specifies the guard interval of the input signal.

When "Auto Guard Interval" is set to "ON" then Guard Interval is read only and displays the detected guard interval.

SCPI command:
CONFigure:WLAN:GTIMe:SELect on page 125

Equal Burst Length
Activates or deactivates the burst selection for measurement analysis according to the range or specific number of data symbols/bytes.

Standard	State	Description
IEEE 802.11a, j, n	On	Only bursts with exactly the number of symbols specified in the "Data Symbols" field are considered for measurement analysis (see "Data Symbols (IEEE 802.11a, j, n)" on page 78).
	Off	Only bursts within the range of data symbols specified by the "Min Data Symbols" and "Max Data Symbols" fields are considered for measurement analysis. (See "Min Data Symbols (IEEE 802.11a, j, n)" on page 78 and "Max Data Symbols (IEEE 802.11a, j, n)" on page 78)
IEEE 802.11b, g (Single Carrier)	On	Only bursts with exactly the number of data bytes or duration specified in the "Payload Length" field are considered for measurement analysis. (See "Payload Length (IEEE 802.11b, g)" on page 79)
	Off	Only bursts within the range of data bytes or duration specified by the "Min Payload Length" and "Max Payload Length" fields are considered for measurement analysis. (See "Min Payload Length (IEEE 802.11b, g)" on page 79 and "Max Payload Length (IEEE 802.11b, g)" on page 79)
IEEE 802.11g (OFDM)	On	Only bursts with exactly the number of data symbols or duration specified in the "Payload Length" field are considered for measurement analysis. (See "Payload Length (IEEE 802.11b, g)" on page 79)
	Off	Only bursts within the range of data symbols or duration specified by the "Min Payload Length" and "Max Payload Length" fields are considered for measurement analysis. (See "Min Payload Length (IEEE 802.11b, g)" on page 79 and "Max Payload Length (IEEE 802.11b, g)" on page 79)

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal` on page 148
`[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal` on page 145
`[SENSe:]DEMod:FORMat:BANalyze:DURation:EQUal` on page 146

Data Symbols (IEEE 802.11a, j, n)
Specifies the number of data symbols of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is activated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN` on page 148

Min Data Symbols (IEEE 802.11a, j, n)
Specifies the minimum number of data symbols of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is deactivated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN` on page 148

Max Data Symbols (IEEE 802.11a, j, n)
Specifies the maximum number of data symbols of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is deactivated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX` on page 148

Channel Estimation (IEEE 802.11a, g (OFDM), j, n)
Specifies how accurately the EVM results are calculated.

"Preamble"	The channel estimation is performed in the preamble as required in the standard.
"Payload"	The channel estimation is performed in the payload.

SCPI command:
`[SENSe:]DEMod:CESTimation` on page 143

Payload Length (IEEE 802.11b, g)
Specifies the number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is activated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN` on page 146
`[SENSe:]DEMod:FORMat:BANalyze:DURation:MIN` on page 147

Min Payload Length (IEEE 802.11b, g)
Specifies the minimum number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is deactivated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN` on page 146
`[SENSe:]DEMod:FORMat:BANalyze:DURation:MIN` on page 147

Max Payload Length (IEEE 802.11b, g)
Specifies the maximum number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the "Equal Burst Length" option is deactivated.

SCPI command:
`[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MAX` on page 146
`[SENSe:]DEMod:FORMat:BANalyze:DURation:MAX` on page 147

Phase
Activates or deactivates the compensation for phase error. If activated, the measurement results are compensated for phase error on a per-symbol basis.

SCPI command:
`[SENSe:]TRACking:PHASe` on page 154

Timing
Activates or deactivates the compensation for timing error. If activated, the measurement results are compensated for timing error on a per-symbol basis.

SCPI command:
`[SENSe:]TRACking:TIME` on page 155

Level

Activates or deactivates the compensation for level error. If activated, the measurement results are compensated for level error on a per-symbol basis.

SCPI command:

`[SENSe:]TRACking:LEVel` on page 154

Transmit Filter

Specifies the transmit filter to be used

The settings provided by default are:

- Auto – Specifies the default filter
- DefRecieve – default receive filter
- DefTransimt – default transmit filter

See also chapter 4.1.3, "Signal Processing of the IEEE 802.11b Application", on page 22

Receive Filter

Specifies the receive filter to be used

The settings provided by default are:

- Auto – Specifies the default filter
- DefRecieve – default receive filter
- DefTransimt – default transmit filter

See also chapter 4.1.3, "Signal Processing of the IEEE 802.11b Application", on page 22

4.2.5 Softkeys of the Sweep Menu – SWEEP key (R&S FSV-K91/91n)

The following table shows all softkeys available in the ""Sweep"" menu in ""WLAN"" mode (SWEEP key). It is possible that your instrument configuration does not provide all soft-keys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Run Single/Cont

Selects the sweep mode.

"Single" single sweep mode

"Cont" continuous sweep mode

SCPI command:

`INITiate<n>:CONTinuous` on page 136

Auto Level
Starts an automatic level detection measurement. If this softkey is pressed while a measurement is running, the current measurement is aborted and the automatic level detection measurement is started. If the aborted measurement was a continuous measurement it is resumed after the automatic level detection is completed.

SCPI command:

`CONFigure:POWer:AUTO` on page 123

Refresh
Updates the current measurement results with respect to the current gate settings. This softkey is only available if the measurement results are effected by the gate settings (Spectrum FFT, PVT and CCDF) and if the gate settings are modified after a measurement result has been obtained.

4.2.6 Softkeys of the Trace Menu – TRAC key (R&S FSV-K91/91n)

The following table shows all softkeys available in the "Trace" menu in "WLAN" mode (TRACE key). It is possible that your instrument configuration does not provide all softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Display List/Graph
Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

SCPI command:

`DISPlay[:WINDow<n>]:TABLe` on page 126

For result queries see chapter 4.3.9, "FETCh Subsystem (WLAN, R&S FSV-K91/91n)", on page 129

Screen Focus A/B
Selects the active screen for IQ measurement results in split and full screen mode. Only the markers of an active screen can be controlled.

SCPI command:

`DISPlay[:WINDow<n>]:SSELect` on page 125

Screen Size Full/Split
Changes the display between split and full screen for IQ measurement results. Frequency sweep measurement results are always displayed in full screen.

SCPI command:

`DISPlay:FORMat` on page 125

4.2.7 Softkeys of the Marker Menu – MKR key (R&S FSV-K91/91n)

The following table shows all softkeys available in the "Marker" menu in "WLAN" mode (MKR key). It is possible that your instrument configuration does not provide all softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description. Close all settings dialog boxes before opening the "Marker" menu.

Marker 1

Opens a dialog box to adjust the marker. The contents of the dialog box depend on the type of graph the marker is adjusted to. After every change, the marker position in the trace and the marker information are updated.

SCPI command:

`CALCulate<n>:MARKer<m>[:STATe]` on page 111

`CALCulate<n>:MARKer<1>:X` on page 115

`CALCulate<n>:MARKer<1>:Y` on page 115

`CALCulate<n>:MARKer<1>:SYMBol` on page 113

`CALCulate<n>:MARKer<1>:CARRier` on page 113

Unzoom

Cancels the marker zoom.

SCPI command:

`CALCulate<n>:MARKer<1>:FUNCtion:ZOOM` on page 117

Marker Zoom

Opens an edit dialog box to select the magnification factor for the zoom. The zoom facility is provided for the following result displays: Magnitude Capture Buffer, PVT, Constellation vs Symbol, Constellation vs Carrier. The maximum magnification depends on the type of result display.

SCPI command:

`CALCulate<n>:MARKer<1>:FUNCtion:ZOOM` on page 117

Marker Off

Switches off all makers in the active result display.

SCPI command:

`CALCulate<n>:MARKer<m>:AOFF` on page 112

4.2.8 Softkeys of the Marker To Menu – MKR-> key (R&S FSV-K91/91n)

The following table shows all softkeys available in the "Marker To" menu in "WLAN" mode (MKR-> key). It is possible that your instrument configuration does not provide all softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

Peak (Spectrum Flatness result display)

Sets the marker to the peak value of the assigned trace.

SCPI command:

`CALCulate<n>:MARKer<1>:MAXimum` on page 113

Min (Spectrum Flatness result display)
Sets the marker to the minimum value of the assigned trace.

SCPI command:
`CALCulate<n>:MARKer<1>:MINimum` on page 113

MKR -> Trace
Opens an edit dialog box to enter the number of the trace, on which the marker is to be placed. This softkey is available for all result displays with more than one trace.

SCPI command:
`CALCulate<n>:MARKer<1>:TRACe` on page 114

4.2.9 Softkeys of the Lines Menu – LINES key (R&S FSV-K91/91n)

The following table shows all softkeys available in the ""Lines"" menu in ""WLAN"" mode (LINES key). It is possible that your instrument configuration does not provide all softkeys. If a softkey is only available with a special option, model or (measurement) mode, this information is delivered in the corresponding softkey description.

This menu is only available if the results are displayed in form of a list (for details see chapter 4.2.1.2, "Result Summary List", on page 38 and the "Display Graph/List" softkey, "Display List/Graph" on page 46).

Default Current
Resets all limits for the current modulation scheme to the values specified in the selected standard.

SCPI command:
chapter 4.3.5, "CALCulate:LIMit Subsystem (WLAN, R&S FSV-K91/91n)", on page 94

Default All
Resets all limits for all modulation schemes to the values specified in the selected standard.

SCPI command:
chapter 4.3.5, "CALCulate:LIMit Subsystem (WLAN, R&S FSV-K91/91n)", on page 94

4.2.10 Softkeys of the Input/Output Menu for WLAN Measurements

The following chapter describes all softkeys available in the "Input/Output" menu for WLAN measurements.

Note that the digital baseband functions are only available if the optional Digital Baseband Interface (R&S FSV-B17) is installed.

For details see the base unit description.

EXIQ
Opens a configuration dialog box for an optionally connected R&S EX-IQ-BOX and a submenu to access the main settings quickly.

If the optional R&S DigIConf software is installed, the submenu consists only of one key to access the software. **Note that R&S DigIConf requires a USB connection (not LAN!) from the analyzer to the R&S EX-IQ-BOX in addition to the Digital Baseband Interface connection. R&S DigIConf version 2.10 or higher is required.**

For typical applications of the R&S EX-IQ-BOX see also the description of the Digital Baseband Interface (R&S FSV-B17) in the base unit manual.

For details on configuration see the "R&S®Ex I/Q Box - External Signal Interface Module Manual".

For details on installation and operation of the R&S DigIConf software, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

TX Settings ← EXIQ
Opens the "EX-IQ-BOX Settings" dialog box to configure the analyzer for digital output to a connected device ("Transmitter" Type).

RX Settings ← EXIQ
Opens the "EX-IQ-BOX Settings" dialog box to configure the analyzer for digital input from a connected device ("Receiver" Type).

Send To ← EXIQ
The configuration settings defined in the dialog box are transferred to the R&S EX-IQ-BOX.

Firmware Update ← EXIQ
If a firmware update for the R&S EX-IQ-BOX is delivered with the analyzer firmware, this function is available. In this case, when you select the softkey, the firmware update is performed.

R&S Support ← EXIQ
Stores useful information for troubleshooting in case of errors.

This data is stored in the `C:\R_S\Instr\user\Support` directory on the instrument.

If you contact the Rohde&Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

DigIConf ← EXIQ
Starts the optional R&S DigIConf application. This softkey is only available if the optional software is installed.

To return to the analyzer application, press any key on the front panel. The application is displayed with the "EXIQ" menu, regardless of which key was pressed.

For details on the R&S DigIConf application, see the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".

Note: If you close the R&S DigIConf window using the "Close" icon, the window is minimized, not closed.
If you select the "File > Exit" menu item in the R&S DigIConf window, the application is closed. Note that in this case the settings are lost and the EX-IQ-BOX functionality is no longer available until you restart the application using the "DigIConf" softkey in the analyzer once again.

SCPI command:
Remote commands for the R&S DigIConf software always begin with `SOURce:EBOX`. Such commands are passed on from the analyzer to the R&S DigIConf automatically which then configures the R&S EX-IQ-BOX via the USB connection.
All remote commands available for configuration via the R&S DigIConf software are described in the "R&S®EX-IQ-BOX Digital Interface Module R&S®DigIConf Software Operating Manual".
Example 1:
`SOURce:EBOX:*RST`
`SOURce:EBOX:*IDN?`
Result:
"Rohde&Schwarz,DigIConf,02.05.436 Build 47"
Example 2:
`SOURce:EBOX:USER:CLOCk:REFerence:FREQuency 5MHZ`
Defines the frequency value of the reference clock.

4.3 Remote Commands for WLAN TX Measurements (R&S FSV-K91/91n)

This section describes the remote commands specific to the WLAN TX Measurements option (R&S FSV-K91/91n). The abbreviation WLAN stands for the Wireless LAN operating mode. For details on conventions used in this chapter refer to chapter 4.3.1, "Notation", on page 87 at the beginning of this chapter.

For further information on analyzer or basic settings commands, refer to the corresponding subsystem in the base unit description.

Subsystems of the WLAN TX Measurements option (R&S FSV-K91/91n)

4.3.1 Notation

In the following sections, all commands implemented in the instrument are first listed and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

Individual Description

The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.

The options and operating modes for which a command can be used are indicated by the following abbreviations:

Abbreviation	Description
A	signal analysis
A-F	signal analysis – span > 0 only (frequency mode)
A-T	signal analysis – zero span only (time mode)
ADEMOD	analog demodulation (option R&S FSV-K7)
BT	Bluetooth (option R&S FSV-K8)
CDMA	CDMA 2000 base station measurements (option R&S FSV-K82)
EVDO	1xEV-DO base station analysis (option R&S FSV-K84)
GSM	GSM/Edge measurements (option R&S FSV-K10)
IQ	IQ Analyzer mode
OFDM	WiMAX IEEE 802.16 OFDM measurements (option R&S FSV-K93)
OFDMA/WiBro	WiMAX IEEE 802.16e OFDMA/WiBro measurements (option R&S FSV-K93)
NF	Noise Figure measurements (R&S FSV-K30)
PHN	Phase Noise measurements (R&S FSV-K40)
PSM	Power Sensor measurements (option R&S FSV-K9)
SFM	Stereo FM measurements (optionR&S FSV-K7S)
SPECM	Spectogram mode (option R&S FSV-K14)
TDS	TD-SCDMA base station / UE measurements (option R&S FSV-K76/K77)
VSA	Vector Signal Analysis (option R&S FSV-K70)
WCDMA	3GPP Base Station measurements (option R&S FSV-K72), 3GPP UE measurements (option R&S FSV-K73)
WLAN	WLAN TX measurements (option R&S FSV-K91)

The signal analysis (spectrum) mode is implemented in the basic unit. For the other modes, the corresponding options are required.

Upper/Lower Case Notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see chapter 5 "Remote Control – Basics"). The instrument itself does not distinguish between upper and lower case letters.

Special Characters

|	A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example:

`SENSe:FREQuency:CW|:FIXed`

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:

`SENSe:FREQuency:CW 1E3`

`SENSe:FREQuency:FIXed 1E3`

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.

Example: Selection of the parameters for the command

`[SENSe<1…4>:]AVERage<1…4>:TYPE VIDeo | LINear`

[]	Key words in square brackets can be omitted when composing the header. The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards. Parameters in square brackets can be incorporated optionally in the command or omitted as well.

{}	Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.

Description of Parameters

Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<…>) and is briefly explained in the following (see also chapter 5 "Remote Control – Basics", section "Parameters").

<Boolean>

This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword OFF or by the numeric value 0, the "on" state is indicated by ON or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value> <num>

These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data). The following keywords given below are permitted:

- MAXimum: This keyword sets the parameter to the largest possible value.
- MINimum: This keyword sets the parameter to the smallest possible value.
- DEFault: This keyword is used to reset the parameter to its default value.
- UP: This keyword increments the parameter value.
- DOWN: This keyword decrements the parameter value.

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example:

SENSe:FREQuency:CENTer? MAXimum

Returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

This keyword is provided for commands the parameters of which consist of a binary data block.

4.3.2 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

***CAL**

Calibration Query

Initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

***CLS**

CLear Status

Sets the status byte (STB), the standard event register (ESR) and the `EVENt` part of the `QUEStionable` and the `OPERation` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE** <Value>

Event Status Enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:

<Value>

Range: 0 to 255

***ESR?**

Event Status Read

Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:

<Contents>

Range: 0 to 255

Usage: Query only

***IDN?** <Format>

IDeNtification: returns the instrument identification.

Query parameters:

<Format> LEGacy | NEW

LEGacy
"Rohde&Schwarz,<device type>,**<serial number>/<model>**,<firmware version>"

NEW
"Rohde&Schwarz,<device type>,**<part number>/<serial number>**,<firmware version>"

Example: LEGacy format:
`Rohde&Schwarz,R&S FSV-7,101768/007,1.05`
NEW format:
`Rohde&Schwarz,R&S FSV-7,1307.9002K07/101768,1.05`

Usage: Query only

***IST?**

Individual STatus query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:

<ISTflag> 0 | 1

Usage: Query only

***OPC**

OPeration Complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

***OPT?**

OPTion identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the CD-ROM.

Return values:

<Options> The query returns a list of all installed options, separated by commas, where:
B<number> describes hardware options
K<number> describes software options

Example: B4,B5,B6,B7,B8,B10,B22,B30,B31,K7,K9

Usage: Query only

***PCB** <Address>

Pass Control Back

Indicates the controller address to which remote control is returned after termination of the triggered action.

Setting parameters:
<Address>

Range: 0 to 30

Usage: Setting only

***PRE** <Value>

Parallel poll Register Enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value>

Range: 0 to 255

***PSC** <Action>

Power on Status Clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:
<Action> 0 | 1

0
The contents of the status registers are preserved.

1
Resets the status registers.

***RST**

ReSeT

Sets the instrument to a defined default status. It is equivalent to `SYSTem:PRESet`. The default settings are indicated in the description of commands.

See "Initializing the Configuration - PRESET Key".

Usage: Setting only

***SRE** <Contents>

Service Request Enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

STatus Byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

TRiGger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal (Manual Trigger). This common command complements the commands of the `TRIGger` subsystem.

`*TRG` corresponds to the `INITiate:IMMediate` command. For details, see the "Remote Control - Description of Analyzer Commands", "TRIGger Subsystem".

Usage: Event

***TST?**

self TeST query

Triggers selftests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). "0" indicates no errors occured.

Usage: Query only

***WAI**

WAIt to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and `*OPC`).

Usage: Event

4.3.3 ABORt Subsystem

ABORt

This command aborts a current measurement and resets the trigger system.

Example: `ABOR;INIT:IMM`

Mode: all

4.3.4 CALCulate:BURSt Subsystem (WLAN, R&S FSV-K91/91n)

The CALCulate:BURSt subsystem checks the IQ measurement results.

CALCulate<n>:BURSt[:IMMediate]

This command forces the IQ measurement results to be recalculated according to the current settings.

Suffix:

<n> 1...4
irrelevant

Example: `CALC1:BURS`
Starts the recalculation of the IQ measurement results.

Usage: Event

Mode: WLAN

4.3.5 CALCulate:LIMit Subsystem (WLAN, R&S FSV-K91/91n)

The CALCulate:LIMit subsystem contains commands for the limit lines and the corresponding limit checks.

CALCulate<n>:LIMit<1>:ACPower:ACHannel?

This command returns the ACP adjacent channel limit for IEEE 802.11j if defined.

Suffix:

<n>	1...4 irrelevant

Return values:

<Result>	numeric value in dB
Example:	`CALC:LIM:ACP:ACH?` Returns the IEEE 802.11j ACP adjacent channel limit.
Usage:	Query only
Mode:	WLAN

CALCulate<n>:LIMit<k>:ACPower:ACHannel:RESult

This command queries the result of the limit check for the upper/lower adjacent channel when adjacent channel power measurement is performed.

If the power measurement of the adjacent channel is switched off, the command produces a query error.

Suffix:

<n>	window; For applications that do not have more than 1 measurement window, the suffix <n> is irrelevant.
<k>	irrelevant

Return values:

Result	The result is returned in the form <result>, <result> where <result> = PASSED | FAILED, and where the first returned value denotes the lower, the second denotes the upper adjacent channel.

Example:

`CALC:LIM:ACP:ACH 30DB, 30DB`
Sets the relative limit value for the power in the lower and upper adjacent channel to 30 dB below the channel power.
`CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM`
Sets the absolute limit value for the power in the lower and upper adjacent channel to -35 dB.
`CALC:LIM:ACP ON`
Switches on globally the limit check for the channel/adjacent channel measurement.
`CALC:LIM:ACP:ACH:STAT ON`
Switches on the limit check for the adjacent channels.
`INIT;*WAI`
Starts a new measurement and waits for the sweep end.
`CALC:LIM:ACP:ACH:RES?`
Queries the limit check result in the adjacent channels.

Mode: A, CDMA, EVDO, TDS, WLAN, WCDMA

CALCulate<n>:LIMit<1>:ACPower:ALTernate?

This command returns the ACP alternate channel limit for IEEE 802.11j if defined.

Suffix:

<n>	1...4 irrelevant

Return values:

<Result>	numeric value in dB

Example:

`CALC:LIM:ACP:ALT?`
Returns the IEEE 802.11j ACP alternate channel limit.

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<k>:ACPower:ALTernate<channel>[:RELative] <LowerLimit>, <UpperLimit>

This command defines the limit for the alternate adjacent channels for adjacent channel power measurements. The reference value for the relative limit value is the measured channel power.

Suffix:

<n>	window; For applications that do not have more than 1 measurement window, the suffix <n> is irrelevant.
<k>	irrelevant
<Channel>	1...11 the alternate channel

Parameters:

<LowerLimit>, <UpperLimit>	first value: 0 to 100dB; limit for the lower and the upper alternate adjacent channel *RST: 0 DB
Example:	`CALC:LIM:ACP:ALT2 30DB, 30DB` Sets the relative limit value for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.
Mode:	A, CDMA, EVDO, TDS, WLAN, WCDMA

CALCulate<n>:LIMit<1>:BURSt:ALL

This command sets or returns all the limit values.

Suffix:

<n>	1...4 irrelevant

Return values:

<Results>

The results are input or output as a list of values separated by ',' in the following (ASCII) format:

<average frequency error>, <max frequency error>,

<average symbol error>, <max symbol error>,

<average IQ offset>, <maximum IQ offset>,

<average EVM all bursts>, <max EVM all bursts>,

<average EVM data carriers >, <max EVM data carriers >

<average EVM pilots >, <max EVM pilots >

The units for the EVM results are specified with the `UNIT:EVM` command.

Example:	`CALC:LIM:BURS:ALL?` All limit values are returned
Mode:	WLAN

CALCulate<n>:LIMit<1>:BURSt:ALL:RESUlt?

This command returns all the limit results.

Suffix:

<n>	1...4 irrelevant

Return values:

<Results> For details on formats refer to `FETCh:BURSt:ALL` on page 131.

Example: `CALC:LIM:BURS:ALL:RES?`
All limit values are returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM[:AVERage] <Value>

This command sets the average error vector magnitude limit for the IEEE 802.11b standard.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM -25.0`
Average EVM limit is set to -25 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM[:AVERage]:RESult?

This command returns the average error vector magnitude limit result for the IEEE 802.11b standard.

Suffix:

<n> 1...4
irrelevant

Return values:

<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:RES?`
Average EVM limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:ALL[:AVERage] <Value>

This command sets the average error vector magnitude limit. This is a combined figure that represents the pilot, data and the free carrier.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:ALL -25.0`
Average EVM for all carrier limit is set to -25.0 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:ALL[:AVERage]:RESult?

This command returns the average error vector magnitude limit result. This is a combined figure that represents the pilot, data and the free carrier.

Suffix:
<n> 1...4
irrelevant

Return values:
<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:ALL:RES?`
Average EVM for all carrier limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:ALL:MAXimum <Value>

This command sets the maximum error vector magnitude limit. This is a combined figure that represents the pilot, data and the free carrier.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:ALL:MAX?`
Maximum EVM for all carrier limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult?

This command returns the maximum error vector magnitude limit result. This is a combined figure that represents the pilot, data and the free carrier.

Suffix:
<n> 1...4
irrelevant

Return values:
<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:ALL:MAX:RES?`
Maximum EVM for all carrier limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:DATA[:AVERage] <Value>

This command sets the average error vector magnitude limit summary for the data carrier.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:DATA -30.0`
Average EVM for data carrier limit is set to -30.0 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:DATA[:AVERage]:RESult?

This command returns the average error vector magnitude limit result summary for the data carrier.

Suffix:
<n> 1...4
irrelevant

Return values:
Results 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:DATA:RES?`
Average EVM for data carrier limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:DATA:MAXimum <Value>

This command sets the maximum error vector magnitude limit summary for the data carrier.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:DATA:MAX?`
Maximum EVM for data burst limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult?

This command returns the maximum error vector magnitude limit result summary for the data carrier.

Suffix:

<n> 1...4
irrelevant

Return values:

<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:DATA:MAX:RES?`
Maximum EVM for data carrier limit result is returned Characteristics.

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:MAXimum <Value>

This command sets the maximum error vector magnitude limit for the IEEE 802.11b standard.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:MAX?`
Maximum EVM limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:MAXimum:RESult?

This command returns the maximum error vector magnitude limit result for the IEEE 802.11b standard.

Suffix:

<n> 1...4
irrelevant

Return values:

<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:MAX:RES?`
Maximum EVM limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:PILot[:AVERage] <Value>

This command sets the average error vector magnitude limit summary for the pilot carriers.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:PIL -8.0`
Average EVM for pilot carrier limit is set to -8.0 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:PILot[:AVERage]:RESult?

This command returns the average error vector magnitude limit result summary for the pilot carriers.

Suffix:

<n> 1...4
irrelevant

Return values:

<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:PIL:RES?`
Average EVM for pilot carrier limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:PILot:MAXimum <Value>

This command sets the maximum error vector magnitude limit summary for the pilot carriers.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in dB

Example: `CALC:LIM:BURS:EVM:PIL:MAX?`
Maximum EVM for pilot carrier limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:EVM:PILot:MAXimum:RESult?

This command returns the maximum error vector magnitude limit result summary for the pilot carriers.

Suffix:
<n> 1...4
irrelevant

Return values:
<Results> 0 | 1

0
PASSED

1
FAILED

Example: `CALC:LIM:BURS:EVM:PIL:MAX:RES?`
Maximum EVM for pilot carrier limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:FERRor[:AVERage] <Value>

This command sets the average frequency error limit.

Suffix:
<n> 1...4
irrelevant

Parameters:

<Value> numeric value in Hertz

Example: `CALC:LIM:BURS:FERR 10000`
The average frequency error limit is set to 10 kHz

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult?

This command returns the average frequency error limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:FERR:RES?`
Average frequency error limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:FERRor:MAXimum <Value>

This command sets the maximum frequency error limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in Hertz

Example: `CALC:LIM:BURS:FERR:MAX?`
Maximum frequency error limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?

This command returns the maximum frequency error limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:FERR:MAX:RES?`
Maximum frequency error limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:IQOFfset[:AVERage] <Value>

This command sets the average IQ Offset error limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value>
Range: -1000000 to 1000000
Default unit: dB

Example: `CALC:LIM:BURS:IQOF -10.0`
Average IQ Off set error limit is set to -10.0 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult?

This command returns the average IQ Offset error limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:IQOF:RES?`
Average IQ Offset error limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:IQOFfset:MAXimum <Value>

This command sets the maximum IQ Offset error limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value>
Range: -1000000 to 1000000
Default unit: dB

Example: `CALC:LIM:BURS:IQOF:MAX 15.0`
Maximum IQ Off set error limit is set to -15.0 dB

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult?

This command returns the maximum IQ Offset error limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:IQOF:MAX:RES?`
Maximum IQ Offset error limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:SYMBolerror[:AVERage] <Value>

This command sets the average symbol error limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in Hertz

Example: `CALC:LIM:BURS:SYMB 10000`
The average symbol error limit is set to 10kHz

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult?

This command returns the average symbol error limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:SYMB:RES?`
Average symbol error limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:SYMBolerror:MAXimum <Value>

This command sets the maximum symbol error limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in Hertz

Example: `CALC:LIM:BURS:SYMB:MAX?`
Maximum symbol error limit is returned

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult?

This command returns the maximum symbol error limit result.

Suffix:
<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:SYMB:MAX:RES?`
Maximum symbol error limit result is returned.

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TFALl[:AVERage] <Value>

This command sets the average fall time limit.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in seconds

Example: `CALC:LIM:BURS:TFAL 0.000001`
The average fall time limit is set to 1 □s

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TFALl[:AVERage]:RESult?

This command returns the average fall time limit result.

Suffix:
<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:TFALl:RES?`
Average fall time limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TFALl:MAXimum <Value>

This command sets the maximum fall time limit.

Suffix:
<n> 1...4
irrelevant

Parameters:
<Value> numeric value in seconds

Example: `CALC:LIM:BURS:TFALl:MAX 0.000001`
The maximum fall time limit set to 1 □s.

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TFALl:MAXimum:RESult?

This command returns the maximum fall time limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:TRIS:MAX:RES?`
Maximum fall time limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TRISe[:AVERage] <Value>

This command sets the average rise time limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in seconds

Example: `CALC:LIM:BURS:TRIS 0.000001`
The average rise time limit is set to 1 □s

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TRISe[:AVERage]:RESult?

This command returns the average rise time limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:TRIS:RES?`
The average rise time limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TRISe:MAXimum <Value>

This command sets the maximum rise time limit.

Suffix:

<n> 1...4
irrelevant

Parameters:

<Value> numeric value in seconds

Example: `CALC:LIM:BURS:TRIS:MAX 0.000001`
Maximum rise time limit is set to 1 □s

Mode: WLAN

CALCulate<n>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?

This command returns the maximum rise time limit result.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:BURS:TRIS:MAX:RES?`
Maximum rise time limit result is returned

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:CONTrol[:DATA] <Value>

This command defines the X-axis values (frequencies) of the upper or lower limit lines. The number of values for the CONTrol axis and for the corresponding UPPer limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

Parameters:

<Value> <numeric_value>, <numeric_value>...

Example: `CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz`
Defines 5 reference values for the X-axis of limit line 2
`CALC:LIM2:CONT?`
Outputs the reference values for the X-axis of limit line 2 separated by a comma.

Mode: WLAN

CALCulate<n>:LIMit<k>:FAIL

This command queries the result of the limit check of the indicated limit line. It should be noted that a complete sweep must have been performed for obtaining a correct result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check is given with 0 for PASS, 1 for FAIL, and 2 for MARGIN.

Suffix:

<n> irrelevant

<k> limit line
For option WLAN TX Measurements, R&S FSV-K91/91n, see table below

Return values:

Return values 0 for pass, 1 for fail

Example: `INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC:LIM3:FAIL?`
Queries the result of the check for limit line 3.

Mode: A, ADEMOD, CDMA, EVDO, NF, PHN, TDS, WLAN, WCDMA

For option WLAN TX Measurements, R&S FSV-K91/91n, the numeric suffix <m> specifies the limit lines as follows:

Suffix	Limit
1 to 2	These indexes are not used
3	ETSI Spectrum Mask limit line
4	Spectrum Flatness (Upper) limit line
5	Spectrum Flatness (Lower) limit line
6	IEEE Spectrum Mask limit line
7	PVT Rising Edge max limit
8	PVT Rising Edge mean limit
9	PVT Falling Edge max limit
10	PVT Falling Edge mean limit

CALCulate<n>:LIMit<1>:SPECtrum:MASK:CHECk:X?

This command returns the X-value at the maximum overstepping of the spectrum mask limits.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:SPEC:MASK:CHEC:X?`
Returns the frequency at the maximum overstepping.

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:SPECtrum:MASK:CHECk:Y?

This command returns the Y-value at the maximum overstepping of the spectrum mask limits.

Suffix:

<n> 1...4
irrelevant

Example: `CALC:LIM:SPEC:MASK:CHEC:Y?`
Returns the power at the maximum overstepping.

Usage: Query only

Mode: WLAN

CALCulate<n>:LIMit<1>:UPPer[:DATA] <Value>

This command defines the values for the upper limit lines independently of the measurement window. The number of values for the CONTrol axis and for the corresponding UPPer limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

Suffix:

<n>	1...4
	irrelevant

Parameters:

<Value>	<numeric_value>, <numeric_value>...

Example:	`CALC:LIM2:UPP -10,0,0,-10,-5`
	Defines 5 upper limit values for limit line 2 in the preset unit.
	`CALC:LIM2:UPP?`
	Outputs the upper limit values for limit line 2 separated by a comma.

Mode:	WLAN

4.3.6 CALCulate:MARKer Subsystem (WLAN, R&S FSV-K91/91n)

The CALCulate:MARKer subsystem checks the marker functions of the instrument.

The following subsystem is included:

chapter 4.3.6.2, "CALCulate:MARKer:FUNCtion Subsystem (WLAN, R&S FSV-K91/91n)", on page 116

4.3.6.1 Description of the CALCulate:MARKer Subsystem (WLAN, R&S FSV K91/91n)

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

This command activates a marker in the specified window. If no indication is made, marker 1 is selected automatically. If activate, the marker is switched to normal mode.

Suffix:

<n>	window; For applications that do not have more than 1 measurement window, the suffix <n> is irrelevant.
<m>	depends on mode marker number; For applications that do not have more than 1 marker, the suffix <m> is irrelevant.

Parameters:

<State>	ON | OFF *RST: OFF
Example:	`CALC:MARK3 ON` Switches on marker 3 or switches to marker mode.
Mode:	all

CALCulate<n>:MARKer<m>:AOFF

This command switches off all active markers, delta markers, and marker measurement functions in the specified window.

Suffix:

<n>	window; For applications that do not have more than 1 measurement window, the suffix <n> is irrelevant.
<m>	depends on mode irrelevant
Example:	`CALC:MARK:AOFF` Switches off all markers.
Mode:	all

CALCulate<n>:MARKer<1>:BSYMbol <BurstNumber>, <SymbolNumber>

This command positions the selected marker to the indicated symbol in the indicated burst.

This command only applies to 802.11b standard for the following result displays:

- Constellation vs Symbol
- EVM vs Symbol

Suffix:

<n>	1...4 irrelevant

Parameters:

<BurstNumber>, <SymbolNumber>	<numeric_value>,<numeric_value> The first numeric value is the burst number and the second numeric value is the symbol number.

Example:	`CALC:MARK1:BSYM 2,10`
	Positions marker 1 to symbol 10 of burst 2.
	`CALC:MARK1:BSYM?`
	Outputs the burst and symbol values of marker 1.

Mode: WLAN

CALCulate<n>:MARKer<1>:CARRier <Carrier>

This command positions the selected marker to the indicated carrier.

This command is query only for the following result displays:

- Constellation vs Symbol
- Constellation vs Carrier

Suffix:

<n> 1...4
irrelevant

Parameters:

<Carrier> <numeric_value>

Example: `CALC:MARK:CARR -7`
Positions marker 1 to carrier -7.
`CALC:MARK:CARR?`
Outputs the carrier value of marker 1.

Mode: WLAN, OFDM, OFDMA/WiBro

CALCulate<n>:MARKer<1>:MAXimum

This command sets the selected marker to the maximum peak value in the current trace. This command is only available for the Spectrum Flatness result display.

Suffix:

<n> 1...4
window

Example: `CALC2:MARK:MAX`
Set marker 1 in screen B to maximum value in trace.

Mode: WLAN, OFDM, OFDMA/WiBro

CALCulate<n>:MARKer<1>:MINimum

This command sets the selected marker to the minimum peak value in the current trace. This command is only available for the Spectrum Flatnes result display.

Suffix:

<n> 1...4
window

Example: `CALC2:MARK:MIN`
Set marker 1 in screen B to minimum value in trace.

Mode: WLAN, OFDM, OFDMA/WiBro

CALCulate<n>:MARKer<1>:SYMBol <Symbol>

This command positions the selected marker to the indicated symbol.

This command is query only for the following result displays:

- Constellation vs Symbol
- Constellation vs Carrier

Suffix:

<n> 1...4
window

Parameters:

<Symbol> 1 to <number of symbols in selected burst>

Example: `CALC2:MARK:SYMB 2`
Positions marker 1 in screen B to symbol 2.
`CALC2:MARK:SYMB?`
Outputs the symbol value of marker 1 in screen B.

Mode: WLAN, OFDM, OFDMA/WiBro

CALCulate<n>:MARKer<1>:TRACe <TraceNo>

This command assigns the selected marker to the indicated measurement curve in the selected measurement window.

This command is only available for the following result displays:

- Constellation versus Carrier
- EVM vs Symbol
- Frequency Error vs Preamble
- Phase Error vs Preamble
- PVT Full Burst
- PVT Rising/Falling
- Spectrum Flatness
- Spectrum Mask, if Max Hold trace is displayed
- Spectrum ACP/ACPR, if Max Hold trace is displayed

Suffix:

<n> 1...4
window

Parameters:

<TraceNo> Trace number to be assigned to the marker.
*RST: 1

Example: `"CALC2:MARK:TRAC 2`
Assigns marker 1 in screen B to trace 2.

Mode: WLAN

CALCulate<n>:MARKer<1>:X <Position>

This command positions the selected marker to the indicated inphase (Constellation vs Symbol), frequency (Spectrum FFT, Spectrum Mask, Spectrum APCR), time (Magnitude Capture Buffer, Auto level, PVT Full Burst, PVT Rising / Falling), power (CCDF), sub-carrier (Constellation vs Carrier, EVM vs Carrier, Spectrum Flatness) or symbol (EVM vs Symbol) in the selected measurement window.

This command is query only for the following result displays:

- Constellation vs Symbol
- Constellation vs Carrier

Suffix:

<n> 1...4
window

Parameters:

<Position> 1 to <maximum range for selected measurement>

Example: `CALC:MARK:X 2ms`
Positions marker 1 in screen A to time 2ms.

Mode: WLAN, OFDMA/WiBro

CALCulate<n>:MARKer<1>:Y <Position>

This command positions the selected marker to the indicated quadrature (Constellation vs Symbol), magnitude of I or Q (Constellation vs Carrier), EVM (EVM vs Carrier) or abs (Spectrum Flatness) in the selected measurement window.

This command is query only for the following result displays:

- Auto Level
- Constellation vs Symbol
- Constellation vs Carrier
- EVM vs Symbol
- PVT Full
- PVT Rising/Falling
- Magnitude Capture Buffer
- Spectrum Mask
- Spectrum ACP/ACPR
- Spectrum FFT
- CCDF

Suffix:

<n> 1...4
window

Parameters:

<Position> <numeric_value> in percent or dB

Example: `CALC2:MARK:Y -2`
Positions marker 1 in screen B to -2.
`CALC:MARK:Y?`
Outputs the measured value of marker 1.

Mode: WLAN; OFDMA/WiBro

4.3.6.2 CALCulate:MARKer:FUNCtion Subsystem (WLAN, R&S FSV-K91/91n)

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

CALCulate<n>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

This command queries the current result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run, for there to be summary data available.

Results are output separated by commas in the following order:

- Power of main channel
- Power of lower adjacent channel
- Power of upper adjacent channel
- Power of lower alternate adjacent channel 1
- Power of upper alternate adjacent channel 1
- Power of lower alternate adjacent channel 2
- Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.
Suffix:
<n> 1...4
irrelevant

Example: `CALC:MARK:FUNC:POW:RES?`

Usage: Query only

Mode: WLAN

CALCulate<n>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold?

This command queries the maximum result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run with more than one sweep, for there to be maximum summary data available.

For details on the output refer to `CALCulate<n>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]` on page 116 .

Suffix:

<n> 1...4
irrelevant

Example: `CALC:MARK:FUNC:POW:RES:MAXH?`

Usage: Query only

Mode: WLAN

CALCulate<n>:MARKer<1>:FUNCtion:ZOOM <Factor>

This command sets the magnification factor for the zoom. It is only available for the following result displays:

- Constellation vs Carrier
- Constellation vs Symbol
- PVT
- Magnitude Capture Buffer

Suffix:

<n> 1...4
irrelevant

Parameters:

<Factor> <numeric_value>

Example: `INIT:CONT OFF`
Switches to single sweep mode
`CALC:MARK:FUNC:ZOOM 3;*WAI`
Activates zooming and waits for its end.

Mode: WLAN

4.3.7 CONFigure Subsystem (WLAN, R&S FSV-K91/91n)

The CONFigure subsystem contains commands for configuring complex measurement tasks. The CONFigure subsystem is closely linked to the functions of the FETCH subsystem, where the measurement results are queried.

CONFigure:BURSt:CONStellation:CARRier:SELect <Mode>

This remote control command is only available when Constellation vs Symbol measurement is selected. When the Constellation versus Symbol measurement is initiated, it will calculate the results of the selected carrier.

Parameters:

<Mode> -26 to 26 | ALL | PILOTS

*RST: ALL

Example:

`CONF:BURS:CONS:CARR:SEL -26`
Carrier -26 is selected.
`CONF:BURS:CONS:CARR:SEL 10`
Carrier 10 is selected.
`CONF:BURS:CONS:CARR:SEL ALL`
All carriers are selected.
`CONF:BURS:CONS:CARR:SEL PIL`
Pilots only.

Mode: WLAN

CONFigure:BURSt:CONStellation:CCARrier[:IMMediate]

This remote control command configures the measurement type to be Constellation vs Carrier. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example:

`CONF:BURS:CONS:CCAR`
Configures the Constellation versus Carrier measurement type.

Mode: WLAN

CONFigure:BURSt:CONStellation:CSYMbol[:IMMediate]

This remote control command configures the measurement type to be Constellation vs Symbol. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command

Example: `CONF:BURS:CONS:CSYM`
Configures the Constellation versus Symbol measurement type.

Mode: WLAN

CONFigure:BURSt:EVM:ECARrier[:IMMediate]

This remote control command configures the measurement type to be EVM vs Carrier. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:EVM:ECAR`
Configures the EVM vs Carrier measurement type.

Mode: WLAN

CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

This remote control command configures the measurement type to be EVM vs Symbol. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:EVM:ESYM`
Configures the EVM vs Symbol measurement type.

Mode: WLAN

CONFigure:BURSt:PREamble[:IMMediate]

This remote control command configures the measurement type to be Phase or Frequency vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:PRE`
Configures the preamble measurement type.

Mode: WLAN

CONFigure:BURSt:PREamble:SELect <Mode>

This remote control command configures the interpretation of the preamble measurement results.

Parameters:
<Mode> PHASe | FREQuency

Example: `CONF:BURS:PRE:SEL PHAS`
Configures the Phase vs Preamble measurement type.

Mode: WLAN

CONFigure:BURSt:PVT[:IMMediate]

This remote control command configures the measurement type to be Power vs Time. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:PVT`
Configures the Power vs Time measurement type.

Mode: WLAN

CONFigure:BURSt:PVT:AVERage <Value>

This remote control command configures the measurement type to set the burst power averaging length to the desired value. This command is only valid when the selected standard is IEEE 802.11b.

Parameters:
<Value> <numeric_value>

Example: `CONF:BURS:PVT:AVER 31`
Configures the burst power average length of 31.

Mode: WLAN

CONFigure:BURSt:PVT:RPOWer <Mode>

This remote control command configures the use of either mean or maximum burst power as a reference power for the 802.11b PVT measurement.

Parameters:
<Mode> MEAN | MAXimum

Example: `CONF:BURS:PVT:RPOW MEAN`
Configures to use mean burst power as a reference power.

Mode: WLAN

CONFigure:BURSt:PVT:SELect <Mode>

This remote control configures how to interpret the Power vs Time measurement results.

Parameters:
<Mode>

Parameter = Description = Wireless LAN standard

EDGE = configures the measurement to be rising and falling edge = all

FALL = configures the measurement to be falling edge only = IEEE 802.11b & g (CCK)

FULL = configures the measurement to be full burst = IEEE 802.11a, j & g (OFDM) & n, IEEE 802.11 Turbo Mode

RISE = configures the measurement to be rising edge only = IEEE 802.11b & g (CCK)

Example: `CONF:BURS:PVT:SEL FULL`
Interprets the measurement results as full burst

Mode: WLAN

CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

This remote control command configures the measurement type to be ACPR (adjacent channel power relative) After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:SPEC:ACPR`
Configures the ACPR measurement type.

Mode: WLAN

CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

This remote control command configures the measurement type to be FFT (Fast Fourier Transform). After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:SPEC:FFT`
Configures the FFT measurement type.

Mode: WLAN

CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

This remote control command configures the measurement type to be Spectrum Flatness. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:SPEC:FLAT`
Configures the Spectrum Flatness measurement type.

Mode: WLAN

CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

This remote control command configures the measurement type to be Spectrum Mask. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command

Example: `CONF:BURS:SPEC:MASK`
Configures the Spectrum Mask measurement type.

Mode: WLAN

CONFigure:BURSt:SPECtrum:MASK:SELect <Mode>

This remote control configures the interpretation of the Spectrum Mask measurement results. This command is only available for IEEE 802.11a.

Parameters:

<Mode> IEEE | ETSI

Example: `CONF:BURS:SPEC:MASK:SEL ETSI`
Interprets the measurement results using the ETSI standard.

Mode: WLAN

CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

This remote control command configures the measurement type to be Bitstream. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:STAT:BSTR`
Configures the Bitstream measurement type.

Mode: WLAN

CONFigure:BURSt:STATistics:CCDF[:IMMediate]

This remote control command configures the measurement type to be CCDF (conditional cumulative distribution functions.). After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:STAT:CCDF`
Configures the CCDF measurement type.

Mode: WLAN

CONFigure:BURSt:STATistics:SFIeld[:IMMediate]

This remote control command configures the measurement type to be Signal Field. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate<n>[:IMMediate]` command.

Example: `CONF:BURS:STAT:SFIeld`
Configures the Signal Field measurement type.

Mode: WLAN

CONFigure:CHANnel <Channel>

This remote control command is used to specify the input channel for which measurements are to be performed. This command will automatically cause the internal measurement frequency to be re-calculated.

Parameters:
<Channel> <numeric_value>

*RST: 0

Example: `CONF:CHAN 9`
Specifies channel 9 as frequency measurement.

Mode: WLAN

CONFigure:POWer:AUTO <Mode>

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep.

Parameters:
<Mode> ONCE | ON | OFF

If this command is issued with the ONCE parameter then the auto level routine is performed immediately one time.

Example: `CONF:POW:AUTO ON`
Configures the automatic detection of the input power level.

Mode: WLAN

CONFigure:POWer:AUTO:SWEep:TIME <Time>

This remote control command is used to specify the sweep time for the automatic power level detection.

Parameters:
<Time> numeric value in seconds

*RST: 100ms

Example: `CONF:POW:AUTO:SWE:TIME 200MS`
Configures a 200 ms sweep time for the auto-level detection.

Mode: WLAN

CONFigure:POWer:EXPected:RF <Level>

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer RF input. This value will be overwritten if Auto Level is turned on.

Parameters:
<Level> <numeric_value> in dBm

Example: `CONF:POW:EXP:RF 9`
Assumes an input signal strength of 9 dBm.

Mode: WLAN

CONFigure:POWer:EXPected:IQ <Level>

This remote control command is used to specify the mean power level of the source signal as supplied to the optional **Digital Baseband Interface (R&S FSV-B17)**. This value will be overwritten if Auto Level is turned on.

Parameters:

<Level> <numeric_value> in V

Example: `CONF:POW:EXP:IQ 9 MV`
Assumes an input signal strength of 9 mV.

Mode: WLAN

CONFigure:STANdard <Standard>

This remote control command specifies which Wireless LAN standard the option is configured to measure.

Parameters:

<Standard> 0 | 1 | 2 | 3 | 4 | 5 | 6

0
IEEE 802.11a

1
IEEE 802.11b

2
IEEE 802.11j (10 MHz)

3
IEEE 802.11j (20 MHz)

4
IEEE 802.11g

5
Turbo

6
IEEE 802.11n

*RST: 0

Example: `CONF:STAN 0`
Selects the IEEE 802.11a standard for the measurement.

Mode: WLAN

CONFigure:WLAN:GTIMe:AUTO

This remote control command specifies wether the guard time of the IEEE 802.11n input signal is automatically detected or specified manually.

Example: `CCONF:WLAN:GTIM:AUTO ON`
Sets automatic detection of the guard time of the input signal

Mode: WLAN

CONFigure:WLAN:GTIMe:SELect

This remote control command specifies the guard time of the IEEE 802.11n input signal. If the guard time is specified to be detected from the input signal using the CONFigure:WLAN:GTIMe:AUTO command then this command is query only and allows the detected guard time to be obtained.

Example: `CCONF:WLAN:GTIM:SEL SHOR`
Configures signal measurements with short guard times

Mode: WLAN

4.3.8 DISPlay Subsystem (WLAN, R&S FSV-K91/91n)

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display. In contrast to the basic device, the WLAN TX Measurements option supports the split screen modus.

DISPlay:FORMat <Format>

This command switches the measurement result display between FULL SCREEN and SPLIT SCREEN.

Parameters:

<Format> SINGle | SPLit

SPLit
Show 2 or more screens on the display

SINGle
Show only 1 screen on the display

*RST: SPL

Example: `DISP:FORM:SING`

Mode: all

DISPlay[:WINDow<n>]:SSELect

This command selects whether screen A or screen B is active. SSELect means Screen SELect.

Suffix:

<n> 1 | 2
window; 1=A, 2=B

Parameters:

	*RST: 1
Example:	`DISP:WIND1:SSEL`
	Sets the screen A active.
Mode:	WLAN

DISPlay[:WINDow<n>]:TABLe <State>

This command selects whether the results table is displayed.

Suffix:

<n>	1 | 2 window; 1=A, 2=B

Parameters:

<State>	ON | OFF
	*RST: ON
Example:	`DISP:WIND1:TABL ON`
	Hides the results table
Mode:	WLAN

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

This command switches on or off automatic scaling of the Y-axis for the specified trace display. Automatic scaling sets the Y-axis to automatically scale to best fit the measurement results. This command is only available for the following result displays:

- EVM vs Carrier
- EVM vs Symbol.
- Frequency error vs Preamble
- Phase error vs Preamble

Suffix:

<n>	2 window; must be 2 as the relevant results are always displayed in screen B
<t>	1 trace; must be 1

Parameters:

<State>	ON | OFF
	*RST: ON
Example:	`DISP:WIND2:TRAC:Y:SCAL:AUTO ON`
	Switches on automatic scaling of the Y-axis for the active trace
Mode:	WLAN

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

This command sets the size of each Y scale division for the specified trace display. Note that this command has no affect if automatic scaling of the Y-axis is enabled. This command is only available for the following result displays:

- EVM vs Carrier
- EVM vs Symbol.
- Frequency error vs Preamble
- Phase error vs Preamble

Suffix:

<n> 2
window; must be 2 as the relevant results are always displayed in screen B

<t> 1
trace; must be 1

Parameters:

<Size> <numeric_value>

*RST: 3

Example: `DISP:WIND2:TRAC:Y:SCAL:DPIV 2`
Sets the Y scale division to size to 2.

Mode: WLAN

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

This command queries the current internal instrument reference level used when performing measurements.

Suffix:

<n> 1 | 2
irrelevant

<t> 1...3
irrelevant

Example: `DISP:TRAC:Y:RLEV?`
Returns the current reference level in use.

Usage: Query only
SCPI conform

Mode: WLAN

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

This command can be used to retrieve or set the current internal instrument reference level for RF input used when performing measurements.

Suffix:

<n>	1 | 2 irrelevant
<t>	1...3 irrelevant

Parameters:

<Level>	<numeric value> in dB *RST: -5 dB

Example: `DISP:TRAC:Y:RLEV?`
Returns the current RF reference level in use.
`DISP:TRAC:Y:RLEV: -20`
Sets the instrument reference level to -20.

Mode: WLAN

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

This command can be used to retrieve or set the current internal instrument reference level for baseband input used when performing measurements.

Suffix:

<n>	1 | 2 irrelevant
<t>	1...3 irrelevant

Parameters:

<Level>	<numeric value> in V *RST: 1 V

Example: `DISP:TRAC:Y:IQ?`
Returns the current baseband reference level in use.
`DISP:TRAC:Y:RLEV:IQ 1`
Sets the instrument reference level to 1.

Mode: WLAN

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

This command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in the spectrum analyzer mode.

Suffix:

<n>	1 | 2 irrelevant
<t>	1...3 irrelevant

Parameters:

<Level>	<numeric value> in dB *RST: 0 dB

Example: `DISP:TRAC:Y:RLEV:OFFS 10`
External attenuation (level offset) of the analyzer is 10 dB.
`DISP:TRAC:Y:RLEV:OFFS -10`
External attenuation of the analyzer is -10 dB. i.e. a gain of 10 dB.

Mode: WLAN

4.3.9 FETCh Subsystem (WLAN, R&S FSV-K91/91n)

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

4.3.9.1 ASCII formats for returned values

The results are output as a list of result strings separated by commas.

Returned values for IEEE 802.11a, j, g(OFDM), n & Turbo Mode

<preamble power>, <payload power>, <min rms power>,

<average rms power>,<max rms power>, <peak power>,

<min crest factor>,<average crest factor>,<max crest factor>,

<min frequency error>,<average frequency error>, <max frequency error>,

<min symbol error>, <average symbol error>, <max symbol error>,

<min IQ offset>, <average IQ offset>, <maximum IQ offset>,

<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,

<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,

<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,

<min EVM data carriers>, <average EVM data carriers >, <max EVM data carriers >

<min EVM pilots>, <average EVM pilots >, <max EVM pilots >

Returned values for IEEE 802.11b & g (CCK)

<min rise time>,<average rise time>,<max rise time>,

<min fall time>,<average fall time>,<max fall time>,

<min rms power>,<average rms power>,<max rms power>,

<min peak power>,<average peak power>,<max peak power>,

<min crest factor>,<average crest factor>,<max crest factor>,

<min frequency error>,<average frequency error>, <max frequency error>,

<min chip clock error>, <average chip clock error>, <max chip clock error>,

<min phase error>, <average phase error>, <max phase error>,

<min IQ offset>, <average IQ offset>, <maximum IQ offset>,

<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,

<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,

<min EVM IEEE>, <average EVM IEEE>, <max EVM IEEE>,

<min EVM Direct>, <average EVM Direct >, <max EVM Direct >

4.3.9.2 Commands of the Fetch Subsystem (K91)

FETCh:BURSt:ALL?

This command returns all the results. The results are output as a list of result strings separated by commas in ASCII format. For details on the format refer to chapter 4.3.9.1, "ASCII formats for returned values", on page 129. The units for the EVM results are specified with the `UNIT:EVM` command.

Example: `FETC:BURS:ALL?`
All calculated results are returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:COUNt[:ALL]?

This command returns the number of analyzed bursts.

Example: `FETC:BURS:COUN?`
The analyzed number of bursts is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:CRESt[:AVERage]?
FETCh:BURSt:CRESt:MAXimum?
FETCh:BURSt:CRESt:MINimum?

This command returns the average, minimum or maximum determined CREST factor (= ratio of peak power to average power) in dB.

Example: `FETC:BURS:CRES:MAX?`
The maximum calculated crest factor from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:EVM:[IEEE]:AVERage?
FETCh:BURSt:EVM:[IEEE]:MAXimum?

FETCh:BURSt:EVM:[IEEE]:MINimum?

This command returns the error vector magnitude measurement results summary (average, minimum or maximum value) in dB for the IEEE 802.11b standard. This result is the value before filtering.

Example: `FETC:BURS:EVM:MAX?`
The maximum EVM recorded before filtering.

Usage: Query only

Mode: WLAN

FETCh:BURSt:EVM:ALL:AVERage?
FETCh:BURSt:EVM:ALL:MAXimum?
FETCh:BURSt:EVM:ALL:MINimum?

This command returns the error vector magnitude measurement results summary (average, minimum or maximum value) in dB. This is a combined figure that represents the pilot, data and the free carrier.

Example: `FETC:BURS:EVM:ALL:MAX?`
The maximum EVM recorded for all measurement carrier is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:EVM:DATA:AVERage?
FETCh:BURSt:EVM:DATA:MAXimum?
FETCh:BURSt:EVM:DATA:MINimum?

This command returns the error vector magnitude measurement results summary for the data carrier (average, minimum or maximum value) in dB.

Example: `FETC:BURS:EVM:DATA:MAX?`
The maximum EVM recorded for the data carrier is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:EVM:DIRect:AVERage?
FETCh:BURSt:EVM:DIRect:MAXimum?
FETCh:BURSt:EVM:DIRect:MINimum?

This command returns the error vector magnitude measurement results summary (average, minimum or maximum value) in dB for the IEEE 802.11b standard. This result is the value after filtering.

Example: `FETC:BURS:EVM:DIR:MAX?`
The maximum EVM recorded after filtering.

Usage: Query only

Mode: WLAN

FETCh:BURSt:EVM:PILot:AVERage?
FETCh:BURSt:EVM:PILot:MAXimum?
FETCh:BURSt:EVM:PILot:MINimum?

This command returns the error vector magnitude measurement results summary for the EVM pilot carrier (average, minimum or maximum value) in dB.

Example: `FETC:BURS:EVM:PIL:MAX?`
The maximum EVM recorded for the EVM pilot carrier is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:FERRor:AVERage?
FETCh:BURSt:FERRor:MAXimum?
FETCh:BURSt:FERRor:MINimum?

This command returns the measured average, minimum or maximum frequency errors in Hertz.

Example: `FETC:BURS:FERR:MAX?`
The maximum frequency error from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:GIMBalance:AVERage?
FETCh:BURSt:GIMBalance:MAXimum?
FETCh:BURSt:GIMBalance:MINimum?

This command returns the measured average, minimum or maximum IQ Imbalance errors in dB.

Example: `FETC:BURS:GIMB:MAX?`
The maximum IQ Imbalance error from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:IQOFfset:AVERage?
FETCh:BURSt:IQOFfset:MAXimum?
FETCh:BURSt:IQOFfset:MINimum?

This command returns the measured average, minimum or maximum IQ Offset errors in dB.

Example: `FETC:BURS:IQOF:MAX?`
The maximum IQ Offset error from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:PAYLoad?

This command returns the measured power in the payload of the burst.

Example: `FETC:BURS:PAYL?`
The burst payload power is returned

Usage: Query only

Mode: WLAN

FETCh:BURSt:PEAK?

This command returns the Peak power in dBm measured during the measurement time.

Example: `FETC:BURS:PEAK?`
The calculated peak power from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:PREamble?

This command returns the measured power in the burst preamble.

Example: `FETC:BURS:PRE?`
The burst preamble power is returned

Usage: Query only

Mode: WLAN

FETCh:BURSt:QUADoffset:AVERage?
FETCh:BURSt:QUADoffset:MAXimum?
FETCh:BURSt:QUADoffset:MINimum?

This command returns the accuracy in terms of the phase error of symbols within a burst.

Example: `FETC:BURS:QUAD:MAX?`
The maximum angle error recorded for a symbol during the measurement.

Usage: Query only

Mode: WLAN

FETCh:BURSt:RMS[:AVERage]?
FETCh:BURSt:RMS:MAXimum?

FETCh:BURSt:RMS:MINimum?

This command returns the average, minimum or maximum RMS burst power in dBm measured during the measurement.

Example: `FETC:BURS:RMS:MAX?`
The maximum calculated RSM burst power from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:SYMBolerror:AVERage?
FETCh:BURSt:SYMBolerror:MAXimum?
FETCh:BURSt:SYMBolerror:MINimum?

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example: `FETC:BURS:SYMB:MAX?`
The maximum number of symbols that were out of range per burst.

Usage: Query only

Mode: WLAN

FETCh:BURSt:TFALl:AVERage?
FETCh:BURSt:TFALl:MAXimum?
FETCh:BURSt:TFALl:MINimum?

This command returns the average, minimum or maximum burst fall time in seconds.

Example: `FETC:BURS:TFAL:MAX?`
The maximum calculated fall time from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:BURSt:TRISe:AVERage?
FETCh:BURSt:TRISe:MAXimum?
FETCh:BURSt:TRISe:MINimum?

This command returns the average, minimum or maximum burst rise time in seconds.

Example: `FETC:BURS:TRIS:MAX?`
The maximum calculated rise time from the most recent measurement is returned.

Usage: Query only

Mode: WLAN

FETCh:SYMBol:COUNt?

This command returns the number of symbols for each analyzed burst as a comma separated list.

Example: `FETC:SYMB:COUN?`
The analyzed number of symbols for each burst are returned

Usage: Query only

Mode: WLAN

4.3.10 FORMat Subsystem

FORMat[:DATA] <Format>

This command specifies the data format for the data transmitted from the instrument to the control PC. It is used for the transmission of trace data. The data format of trace data received by the instrument is automatically recognized, regardless of the format which is programmed.

(See also `TRACe[:DATA]` on page 156).

Parameters:

<Format> ASCii | REAL | UINT

ASCii
ASCII data are transmitted in plain text, separated by commas.

REAL
REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block format".

UINT
In operating mode "WLAN" (R&S FSV-K91,91n option), bit stream data is sent as unsigned integers in binary format.

*RST: ASCII

Example:
```
FORM REAL,32
FORM ASC
```

Mode: all

4.3.11 INITiate Subsystem

INITiate<n>:CONTinuous <State>

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

In the **"Spectrum" mode**, this setting refers to the sweep sequence (switching between continuous/single sweep).

Suffix:

<n>	irrelevant

Parameters:

<State>	ON | OFF *RST: ON

Example:	`INIT:CONT OFF`
	Switches the sequence to single sweep.
	`INIT:CONT ON`
	Switches the sequence to continuous sweep.

Mode:	all

INITiate<n>[:IMMediate]

The command initiates a new measurement sequence.

With sweep count > 0 or average count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, synchronization to the end of the indicated number of measurements can be achieved with the command *OPC, *OPC? or *WAI. In continuous-sweep mode, synchronization to the sweep end is not possible since the overall measurement never ends.

Suffix:

<n>	irrelevant

Example:	`INIT:CONT OFF`
	Switches to single sweep mode.
	`DISP:WIND:TRAC:MODE AVER`
	Switches on trace averaging.
	`SWE:COUN 20`
	Setting the sweep counter to 20 sweeps.
	`INIT;*WAI`
	Starts the measurement and waits for the end of the 20 sweeps.

Mode:	all

4.3.12 INPut Subsystem

INPut:ATTenuation <Value>

This command programs the input attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can be obtained by entering numerals, not by using the DOWN command.

The attenuation can be set in 5 dB steps (with option R&S FSV-B25: 1 dB steps). If the defined reference level cannot be set for the set RF attenuation, the reference level is adjusted accordingly.

In the default state with "Spectrum" mode, the attenuation set on the step attenuator is coupled to the reference level of the instrument. If the attenuation is programmed directly, the coupling to the reference level is switched off.

This function is not available if the Digital Baseband Interface (R&S FSV-B17) is active.

Parameters:

<Value> <numeric_value> in dB; range specified in data sheet

*RST: 10 dB (AUTO is set to ON)

Example: `INP:ATT 30dB`
Sets the attenuation on the attenuator to 30 dB and switches off the coupling to the reference level.

Mode: all

INPut:DIQ:RANGe[:UPPer] <Level>

Defines the level that should correspond to an I/Q sample with the magnitude "1".

It can be defined either in dBm or Volt (see "Full Scale Level" on page 74).

This command is only available if the optional Digital Baseband interface (option R&S FSV-B17) is installed.

For details see the Digital Baseband Interface (R&S FSV-B17) description of the base unit.

Parameters:

<Level> <numeric value>

Range: 70.711 nV to 7.071 V
*RST: 1 V

Example: `INP:DIQ:RANG 1V`

Mode: A, IQ, NF, TDS, VSA, CDMA, EVDO, WCDMA, ADEMOD, GSM, OFDM, OFDMA/WiBro, WLAN

INPut:DIQ:SRATe <SampleRate>

This command specifies the sample rate of the digital baseband IQ input signal (see "Input Sample Rate" on page 74).

This command is only available if the optional Digital Baseband interface (option R&S FSV-B17) is installed.

For details see the Digital Baseband Interface (R&S FSV-B17) description of the base unit.

Parameters:

<SampleRate>

Range: 1 Hz to 10 GHz
*RST: 32 MHz

Example: INP:DIQ:SRAT 200 MHz

Mode: A, IQ, NF, TDS, VSA, CDMA, EVDO, WCDMA, ADEMOD, GSM, OFDM, OFDMA/WiBro, WLAN

INPut:SELect <Source>

This command selects the signal source for measurements.

Parameters:

<Source> RF | DIQ

RF
Radio Frequency ("RF INPUT" connector)

DIQ
Baseband Digital (IQ) (only available with Digital Baseband Interface, option R&S FSV-B17)

*RST: RF

Example: INP:SEL RF

Mode: A, IQ, NF, TDS, VSA, CDMA, EVDO, WCDMA, ADEMOD, GSM, OFDM, OFDMA/WiBro, WLAN

4.3.13 INSTrument Subsystem (WLAN, R&S FSV-K91/91n)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

INSTrument[:SELect] <Mode>

Parameters:

<Mode> WLAN

Selects WLAN TX mode (R&S FSV-K91/91n option)

INSTrument:NSELect <Mode>

Parameters:

<Mode> 16

Selects WLAN TX mode (R&S FSV-K91/91n option)

4.3.14 MMEMory Subsystem (WLAN, R&S FSV-K91/91n)

The MMEMory (mass memory) subsystem provides commands to store and load IQ data.

MMEMory:LOAD:IQ:STATe 1, <FileName>

This command loads the IQ data from the specified .iqw file.

Parameters:

<FileName> 1,<file_name>

Example: `MMEM:LOAD:IQ:STAT 1, 'C:\R_S\Instr\user\data.iqw'`
Loads IQ data from the specified file.

Mode: WLAN, OFDM, OFDMA/WiBro

MMEMory:LOAD:SEM:STATe 1, <FileName>

This command loads a spectrum emission mask setup from an xml file.

Parameters:

<FileName> 1,<file_name>

Example: `MMEM:LOAD:SEM:STAT 1,'D:\USER\ETSI_SEM.xml'`
Loads a spectrum emission mask setup from the specified file.

Mode: WLAN

MMEMory:STORe:IQ:STATe 1, <FileName>

This command stores the IQ data to the specified .iqw file.

Parameters:

<FileName> 1,<file_name>

Example: `MMEM:STOR:IQ:STAT 1, 'C:\R_S\Instr\user\data.iqw'`
Stores IQ data to the specified file.

Mode: WLAN, OFDM, OFDMA/WiBro

4.3.15 SENSe Subsystem (WLAN, R&S FSV-K91/91n)

The SENSe command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSe command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

4.3.15.1 Analysis modulation format

The following modulation formats are available for analysis using R&S FSV-K91 (see also [SENSe:]DEMod:FORMat:BANalyze on page 144):

Parameter	Standard	Description
'BPSK'	Alias for BI-Phase shift keying at higher data rate for selected standard	
'BPSK3'	IEEE 802.11j (10 MHz)	BI-Phase shift keying at 3 Mbps
'BPSK6'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	BI-Phase shift keying at 6 Mbps
'BPSK9'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	BI-Phase shift keying at 9 Mbps
'BPSK45'	IEEE 802.11j (10 MHz)	BI-Phase shift keying at 4.5 Mbps
'BPSK65'	IEEE 802.11n	BI-Phase shift keying at 6.5 Mbps
'BPSK72'	IEEE 802.11n	BI-Phase shift keying at 7.2 Mbps
'CCK11'	IEEE 802.11b & g (Single Carrier)	Complementary Code Keying at 11 Mbps
'CCK55'	IEEE 802.11b & g (Single Carrier)	Complementary Code Keying at 5.5 Mbps
'DBPSK1'	IEEE 802.11b & g (Single Carrier)	Differential BI-Phase shift keying
'DQPSK2'	IEEE 802.11b & g (Single Carrier)	Differential Quadrature phase shift keying
'PBCC11'	IEEE 802.11b & g (Single Carrier)	PBCC at 11 Mbps
'PBCC22'	IEEE 802.11g (Single Carrier)	PBCC at 11 Mbps
'PBCC55'	IEEE 802.11b & g (Single Carrier)	PBCC at 5.5 Mbps
'QAM16'	Alias for Quadrature Amplitude Modulation at higher data rate for selected standard	
'QAM64'	Alias for Quadrature Amplitude Modulation at higher data rate for selected standard	
'QAM1612'	IEEE 802.11j (10 MHz)	Quadrature Amplitude Modulation at 12 Mbps
'QAM1618'	IEEE 802.11j (10 MHz)	Quadrature Amplitude Modulation at 18 Mbps
'QAM1624'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	Quadrature Amplitude Modulation at 24 Mbps
'QAM1626'	IEEE 802.11n	Quadrature Amplitude Modulation at 26 Mbps
'QAM1636'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	Quadrature Amplitude Modulation at 36 Mbps
'QAM1639'	IEEE 802.11n	Quadrature Amplitude Modulation at 39 Mbps
'QAM6424'	EEE 802.11j (10 MHz)	Quadrature Amplitude Modulation at 24 Mbps
'QAM6427'	IEEE 802.11j (10 MHz)	Quadrature Amplitude Modulation at 27 Mbps
'QAM6448'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	Quadrature Amplitude Modulationat 48Mbps
'QAM6452'	IEEE 802.11n	Quadrature Amplitude Modulation at 52 Mbps
'QAM6454'	IEEE802.11a,g(OFDM),j(20MHz)&Turbo	Quadrature Amplitude Modulation at 54 Mbps
'QAM6465'	IEEE 802.11n	Quadrature Amplitude Modulation at 65 Mbps
'QAM16289'	IEEE 802.11n	Quadrature Amplitude Modulation at 28.9 Mbps
'QAM16433'	IEEE 802.11n	Quadrature Amplitude Modulation at 43.3 Mbps

'QAM64578'	IEEE 802.11n	Quadrature Amplitude Modulation at 57.8 Mbps
'QAM64585'	IEEE 802.11n	Quadrature Amplitude Modulation at 58.5 Mbps
'QAM64722'	IEEE 802.11n	Quadrature Amplitude Modulation at 72.2 Mbps
'QPSK'	Alias for Quadrature phase shift keying at higher data rate for selected standard	
'QPSK6'	IEEE 802.11j (10 MHz)	Quadrature phase shift keying at 6 Mbps
'QPSK9'	IEEE 802.11j (10 MHz)	Quadrature phase shift keying at 9 Mbps
'QPSK12'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	Quadrature phase shift keying at 12 Mbps
'QPSK13'	IEEE 802.11n	Quadrature phase shift keying at 13 Mbps
'QPSK18'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo	Quadrature phase shift keying at 18 Mbps
'QPSK144'	IEEE 802.11n	Quadrature phase shift keying at 14.4 Mbps
'QPSK195'	IEEE 802.11n	Quadrature phase shift keying at 19.5 Mbps
'QPSK217'	IEEE 802.11n	Quadrature phase shift keying at 21.7 Mbps

4.3.15.2 Commands of the SENSe Subsystem

[SENSe:]BURSt:COUNt <NumberBursts>

This command defines the number of bursts that will be analyzed by the measurement. This parameter is ignored if the setting for the `[SENSe:]BURSt:COUNt:STATe` on page 143 parameter is off.

Parameters:

<NumberBursts> <numeric_value>

*RST: 1

Example: `BURS:COUN 16`
Sets the number of bursts to 16.

Mode: WLAN

[SENSe:]BURSt:COUNt:STATe <State>

When this command is set to on, the burst count parameter will be used by the measurement, otherwise the burst count parameter will be ignored.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `BURS:COUN:STAT ON`
Sets the burst count state to ON

Mode: WLAN

[SENSe:]DEMod:CESTimation <State>

This command defines whether channel estimation will be done in preamble and payload (if set to 1) or only in preamble (if set to 0). The effect of this is most noticeable for the EVM measurement results, where the results will be improved when this feature is enabled.

However, this functionality is not supported by the IEEE 802.11 standard and must be disabled if the results are to be strictly measured against the standard.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DEMod:CEST ON`
Specifies that the IQ measurement results will use channel estimation in preamble & payload.

Mode: WLAN

[SENSe:]DEMod:FILTer:CATalog?

This command reads the names of all available filters. The file names are output without file extension. Syntax of output format: filter_1, filter_2, …, filter_n.

Parameters:

*RST: 0

Example: `DEM:FILT:CAT?`
Reads all filter names

Usage: Query only

Mode: WLAN

[SENSe:]DEMod:FILTer:MODulation <TXFilter>, <RXFilter>

This command selects the TX and RX filters. The names of the filters correspond to the file names; a query of all available filters is possible by means of the `[SENSe:]DEMod:FILTer:CATalog` on page 144 command.

Parameters:
<TXFilter>, <RXFilter><string>,<string>

*RST: AUTO,AUTO
DEF_TX: default transmit filter, DEF_RX: default receive filter

Example: `DEM:FILT:MOD 'DEF_TX','DEF_RX'`
DEF_TX is selected for the TX filter and DEF_RX for the RX filter

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze <Format>

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed. If the `[SENSe:]DEMod:FORMat:SIGSymbol` on page 150 parameter has been set to ON, this command can be used to measure only certain burst types within a measurement sequence.

Parameters:
<Format>

*RST: QAM64
For details refer to chapter 4.3.15.2, "Commands of the SENSe Subsystem", on page 142.

Example: `DEM:FORM:BAN 'QAM16'`
Only bursts that are of the QAM16 modulation format are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:BTYPe <BurstType>

This remote control command specifies the type of burst to be analyzed. Only bursts of the specified type take part in measurement analysis.

Parameters:

<BurstType> DIRECT | LONG-OFDM | SHORT-OFDM | LONG | SHORT | MM20 | GFM20 | MM40 | GFM40

DIRECT
IEEE 802.11a, IEEE 802.11j (10MHz), IEEE 802.11j (20MHz), IEEE 802.11g, 802.11 OFDM Turbo – Direct Link Burst

LONG-OFDM
IEEE 802.11g – Long DSSS OFDM

SHORT-OFDM
IEEE 802.11g – Short DSSS OFDM

LONG
IEEE 802.11b, IEEE 802.11g – Long PLCP Burst

SHORT
IEEE 802.11b, IEEE 802.11g – Short PLCP Burst

MM20
IEEE 802.11n, Mixed Mode, 20 MHz sampling rate

GFM20
IEEE 802.11n Green Field Mode, 20 MHz sampling rate

MM40
IEEE 802.11n, Mixed Mode, 40 MHz sampling rate

GFM40
IEEE 802.11n Green Field Mode, 40 MHz sampling rate

*RST: DIRECT

Example: `DEM:FORM:BAN:BTYPe 'DIRECT'`
Only DIRECT bursts are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal <State>

When this command is set to ON then only bursts of equal length will take part in the measurement analysis. The number of data bytes that a burst must have in order to take part in measurement analysis is specified by the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN` on page 146 command.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DEM:FORM:BAN:DBYTes:EQU ON`
Only bursts of equal length will take part in the measurement analysis.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MAX <NumberDataBytes>

This command specifies the maximum number of data bytes required for bursts to qualify for measurement analysis. Only bursts with the specified number of data bytes will be used in the measurement analysis.

This value will not have any immediate effect if the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal` on page 145 command has been set to ON. In this case, no range of symbols is allowed and only bursts with exactly the number of data bytes specified by the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN` on page 146 command shall take part in measurement analysis.

Parameters:

<NumberDataBytes> <numeric_value>

*RST: 64

Example: `DEM:FORM:BAN:DBYTes:MAX 1300`
Only bursts which contain a maximum of 1300 data bytes are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN <NumberDataBytes>

This command specifies the number of data bytes required for bursts to qualify for measurement analysis. Only bursts with the specified number of data bytes will be used in the measurement analysis.

If the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal` on page 145 command has been set to ON, this command specifies the exact number of data bytes required for a burst to take part in measurement analysis. If the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal` on page 145 command is set to OFF, this command specifies the minimum number of data bytes required for a burst to take part in measurement analysis.

Parameters:

<NumberDataBytes> <numeric_value>

*RST: 1

Example: `DEM:FORM:BAN:DBYTes:MIN 16`
Only bursts which contain 16 data bytes are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DURation:EQUal <State>

When this command is set to ON then only bursts of equal length will take part in the PVT analysis. When this command is set to true the value specified by the `[SENSe:]DEMod:FORMat:BANalyze:DURation:MIN` on page 147 command specifies the duration that a burst must last in order to take part in measurement analysis.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DEM:BAN:DUR:EQU ON`

Only bursts of equal length will take part in the measurement analysis.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DURation:MAX <Duration>

This command specifies the maximum duration in microseconds required for bursts to qualify for measurement analysis. Only bursts with the specified duration will be used in the measurement analysis.

This value will not have any immediate effect if the `[SENSe:]DEMod:FORMat:BANalyze:DURation:EQUal` on page 146 command has been set to true as in this case no range of durations is allowed and only bursts with exactly the duration specified by the `[SENSe:]DEMod:FORMat:BANalyze:DURation:MIN` on page 147 command shall take part in measurement analysis

Parameters:

<Duration> <numeric_value>

*RST: 5464

Example: `DEM:BAN:DUR:MAX 1300`

Only bursts which have a maximum duration of 1300 microseconds are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:DURation:MIN <Duration>

This command specifies the duration in microseconds required for bursts to qualify for measurement analysis. Only bursts with the specified duration will be used in the measurement analysis.

If the `[SENSe:]DEMod:FORMat:BANalyze:DURation:EQUal` on page 146 command has been set to true then this command specifies the exact duration required for a burst to take part in measurement analysis.

If the `[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal` on page 145 command is set to false this command specifies the minimum duration required for a burst to take part in measurement analysis.

Parameters:

<Duration> <numeric_value>

*RST: 1

Example: `DEM:BAN:DUR:MIN 45`

Only bursts which last 48 microseconds are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal <State>

When this command is activated then only bursts of equal length will take part in the measurement analysis. When this command is set to true the value specified by the `[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal` on page 148 command specifies the number of symbols that a burst must have in order to take part in analysis.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DEM:FORM:BAN:SYM:EQU ON`

Only bursts of equal length will take part in analysis.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MAX <NumberDataSymbols>

This command specifies the maximum number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

This value will not have any immediate effect if the `[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal` command has been set to true as in this case no range of symbols is allowed and only bursts with exactly the number of symbols specified by the `[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN` command shall take place in measurement analysis.

Parameters:

<NumberDataSymbols> <numeric_value>

*RST: 64

Example: `DEM:FORM:BAN:SYM:MAX 1300`

Only bursts which contain a maximum symbol count of 1300 are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat:BANalyze:SYMBols:MIN <NumberDataSymbols>

This command specifies the number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

When the `[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal` command has been set to true then this command specifies the exact number of symbols required for a burst to take part in measurement analysis. When the `[SENSe:]DEMod:FORMat:BANalyze:SYMBols:EQUal` command is set to false this command specifies the minimum number of symbols required for a burst to take part in measurement analysis.

Parameters:

<NumberDataSymbols> <numeric_value>

*RST: 1

Example: `DEM:FORM:BAN:SYM:MIN 16`

Only bursts which contain a symbol count of 16 are analyzed.

Mode: WLAN

[SENSe:]DEMod:FORMat[:BCONtent]:AUTO <State>

When this command is set to ON, the signal symbol field, resp. the PLCP header field of the burst is analyzed to determine the details of the burst. When this field is set to ON, only bursts that match the supplied burst type and modulation are considered in results analysis.

Parameters:

<State> ON | OFF

Example: `DEM:FORM:AUTO ON`

Specifies that the signal symbol field should be decoded.

Mode: WLAN

[SENSe:]DEMod:FORMat:BTRate <BitRate>

The remote control command is used to specify the bit rate for IEEE 802.11b signals. This command can be used as an alternative to `[SENSe:]DEMod:FORMat:BANalyze` on page 144. The bit rate can be set as follows:

Parameters:

<BitRate> 10 | 20 | 55 | 110

10
1 Mbit/s

20
2 Mbit/s

55
5.5 Mbit/s

110
11 Mbit/s

*RST: 10 (= 1mbit)

Example: `DEM:FORM:BTR 20`

Configures to demodulate 2 Mbit/s signals

Mode: WLAN

[SENSe:]DEMod:FORMat:SIGSymbol <State>

If this command is set to ON, the signal symbol field of the burst is analyzed to determine the details of the burst. Only burst which match the supplied burst type and modulation are considered in results analysis. For IEEE 802.11b this command can only be queried as the decoding of the signal field is always performed for the IEEE 802.11b standard.

Parameters:

<State> ON | OFF

Example: `DEM:FORM:SIGS ON`
Specifies that the signal symbol field should be decoded.

Mode: WLAN

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

Parameters:

<Frequency> <numeric_value>

Range: 0 to fmax
*RST: fmax/2
Default unit: Hz
f_{max} is specified in the data sheet. min span is 10 Hz

Example: `FREQ:CENT 100 MHz`

Mode: all

[SENSe:]POWer:ACHannel:MODE <Mode>

This command sets the ACP measurement mode for the IEEE 802.11j standard to either absolute or relative.

Parameters:

<Mode> ABS | REL

ABS
Absolute measurement

REL
Relative measurement

*RST: REL

Example: `POW:ACH:MODE ABS`
Sets the ACP measurement to absolute mode

Mode: WLAN

[SENSe:]POWer:SEM:CLASs

This command sets the Spectrum Emission Mask (SEM) power class index. The index represents the power classes to be applied. The index is directly related to the entries displayed in the power class drop down combo box, within the SEM settings configuration page.

Parameters:

*RST: 0

Example: `POW:ACH:SEM:CLAS 0`
Sets the SEM power class to automatic

Mode: WLAN

[SENSe:]POWer:SEM <Type>

This command sets the Spectrum Emission Mask (SEM) measurement type. This is either IEEE, ETSI Spectrum mask or a user defined file.

Parameters:

<Type> IEEE | ETSI | User

IEEE

ETSI

User

*RST: IEEE

Example: `POW:SEM ETSI`
Sets the SEM ETSI measurement type

Mode: WLAN

[SENSe:]SWAPiq <State>

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

Parameters:

<State> ON | OFF

ON
I and Q are exchanged, inverted sideband, Q+j*I

OFF
Normal sideband, I+j*Q,

*RST: OFF

Example: `SWAP ON`
Specifies that IQ values should be swapped.

Mode: WLAN, GSM, OFDM, OFDMA/WiBro

[SENSe:]SWEep:COUNt <NumberSweeps>

This command specifies the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Parameters:

<NumberSweeps> <numeric_value>

*RST: 1

Example: `SWEep:COUNt 64`
Sets the number of sweeps to 64.

Usage: SCPI conform

Mode: WLAN

[SENSe:]SWEep:EGATe <State>

This command switches on/off the sweep control by an external gate signal. If the external gate is selected the trigger source is automatically switched to EXTernal as well.

In case of measurement with external gate, the measured values are recorded as long as the gate is opened. During a sweep the gate can be opened and closed several times. The synchronization mechanisms with *OPC, *OPC? and *WAI remain completely unaffected.

The sweep end is detected when the required number of measurement points (691 in "Spectrum" mode) has been recorded.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SWE:EGAT ON`
Switches on the external gate mode.
`SWE:EGAT:TYPE EDGE`
Switches on the edge-triggered mode.
`SWE:EGAT:HOLD 100US`
Sets the gate delay to 100 µs.
`SWE:EGAT:LEN 500US`
Sets the gate opening time to 500 µs.
`INIT;*WAI`
Starts a sweep and waits for its end.

Mode: A, BT, EVDO, TDS, WLAN, OFDM, OFDMA/WiBro

[SENSe:]SWEep:EGATe:HOLDoff[:TIME] <Time>

This command defines the gate delay in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Parameters:

<Time> <numeric_value>

*RST: 100µs

Example: `SWE:EGAT:HOLD 125us`
Sets a delay of 125µs in the capture buffer.

Mode: WLAN

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle <NumberSamples>

This command defines the gate delay in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Parameters:
<NumberSamples> <numeric_value>

*RST: 2000

Example: `SWE:EGAT:HOLD:SAMP 2500`
Sets a delay of 2500 samples in the capture buffer.

Mode: WLAN

[SENSe:]SWEep:EGATe:LENGth[:TIME] <Time>

This command defines the gate time in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Parameters:
<Time> <numeric_value>

*RST: 400µs

Example: `SWE:EGAT:LENG 20ms`
Sets a gate length of 20 milliseconds between sweeps.

Mode: WLAN

[SENSe:]SWEep:EGATe:LENGth:SAMPle <NumberSamples>

This command defines the gate time in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Parameters:
<NumberSamples> <numeric_value>

*RST: 8000

Example: `SWE:EGAT:LENG:SAMP 200000`
Sets a gate length of 200000 samples in the capture buffer.

Mode: WLAN

[SENSe:]SWEep:EGATe:LINK <State>

This command links together the movement of the gating lines and the capture buffer marker.

Parameters:

<State> ON | OFF

*RST: 0

Example: `SWE:EGAT:LINK ON`

Links the gating lines as marker with the gating line delay and length are changed gate position.

Mode: WLAN

[SENSe:]SWEep:TIME <Time>

This command defines the sweep time.

The range depends on the frequency span.

If this command is used in analyzer mode, automatic coupling to resolution bandwidth and video bandwidth is switched off.

Parameters:

<Time> refer to data sheet

*RST: (AUTO is set to ON)

Example: `SWE:TIME 10s`

Mode: ALL

[SENSe:]TRACking:LEVel <State>

This command defines whether or not the measurement results should be compensated for level.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `TRAC:LEV ON`

Specifies that the measurement results should be compensated for level.

Mode: WLAN

[SENSe:]TRACking:PHASe <State>

This command defines whether or not the measurement results should be compensated for phase.

Parameters:

<State> ON | OFF

*RST: ON

Example: `TRAC:PHAS ON`

Specifies that the measurement results should be compensated for phase.

Mode: WLAN

[SENSe:]TRACking:TIME <State>

This command defines whether or not the measurement results should be compensated for time.

Parameters:

<State> ON | OFF

Mode: WLAN

4.3.16 TRACe Subsystem (WLAN, K91/91n)

The TRACe subsystem controls access to the instrument's internal trace memory.

4.3.16.1 Commands of the TRACe Subsystem

TRACe[:DATA]? <ResultType>

This command returns all the measured data that relates to the currently selected measurement type. All results are returned in ASCII format. The returned data depends on the currently selected measurement type. `DISPlay:FORMat` is not supported with this command.

The following measurement types are available:

- "Constellation vs Symbol", on page 157
- "Constellation vs Carrier", on page 157
- chapter 4.3.16.3, "Power vs Time – Full Burst and Rising/Falling Data", on page 158
- chapter 4.3.16.4, "Spectrum Flatness", on page 159
- chapter 4.3.16.5, "Spectrum FFT", on page 159
- chapter 4.3.16.6, "Statistics Bitstream Data", on page 159
- chapter 4.3.16.7, "Statistics CCDF – Complementary Cumulative Distribution Function", on page 160
- chapter 4.3.16.8, "Statistics Signal Field Data", on page 160
- chapter 4.3.16.9, "EVM vs Carrier", on page 160
- chapter 4.3.16.10, "EVM vs Symbol", on page 160
- chapter 4.3.16.11, "Error vs Preamble", on page 161
- "Spectrum Mask", on page 161
- chapter 4.3.16.13, "Spectrum ACPR", on page 162

Query parameters:

<ResultType> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | LIST

For details on the parameters refer to the corresponding measurement type (see list above).

Example: `TRAC? TRACE2`
The measurement data for the selected graph is returned.

Usage: Query only
SCPI conform

Mode: WLAN

TRACe:IQ:SRATe <SampleRate>

This command allows the sample rate for IQ measurements to be specified.

Parameters:

<SampleRate>

Range: 1440000 to 32.248E6 Hz

Example: `TRAC:IQ:SRAT 2000000`
Specifies a sample rate of 20 MHz.

Mode: WLAN

TRACe:IQ:DATA:MEMory ? <OffsetSa>, <NoSamples>

Returns all the I/Q data associated with the measurement acquisition time. The result values are scaled linearly in Volts and correspond to the voltage at the RF input of the instrument. The command returns a comma-separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * the number of samples, the first half being the I values, the second half the Q values.

Query parameters:

<OffsetSa> Offset of the values to be read related to the start of the acquired data.

Range: 0 to <NoSamples>
*RST: RST value

<NoSamples> Number of measurement values to be read.

Range: 1 to (<NoSamples>-<OffsetSa>)
*RST: RST value

Example: `TRAC:IQ:DATA:MEM? 0,2000`
Requests first 2000 samples.

Usage: Query only

Mode: WLAN

4.3.16.2 I/Q Measurements

There are a number of measurements that can be performed in I/Q mode. No data is returned for any of the following measurements, should it be requested, until a measurement belonging to the I/Q group has been run. Running a frequency sweep measurement, for example Spectrum Mask, does not generate results for this measurement group.

Constellation vs Symbol

This measurement represents I and Q data. Each I and Q point is returned in floating point format. TRACE1 is used for these measurement results.

For the IEEE 802.11a, j and n standard, data is returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted. The following rules apply:

- If "All Carriers" is selected, 52 pairs of I and Q data per symbol are returned.
- If "Pilots Only" is selected, 4 pairs of I and Q data per symbol are returned in the following order: Carrier –21, Carrier –7, Carrier 7, Carrier 21.
- If a single carrier is selected, 1 pair of I and Q data per symbol is returned.

For IEEE 802.11b, the data is returned as a repeating array of interleaved I and Q data in symbol order until all the data is exhausted.

Constellation vs Carrier

This measurement represents I and Q data. Data is returned as a repeating array of interleaved I and Q data in groups of 53 channels (57 within the n standard) including DC, until all the data is exhausted.

Each I and Q point is returned in floating point format. TRACE1 is used for these measurement results.

Supported data formats (see FORMat[:DATA] on page 136): ASCii|REAL

4.3.16.3 Power vs Time – Full Burst and Rising/Falling Data

Both measurement results are again simply slightly different views of the same results data.

All complete bursts within the capture time are analyzed in three master bursts. The three master bursts relate to the minimum, maximum and average values across all complete bursts. This data is returned in dBm values on a per sample basis. Each sample relates to an analysis of each corresponding sample within each processed burst.

The type of PVT data returned is determined by the TRACE number passed as an argument to the SCPI command, in addition to the graphic type that is selected.

If the graphic type selected is "Full burst", then the return data is as follows.

TRACE1	full burst, minimum burst data values
TRACE2	full burst, mean burst data values
TRACE3	full burst, maximum burst data values

If the graphic type selected is "EDGe", then the return data is as follows.

TRACE1	rising edge, minimum burst data values
TRACE2	rising edge, mean burst data values
TRACE3	rising edge, maximum burst data values
TRACE4	falling edge, minimum burst data values
TRACE5	falling edge, mean burst data values
TRACE6	falling edge, maximum burst data values

Supported data formats (see FORMat[:DATA] on page 136): ASCii|REAL

For IEEE 802.11b:

If the graphic type selected is "RISing" or "FALLing", only 3 traces are available (1 to 3) and represent the minimum, mean and maximum bursts data for the respective graph selection. The number of samples returned during full burst analysis depends on the modulation type and is typically 5000.

The number of samples returned when the "Rising and falling" graphic type is selected is less than what is returned for full burst and is approximately 400 samples. The samples are returned in floating point format as a single sequence of comma delimited values.

4.3.16.4 Spectrum Flatness

Four separate traces are available for these measurements. Trace data for a particular trace is only obtainable by querying the appropriate trace.

Spectrum flatness provides two basic graph types: an absolute power value graph (ABS) and a relative group delay graph. Both are plotted on a per carrier basis. All 52 carriers are drawn, in addition to the unused 0 carrier. Both the absolute power and group delay graph groups allow all the data points to be returned as one trace and an average of all the channels as the other trace.

For example, the return data is either one single group of 53 carriers (or 57 within the n standard) if the average trace is selected, or a repeating group of 53 (or 57 within the n standard) carriers if all the data is requested.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|REAL`

TRACE1	ABS	All analyzed traces
TRACE2	Group Delay	All analyzed traces
TRACE3	ABS	Average trace
TRACE4	Group Delay	Average trace

Absolute power results are returned in dB or dB difference and group delay results are returned in ns.

4.3.16.5 Spectrum FFT

All FFT points are returned if the data for this measurement is requested. This is an exhaustive call, due to the fact that there are nearly always more FFT points than IQ samples. The number of FFT points is the number presented by a power of 2 that is higher than the total number of samples.

E.g. if there were 20000 samples, then 32768 FFT points would be returned.

Data is returned in floating point format in dBm. TRACE1 is used for these measurement results.

4.3.16.6 Statistics Bitstream Data

Data is returned depending on the selected standard from which the measurement was executed:

- For the IEEE 802.11a,j & n standard, data is returned in repeating groups of 52 data channels (or 56 channels within the n standard) where each symbol value is represented by an integer value within one byte. Channel 0 is unused and therefore does not have any data associated with it, with no return data being provided.
- For the IEEE 802.11b standard, the data is returned iin burst order. Each burst is represented as a series of bytes. For each burst, the first 9 or 18 bytes represent the PLCP preamble for short and long burst types, respectively. The next 6 bytes represent the PLCP header. The remaining bytes represent the PSDU. Data is returned

in ASCII printable hexadecimal character format. TRACE1 is used for these measurement results.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|UINT`

4.3.16.7 Statistics CCDF – Complementary Cumulative Distribution Function

Up to a maximum of 201 data points is returned in addition to a data count value. The first value in the return data represents the quantity of probability values that follow. Each of the potential 201 data points is returned as probability value and represents the total number of samples that are equal to or exceed the corresponding power level. Probability data is returned up to the power level that contains at least one sample. It is highly unlikely that the full 201 data values will ever be returned.

Each probability value is returned as a floating point number, with a value less than 1.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|REAL`

4.3.16.8 Statistics Signal Field Data

Data is returned as an array of hexidecimal values, with each hexidecimal value representing the 24 bit (IEEE 802.11b standard: 48 bit) long signal field for a single burst.

4.3.16.9 EVM vs Carrier

Two trace types are provided with this measurement. There is an average EVM value for each of the 53 (or 57 within th n standard) carriers or a repeating group of EVM values for each channel. The number of repeating groups corresponds to the number of fully analyzed trains.

Each EVM value is returned as a floating point number, expressed in units of dBm.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|UINT`

TRACE1	Average EVM values per channel
TRACE2	All EVM values per channel for each full train of the capture period

4.3.16.10 EVM vs Symbol

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum EVM value, as measured over the complete capture period.

The number of repeating groups that are returned is equal to the number of measured symbols.

Each EVM value is returned as a floating point number, expressed in units of dBm.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|REAL`

Table 4-1: IEEE 802.11a, j & n

TRACE1	Minimum EVM values
TRACE2	Mean EVM values
TRACE3	Maximum EVM values

Table 4-2: IEEE 802.11b

TRACE1	EVM IEEE values
TRACE2	EVM Direct values

4.3.16.11 Error vs Preamble

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum frequency or phase value as measured over the preamble part of the burst.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|REAL`

4.3.16.12 Frequency Sweep Measurements

Currently, there is only one measurement that is performed in frequency sweep mode. This is the Spectrum Mask measurement. No data is returned for this measurement, should it be requested, until such a measurement has been previously run.

Running an IQ measurement does not generate results for this type of measurement.

Spectrum Mask

Result data is returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data is returned.

Supported data formats (see `FORMat[:DATA]` on page 136): `ASCii|REAL`

TRACE1	Clear write values
TRACE2	Max hold values
LIST	Spectrum Emission Mask (SEM) summary results

Table 4-3: SEM summary results formats:

1st value	Index into table of results (1 – 50)
2nd value	Start frequency band (Hz)
3rd value	Stop frequency band (Hz)
4th value	RBW (Hz)
5th value	Limit fail frequency (Hz)
6th value	Power absolute (dBm)

7th value	Power relative (dBc)
8th value	Limit distance (dB)
9th value	Failure flag (1 = fail, 0 = pass)

4.3.16.13 Spectrum ACPR

Result data is returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data is returned. TRACE1 is used for these measurement results.

Supported data formats (see FORMat[:DATA] on page 136): ASCii|REAL

TRACE1	Clear write values
TRACE2	Max hold values

4.3.17 TRIGger Subsystem (WiMAX, K91/91N)

The trigger subsystem is used to synchronize device action(s) with events.

TRIGger[:SEQuence]:HOLDoff <Delay>

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set in zero span only.

Parameters:

<Delay>

Range: -3.25 to 837.33
*RST: 0 s
Default unit: ms

Example: `TRIG:HOLD 500us`
A holdoff period of 500 µs is used after the trigger condition has been met.

Usage: SCPI conform

Mode: WLAN

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

This command sets the level of the external trigger source in Volt.

Suffix:

<n> irrelevant

Parameters:
<TriggerLevel>

Range: 0.5 V to 3.5 V
*RST: 1.4 V

Example: `TRIG:LEV 2V`

Mode: All

TRIGger[:SEQuence]:MODE <Mode>

This command configures how triggering is to be performed.

Parameters:
<Mode> IMMediate | EXTernal | POWer

IMMediate
No triggering is performed. This corresponds to the Free Run trigger mode.

EXTernal
The next measurement is triggered by the signal at the external trigger input e.g. a gated trigger.

POWer
The next measurement is triggered by signals outside the measurement channel.

*RST: IMMediate

Example: `TRIG:MODE IMM`
No triggering is performed.

Mode: WLAN

TRIGger[:SEQuence]:LEVel:POWer <Level>

This command sets the level of the input signal for which triggering will occur.

Parameters:
<Level>

Range: -50 to 20
*RST: -20 DBM
Default unit: dBm

Example: `TRIG:MODE POW`
Sets the external trigger mode.
`TRIG:LEV:POW 10 DBM`
Sets the level to 10 dBm for RF measurement.

Mode: WLAN

TRIGger[:SEQuence]:LEVel:POWer:AUTO <State>

This command specifies whether or not an automatic power trigger level calculation is performed before each main measurement. The setting of this command is ignored if the setting for the `TRIGger[:SEQuence]:MODE` on page 163 command is not POWer.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `TRIG:LEV:POW:AUTO ON`

Specifies that an automatic power trigger level calculation should be performed before the start of each main measurement.

Mode: WLAN

4.3.18 UNIT Subsystem (K91)

UNIT:EVM <Unit>

This command specifies the units for EVM results.

Parameters:

<Unit> DB | PCT

DB
EVM results returned in dB

PCT
EVM results returned in %

*RST: DB

Example: `UNIT:EVM PCT`

EVM results to be returned in %.

Mode: WLAN

UNIT:GIMBalance <Unit>

This command specifies the units for gain imbalance results.

Parameters:

<Unit> DB | PCT

DB
Gain imbalance results returned in dB

PCT
Gain imbalanceresults returned in %

*RST: DB

Example: `UNIT:EVM PCT`

Gain imbalance results to be returned in %.

Mode: WLAN

UNIT:PREamble <Unit>

This command specifies the units for preamble error results.

Parameters:

<Unit> HZ | PCT

HZ
Preamble error results returned in HZ

PCT
Preamble error results returned in %

*RST: HZ

Example: `UNIT:EVM PCT`
Preamble error results to be returned in %.

Mode: WLAN

List of Commands

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